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Irrelevant Information and Mediated Intertemporal Choice

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Results from 4 experiments suggest that currencies such as loyalty-program points are overvalued. Different allocations of the same quantity of points across the same number of purchases (e.g., 100 points for each first, 200 for each second, 300 for each third purchase vs. 200 for each first, second, and third purchase) yielded irrelevant trends and should have led participants to ignore loyalty points as a basis for choice. However, choices were influenced by points even when consumers were provided with other truly discriminating information (e.g., price) and the irrelevance of the loyalty points was readily discernable. This implies that irrelevant information can influence choice when other, easily justifiable bases for decisions are available and, therefore, that irrelevant information can function as more than a tie-breaker. Other implications for research on irrelevant attributes, medium effects, intertemporal choice, and loyalty programs are discussed.

Numerous studies have demonstrated that consumer decisions can be influenced by attributes that have no direct implication for product quality or provide no discriminating value for brand choice (Broniarczyk & Gershoff, 1997, 2003; Brown & Carpenter, 2000; Carpenter, Glazer, & Nakamoto, 1994; Meyvis & Janiszewski, 2002; Simonson, Carmon, & O'Curry, 1994; Simonson, Nowlis, & Simonson, 1993; van Osselaer & Alba 2003). In fact, such irrelevant or "trivial" attributes have been shown to influence decisions even when consumers are made aware of the irrelevance of the information. This phenomenon is most likely to be observed when the irrelevant information serves as a tie-breaker for otherwise similarly attractive options (e.g., Broniarczyk & Gershoff, 1997; Brown & Carpenter, 2000; see also Shafir, Simonson, & Tversky, 1993). We find a tie-breaking role of irrelevant information to be highly plausible but argue that the irrelevant-attribute effect may be more pervasive. Specifically, we argue that irrelevant information may influence choice even when there is an easily justified basis for choice other than the irrelevant attribute. We speculate that this effect is attributable to associative processes that influence decision making independently of more deliberative processes.

As a second point of departure, our research differs from prior research on information irrelevance by including a temporal dimension. Specifically, we employ a sequential-choice paradigm in which the distribution pattern of an attribute (frequent flyer points) across purchase occasions renders it irrelevant. Consequently, as described at the end of the article, our results are also pertinent to research on the role of currencies (or "media") in judgment and decision making, intertemporal choice, and loyalty programs.

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THEORETICAL BACKGROUND

Deliberative and Associative Influences on Consumer Choice

In many studies of irrelevant attributes, the attributes in question are unfamiliar to the decision makers and therefore may prompt (inappropriate) cognitive elaboration. For example, participants who have never heard about a meaningless attribute such as "Alpine class down fill" (e.g., Carpenter et al., 1994) may generate inferences about its significance. In contrast, a nondiagnostic cue may also influence choice via a simpler associative process. A meaningless attribute can take on value when it is frequently paired with a positive outcome (e.g., via advertising or experience with situations in which it *is* relevant). There is ample evidence that consumers can become attracted to a stimulus through explicit and even implicit classical or evaluative conditioning processes (see e.g., De Houwer, Thomas, & Baeyens, 2001; Olson & Fazio, 2001). In most situations, it is entirely appropriate for consumers to be drawn to stimuli that have been associated with good outcomes. However, we suggest that consumers may find it difficult to ignore an attribute's previously acquired attractiveness, even when the attribute is objectively irrelevant, competing and relevant attributes are available, and consumers are cognizant of the relevance of each attribute. In short, we suggest that when objectively irrelevant cues take on value through an associative process, they may exert an independent influence on choice and therefore serve as more than mere tie-breakers.

For our purposes, the critical question is whether an associative influence will be felt even when consumers can understand the attributes' irrelevance. Several dual-process models of human judgment and decision making suggest that associative processes can influence choice even in the face of countervailing cognitive processes. For example, Sloman (1996) made the distinction between associative and rule-based systems of reasoning. He characterized the associative system as a system that processes information in parallel along diffuse associative links, drawing conclusions on the basis of similarity and contiguity (i.e., co-occurrence). The rule-based system is characterized as a deliberative system that sequentially manipulates internal representations according to a set of abstract rules. An important premise of the model is that people can experience the outputs of both systems at the same time and regard both as valid inputs for judgment. For example, people exhibit the conjunction fallacy even when they appreciate its (il)logic (Tversky & Kahneman, 1983). Sloman (1996) concluded from this and similar examples that the rule-based system can suppress but not completely inhibit the associative system.

An analogous and more widely investigated distinction makes reference to heuristic versus systematic modes of processing (e.g., Chaiken, 1987; Chaiken, Liberman, & Eagly 1989; Chen & Chaiken, 1999). With regard to the present question, Chaiken and Maheswaran (1994) found that heuristic and systematic processing can co-occur and that heuristic processes can "contaminate" or bias systematic processing.

Irrelevant Trends

A test of our hypothesis requires an attribute that consumers have encountered previously, has been associated with positive outcomes, and whose irrelevance can be discerned. In addition, we need a situation in which a different but important attribute varies between options on each choice occasion. To achieve these objectives, a scenario was created in which participants chose between airlines that offered different frequent flyer points and prices on each flying occasion and in which points were allocated in a way that made them irrelevant. Most consumers have experience with points and other currencies used in loyalty programs. It is also likely that consumers have learned to associate loyalty points with desirable outcomes. Loyalty points can be objectively irrelevant to choice if competing options allocate points differently over purchases but possess the same overall relation between purchases and the ultimate reward (e.g., a free trip). For example, consider two airlines that require 600 points for a free trip. One of these airlines adopts a simple allocation scheme that awards 200 points for each trip; the other airline increases the number of points per trip as a function of repeat purchase such that it awards 100 points for every first trip, 200 points for every second trip, and 300 for every third trip. Although the trends created by the allocation patterns (e.g., 100, 200, 300 vs. 200, 200, 200) differ, the difference is irrelevant in the sense that both airlines require exactly the same actions (i.e., purchasing three trips) for the same reward (i.e., a free trip). If consumers are informed of the point allocations and number of points required for a free trip, they should not allow points to influence choice. If prices vary between options on each choice occasion, points should not even rise to the status of a tie-breaker. However, if points are imbued with a value of their own, their biasing influence may be difficult to ignore completely and consumers may exhibit a tendency to choose the option with the highest number of points on the current choice occasion.

PARADIGM AND PREDICTIONS

Paradigm

As in the aforementioned example, participants made a series of choices between two airlines that provided frequent flyer points toward free trips and required the same number of points and paid trips to be eligible for a free trip. The key difference between airlines was the way in which the points were allocated to trips. For example, consider the allocations in our initial experiment. Both airlines required 600 points for a free trip, which could be attained with no more and no less than three paid trips. In both experimental conditions, one of the two airlines' programs had a flat reward schedule that offered 200 points for each paid trip. In the ascending- versus flat-schedule condition, the competing airline had a program in which the allocation of points to purchases increased, such that participants received 100 points for every first paid trip on that airline, 200 points for every second trip, and 300 points for every third trip. In the descending- versus flat-schedule condition, the allocation of points to purchases decreased, such that participants received 300 points for every first trip, 200 points for every second trip, and 100 points for every third trip. Thus, every fourth trip on an airline was free. Prices of trips on each airline were determined randomly from the same distribution; consequently, prices varied between airlines for individual trips, but the average price was the same for each airline. Participants were told points would expire at the end of the experiment. The task was made transparent by fully informing participants of the reward schedules prior to the first choice occasion. Table 1 summarizes the point-allocation schedules used in all four experiments.

Influence of Points

Insofar as participants treat points properly, the expected choice patterns are straightforward. Because the number of paid trips required for a free trip was constant between airlines, points should logically exert no influence on choice. In addition, because prices were determined at random, prices should influence the individual choices made by each participant but should not lead to significant differences in aggregate choice proportions.

TABLE 1
Point Allocation Schedules

	Points Allocated on Every Xth Trip a Customer Flies on an Airline			
Experiment/Schedule	*1st*	*2nd*	*3rd*	*4th*
Experiment 1				
Flat	200	200	200	0 (free)
Descending	300	200	100	0 (free)
Ascending	100	200	300	0 (free)
Experiment 2				
Flat	200	200	200	0 (free)
Descending	300	200	100	0 (free)
Experiment 3				
Flat	200	200	200	0 (free)
Descending	400	100	100	0 (free)
Experiment 4				
None	—	—	—	—(not free)
Flat	200	200	200	0 (free)
Descending	300	200	100	0 (free)
Ascending	100	200	300	0 (free)

Note. In Experiment 2, two experimental groups received the same Flat and Descending schedules but had different expectations about point expiry. In Experiment 4, Flat-, Descending-, and Ascending-schedule airlines were contrasted with an airline without a loyalty program.

Insofar as the loyalty points offered by competing airlines do influence choice, the intertemporal choice literature suggests several possibilities. For example, consumers may prefer either improving (i.e., ascending) sequences (e.g., Loewenstein & Prelec, 1993) or "normal" sequences (e.g., flat) sequences (e.g., Chapman, 2000). Our hypothesis, however, is that the influence of points is due to a low-level associative process that influences choice independent from more deliberative processes. To the extent that such low-level associative processes are comparable to other low-level processes such as the visceral processes described by Loewenstein (1996), we believe these processes are myopic. Loewenstein argued that visceral processes focus attention on the present. In the same vein, it is interesting that theories of classical or evaluative conditioning do not allow for influences of stimuli beyond the current trial. Still other evidence suggests that animals and humans tend to ignore the impact of current behavior on future outcomes in distributed choice (see e.g., Herrnstein, Rachlin, & Laibson, 1997). Consequently, we expect participants to ignore the trend information contained in the allocation of points to purchases (and therefore to be relatively insensitive to the irrelevance of points) and instead focus mostly on the differences in points associated with the immediate choice.

Influence of Price and Accumulated Trips

Deliberative thought as well as associative processes should cause participants to value price, leading to choice of the lower priced option. Deliberative thought should also lead participants to maximize the number of free trips they receive and avoid getting stuck with unredeemed points. As a result, they should exhibit some tendency to stay with an airline on which at least one paid trip has been accumulated. Thus, the number of accumulated paid trips should also influence choice, with preference being given to the airline on which more trips have been accumulated. Note that a tendency to stick with an option and avoid accumulating points in multiple accounts across different companies should coincide with reality whenever there is a risk of inflation (e.g., airlines requiring more points for the same reward) or a risk of points becoming worthless (e.g., due to expiry of points or bankruptcy of the airline).

Experiment 1 tests our predictions regarding all three influences by contrasting airlines with flat schedules to airlines with ascending or descending schedules. Experiment 2 focuses on the influence of accumulated paid trips and the legitimate fear of expiry of the loyalty program. Experiment 3 examines the uninteresting possibility that our results are driven by a segment of misguided participants. Experiment 4 illustrates a boundary in which points are more appropriately devalued.

EXPERIMENT 1

Method

Design and participants. The experiment consisted of two experimental groups and one control group. One group of participants made sequential choices between an airline with a flat allocation of points to purchases and an airline with an ascending allocation. The second group of participants made sequential choices between an airline with a flat allocation and an airline with a descending allocation. A third (control) group received only the instructions, which included the descriptions of the programs for both the descending-versus-flat and ascending-versus-flat cases. This group predicted how often they expected to fly each airline in each condition without making trial-by-trial choices. All participants in this and the following experiments were undergraduate students who volunteered in exchange for extra course credit in an introductory marketing class. There were 80 participants in Experiment 1 (30 in each of the sequential conditions, 20 in the control condition).

Procedure and stimuli. Participants in the sequential conditions took part in a simulation of airline choices in a computerized environment. On the first screen, participants in the ascending-versus-flat condition were asked to carefully read the following instructions:

> This is an experiment about transportation choices. In this experiment, you are a leisure traveler who lives in Jacksonville and who has family and friends in Memphis, TN. Whenever you want to go to Memphis, you have two choices of airlines flying to Memphis. You're enrolled in the frequent flyer programs of both airlines. On both airlines, you need 600 frequent flyer points to get a free flight to Memphis and back. On Airline A, you get 100 points for every first round-trip (after getting a free flight or when you fly them for the first time), 200 points for every second round-trip, and 300 points for every third round-trip. On Airline B, you get 200 points for every round-trip. You can use each airline's points only on that airline and you cannot redeem points against anything else than free flights to Memphis and back.
>
> You will be a traveler making a number of trips from Jacksonville to Memphis and back. You don't know in advance how many trips you'll take—you'll be moving back to Memphis at some unpredictable point in time, which would reduce your need to fly to zero, leading to the expiration of your frequent flyer points. Thus, your points could expire any time. Prices for flights between Jacksonville and Memphis vary. Each time you're planning to go, you have to decide whether to fly Airline A or Airline B.
>
> We're interested to see what real people like you would do, so try to play the game as if you were really in this situation.

Participants in the descending-versus-flat condition received identical instructions with the obvious exception of the point sequence for the descending-schedule airline (300, 200, 100). The assignment of flat and nonflat programs to airlines A and B was counterbalanced between participants. Note that these instructions make clear that points were worthless for uses other than free trips.

Participants then were presented with the first choice screen (see Figure 1, Panel A for an example of a choice screen), which displayed price and frequent flyer points information for Trip 1 on Airlines A and B, along with two "buy" buttons, one for each airline. To increase participants' involvement in the experiment, the information format for both airlines was made to resemble the format used by internet travel agencies (e.g., travelocity.com). Prices were chosen randomly and reflected two sources of variation—temporal variation and variation between airlines. On each trip, a base price was drawn from a uniform distribution between $160 and $340 to mimic seasonal variation in airline prices. Prices for Airlines A and B were then determined by incorporating two deviations from the base price. These deviations were drawn from a uniform distribution between –$10 and $10. Thus, the average prices of the two airlines were the same, but prices on any trip could differ between the two airlines from $0 (no price difference) to ±$20. After every third paid trip on an airline, the next trip on that airline was free. On the free trip, the trip screen contained only one button (see Figure 1, Panel B). This button belonged to the airline on

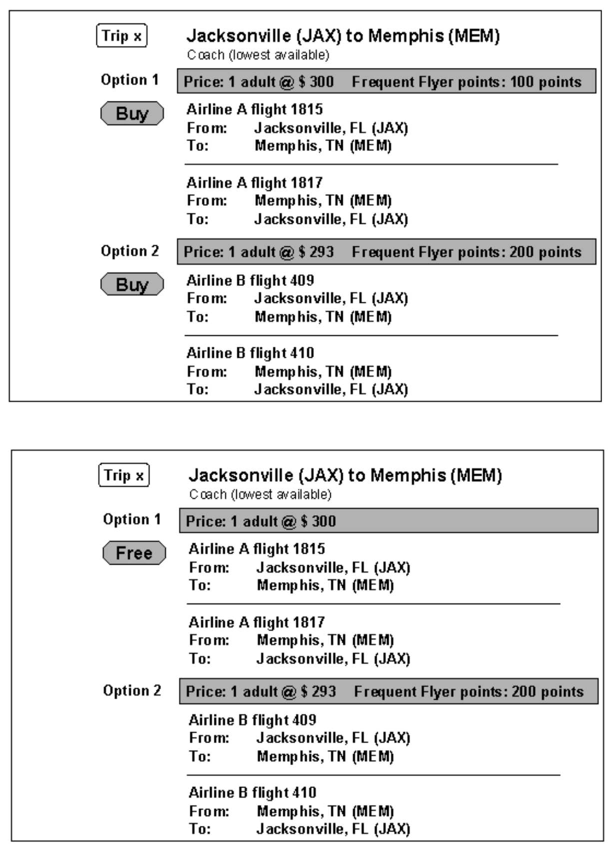

FIGURE 1 Illustration of computer screens (Panel A: Paid trip screen; Panel B: Free trip screen).

which the participant had earned the free trip and was labeled "free." Thus, participants could not "bank" free trips. After 20 trips, the simulation was terminated. Participants did not know in advance when the simulation would be terminated.

After the simulation, participants were asked to fill out a two-part answer booklet. One part consisted of evaluative judgments of the airlines and their programs. Specifically, participants were asked to rate on seven-point scales (a) which airline they flew most often, with verbal anchors accompanying scale points 1 (*flew A much more often than B*), 4 (*equal*), and 7 (*flew B much more often than A*); (b) which airline's frequent flyer program they liked most, with the labels *liked A much more than B*, *equal*, and *liked B much more than A* accompanying scale points 1, 4, and 7, respectively; and (c) which airline's frequent flyer program was most successful at making them choose their airline, with the verbal anchors *A much more successful than B*, *equal*, and *B much more successful than A* accompanying scale points 1, 4, and 7, respectively. Because the assignment of flat versus nonflat programs to A and B was counterbalanced, ratings had to be reverse-coded for half the participants. These judgments were coded such that an answer of 7 on the seven-point scales indicates more choices for the flat-schedule airline, 4 indicates equal choice proportions, and 1 indicates more choices for the non-flat-schedule airline. The counterbalancing neutralizes any response tendencies that would alter the interpretation of 4 as the psychological midpoint of the scale. The other part of the questionnaire assessed participants' perceptions of the parameters of the choice situation, including their perception of the number of paid trips each airline required to qualify for a free one. The order of the two parts of the answer booklet was counterbalanced.

Participants in the description-only control group received the same initial instructions as in the sequential conditions followed by the same evaluative questions about the airlines and their frequent flyer programs. The stimuli (i.e., ascending-vs.-flat and descending-vs.-flat) were presented within-subject in a single booklet in a counterbalanced order.

Results

The influence of points on choice was tested in several ways. First we analyzed participants' first choices, which could logically only be affected by points and price, using logistic regression analysis. Second, we examined choices across all 20 trials, also by using logistic regression. Twelve participants failed to indicate that the airlines required equal numbers of paid trips for a free trip—a rate of miscomprehension not atypical of research on irrelevant attributes (e.g., Broniarczyk & Gershoff, 2003). These participants were removed from the analysis.

To summarize the results, participants were influenced by currently offered points despite an ability to comprehend that the behavior–outcome relation was identical at each airline. Choices were biased toward higher points, lower prices, and higher accumulated paid trips.

Initial choice. First choices between the flat- and non-flat-schedule airline were analyzed at the individual level using a standard logistic regression analysis (see e.g., Ben-Akiva & Lerman, 1985) in which each individual choice is regressed on the differences between the airlines in price and points offered on the current choice occasion. (Unless stated otherwise, all factors in the analyses represent main effects.) As with analysis of variance and other basic forms of regression, this type of analysis assumes that the data do not contain different groups of people with systematically different choice strategies within each condition—an assumption that is explicitly tested in Experiment 3.

On the first choice in the experimental conditions, points were completely unconfounded with factors such as the number of trips already made on each airline (i.e., the number of accumulated trips was zero for both airlines). Thus, the difference between airlines in terms of accumulated paid trips was not included in the analysis. The logistic regression analysis of the first choice indicated a significant effect of points (asymptotic $t = 4.01$, $p < .001$) and a marginally significant effect of price (asymptotic $t = -1.70$, $p = .09$). That is, the likelihood of choosing an airline increased with its competitive advantage in points and price. In the ascending-versus-flat (sequential) group, 20 of 23 participants chose the flat-schedule airline offering 200 points over the ascending-schedule airline offering 100 points. In the descending-versus-flat (sequential) group, 20 of 25 participants chose the descending-schedule airline offering 300 points over the flat-schedule airline offering 200 points. Because prices were determined at random and therefore should be equal on average, choice based on price-only would have led to equal choice proportions. Clearly, first choices were strongly influenced by irrelevant points. In fact, across both experimental conditions, participants chose the option with the higher number of points in 16 out of 22 (73%) first choices in which the price of that option was higher than the price of the option offering fewer points. (When the option offering more points also had a lower price, 21 out of 23 [91%] chose that option. Participants chose the option offering more points in all three cases with equal prices.)

All choices. Across all trials, we expected preference to be influenced by current points, price, and accumulated paid trips. The data were analyzed using a logistic regression analysis in which individual choice outcomes on all 20 trials were regressed on the differences between the airlines in current points, price, and accumulated paid trips. Thus, each choice was considered as an independent datum and participant-specific effects were not included in the analysis. Significant effects were found in the expected directions for all three predictors (points: asymptotic $t = 7.50$, $p < .001$; accu-

TABLE 2
Experiment 1, Proportion of Choices for Ascending- or Descending-Schedule Airline

	Cumulative trips, flat-schedule airline		
	0 (200 points)	*1 (200 points)*	*2 (200 points)*
Cumulative trips, ascending-schedule airline			
0 (100 points)	.20 (19/96)	.06 (5/82)	.08 (7/85)
1 (200 points)	.63 (15/24)	.50 (7/14)	.64 (9/14)
2 (300 points)	.88 (14/16)	.78 (7/9)	.89 (8/9)
Cumulative trips, descending-schedule airline			
0 (300 points)	.59 (60/101)	.15 (7/47)	.05 (2/44)
1 (200 points)	.90 (55/61)	.69 (9/13)	.67 (4/6)
2 (100 points)	.76 (52/68)	.28 (7/25)	.24 (4/17)

Note. Numbers in parentheses indicate the frequency of choices for the ascending- or descending-schedule airline divided by the overall frequency of choices in each situation.

mulated paid trips: asymptotic $t = 12.67$, $p < .001$; price: asymptotic $t = -8.79$, $p < .001$).

These results are reflected in Table 2, which depicts the choice proportions and raw choice frequencies conditional on current points and accumulated paid trips. Recall that choices were also influenced by price. However, prices were determined at random and, therefore, were the same on average. Moreover, our context is one in which current choices influence the choice parameters encountered later. Therefore, the frequency with which participants encounter a particular set of parameters varies. Caution should be exercised when interpreting proportions based on few observations, especially given variations in price. Similarly, because not all parameter combinations were encountered equally often and because choices were influenced by competing factors, aggregate proportions are not very informative and may hide important effects.

With these caveats in mind, the results in Table 2 are consistent with predictions. The effect of points can be appreciated easily by inspecting cases in which accumulated paid trips on both airlines are equal but points differ. In these situations, participants clearly preferred the airline with more points. For example, in the ascending-versus-flat condition, 77 out of 96 choices favored the flat schedule's 200 points over the ascending schedule's 100 points when no prior trips had been accumulated on each airline; 8 out of 9 favored the ascending schedule's 300 over the flat schedule's 200 points when two trips had been accumulated on each airline. In the descending-versus-flat condition, 60 out of 101 choices favored the descending schedule's 300 points over the flat schedule's 200 points when no trips had been accumulated on each airline; 13 out of 17 favored the flat schedule's 200 points over the descending schedule's 100 points when two trips had been accumulated on each airline. Overall, 158 out of 223 (71%) of choices in these unconfounded situations favored the option with the highest number of points.

The influence of accumulated paid trips can be seen by examining situations in which both airlines offer 200 points but differ in terms of accumulated paid trips. In these situations, 77 out of 105 (73%) of choices favored the option with the highest number of accumulated paid trips. The effect of price is not evident in Table 2. Across all choices, participants favored the lower priced option in 446 out of the 695 choices (64%) in which prices differed between options.

Overall proportions of trips participants took on each airline reflected the influence of points and accumulated paid trips. In the ascending-versus-flat condition, the tendency to choose the option with the highest current points and the tendency to choose the option with the highest number of accumulated paid trips both favored the flat-schedule airline. For example, on the first choice, participants chose between 200 points and zero accumulated paid trips on the flat-schedule airline versus 100 points and zero trips on the ascending-schedule airline. If they chose the flat-schedule airline, the second choice was again between 200 points on the flat- and 100 points on the ascending-schedule airline, but now with one trip accumulated on the flat- and zero trips accumulated on the ascending-schedule airline. If they chose the flat-schedule airline again, the third choice would be between 200 points and two accumulated paid trips on the flat- and 100 points and zero trips on the ascending-schedule airline. As a result, participants flew the flat-schedule airline significantly more often (74% of trips) than the ascending-schedule airline; $t(22) = 4.48$, $p < .001$. In the descending-versus-flat condition, current points and accumulated paid trips started favoring different options as soon as two trips had been accumulated on the descending-schedule airline. As a result, the overall proportions of trips taken on the two airlines were more balanced (52% of trips were on the descending-schedule airline; $t(24) = .41$, *ns*.

Ratings. After making their choices, participants rated how often they flew each airline, how much they liked each frequent flyer program, and how successful each frequent flyer program was at making them choose each airline. Results were entirely consistent with actual choice behavior and will not be discussed in detail. That is, participants accurately reported the relative frequency with which they chose each airline and provided liking and success ratings that were consistent with actual and reported choice frequency. Of note, however, are the corresponding responses by participants in the control group, who did not make trip-by-trip choices. These participants indicated they would be equally likely to fly the flat-schedule airline as the ascending-schedule airline, as measured by deviation from the neutral scale-point, $t(19) = .49$, *ns*, and equally likely to fly the flat-schedule as the descending-schedule airline, $t(19) = .70$, *ns*; the difference between the means for the ascending-versus-flat and descending-versus-flat conditions was also nonsignificant, $F(1, 19) = .005$. The results suggest that the control group understood that the behavior-outcome relations were identical across options and, therefore, that points should have no influence on behavior. In comparison to the corresponding results from the sequential-choice groups, the anticipated flying frequency for the control group was significantly different from the rated flying frequency in the ascending-versus-flat condition, $F(1, 41) = 4.61$, $p = .04$, but not from the descending-versus-flat condition, $F(1, 43) = 1.06$, *ns*.

Discussion

Reward schedule exerted an influence on choice in a situation in which the objective incentive structure clearly did not warrant an influence. Irrelevant points had a significant effect on choice despite the presence of truly discriminating price information. These results are consistent with an explanation in which deliberative and associative processes simultaneously affect choice.

The results also show an effect of accumulated paid trips. We have hypothesized that this effect is at least partially the result of an analytically appropriate process, inasmuch as a tendency to stick with an option may reflect an appropriate desire to capture a free trip prior to expiry (i.e., a desire to avoid getting stuck with three or more paid trips across both airlines at expiry). If consumers reason logically, they should be more likely to stick with an option as the risk of expiry increases. Experiment 2 addresses this point.

EXPERIMENT 2

Experiment 1 revealed a tendency for participants to stick with a chosen option. To determine whether stickiness is driven at least in part by an analytically warranted tendency to avoid risk instead of another, perhaps more thoughtless process, a simple test can be performed in the descending-versus flat-schedule condition by manipulating threat of point expiry. When risk of expiry is high, analytical consumers should place more weight on the number of trips already accumulated on an airline and should place less weight on price and points. More specifically, the first choice should be based on price only. Analytical thought should lead participants to base subsequent choices on a mix of price and accumulated trips, with price decreasing in importance and accumulated trips increasing in importance as risk of expiry increases.

Stimuli and procedure were identical to those in the descending-versus-flat condition of Experiment 1, with the exception of two sentences of instructions. In the *low-risk* condition the sentences mentioning potential expiry of points were replaced by sentences stating that points would never expire. In the *high-risk* condition, the corresponding sentences stated that points on both airlines expire quickly, the participant does not fly very much in some years, and there was a high risk that the points would expire before they could be used. An equal number of participants (39) took part in each condition. Data from 15 participants were removed from the analysis because they failed to indicate that both airlines required the same numbers of paid trips for a free trip.

Results were consistent with the existence of a rational tendency to avoid expiry, but also showed a continued effect of points that was not affected by risk of expiry. A logistic regression analysis on participants' first choices showed that the effect of points was significant (asymptotic $t = 1.99$, $p < .05$) and was not significantly influenced by risk of expiry (asymptotic $t = -.37$, *ns*), as would be expected if no trips have yet been accumulated. The effect of price on the first choice was not significant in the full model (asymptotic $t = -1.59$, $p = .11$) and did not significantly interact with risk of expiry (asymptotic $t = -.97$, *ns*). As reflected by the significant effect of points, participants in both conditions favored the descending-schedule airline on the first choice (20 out of 30 in the low-risk and 23 out of 33 in the high-risk-of-expiry condition). Across the two conditions, the higher points option was chosen despite having the higher price in 10 out of 25 (40%) first choices. (When it had the lower price, the higher points option was chosen 29 times out of 34 [85%]. The same option was chosen in all four cases in which prices were equal).

To examine behavior across all trials, we ran a logistic regression including price, points, number of accumulated paid trips, risk level, and the interaction terms of risk level and the other independent variables. As in Experiment 1, the effect of accumulated trips was significant (asymptotic $t = 7.69$, $p < .001$). Consistent with the interpretation of the effect of accumulated trips as driven by a warranted fear of expiry, a marginally significant interaction effect of accumulated trips and risk of expiry was obtained (asymptotic $t = 1.67$, $p < .10$), indicating a stronger tendency to stick with an option when risk of expiry is higher. However, we also found a strong and analytically unwarranted effect of points (asymptotic $t = 4.93$, $p < .001$) that showed no evidence of being influenced negatively by risk of expiry (asymptotic $t = .85$, *ns*). In addition, whereas price had a significant effect on choices (asymptotic $t = -6.48$, $p < .001$), this effect also did not differ as a function of risk of expiry (asymptotic $t = -.64$, *ns*). Finally, the main effect of risk was not statistically significant (asymptotic $t = -1.53$, *ns*).

TABLE 3
Experiment 2, Proportion of Choices for Descending-Schedule Airline

	Cumulative trips, flat-schedule airline		
Cumulative Trips, Descending-Schedule Airline	*0 (200 Points)*	*1 (200 Points)*	*2 (200 Points)*
Low risk of expiry			
0 (300 points)	.61 (62/102)	.18 (8/44)	.13 (5/40)
1 (200 points)	.68 (54/79)	.36 (12/33)	.23 (6/26)
2 (100 points)	.70 (54/77)	.14 (5/35)	.15 (4/27)
High risk of expiry			
0 (300 points)	.66 (77/116)	.35 (17/48)	.16 (6/37)
1 (200 points)	.80 (71/89)	.43 (15/35)	.46 (12/26)
2 (100 points)	.77 (72/93)	.33 (12/36)	.21 (6/28)

Note. Numbers in parentheses indicate the frequency of choices for the descending-schedule airline divided by the overall frequency of choices in each situation.

Table 3 depicts proportions and frequencies of choices conditional on points and accumulated trips, but collapsed across prices. Across all situations in which participants have accumulated one more trip on one airline than on the other, 115 out of 184 (62.5%) choices in the low-risk condition versus 128 out of 199 (64.3%) choices in the high-risk condition favor the option with the higher number of accumulated trips. Across situations in which participants have accumulated two more trips on one airline than the other, 89 out of 117 (76.1%) choices in the low-risk versus 103 out of 130 (79.2%) choices in the high-risk condition favor the option with the higher number of accumulated trips. From these raw frequencies, the interaction of risk and accumulated paid trips appears small. However, the true effect is partially disguised. The option with the greater number of accumulated trips was fortuitously less likely to have had the higher price in high-risk conditions than in low-risk conditions. In the high-risk condition, the number of choice occasions in which the option with the higher number of accumulated paid trips had the higher price was equivalent to the number of times it had lower price (160 vs. 159 choice occasions). However, in the low-risk condition, the option with the higher number of accumulated paid trips had the lower price (156 choice occasions) more often than the higher price (133 choices occasions). Thus, the relatively large number of choices for the option with the higher number of accumulated trips in the low-risk condition was partially due to the effect of price, which is not represented in Table 3.

These results demonstrate that participants were appropriately influenced by risk, were inappropriately influenced by an irrelevant attribute (points), and that the latter effect was not diminished by the former. As before, the results are consistent with simultaneous and independent effects of deliberative and associative processes.

The previous experiments do not address individual differences between participants. Although participants who did not indicate that both airlines required the same number of paid trips were eliminated from the analysis, it is still possible that a small group of participants merely guessed that the airlines both required three paid trips for a free one when asked, and that this group completely determined the effect of points. Our conclusion that attentive participants can be influenced simultaneously by irrelevant points and relevant price and accumulated trips requires the existence of a large segment of participants who show effects of price, accumulated trips, *and* points rather than separate segments consisting of a large group that responds only to price and accumulated trips and a small group that responds to the irrelevant points cue. Thus, it is important to test for individual differences. We predict that deliberative and associative processes occur simultaneously within the same people. To test this prediction, we needed to be certain that the overall results do not reflect two separate groups of participants—one segment whose responses are wholly driven by deliberative processes and one segment whose responses are drive entirely by associative processes. Experiment 3 addresses this issue.

EXPERIMENT 3

Experiment 3 was designed to facilitate a statistically powerful analysis of heterogeneity by requiring more choices per participant and minimizing the correlation between accumulated paid trips and current points.

Method

A single experimental group ($N = 30$) was used. All participants made a series of purchases in which their options were an airline with a flat schedule and an airline with a "step-descending" schedule offering many points for every first trip (after the beginning of the experiment or after a free trip on that airline) and a lower but constant number of points for all other paid trips. As in Experiment 1, both airlines required three paid trips and 600 points for a free trip. The flat-schedule airline offered 200 points on every paid trip; the step-descending airline offered 400 points on every first and 100 points on every second and third paid trip on that airline. Participants made 30 trips. If the effect of points in the previous experiments is driven by a small segment of participants who (a) are similar to the participants who were excluded from the previous experiments' analyses for failing to understand that both airlines required the same number of paid trips for a free trip but (b) happened to guess that both airlines required the same number of paid trips when filling out the postexperimental question, then the chance of finding statistically significant evidence for separate segments is largest when no participants are excluded from the analyses. Thus, all participants had to be included in the analysis to provide a comprehensive and conservative test of underlying segments. Otherwise, stimuli and procedure were similar to those in Experiment 1.

Results and Discussion

We estimated a finite-mixture logit choice model (cf. Kamakura & Russell, 1989) with choice of airline as the dependent variable and difference between airlines in price, current points, and number of accumulated paid trips as independent variables. This type of analysis determines if the choice results are driven by one or more groups of participants with systematically different choice strategies. If the results from the previous experiments were driven by two segments (i.e., a larger segment driven solely by appropriate desires to minimize prices paid and to minimize losses due to expiry of points and a smaller segment that is influenced by points), we should find support for a two-segment solution.

The data supported a single-segment hypothesis. The one-segment solution showed significant positive coefficients for current points (asymptotic $t = 4.51$, $p < .001$) and accumulated paid trips (asymptotic $t = 8.88$, $p < .001$) in addition to price (asymptotic $t = -9.24$, $p < .001$). Conditional choice proportions and frequencies reflect these conclusions and are presented in Table 4. The two-segment solution showed one large segment influenced by points, accumulated paid trips, and price in addition to a small segment that did not respond strongly to any of the factors. In addition, the two-segment solution did not fit the data significantly better than the one-segment solution. Thus, there was no evidence that the only people influenced by irrelevant points were a small segment of participants who merely guessed that both options required the same number of paid trips for a free trip. A segment comprising the vast majority of participants was influenced by irrelevant points despite also being sensitive to the presence of analytically warranted factors (price and accumulated trips). Details of the analysis are provided in the Appendix.

EXPERIMENT 4

Experiments 1 through 3 suggest that currencies such as points can influence consumers' choices over time even when such influence is clearly unwarranted. Experiment 4 tests a boundary condition. The fact that participants placed value on points in Experiments 1 through 3 might easily be taken to imply that point-based loyalty programs are more effective than financially equivalent offerings that lack a rewards program. Consider, for example, a vendor who offers a free trip after three paid $250 trips and a vendor who lacks a loyalty program but charges an average per-trip price of $187.50. The total prices are identical for a set of four trips ($750). Nonetheless, one might argue that if points are seductive and prices are equal on average over time, we should find a preference for the airline with the loyalty program. However, the previous experiments also suggest that people focus on the current trial; if so, they may ignore the fact that price advantages cancel out across trips and base their choice on the trade-off between the advantage in current price for the discount airline and the advantage in current points for the airline with the loyalty program. It would not be surprising if the effect of current prices overwhelmed the effect of points because price, unlike points, is relevant and a variable to be maximized from an analytical standpoint. In addition, money (price) likely possesses a much longer and stronger associative relation with good outcomes than points. Finally, the fear of expiry should also prompt consumers to choose lower prices over loyalty points and free trips. Thus, our findings in the previous experiments actually suggest that consumers should choose the option without a loyalty program. This hypothesis was tested by contrasting airlines with points programs to airlines with monetarily equivalent price discounts.

Method

The experiment consisted of three groups and a total of 99 participants. Stimuli were similar to those in Experiment 1,

TABLE 4
Experiment 3: Proportion of Choices for Descending-Schedule Airline

	Cumulative Trips, Flat-schedule Airline		
Cumulative trips, descending-schedule airline	*0 (200 Points)*	*1 (200 Points)*	*2 (200 Points)*
0 (400 points)	.56 (73/130)	.21 (14/67)	.21 (12/56)
1 (100 points)	.48 (68/141)	.14 (11/77)	.13 (10/78)
2 (100 points)	.73 (56/77)	.31 (10/32)	.28 (9/32)

Note. Numbers in parentheses indicate the frequency of choices for the descending-schedule airline divided by the overall frequency of choices in each situation.

with the exception that one of the airlines was replaced by an airline without a loyalty program (i.e., no points and no free trips) and an average price of $187.50. In the *descending-versus-none* condition, 34 participants chose between the airline without a loyalty program and an airline offering 300 points on every first, 200 points on every second, and 100 points on every third flight, with a free flight after accumulating 600 points and an average price on paid trips of $250. For every four flights, this yields the same total cost as the no-program airline. The *ascending-versus-none* (32 participants) and *flat-versus-none* (33 participants) conditions were identical, except that the airlines with a frequent flyer program used 100, 200, 300 and 200, 200, 200 schedules, respectively.

Results

Across the three conditions, a logistic regression analysis of the first choice yielded a significant effect of price (asymptotic $t = -1.94$, $p = .05$) but not of points (asymptotic $t = 1.32$, $p = .19$). As expected, overall choice patterns favored the no-program option. Participants flew the airline without a loyalty program significantly more often (64% of trips) than the airline with a loyalty program, $t(98) = -4.35$, $p < .001$; this effect did not significantly depend on whether the latter program had an ascending (70% of trips on the no-program option), flat (63%), or descending (60%) schedule, $F(2, 96) = .93$. A logistic regression analysis of all 20 choices yielded significant effects of price (asymptotic $t = -12.90$, $p < .001$) and accumulated paid trips (asymptotic $t = 9.62$, $p < .001$), as well as a significant effect of points (asymptotic $t = 5.81$, $p < .001$). Taken together, these results suggest that the analytically unwarranted effect of points can be reduced, although the most powerful statistical analysis still indicated a residual effect of points.

GENERAL DISCUSSION

In four experiments, participants made repeated choices between airlines whose offerings differed in terms of price and loyalty program points. Points were allocated such that the competing options required the same number of paid trips for a free trip, but differed in terms of trend over purchases (e.g., 100 points for each first, 200 for each second, and 300 for each third paid trip vs. 200 for each first, second, and third paid trip). Thus, points were irrelevant. Choices revealed an influence of objectively irrelevant trends in points on repeated consumer choices. Logistic regression analyses showed that individual choices depended on currently offered points, price, and the number of paid trips accumulated with each airline (Experiments 1–4). The latter influence reflects an analytically appropriate tendency to stick with an option on which more paid trips have already been accumulated toward a free trip reward. This tendency minimizes the likelihood of being stuck with several paid trips in multiple accounts when points expire. Results suggest that the tendency to stick with an option increases as the risk of point expiry increases (Experiment 2). We found no support for the existence of separate segments of participants—one exhibiting only deliberative thought and one exhibiting only "mindless" behavior (Experiment 3). Finally, we found that the effect of points can be reduced when participants have the option to choose an airline without a loyalty program offering much lower prices (Experiment 4). Before speaking to the theoretical implications of these results, we consider some alternative explanations.

Alternative Explanations

It is important to rule out uninteresting alternative explanations of our results. We first note that we used only the data from participants who understood the payoffs from the choice alternatives. In addition, participants in the control group of Experiment 1 received the same loyalty-program information as participants in the experimental groups. The control group's results suggest participants were able to comprehend that points were irrelevant. Finally, the influence of points was not limited to the first few choices; in all our experiments, the influence of points was not significantly different in the second half versus the first half of the choices (all *p*s > .30). Thus, general or even just initial miscomprehension seems an unlikely explanation.

It is also unlikely that general mindlessness drove the results. Participants were sensitive to the risk of expiry (Experiment 2) and any effect of accumulated trips requires attention to past choices. In addition, the two-segment solution in Experiment 3 suggests that if any segments did exist, a small segment of participants that exhibited general mindless behavior was not the segment influenced by points. Rather, sensitivity to points characterized the larger segment that was also appropriately sensitive to price and accumulated paid trips.

On a more interesting note, it is also unlikely that participants misperceived that points rather than paid trips would bring them closer to the goal of a free trip (cf. Heath, Larrick, & Wu, 1999). To test this hypothesis, we conducted two additional experiments that disambiguated accumulated paid trips and accumulated points by endowing the options with different numbers of points prior to the first choice but holding constant the number of accumulated paid trips. We found no evidence that preference is driven by the number of accumulated points.

Implications

This research investigated a limited set of parameters within a single context. Additional research, including stringent manipulation checks and introspective measures of participants' liking for loyalty points, is required to shed light on the generalizability of our findings as well as underlying process. Nonetheless, our findings thus far have implications for several important streams of research.

Irrelevant information effects. Our experiments contribute to the literature on irrelevant or "rivial" attributes and their surprising influence on consumer decisions (e.g., Broniarczyk & Gershoff, 1997, 2003; Brown & Carpenter, 2000; Carpenter et al., 1994; Meyvis & Janiszewski, 2002; Simonson et al., 1994). Brown and Carpenter (2000) persuasively argued that irrelevant cues may influence choice by providing reasons to favor or reject choice alternatives when more diagnostic information is unavailable or when important attributes fail to identify a superior option. In our experiments, choice alternatives differed on price and (after the first choice) the number of trips already accumulated, which eliminated any need to appeal to points as a tie-breaker. Thus, our results suggest that alternative attributes can be more than a tie-breaker, even if participants can understand the attribute's irrelevance.

Our experiments also extend the irrelevant-attribute paradigm in several ways. First, loyalty points in our studies were not worthless, per se, inasmuch as the accumulation of points was a necessary condition to obtain a reward. Instead, points should have had no influence because the same behaviors were required to obtain the same reward regardless of how points were allocated. Thus, attributes can be irrelevant not just because they are explicitly worthless and do not bring any reward, but also because they create illusory advantages. Second, by using loyalty points, we show that the phenomenon is not restricted to cases in which the irrelevant attribute is unfamiliar to the decision maker. A third extension of the paradigm involves the intertemporal nature of our experiments. Prior research on irrelevant attributes has employed "one-shot" or "two-shot" choice tasks. In contrast, participants in our experiments made multiple choices and therefore had ample opportunity to learn from the consequences of prior decisions. The results suggest that irrelevant-attribute effects are not ephemeral.

Associative effects on choice. We make the uncontroversial assertion that a familiar irrelevant attribute can acquire valence through classical or evaluative conditioning. We further speculate that the influence of such associative learning processes can occur simultaneously with more deliberative cognitive processes. As suggested by several dual-process models of decision making and evaluation, associative and deliberative processes simultaneously influence behavior even when their evaluative outputs run in opposite directions (e.g., Chaiken & Maheswaran, 1994; Sloman, 1996). Although we have little direct process evidence, our data are consistent with such an account. We find that the same people show both a rational influence of accumulated trips and an irrational influence of current points, in addition to an influence of price (which presumably influences choice both through deliberative and associative processes). The influence of points seems to be concentrated in the present, which is what one would expect if the influence of points were associative. We also find that participants are appropriately sensitive to the risk of future point expiry. The hypothesis of independent influence of associative and more deliberative processes on choice is also consistent with the lack of interaction in Experiment 2 between fear of expiry and the influence of points.

In this context, the different pattern of results observed in experimental and control conditions of Experiment 1 is informative. Participants in the control group were informed of the choice payoffs and expressed a global preference for one schedule vis-à-vis the other; participants in the experimental conditions made local, trip-by-trip choices. In the control group, the overall number of points was globally identical and therefore any associative influence would not lead to a preference for one option over the other; in the experimental conditions, points awarded by each airline on each trip were not identical and therefore the associative effect of points would pull the consumer toward the option with the greater number of points. Consequently, the former made more analytically appropriate decisions than the latter.

Although the associative influence of points may be seductive, it is not without boundary. For example, points may have no influence when encountered in the presence of very strong countervailing forces. To test this hypothesis, we conducted an additional experiment that pitted a step-descending schedule against a flat schedule and increased the range of price differences used in Experiments 1 through 3 by a factor of six. Results showed a strong effect of price and no significant effect of points. More generally, it is reasonable to assume that one associative influence can be neutralized by a stronger and opposite associative influence or by a more severe set of analytic trade-offs.

Medium effects. Our experiments contribute to the emerging literature on medium effects (Hsee, Yu, Zhang, & Zhang, 2003). The points in our experiments function as a medium in the sense that they serve as an intermediary payoff that mediates the relation between behavior (e.g., effort or choice behavior) and desirable outcomes (e.g., free trips). By itself, the points medium should have no value. It merely represents something that can be traded for actual desired outcomes. In a representative experiment, Hsee et al. (2003) asked two separate groups of participants to make a choice. In the control group, participants chose between a 6-min task with a reward of one gallon of vanilla ice cream and a 7-min task with a reward of one gallon of pistachio ice cream. In the experimental group, participants chose between the same 6-min task, for which they would receive 60 points to be exchanged for a gallon of vanilla ice cream and the 7-min task, for which they would receive 100 points to be exchanged for a gallon of pistachio ice cream. Thus, the behavior–outcome relation was constant between conditions. The conditions only differed in terms of the points medium. As predicted, the proportion of participants choosing the pistachio ice cream was much higher in the experimental than in the control condition.

Our work contributes to this literature in several important ways. First, as Hsee et al. (2003) noted, we discovered that participants suffered from an *illusion of trend*. Second, the equivalence of the behavior–reward relation was more transparent in our experiments than in the experiments of Hsee et al., which speaks to the potential robustness of medium effects. Most important, Hsee et al. accounted for their results in terms of *medium maximization*; that is, failing to skip the medium and underweighting the medium-outcome relation relative to the behavior–medium relation. Medium maximization cannot explain our results, because the relation between points (medium) and free trips (outcome) was kept constant between options (600 points were required for a free trip on both airlines). Thus, the weighting of this relation could not affect choice between the options. Our finding, of course, does not preclude the possibility that medium maximization plays a role in other situations.

Intertemporal choice. Our method and results provide an interesting contrast to prior research on intertemporal choice. Participants in intertemporal choice experiments traditionally are presented either with (a) an entire sequence of experiences and asked to make a single, global choice or (b) individual experiences and asked to make a local choice about each experience separately. In studies that employ a global choice paradigm, consumers often show a preference for improving sequences of valued outcomes (e.g., Loewenstein & Prelec, 1993). To the extent that consumers have learned to value points, this implies a preference for ascending-schedule airlines over flat-schedule airlines. In our choice data, we find the opposite. More recent research in this paradigm (Chapman, 2000) suggests that consumers' global preferences for sequences favor "normal" patterns (e.g., ascending for salaries, descending for health outcomes). In the context of frequent flyer programs, flat schedules, ascending schedules (e.g., bonus miles for very frequent flyers, special offers promising more miles for more trips to a particular destination), and step-descending schedules (e.g., large initial offers of miles for airlines' credit cards) seem more normal than linearly descending schedules. We do not find evidence that the former are systematically preferred to the latter. In fact, ascending and step-descending options are clearly chosen less often. In studies that employ a local "distributed" choice paradigm (e.g., Herrnstein et al., 1997), researchers often report very myopic behavior characteristic of hyperbolic discounting (e.g., Hoch & Loewenstein, 1991; Kirby & Herrnstein, 1995; Loewenstein & Prelec, 1992). In our experiments, purely myopic behavior would have led participants to choose a flat-schedule airline over a linear-descending airline (because participants would have opted for the flat-schedule airline after the first or second flight and then would have stayed with that airline to obtain its 200 points rather than the 100 points on the descending-schedule airline on subsequent choices). We find no evidence for such a pattern.

Participants in our experiments received both global and local information and had the opportunity to base their choices on either. The global information consisted of the general descriptions of the point allocations by each airline prior to making the first choice. Had our participants formed a global preference at this time, prior research suggests that they should have shown a preference for improving sequences, a preference for "normal" step-descending (e.g., 400, 100, 100) schedules, or a general preference for "normal" flat schedules. We found that none of these schedules yielded significantly more choices than the linear-descending schedule. Whatever the effect of the global information, our participants were influenced by local, trial-by-trial information. As noted, prior research suggests a myopic preference for the flat schedule in purely local choice situations. Our failure to find a preference for the flat schedule is consistent with a modified form of myopia that may be referred to as "sticky myopia." Participants were influenced locally and myopically by current points but also chose to stick with an airline on which they had already made trips toward a free one. These results suggest that when both global and local information is available, local information about the current choice will be weighted heavily. However, when currencies or media such as points are involved, the current choice may also be influenced by previous choices when these currencies can potentially lose their value.

Loyalty programs. Finally, our experiments contribute to the growing literature on the effects of loyalty programs (e.g., Bolton, Kannan, & Bramlett, 2000; Dowling & Uncles, 1997; Kivetz, 2003; Kivetz & Simonson, 2002a, 2002b; Leenheer, Bijmolt, van Heerde, & Smidts, 2002; Mägi, 2003; O'Brien & Jones, 1995; Roehm, Pullins, & Roehm, 2002; Sharp & Sharp, 1997). Our experiments suggest that the manner in which points are allocated to purchases matters. In the business world, consumers are often given large introductory offers of points or other currencies, not unlike the step-descending schedule described in Experiment 3. Firms also use ascending schedules similar to the ascending condition in Experiment 1. For example, a major airline recently offered 5,000 bonus miles for the first transatlantic trip during the winter season, 10,000 for the second trip, and 15,000 for the third trip. In addition, frequent buyers often receive bonus points or miles. Although much more research is required, our results suggest that the effects of such programs may deviate from firms' expectations. At a minimum, firms should be aware of a possible discrepancy between the way consumers react to global descriptions of a loyalty program and actual occasion-by-occasion behavior.

From a consumer-welfare perspective, placing value on points beyond their exchange rate with real rewards leaves consumers vulnerable to quasi-deceptive practices. In particular, consumers may fall prey to firms that increase point allocations via bonus or partner programs while simultaneously increasing the number of points required for a reward.

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APPENDIX
Finite-Mixture Logit Choice Model

A finite-mixture logit choice model was estimated on the trip-by-trip choice data from Experiment 3. We followed the procedure suggested by Kamakura and Russell (1989). The utility for alternative *i* for participant *j* on choice occasion *t* was specified as

$$u_{ijt} = \chi_{ijt}\beta_{ij} + \varepsilon_{ijt} \tag{1}$$

where χ is a vector of explanatory variables, β represents the vector of response parameters, and ε is an extreme-value distributed error term. The choice probability for alternative *i* (=1…*I*) is given by

$$p_{ijt} = \exp(u_{ijt}) / \Sigma_{i=1}^{I} \exp(u_{ijt}) \tag{2}$$

The unconditional likelihood for participant *j* is obtained by integrating over the distribution $G(\beta)$ of the random variable β. Doing so, we obtain

$$L_i = \int_{\beta} L_{i|\beta} dG(\beta) \tag{3}$$

The distribution of β is determined empirically from the data by approximating it by a discrete number, Q, of supports, β_q, $q = 1, 2, \ldots, Q$, and their associated probabilities π_q, $q = 1, 2, \ldots, Q$. Consequently, the consumer's unconditional likelihood can be written as

$$L_i = \sum_{q=1}^{Q} L_{i|\beta_s}\pi(\beta_s) \tag{4}$$

Standard maximum likelihood methods can be used to estimate the model parameters.

There was a total of 690 choice occasions in Experiment 3. We used the price of the trip (PRICE), the cumulative number of unredeemed paid trips on each airline (CUMTRP), and the number of currently offered points by each airline (CURPTS) on each choice occasion as the explanatory variables.

To summarize briefly, the results showed that, using a Bayesian Information Criterion; BIC = –2 × Loglikelihood + number of parameters × log(number of parameters); a one-segment solution fits the data the best. Detailed results from the one-segment and the two-segment solution are given in Table A1.

As can be seen from the table, all the coefficients are significant ($p < 0.05$) for the one-segment solution. In addition, their signs are as expected—the coefficient for PRICE coefficient is negative and the coefficients for CUMTRP and CURPTS are positive.

The overall model fits show that a two-segment solution does not fit the data better. The loglikelihood of the two-segment solution is almost exactly equal to the loglikelihood from the one-segment solution, whereas the use of a penalized likelihood (BIC) shows that the one-segment solution provides a better fit than the two-segment solution. An examination of the two-segment solution also shows that there is a large segment for which the coefficients are significant ($p < 0.10$) and signed the same as for the one-segment solution. The coefficients are insignificant for the smaller segment. Thus, there is no evidence to show the existence of more than one segment. In addition, the results from a two-segment solution show that a majority of participants behave consistently with our explanation.

TABLE A1

			Two-Segment Solution			
	One Segment Solution		*Segment 1*		*Segment 2*	
	Estimate	*SE*	*Estimate*	*SE*	*Estimate*	*SE*
PRICE	–0.0971	0.0105	–0.1597	0.0780	0.0177	0.1276
CUMTRP	0.8947	0.1009	1.0651	0.4551	0.7672	0.9089
CURPTS	0.3314	0.0734	0.4084	0.2269	0.2586	0.4670
Segment size	1.00		0.74		0.26	
LL	–395.21		–394.40			
BIC	816.56		834.56			