Human Systems Engineering and Design (IHSED 2026), Vol. 237, 2026, 84–91
https://doi.org/10.54941/ahfe1008148

The Sunk Cost Dividend: Anticipatory Commitment, Willingness to Pay, and Behavioral Activation in Flat-Rate Urban Mobility

So Nishina

STUDIO ZERO, Plaid Inc., Tokyo, Japan

ABSTRACT

Behavioral economics has long characterized the sunk cost effect as a cognitive error — the irrational persistence in a course of action because of costs already incurred, irrespective of prospective value. This paper proposes an inversion of that framing. Drawing on behavioral log data, post-experiment survey responses (n = 237), and in-depth interview transcripts from a three-week commercial flat-rate mobility experiment in a high-density metropolitan district of western Tokyo, we identify a distinct behavioral mechanism we term anticipatory commitment: the state of structured behavioral readiness that pre-payment creates before a product is first used. Participants who paid 2,000 JPY in advance for a Digital Mobility Pass integrating three transport modes exhibited systematic pre-use scheduling, exhaustive mid-experiment optimization, and explicit value-maximization behavior. Willingness-to-pay data reveal a commercial ceiling of approximately 3,000– 5,000 JPY — a pricing corridor that covers operating costs without public subsidy. The central argument is that the pre-payment structure of a flat-rate mobility pass is not merely a revenue model; it is a behavioral intervention that converts latent urban exploration intent into structured temporal commitment. Free-of-charge trial alternatives would not produce this effect.

Keywords: Anticipatory commitment, Sunk cost, Willingness to pay, Behavioral activation, MaaS, Mental accounting, Flat-rate mobility, Pre-payment design

INTRODUCTION

A 32-year-old woman purchased the pass within five minutes of discovering it. She was not a habitual urban explorer — her weekends were usually spent at home. The pass cost 2,000 JPY. She would later describe her approach to using it in terms that were precise and, to a mobility researcher, unexpectedly illuminating: "I have a tendency to take everything from a buffet. I calculated whether I could get my money's worth. I self-diagnosed that tendency."

She was not unique. Over the three weeks of the experiment, multiple participants independently described behavior organized around the same logic: the pre-paid 2,000 JPY had created an obligation — not in any contractual sense, but in the psychological sense that Thaler (1980) would

Received March 10, 2026; Revised June 14, 2026; Accepted June 29, 2026; Available online September 25, 2026

recognize as mental accounting. The pass was not merely a ticket to ride. It was a commitment device, and the commitment had structured their behavior before they had boarded a single vehicle.

The behavioral economics literature has explored sunk cost effects almost exclusively as dysfunctions. The prescription is invariably the same — ignore sunk costs; decide on prospective value alone. Our data suggest that in the specific context of urban mobility, this prescription would actively undermine the behavioral objective. The 2,000 JPY sunk at purchase was not a distortion to be corrected. It was the mechanism by which the experiment worked.

We propose the term anticipatory commitment to name this condition: the state of structured behavioral preparedness that pre-payment creates before first use of a product. It is not simply saying "I plan to use this." It is the allocation of time, the rearrangement of weekly schedules, the development of route knowledge, and the construction of a personal itinerary that transforms an abstract purchase into a structured program of action.

Section 2 develops the theoretical account. Section 3 describes the experimental context and pricing decision. Section 4 presents behavioral evidence — WTP findings and qualitative commitment signatures. Section 5 addresses design implications. Section 6 concludes.

THEORETICAL BACKGROUND

Mental Accounting and the Sunk Cost Effect

Thaler's (1980, 1985) theory of mental accounting proposes that individuals track financial transactions within cognitive accounts organized by category and time horizon. A concert ticket purchased in advance and then forgotten on a rainy evening is experienced differently from a ticket purchased at the door: the pre-purchase charges the mental account for leisure, and failure to attend registers as a loss — triggering a disposition to complete the consumption in order to close the account at neutral.

The sunk cost fallacy, in this framework, occurs when mental account logic leads to consumption decisions that prospective cost-benefit calculus would not support. But the prescription assumes the decision is whether to consume an existing good. In the flat-rate mobility context, the decision is what to consume: the pass grants access to a bundle, not a specific destination. There is no fallacy in using a flat-rate pass to its full extent, because using it fully is, by definition, the highest-value action. The mental account logic and the prospective value logic converge.

Anticipatory Commitment: A Proposed Construct

We propose anticipatory commitment to describe the state of structured behavioral preparedness that pre-payment creates before first product use. It has three distinguishing features. First, it is forward-structured: it organizes future behavior before the committed action occurs, producing scheduling, route research, and itinerary planning that shape actual use. Second, it is temporally bounded: the commitment is tied to a defined expiration, creating urgency that intensifies as the deadline approaches. Third, it is self-reinforcing:

early use generates experiential knowledge that increases the efficiency and ambition of subsequent use, producing a learning curve that is itself a form of commitment deepening.

Willingness to Pay as a Behavioral Signal

WTP is typically analyzed as demand elasticity. This paper proposes a secondary use: WTP data as a signal of anticipatory commitment depth. A user willing to pay 5,000 JPY for a product priced at 2,000 JPY reveals that the subjective value of the commitment experience itself exceeds the current price by a factor of 2.5. This premium is not captured by models that treat transport demand as a function of origin-destination pairs and time savings alone. Operationalizing this insight requires post-experiment elicitation from participants who can ground their stated valuations in actual behavioral outcomes — precisely the context this experiment provides.

THE EXPERIMENT AND THE PRICING DECISION

The experiment was conducted between January 27 and February 16, 2025 (21 days) in a high-density residential district of western Tokyo. A pre-sales window ran from January 8 to January 22, during which 559 Digital Mobility Passes were sold at 2,000 JPY via a commercial mobile ticketing platform. The pass granted unlimited access to one light rail line, four bus routes operated by two competing bus companies, and up to 21 electric micro-mobility rides of up to 30 minutes each. The experimental context is described in full in companion papers (Nishina, 2026a, 2026b, 2026c).

No public subsidy was involved. All revenues were distributed to participating operators according to pre-agreed usage-linked formulae. At 559 passes sold, the experiment generated approximately 1.12 million JPY in gross revenue — demonstrating, at least in principle, that a behaviorally effective MaaS social experiment need not depend on public funding. The 2,000 JPY price was set based on estimated operator cost recovery rather than demand modeling; no formal WTP research was conducted in advance. It was a pragmatic starting point, not a theoretically optimized figure.

Pass purchasers received a digital token for light rail and bus access via screen-display validation, and a coupon code for micro-mobility rides delivered by email. The email delivery created a friction point several participants reported encountering, but with an unintended behavioral consequence: it forced users to engage consciously with the product's structure before first use, reinforcing the anticipatory commitment mechanism.

RESULTS

Behavioral Signatures of Anticipatory Commitment

Analysis of survey narratives and in-depth interview transcripts identified five recurring behavioral signatures among highly engaged users, appearing across different demographic profiles and household types — suggesting they reflect the pre-payment mechanism rather than pre-existing personal characteristics.

Pre-use scheduling: deliberate restructuring of weekly plans before first use. A 28-year-old male resident described having "set a schedule for going out alone for dinner during this period" — treating the three-week window as a defined program. The pass had not merely lowered the cost of existing trips; it had created a category of trip that did not previously exist in his behavioral repertoire.

Value-maximization orientation: an explicit cost-benefit stance that frames non-use as loss. The 32-year-old from outside the district described calculating whether she could "get her money's worth" and connected this to a dispositional tendency she called a "habit of wanting to take everything from a buffet." She was not describing irrationality. She was describing a motivational structure that made her explore.

Exhaustive use intent and progressive optimization formed the third and fourth signatures. A 50-year-old resident decided to "use it thoroughly" from the moment of purchase; a 28-year-old described studying the map "thoroughly" in the first week and deploying the resulting knowledge efficiently in the second half — a learning curve operating entirely within the three-week window.

The fifth and most theoretically significant signature: when asked why they would repurchase, several participants cited the structural property of pre-payment itself. "Because the pre-payment format expands behavioral options," one respondent stated. He was articulating an insight about the architecture of motivation — that paying in advance transforms the decisional environment for all subsequent trips, making each departure feel free and therefore possible. Table 1 summarizes the five signatures.

Quantitatively, these signatures were not uniformly distributed across the survey sample. Of the 237 post-experiment respondents, open-ended responses consistent with at least one commitment signature were present in approximately 38% of cases ($n \approx 90$). Pre-use scheduling was the most frequently cited behavior ($n \approx 63$, 26.6% of sample), followed by value-maximization orientation ($n \approx 54$, 22.8%), exhaustive use intent ($n \approx 47$, 19.8%), progressive optimization ($n \approx 41$, 17.3%), and pre-payment as structural value ($n \approx 28$, 11.8%). The five signatures were not mutually exclusive: respondents describing three or more signatures ($n \approx 31$, 13.1%) overlapped substantially with the Tri-modal Hybrid segment identified in the companion segmentation study (Nishina, 2026c), in which 47.8% of users reported daily spending increases — compared to 33.3% among Single Rail/Bus users. This convergence between qualitative commitment depth and quantitative behavioral outcomes provides indirect cross-validation for the anticipatory commitment construct: users who articulate commitment-consistent motivations are disproportionately the same users who exhibit the strongest measurable behavioral change.

Table 1: Behavioral commitment signatures identified in survey and interview data.

Commitment Phase	Representative Statement / Behavioral Signature
Pre-use planning	"I set a schedule for going out alone for dinner during this period" (M, 28, Daizawa)
Value maximization	"I have a tendency to take everything from a buffet — I self-diagnosed that tendency" (F, 32, Omori)
Exhaustive use	"I decided I would use it thoroughly; the weather was good, so I used it a lot" (F, 50, Mishuku)
Progressive optimization	"In the second half I used research I had accumulated to use it efficiently — I studied the map thoroughly" (M, 28, Daizawa)
Re-purchase rationale	"Because the pre-payment format expands behavioral options" (M, 20s, Sangenjaya)

Source: In-depth interview transcripts; post-experiment survey open-ended responses (n = 237). Statements translated from Japanese by the author.

Willingness-to-Pay Findings

Post-experiment survey items asked participants to state the maximum price at which they would repurchase the pass under identical conditions. Responses distributed across five strata, presented in Table 2 with representative qualitative statements.

Table 2: Willingness-to-pay strata with representative behavioral statements.

Stated WTP (JPY)	n (Approx.)	Repurchase Intent	Representative Behavioral Statement
≤ 2,000	—	—	"2,000 is cheap" (F, 40s, Matsuin Jinja)
2,500	~35	High	"If LUUP rides stay the same, 2,500 is fair" (F, 33, Sangenjaya)
3,000	~82	High	"I would buy at 3,000 without hesitation" (F, 40s, Matsuin Jinja)
4,000–5,000	~46	Moderate	"5,000 if LUUP alone justifies it — the 30-min ride is very valuable" (M, 36, Shindaita)
> 5,000	~12	Low	"Would reconsider above 5,000; cost-benefit becomes unclear" (M, 47, Hachioji)

Source: Post-experiment survey WTP items; in-depth interview transcripts. n per stratum approximate.

Approximately 50% of the analytical sample stated WTP of 3,000 JPY or above, implying the experiment's 2,000 JPY price left substantial consumer surplus uncaptured. Revenue at 3,000 JPY would be approximately 50% higher with negligible demand erosion. The high-WTP reasoning consistently references the structural value of pre-payment rather than specific modes or destinations — revealing that the commitment experience itself carries independent hedonic value. Most strikingly, participants who reported no

behavioral change did not cluster at the lower end of the WTP distribution: several stated willingness to pay 2,500 – 3,000 JPY despite unchanged behavior, suggesting they were willing to pay for the anticipatory commitment state even when it did not produce additional trips.

A simple revenue sensitivity analysis further illustrates the commercial implications. At the experimental price of 2,000 JPY with 559 passes sold, gross revenue totalled approximately 1,118,000 JPY. If demand remains near-constant up to 3,000 JPY — consistent with the negligible demand erosion suggested by the WTP distribution — revenue at 3,000 JPY with an assumed 5% demand reduction (530 passes) would reach approximately 1,590,000 JPY, a 42% uplift. Even under a more conservative 15% demand reduction (475 passes), revenue at 3,000 JPY exceeds the 2,000 JPY baseline by 27%. Comparative analysis by engagement level reinforces this picture: respondents who described commitment signatures had a median stated WTP of approximately 3,000 JPY, versus approximately 2,200 JPY among respondents whose open-ended responses showed no commitment indicators — a 36% differential that tracks closely with the spending-outcome differential between Tri-modal and Single-mode users reported in Nishina (2026c). Taken together, these figures suggest that price optimization represents the highest-yield near-term lever available to operators of flat-rate mobility passes, ahead of network expansion or promotional investment.

The Free Trial Counterfactual

No control group received free passes, so the question of whether the experiment's results could be replicated at zero price cannot be directly answered. But users who described the most intensive behavioral engagement uniformly mentioned awareness of the price paid as a feature of that engagement. "Because it costs money, I want to use it properly," said one participant — a statement that would not apply to a free pass.

Ariely and colleagues (2008) demonstrate that zero-price goods activate a qualitatively different motivational structure from goods with even trivially non-zero prices. The zero-price effect produces broad, shallow uptake; the non-zero price effect produces narrower, deeper uptake. The experiment's 42.4% survey response rate is consistent with this pattern: participants who paid 2,000 JPY were invested enough to complete a post-experiment survey.

DISCUSSION

Price as a Behavioral Design Parameter

The canonical framework treats lower prices as unambiguously desirable: cheaper transit means more users means greater accessibility. From this standpoint, 2,000 JPY is a barrier to be minimized. The anticipatory commitment framework inverts this logic in the context of exploratory mobility passes. A price of zero removes the sunk-cost activation mechanism entirely. The design question is not "what is the lowest viable price?" but "what is the price that activates anticipatory commitment without creating a meaningful access barrier?" Our data suggest that for working-age urban

residents in high-income residential districts, this range lies between 2,000 and 4,000 JPY. A mobility operator who prices a flat-rate pass at zero in order to maximize trial uptake is not merely leaving revenue on the table. They are removing the mechanism by which the product works.

The Duration–Price Interaction

Anticipatory commitment is a function of the interaction between price and duration. The three-week period appears to have been close to optimal: short enough to create urgency (participants described time pressure in the final week), long enough to permit the learning-and-optimization trajectory that characterized Tri-modal users (Nishina, 2026c). One participant stated that a two-to-three-day alternative would make scheduling difficult, while the three-week format gave her "time to plan." This suggests a duration sweet spot experimentally determinable in the two-to-four-week range, declining on both sides.

Commitment Without Compulsion: A Design Ethics Note

The anticipatory commitment mechanism raises an ethics question: if pre-payment activates behavioral change through sunk-cost psychology, is the design manipulative? The evidence suggests not. All participants purchased voluntarily. The behavioral change produced — increased exploration, increased local spending, expanded activity space — was described positively by virtually all participants; mean overall satisfaction exceeded four on a five-point scale. Most importantly, the 32-year-old who diagnosed her "buffet mentality" was not unaware of the mechanism. She named it, analyzed it, and endorsed it. The anticipatory commitment effect was operating on users who understood it. That is a different ethical situation from nudges that work precisely because they are invisible.

CONCLUSION

The buffet metaphor is more precise than it appears. A buffet is an experience architecture: it places a bounded quantity of possibility in front of a customer who has pre-paid for access, and relies on the customer's own motivational structure to drive consumption patterns that neither party could fully predict. The flat-rate mobility pass works by the same logic. The city is the buffet. The 2,000 JPY is the cover charge. The anticipatory commitment is the state of mind the cover charge produces.

This paper has argued that anticipatory commitment is a distinct and theoretically significant mechanism, present in users across age groups and household types, described explicitly by participants with sufficient self-awareness to name it. It produces behavioral outcomes — structured scheduling, progressive optimization, exhaustive value extraction — that free-of-charge access would not replicate.

The sunk cost effect has been studied for forty years as a pathology of human judgment. It may be time to study it, in at least some contexts, as a feature.

ACKNOWLEDGMENT

The author thanks all participants who completed the post-experiment survey and consented to interview. The behavioral data reported here were collected as part of a commercial mobility experiment coordinated by STUDIO ZERO and made available for research purposes.

REFERENCES

Ariely, D. and Wertenbroch, K. (2002). Procrastination, deadlines, and performance: Self-control by precommitment. Psychological Science, 13(3), pp. 219–224.

Ariely, D., Loewenstein, G. and Prelec, D. (2008). Zero as a special price: The true value of free products. Marketing Science, 27(5), pp. 742–757.

Arkes, H. R. and Blumer, C. (1985). The psychology of sunk cost. Organizational Behavior and Human Decision Processes, 35(1), pp. 124–140.

Hensher, D. A., Ho, C. and Ramsay, D. (2022). Uncertainty and the willingness to invest in MaaS. Transportation Research Part A, 163, pp. 196–213.

Kahneman, D. and Tversky, A. (1979). Prospect theory: An analysis of decision under risk. Econometrica, 47(2), pp. 263–291.

Nishina, S. (2026a). Behavioral design in urban mobility: Cognitive load, choice architecture, and the multimodal flat-rate pass as a tool for spatial habit disruption. AHFE International Conference Proceedings, Paper 1156.

Nishina, S. (2026b). Competing to cooperate: Private-sector orchestration of intermodal mobility infrastructure in a Japanese metropolitan district. AHFE International Conference Proceedings, Paper 1157.

Nishina, S. (2026c). From commuters to explorers: Modal inertia, behavioral commitment, and the segmentation logic of flat-rate urban mobility. AHFE International Conference Proceedings, Paper 1158.

Prelec, D. and Loewenstein, G. (1998). The red and the black: Mental accounting of savings and debt. Marketing Science, 17(1), pp. 4–28.

Thaler, R. H. (1980). Toward a positive theory of consumer choice. Journal of Economic Behavior and Organization, 1(1), pp. 39–60.

Thaler, R. H. (1985). Mental accounting and consumer choice. Marketing Science, 4(3), pp. 199–214.

Thaler, R. H. and Sunstein, C. R. (2008). Nudge: Improving Decisions about Health, Wealth, and Happiness. Yale University Press.