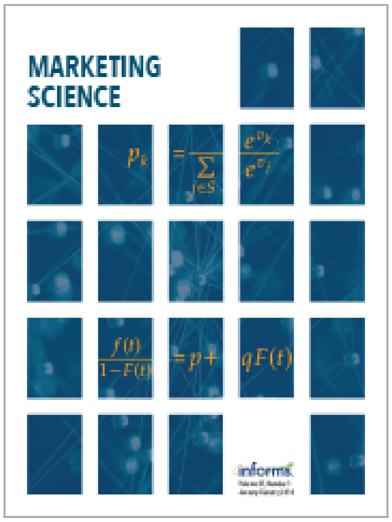

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Marketing Self-Improvement Programs for Self-Signaling Consumers

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Abstract. How does a health club or credit counseling service market itself when its consumer becomes demotivated after a minor slipup? To examine this issue, we utilize a self-signaling model that accounts for the complex process in which a resolution seeker manages his self-control perceptions. Specifically, we employ a planner–doer model wherein a consumer oscillates between long-term resolution planning and short-term implementation: during each implementation juncture, the consumer must determine whether to lapse or use the program as planned, a decision that affects his self-control perceptions in subsequent periods of long-term resolution planning. Using this framework, we derive many significant marketing insights for self-improvement programs, products which assist the pursuit of long-term resolutions. First, we demonstrate that the seller tailors its contract strategy because of self-signaling, the process whereby the decision maker manages his self-control perceptions. Furthermore, we determine that the seller's program contract depends on the level of noise in self-signaling: when the consumer's program-use decisions reveal his general level of self-restraint, the seller imposes relatively high per-usage rates; on the other hand, the firm levies low usage fees when implementation decisions depend on short-term fluctuations in self-control. Additionally, we examine program quality as a strategic decision. We determine that the firm offers additional frills when self-signaling is noisy and provides minimal benefits when self-signaling is more informative. Finally, we analyze program length as a marketing strategy and show that lengthy contracts transpire when usage decisions do not sufficiently reveal self-control.

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Keywords: self-control • pricing strategy • contracts • game theory • behavioral economics

1. Background

Each year, tens of millions of consumers initiate resolutions to narrow their waistlines and fatten their wallets (Kliff 2014, Spector 2017). For many of these consumers, self-improvement pursuit will ultimately prove unrewarding. Credit counseling and financial literacy programs, for instance, amass $1 billion in annual expenditures, yet about 50% of credit counseling participants quit or declare bankruptcy within the first year (Weisbaum 2013, Williams 2013). Similarly, annual health club expenditures exceed $21.4 billion, but 50% of gym enrollees give up within the first six months of enrollment (Wilson and Brookfield 2009, IHRSA 2012).

The precarious nature of resolution pursuit largely stems from the resolution seeker's malleable beliefs about himself. A minor lapse, or slipup, in self-improvement pursuit results in demoralization, making the decision maker view subsequent progress as improbable (Polivy and Herman 1985, Baumeister and Heatherton 1996, Morin 2014). Conversely, resolutions appear more attainable after the consumer has achieved success, particularly for progress viewed as more difficult or meaningful (Bandura 1999). This presents a conundrum for self-improvement programs, products typically consumed to achieve long-term resolutions such as physical or financial health. In devising a self-improvement program, the seller must determine how difficult to make its service: an easier program limits the likelihood of lapses that contribute to enrollee turnover, whereas a tougher alternative generates greater confidence in those who avoid slipups.

Our paper examines this conundrum. We determine how a self-improvement program develops its marketing strategy to influence the self-control beliefs of its participants. To do so, we construct a "planner–doer" model in which the consumer manages his self-control perceptions: during each doer or implementation decision, the consumer may either lapse or follow through with his plans, a decision that sends a noisy signal of self-control limitations during the next period of long-term resolution planning.

Our model analysis illuminates many marketing decisions for products including health clubs, diet programs, and credit counseling services. We first explain the wide range of pricing strategies used for these products. We observe that a firm's pricing strategy depends on the degree of noise in self-signaling, the process wherein the consumer manages his self-control perceptions. When implementation decisions accurately predict future self-control limitations, self-signaling is relatively noise-free. In this scenario, the firm directly ties program use to consumption costs by requiring higher per-usage fees; in effect, the firm dares the decision maker to quit so that implementation provides a stronger signal of self-control. Conversely, the firm charges lower usage rates when self-signaling is less informative, lessening the risk of an initial lapse when implementation decisions are subject to temporary circumstances. Next, we demonstrate the strategic impact of self-signaling itself, showing that its absence causes upfront and usage fees to serve as perfectly substitutable revenue sources. We then extend our framework in two different scenarios. We first analyze program quality, determining that the seller provides lower program benefits as self-signaling becomes more informative. Our second extension looks at program length as a firm strategy and reveals that the seller requires lengthier commitments when self-signaling is subject to greater noise.

The remainder of the paper is organized as follows. In Section 2, we review the existing literature on self-control and explain our contribution to this area. In Sections 3 and 4, we outline our baseline model and present key findings. We analyze program quality and length in Sections 5 and 6, respectively. We conclude in Section 7, discussing both the contributions and limitations of our work.

2. Literature

Social scientists have broadly framed self-control as an ongoing decision-making conflict between two selves: one that is analytic and forward-looking, and another that is instinctive and myopic (Freud 1922, Abelson 1963, Loewenstein 1996). With respect to this conflict, psychologists have demonstrated that myopic decision making often arises in times of emotional duress (Leith and Baumeister 1996, Tice et al. 2001), in response to activating stimuli (Baumeister and Heatherton 1996), and under conditions of depleted self-regulatory resources (Baumeister et al. 1994). Consumer behavior researchers have examined the implications of these findings with respect to attribute valuation (Shiv and Fedorikhin 1999), impulse purchases (Rook 1987, Vohs and Faber 2007), and preference reversals (Hoch and Loewenstein 1991).

Adjacent to these papers, the economics and quantitative marketing literature has analyzed self-control, typically using nonexponential discounting models to express present-bias or time inconsistency in the decision maker's preferences (Strotz 1955, Phelps and Pollak 1968, O'Donoghue and Rabin 1999). Within this framework, researchers have explored the use of precommitment devices to restrict future choice (Laibson 1997, Wertenbroch 1998, Jain 2012a). Other studies have also explored firm responses to present-bias, including the use of mail-in rebates (Gilpatric 2009), multiperiod quotas for salesforce compensation (Jain 2012b), and contract design (DellaVigna and Malmendier 2004).

In these models, the decision maker possesses an exogenous, static belief about his own self-control limitations. This approach, although reasonable in many contexts, does not suit the analysis of long-term resolutions. First, the consumer's[1] self-control beliefs change over the course of a resolution, where each success boosts and each setback deteriorates perceptions; moreover, self-control perceptions equally affect behavior, as the decision maker only exerts resolution effort if he senses his self-control as satisfactorily high (Bandura 1986, Latham and Locke 1991). These feedback processes cause a certain degree of fragility in resolution pursuit: where a slipup sufficiently diminishes self-control perceptions, the consumer engages in lapse-activated misregulation, essentially ceasing effort as a result of his initial misstep (Marlatt 1985, Norcross and Vangarelli 1989, Baumeister and Heatherton 1996). The threat of lapse-activated misregulation motivates each consumer to rigidly pursue any resolution, aiming to maintain a high sense of self-control and prevent later demoralization (Baumeister et al. 1994, Baumeister and Heatherton 1996). Decision makers, in other words, strategically choose effort to infer high self-restraint at a later time; more broadly, consumers influence future self-inferences by engaging in self-signaling (Prelec and Bodner 2003).

Recent research has empirically documented the incidence of self-signaling in pay-what-you-want markets (Gneezy et al. 2012) and charitable donations (Savary et al. 2015). Most related to our paper, Dhar and Wertenbroch (2012) demonstrate the link between opportunity sets and self-signaling, finding that choice of a virtue (vice) creates a self-signal of high (low) self-control whenever the consumer faces both types of options. Similar theoretical work has examined self-signaling in relation to heuristics (Bénabou and Tirole 2004) and peer effects (Battaglini et al. 2005). These analytical models employ a planner–doer framework (Thaler and Shefrin 1981, Ali 2011) in which the consumer oscillates between long-term planning and short-term implementation states: the planning-state consumer observes his past implementation decisions to infer self-control limitations, implying that his implementation-state self can either strategically use or lapse to influence future self-control perceptions (Bénabou and Tirole 2004, Battaglini et al. 2005).

The current literature illustrates the impact of self-signaling on consumer decision making, but as far as we know, no existing work examines the strategic implications of this phenomenon. We accordingly incorporate a profit-maximizing seller into a self-signaling consumer model. In doing so, we determine how marketers price self-improvement programs in response to consumers' self-signaling motives in resolution pursuit. We rationalize the use of low per-usage fees when self-signaling contains more noise and higher usage payments when self-signaling is more informative to the consumer. Next, we provide evidence of self-signaling by examining a counterfactual market without its presence; we find that, where consumers do not self-signal, the seller views upfront and per-usage fees as equivalent sources of revenue. Our paper additionally explores program quality as a marketing strategy. We find that our baseline pricing results hold when the firm also chooses its quality level; moreover, we deduce when the seller offers higher quality and when it markets a program with minimal benefits. Finally, our paper investigates self-improvement program length, establishing that the seller utilizes a longer contract term when self-signaling contains more noise.

To summarize, we contribute the following to the existing literature on self-control: (1) we incorporate firm strategy into a self-signaling consumer framework; (2) we investigate how the process of perception management influences program marketing and consumer resolution progress; (3) we examine how the informativeness of self-signaling affects contract pricing; (4) we consider program quality strategy with respect to self-signaling; and (5) we examine program length, outlining how self-signaling impacts the level of commitment required in a contract.

3. Model

We first introduce model preliminaries, explaining the rationale behind our assumptions as needed. Table 1 lists all symbols appearing in our model.

General Framework

A representative decision maker possesses some resolution. For instance, he may resolve to reduce his cholesterol level, intend to learn a programming language, or plan to increase his 401(k) savings. To undertake his resolution, the decision maker enrolls in a two-period program that assists his self-improvement efforts: a health club, for physical fitness; a university, for professional training; a debt settlement program, for financial security. The consumer's program use amounts to an investment in his long-term well-being: he does not inherently enjoy working toward his resolution and incurs an immediate effort cost κ_t in each period $t \in \{1,2\}$ that he uses the program; however, for each period of use, he improves his future well-being by payoff $\theta \in (0,\overline{\theta})$, attained after the program's conclusion.[2] The decision maker's progress, or lack thereof, in improving his long-term well-being ultimately arises from an internal conflict—his long-term preferences as a planner versus his short-term preferences as a doer or implementer.

Table 1. Model Notation

Symbol	Definition
β	Consumer's present-bias during implementation
$f(\beta)$	Prior distribution of β
$\mu(\beta)$	Posterior distribution of β
κ_t	Period t effort cost
θ	Payoff from implementation
c	Marginal cost to firm
L^*	Optimal upfront fee in Section 4
p^*	Optimal per-usage fee in Section 4
$\{L^*_{\neg}, p^*_{\neg}\}$	Optimal contract without self-signaling
s	Program quality in Section 5
$\{\widehat{L}, \widehat{p}, \widehat{s}\}$	Optimal contract in Section 5
w	Implementation period length in Section 6
$\{\overline{L}, \overline{p}, \overline{w}\}$	Optimal contract in Section 6

When planning, the decision maker does not exert any immediate effort for his objective; rather, he develops a more comprehensive strategy, crafting a schedule of future program use for his resolution (Sniehotta et al. 2005, Sayette et al. 2008). The decision maker, approaching his endeavor on a macro level, focuses on his long-term well-being and possesses a discount factor of 1. Accordingly, the planning-state consumer exhibits greater willingness to continue a resolution, opting to plan future effort so long as he believes he is likely to implement said plan.

The consumer loses his broad outlook, however, when he must follow through with his plan and utilize the self-improvement service. When tasked with using the program, the decision maker concentrates on the momentary difficulty of doing so, a temporary distress created by some external stimuli at the time of implementation (Baumeister and Heatherton 1996). For instance, a diet program participant encounters the unpleasant smell, and anticipated unpleasant taste, of the diet program's prepared meal. Similarly, a worker intends to contribute to an IRA but confronts sales promotions that coincide with his paydays (Thomson 2012). Such stimuli, by inducing a sudden realization of duress, create a momentary impulse for instant gratification that distorts the decision maker's intertemporal preferences. The severity of his impulse corresponds to quasi-hyperbolic discount factor $\beta \in (0,1)$, the degree of present-bias exhibited by the consumer when acting as an implementer. When β is closer to 0, the consumer suffers more severe impulses and prefers immediate gratification, sharply devaluing future payoff θ relative to present-day effort cost κ_t; when β is closer to 1, the implementer experiences minimal deviation from his long-term planning preferences.

In our model, we assume that impulse severity β is deterministic while allowing effort cost κ_t to be stochastic. We effectively model β as the decision maker's inherent type, indicating the general degree of self-control he possesses when implementing his self-improvement plan.[3] Effort cost κ_t, in this framework, captures situational factors that cause short-term fluctuations in self-restraint: a consumer possessing a high β may slip up if he undergoes temporary stress or experiences a brief slump in motivation (i.e., draws a high effort cost κ_t); conversely, a low β individual can implement in time t if he experiences a period of luck (i.e., κ_t is small enough to make program use relatively painless).

Informational Asymmetry

The decision maker's internal conflict, between that of a long-term planner and a short-term implementer, is further compounded by his information, or lack thereof, about his own preferences. The consumer retains full information of his long-term preferences at all times; accordingly, both the planner and implementer realize that the decision maker possesses a discount factor of 1 during planning states. On the other hand, the decision maker's implementation-state impulses represent momentary deviations from his long-term preferences. The fleeting nature of this duress allows the consumer to quickly forget his anguish and misattribute the cause of his prior implementation decisions (Burger and Huntzinger 1985, Nordgren et al. 2006).[4] Thus, the consumer only possesses perfect information of β and κ_t during implementation periods; when planning, he copes with uncertainty about both elements and can only observe past implementation decisions to reduce this uncertainty.

We model this uncertainty by assuming that $\kappa_t \sim Unif[0,1]$ and that β is distributed by $f(\beta)$, a continuously differentiable function with support on all $\beta \in (0,1)$. The consumer carries a prior of $f(\beta)$ and uses his first implementation decision to signal his self-control to his future planning self: program use suggests a lesser impulse problem and results in an upward shift from $f(\beta)$, improving the consumer's perception that he can achieve his resolution; a lapse, or failure to use, implies a more pronounced impulse problem and adversely affects his self-control beliefs. The impact of this signal, though, depends on its level of informativeness, measured by the shape of $f(\beta)$ relative to $Unif[0,1]$. An implementation decision sends a clear signal of β when $f(\beta)$ contains sufficient density toward 0 and 1: here, a consumer with a β close to 1 can tolerate almost any effort cost κ_t, whereas an individual with β near 0 almost never implements. Conversely, program usage depends more on situational factors when $f(\beta)$ possesses little density in its tails, and implementation decisions consequently create a noisy signal of β under such circumstances.[5]

Market Interaction

A monopolistic seller markets a two-period self-improvement program. To market the program, the seller specifies a contract with the following terms: the consumer must pay (1) upfront fee L to receive program *access* for two periods and (2) per-usage fee p for each period of program use. Here, "period" does not strictly imply day: for instance, a health club might require an annual fee L for immediate entry and a recurring monthly payment of p; for a diet program, p may represent the fee required for a week's shipment of food. In this setup, the length of an implementation decision corresponds to the time covered by a payment of p (e.g., a month in the gym example but a week in the diet program example). A planning decision, on the other hand, refers to the short window of time in which the consumer evaluates his progress (e.g., when the consumer decides whether to buy another week's shipment of diet meals).[6]

We detail this timeline below, using the example of a physical fitness plan for illustrative purposes. Each of the two periods contains a planning segment (1.1 and 2.1), followed by an implementation segment (1.2 and 2.2). For additional reference, Figure 1 depicts this sequence of events.

Period 1.1

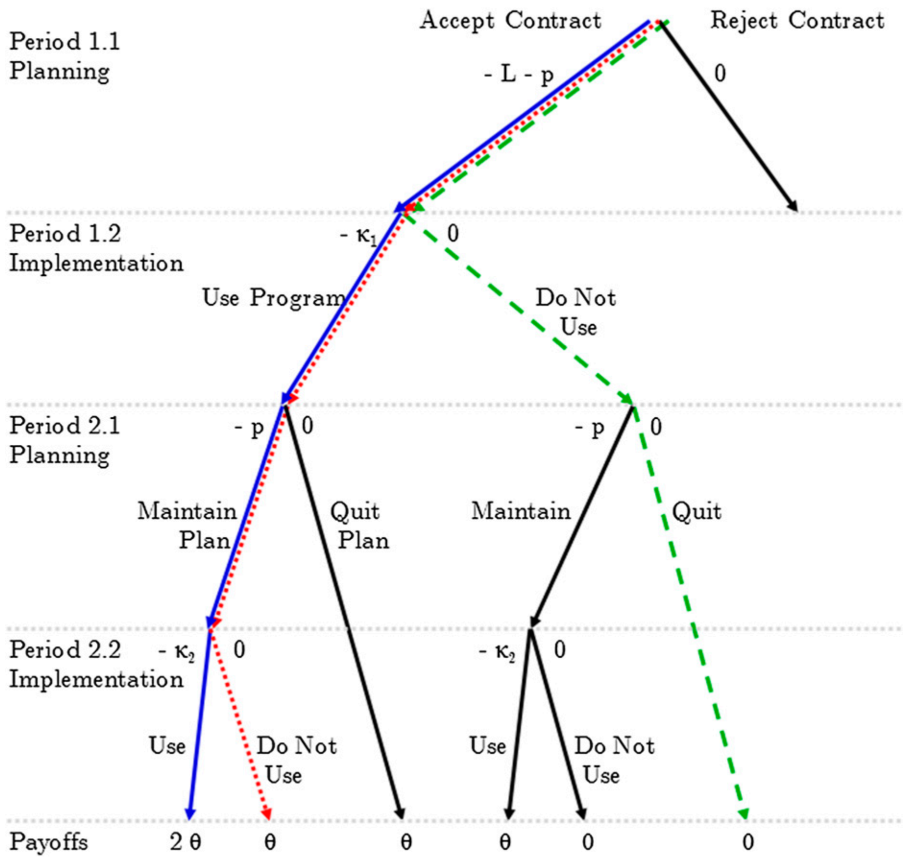
The consumer notices his recent weight gain and contemplates joining a health club. Faced with the club's contract, he must determine whether to join the gym and attempt a workout program for the next two months. To make this decision, he gauges the likelihood that he will follow through with a fitness plan; that is, he utilizes his prior $f(\beta)$ to estimate whether he will push himself to the gym during the course of his program.

If the decision maker suspects he will avoid his workout regimen, he rejects the gym contract and makes no effort toward his resolution. Otherwise, the decision maker immediately pays L to accept the contract and pays p for his first month of use. The consumer, upon joining, plans a tentative workout schedule for the next two months.

Period 1.2

The consumer determines whether to follow through with his gym schedule in the first month. If he sticks to his workouts, the consumer improves his long-term health and earns benefit θ at the end of the second period; on the other hand, he earns a payoff of 0 if he sticks to his couch instead. This latter choice, while yielding no ultimate benefit, may prove optimal for a couple of reasons. First, the decision maker cannot use the program unless he overcomes effort cost κ_1, the cost of forcing his atrophied muscles to the treadmill as originally planned. Second, relative to immediate cost κ_1, the consumer discounts future payoff θ by a factor of β, where a low β implies greater impulses to seek out immediate gratification and remain on the couch.

Figure 1. (Color online) Consumer Decision Tree



The decision maker accordingly utilizes the program if he encounters an adequately high β and low κ_1, or if $\kappa_1 \leq K_1(\beta)$; here, threshold $K_1(\beta)$ increases in β, as a consumer with minimal impulses can withstand a greater range of situational costs during implementation. Program use, in effect, pays off as a self-signaling strategy, in that the consumer will perceive a manageable impulse problem during his next planning decision. Conversely, the consumer signals a relatively low β if he avoids implementation in 1.2; in this case, the decision maker adversely affects his future beliefs and risks quitting his program entirely as a consequence of his initial lapse.

Period 2.1

The first month ends and the consumer must determine whether to make another monthly payment of p. In making this decision, the consumer first needs to estimate his likelihood of using the gym in the second month. He has forgotten the exact level of duress experienced during 1.2; however, he can recall whether he generally adhered to his first month of scheduled workouts. He updates his prior belief $f(\beta)$ according to Bayes's rule and forms posterior $\mu(\beta)$, where only $\kappa_1 \in [0, K_1(\beta)]$ would have used the gym in the first implementation period.

If the consumer exercised in 1.2 as planned, he surmises that he possesses relatively high self-restraint. He updates his self-control belief $\mu(\beta)$ as follows.

$$\frac{K_1(\beta)\, f(\beta)}{\int_0^1 K_1(\beta)\, f(\beta)\, d\beta} \quad \text{for } 1 > \beta > 0. \tag{1}$$

The consumer infers a more severe problem, however, if he dodged his scheduled gym sessions. He adjusts his belief $\mu(\beta)$ downward in this instance.

$$\frac{(1 - K_1(\beta))\, f(\beta)}{\int_0^1 (1 - K_1(\beta))\, f(\beta)\, d\beta} \quad \text{for } 1 > \beta > 0. \tag{2}$$

Based on his updated information, the decision maker determines whether to continue toward his resolution. He ceases all effort if his self-control beliefs significantly worsen and he merely expects to slip up again in 2.2. Otherwise, the consumer perceives his self-control as satisfactory and continues his fitness plan, paying fee p and preparing another schedule of workout dates.

Period 2.2

If the consumer paid p in 2.1, he confronts the same decision as in 1.2.[7]

4. Profit Optimization

Before we derive the seller's profit maximization problem, we must examine the consumer's actions throughout the entire timeline.

We determine the incentive constraints for each $\{\beta, \kappa_1, \kappa_2\}$ and derive three types of behavior in equilibrium. A *finisher* always utilizes the program and completes his self-improvement plan. A *partial* uses in 1.2 and pays in 2.1, only to suffer a high effort cost in 2.2. Finally, a *quitter* does not use the program in 1.2 and subsequently abandons his plan in 2.1. Note that each observed behavioral pattern stems from both the consumer's inherent type β and his short-term fluctuations in self-control, effort costs κ_1, and κ_2.[8]

We describe these consumption patterns in fuller detail below. We reemphasize that, during each planning period, the decision maker only observes past implementation decisions to infer β. Thus, every consumer type possesses the same prior belief in 1.1 and accepts the program contract, provided that the seller sets sufficiently low prices; similarly, a finisher and a partial act on the same information in 2.1 and make the same planning decision at that time.

Finisher

The finisher draws $\kappa_1 \leq K_1(\beta) = \beta\theta - \beta p + \beta\int_0^{\beta\theta}(\theta - \kappa_2)\,d\kappa_2$ and $\kappa_2 \leq \beta\theta$. As both $K_1(\beta)$ and $\beta\theta$ increase in β, a finisher tends to possess a β closer to 1; that is, the finisher experiences minimal present-bias variation and encounters the least difficulty in his resolution pursuit.

The finisher begins his pursuit in 1.1, when he examines the seller's contract and devises an initial resolution plan. Acting as a planner in 1.1, the finisher values future transactions by a discount factor of 1. Although he does not exhibit present-bias, the finisher must estimate β using $f(\beta)$ so that he can determine his likelihood of program use in 1.2 and 2.2. This estimation of β materializes in the integral bounds of (3a): for each level of β, the decision maker implements with probabilities $\int_0^{K_1(\beta)} d\kappa_1$ in 1.2 and $\int_0^{K_1(\beta)}\int_0^{\beta\theta} d\kappa_2\,d\kappa_1$ in 2.2, where a higher β implies a greater chance of implementation. Based on his estimated chance of future implementation, the consumer expects a net benefit from accepting $\{L, p\}$. This action corresponds to (3a).[9]

Having initiated his program, the finisher enters his first period of implementation and learns both β and κ_1. He possesses a sufficiently high β and low κ_1 such that he earns net benefit $\beta\theta - \kappa_1 - \beta p + \beta\int_0^{\beta\theta}(\theta - \kappa_2)\,d\kappa_2 = K_1(\beta) - \kappa_1 \geq 0$ by using the program in 1.2. This sum includes two distinct components. The finisher earns $\beta\theta - \kappa_1$, the discounted payoff directly attributable to his implementation in 1.2. Second, the decision maker expects future payoff $-\beta p + \beta\int_0^{\beta\theta}(\theta - \kappa_2)\,d\kappa_2$ by signaling restraint to himself in 2.1, when he will no longer hold perfect knowledge of β: the consumer realizes that, by following through in 1.2, he will deduce his β as relatively high in 2.1 and feel confident in continuing his program schedule. This corresponds to the LHS of (3b). Conversely, the RHS captures nonuse in 1.2 and its adverse impact of future self-control perceptions: if he lapses and takes no action in 1.2, he will ultimately infer a severe impulse problem in 2.1 and accordingly cease future resolution effort.

Next, the finisher then enters 2.1 and possesses a discount factor of 1, reflecting his long-term preferences as a planner. He determines his long-term plan based on his future resolution prospects, necessitating that he infer β based on his prior implementation decision; having employed his willpower in 1.2, the consumer expects that his β is high enough to justify sustained effort toward his ultimate resolution. Accordingly, he pays p so that he can continue his plan, as reflected in (3c).

Finally, the finisher enters 2.2 and regains perfect knowledge of β. He encounters effort cost $\kappa_2 \leq \beta\theta$, allowing him to complete his resolution pursuit as in (3d). Note that the finisher's resolution progress amounts to the blue path on Figure 1.

$$1.1: -L - p + \int_0^1\int_0^{K_1(\beta)}\left(\theta - \kappa_1 - p + \int_0^{\beta\theta}(\theta - \kappa_2)\,d\kappa_2\right)\cdot f(\beta)\,d\kappa_1\,d\beta \geq 0 \tag{3a}$$

$$1.2: K_1(\beta) - \kappa_1 \geq 0 \tag{3b}$$

$$2.1: -p + \left[\int_0^1\int_0^{K_1(\beta)} f(\beta)\,d\kappa_1\,d\beta\right]^{-1}\cdot\int_0^1\int_0^{K_1(\beta)}\int_0^{\beta\theta}(\theta - \kappa_2)\,f(\beta)\,d\kappa_2\,d\kappa_1\,d\beta > 0 \tag{3c}$$

$$2.2: \beta\theta - \kappa_2 \geq 0. \tag{3d}$$

Partial

The partial confronts moderate duress during his self-improvement program. His actions mostly resemble a finisher: after accepting the contract in 1.1, he commits to use in 1.2 (4a) and infers this as a signal of a high β in 2.1 (4b).[10] Once he enters 2.2, however, the partial is confronted with $\kappa_2 > \beta\theta$ and forgoes any effort in 2.2, as expressed by (4c). Please note that the partial's progress equals the red line in Figure 1.

$$1.2: K_1(\beta) - \kappa_1 \geq 0 \tag{4a}$$

$$2.1: -p + \left[\int_0^1\int_0^{K_1(\beta)} f(\beta)\,d\kappa_1\,d\beta\right]^{-1}\cdot\int_0^1\int_0^{K_1(\beta)}\int_0^{\beta\theta}(\theta - \kappa_2)\,f(\beta)\,d\kappa_2\,d\kappa_1\,d\beta > 0 \tag{4b}$$

$$2.2: \beta\theta - \kappa_2 < 0. \tag{4c}$$

Quitter

The quitter faces the most difficulty in resolution pursuit. In his first stage of implementation, he draws $\{\beta, \kappa_1\}$ such that $\beta\,\theta - \kappa_1 - \beta\,p + \beta \int_0^{\beta\,\theta} (\theta - \kappa_2)\, d\kappa_2 = K_1(\beta) - \kappa_1 < 0$. The expected payoff from signaling restraint, $-\beta\,p + \beta \int_0^{\beta\,\theta} (\theta - \kappa_2)\, d\kappa_2$, does not justify the quitter's immediate costs in exerting effort; in other words, the quitter suffers such an aversive impulse that he must surrender to temptation and decline program use in 1.2. The quitter subsequently enters 2.1 and observes his prior failure to use the program. He realizes that his past behavior indicates a draw of $\{\beta, \kappa_1\}$ such that $K_1(\beta) - \kappa_1 < 0$, suggesting that his β is likely closer to 0; accordingly, he surmises severe self-control limitations and quits his resolution as a result of his initial lapse. Equation (5a) captures his self-control lapse in 1.2, whereas (5b) denotes the decision to quit in 2.1. Please note that the green line in Figure 1 captures the quitter's progress.

$$1.2:\ K_1(\beta) - \kappa_1 < 0 \tag{5a}$$

$$2.1:\ -p + \left[\int_0^1 \int_{K_1(\beta)}^1 f(\beta)\, d\kappa_1\, d\beta\right]^{-1} \cdot \int_0^1 \int_{K_1(\beta)}^1 \int_0^{\beta\,\theta} (\theta - \kappa_2)\, f(\beta)\, d\kappa_2\, d\kappa_1\, d\beta < 0. \tag{5b}$$

We summarize these results in Lemma 1a below:[12]

Lemma 1a. *For any* $p \in \left[0, \frac{1}{2}\theta^2\right]$ *satisfying* (3a) *through* (5b), *the producer expects program usage with probability* $\int_0^1 \int_0^{K_1(\beta)} f(\beta)\, d\kappa_1\, d\beta$ *in 1.2 and with probability* $\int_0^1 \int_0^{K_1(\beta)} \int_0^{\beta\,\theta} f(\beta)\, d\kappa_2\, d\kappa_1\, d\beta$ *in 2.2.*[11]

The present framework captures the wide range of usage behaviors observed in self-improvement programs, illustrating when a decision maker finishes his resolution and when he quits immediately. To do so, this planner–doer model rationalizes self-signaling as a strategy to prevent lapse-activated misregulation, whereby an initial lapse deteriorates the consumer's self-control perceptions and causes him to cease all effort. Such misregulation characterizes resolution progress across a wide range of self-improvement domains. For instance, dieters often binge following a small slipup (Marlatt 1985, Polivy and Herman 1985). Similarly, savers engage in unrestrained spending following a setback in their financial goals, whether a credit card balance (Wilcox et al. 2011) or a broken monetary budget (Soman and Cheema 2004).

The above lemma also permits us to state the seller's optimization problem when it induces self-signaling:

$$\{L^*, p^*\} = \underset{\{L,p\}}{\arg\max}\, L + (p - c) + \int_0^1 \int_0^{K_1(\beta)} (p - c)\, f(\beta)\, d\kappa_1\, d\beta \tag{6}$$

s.t. (3a), (3c), and (5b) are satisfied,

where the aforementioned pricing scheme, the consumer's planning and implementation decisions, and self-control beliefs constitute a perfect Bayesian equilibrium. Here, $c \in (0, \frac{1}{2}\,\theta^2]$ equals the firm's marginal cost of providing the self-improvement program.[13]

Equation (3a) corresponds to the consumer's planning decision during 1.1, where the LHS represents his expected payoff if he accepts the contract and undertakes self-improvement. He determines, based on $f(\beta)$, that the following will transpire if he pursues his resolution: he becomes a finisher with probability $\int_0^1 \int_0^{K_1(\beta)} \int_0^{\beta\,\theta} f(\beta)\, d\kappa_2\, d\kappa_1\, d\beta$; a partial with probability $\int_0^1 \int_0^{K_1(\beta)} \int_{\beta\,\theta}^1 f(\beta)\, d\kappa_2\, d\kappa_1\, d\beta$; and a quitter with likelihood $\int_0^1 \int_{K_1(\beta)}^1 f(\beta)\, d\kappa_1\, d\beta$.

Equation (3c) shows the consumer's planning decision in 2.1, assuming that he utilized in 1.2. Here, he infers that he incurs moderate impulses, expecting to become a finisher with sufficient probability to justify paying p again. Conversely, (5b) expresses the 2.1 planning decision after nonuse: the consumer, in this case, expects a small payoff from continuing, as $\kappa_1 > K_1(\beta)$ hints at a small value of β. Notably, both (3c) and (5b) impose some restrictions on the shape of $f(\beta)$. Equation (3c) necessitates that $f(\beta)$ contains sufficient density toward 1 since $\kappa_1 \le K_1(\beta)$ and $\kappa_2 \le \beta\,\theta$ increase in likelihood with β. On the other hand, thresholds $K_1(\beta)$ and $\beta\,\theta$ indicate that $f(\beta)$ must also possess enough density toward 0, as the LHS of (5b) cannot become too large. Together, these constraints require a $f(\beta)$ with adequate left and right tails, as this means that the consumer's 1.2 decision signals a basic level of information about β.

Having outlined the general requirements of $f(\beta)$, we proceed with our optimization. We restate (6), where (3a) binds in equilibrium.

$$p^* = \underset{\{p\}}{\arg\max} - c + \int_0^1 \int_0^{K_1(\beta)} \left(\theta - \kappa_1 - c + \int_0^{\beta\,\theta} (\theta - \kappa_2)\, d\kappa_2\right) f(\beta)\, d\kappa_1\, d\beta \tag{7}$$

s.t. (3c) and (5b) are satisfied.

For the parameter space in which an interior solution exists, we derive the FOC of Equation (7) to characterize p^*.

$$\int_0^1 \left(-(\beta - \beta^2)\left(\theta - p^* + \beta\,\theta^2 - \frac{\beta^2\,\theta^2}{2}\right) - \beta\,(p^* - c)\right) f(\beta)\, d\beta = 0. \tag{8}$$

To restrict our analysis to interior equilibria, we require a strictly positive first-order derivative at $p = 0$. This condition reduces to $\int_0^1 \left(-(\beta - \beta^2)\left(\theta + \beta\,\theta^2 - \frac{\beta^2\,\theta^2}{2}\right) + \beta\,c\right) f(\beta)\, d\beta > 0$, or $c \int_0^1 \beta\, f(\beta)\, d\beta > \int_0^1 (\beta - \beta^2)\left(\theta + \beta\,\theta^2 - \frac{\beta^2\,\theta^2}{2}\right) f(\beta)\, d\beta$;

that is, the seller only assesses a positive per-usage rate when marginal cost c meets some minimum threshold. In addition to this requirement, an interior equilibrium only occurs if the first-order derivative is strictly negative at $p = \frac{1}{2}\,\theta^2$; however, this second requirement is trivially satisfied for any $c \in (0, \frac{1}{2}\theta^2]$.

To ensure that our self-signaling equilibrium is unique, we need strict concavity of the firm's objective function. This corresponds to the following SOC of (7).

$$\int_0^1 (-\beta^2)\; f(\beta)\; d\beta < 0, \tag{9}$$

which is trivially satisfied for $\beta \in (0,1)$.

Although (7)–(9) outline the conditions for a unique self-signaling equilibrium, we must also rule out equilibria in which self-signaling does not transpire. Whereas (5b) entails a sufficiently large p^*, the seller could feasibly set a pricing strategy that renders self-signaling trivial: if p is sufficiently small, all consumer types would pay p and continue in 2.1, regardless of their prior implementation decision. Setting such a low p, however, generates inferior profits to the above equilibrium so long as marginal costs are sufficiently high. We describe this result in Corollary 1b below and provide a detailed analysis in the technical appendix.[14]

Corollary 1b. *For sufficiently high c, the seller prefers to induce the self-signaling equilibrium characterized by* (7)–(9).

Pricing Impact of Present-Bias

The decision maker's willingness to use the self-improvement program depends on both his short-term situational factors and his inherent impulse problem. If he expects a severe impulse problem, the consumer ascertains that progress will demand extraordinary luck, in the form of a particularly low κ_t. Conversely, the consumer can endure a high κ_t if he incurs minimal impulses, implying that he anticipates success if he believes β is close to 1. The consumer's willingness to undertake a resolution thus depends on his expectation of β: where $E[\beta]$ is low, the consumer dreads the sunk cost of joining and requires a low upfront fee; where $E[\beta]$ is higher, his forecasted outcome justifies paying a higher L for program access.

For a given $E[\beta]$, however, the consumer's resolution pursuit also depends on the dispersion of β. Where $f(\beta)$ lacks density in its extremes, situational factors render more impact on implementation decisions. This influence of effort cost κ_1 poses a problem with respect to the consumer's resolution progress. First, the decision maker only implements in 1.2 if $\kappa_1 \le K_1(\beta) = \beta\,\theta - \beta\,p + \beta\int_0^{\beta\,\theta}(\theta - \kappa_2)\,d\kappa_2$, a restrictive threshold when $f(\beta)$ does not contain density near 1; moreover, if the consumer slips up in 1.2, he ultimately quits his program after forming lower expectations of β in 2.1. To prevent this chain of events, the seller must set a low per-usage p: by raising $K_1(\beta)$, a smaller p lowers the probability of an initial slipup and contains the incidence of lapse-activated misregulation. The seller, in effect, counteracts uncertainty caused by κ_1 and contains the risk of quitting due to unfair situational circumstances.

On the other hand, a $f(\beta)$ with greater spread entails relatively high density proximate to both 0 and 1. This type of distribution limits the effect of situational effort costs: where β is near 0, the individual almost never implements in 1.2; where β is close to 1, the consumer utilizes the program at almost any per-usage rate. Given the consumer's insensitivity to changes in p, the seller can command a larger usage fee without creating any significant lapse risk.

We formally present these insights in Propositions 2a and 2b below:

Define $\{L_f^*, p_f^*\}$ and $\{L_g^*, p_g^*\}$ as the optimal contracts where $\beta \sim f(\beta)$ and $\beta \sim g(\beta)$, respectively.

Proposition 2a. *As the consumer expects higher self-control, the seller increases its upfront fee. That is* $L_f^* > L_g^*$ *whenever* $f(\beta)$ *first-order stochastically dominates* $g(\beta)$.

Proposition 2b. *As self-signaling becomes more informative, the firm increases its per-usage fee. That is* $p_f^* < p_g^*$ *whenever* $g(\beta)$ *is a mean-preserving spread of* $f(\beta)$.

The above framework expresses the consumer's overall duress as two components: (1) his inherent type, as expressed by deterministic β, and (2) stochastic noise, captured through effort cost κ_t. The expected values of these elements dictates the consumer's willingness to join at upfront fee L. However, the overall shape of $f(\beta)$ relative to $Unif[0,1]$ determines the level of informativeness or noisiness in the consumer's self-signaling process.

Self-signaling is considerably noisy where $f(\beta)$ lacks density at its end points and situational factors markedly impact implementation. In this instance, program use provides faint evidence of a high β and only produces a marginal upward shift in self-control perceptions. The consumer, encountering little reputational upside, possesses insufficient reason to pay larger usage fees during resolution pursuit. Accordingly, the seller responds by containing the size of p. This type of contract structure, mostly generating its revenue through upfront fee L, prevails among health clubs targeting inexperienced gym-goers: by requiring fixed prepayment, this strategy avoids mental accounting effects linking consumption to service costs (Prelec and Loewenstein 1998), eliminating a lapse risk when the consumer is unsure of his self-improvement prospects.

On the other hand, where $f(\beta)$ contains density closer to 0 and 1, the consumer's inherent impulse level decidedly impacts his program use decisions. Implementation, in this scenario, supplies the consumer with a rather informative signal of his overall impulse problem. Where the consumer learns his inherent type easily, the seller adjusts its pricing strategy by shifting revenue collection to per-usage fees. This type of pricing strategy achieves two objectives. First, by collecting its revenue through p, the firm lessens the financial penalty if the consumer learns that his β precludes resolution achievement. Second, by creating additional barriers to use, a high p strengthens the signaling capacity of implementation, allowing the consumer to further boost his self-control perceptions during resolution pursuit. These findings elucidate pricing strategies previously overlooked by the existing self-control literature. Consider evidence among boutique fitness studios, those 42% of U.S. gyms that focus on one or a few fitness areas (CBS News 2015). Chains like SoulCycle and Pure Barre enjoy impressive retention rates and heavily dedicated consumers, despite charging single-use fees that rival the monthly rates of traditional chains (Griswold 2013, Henderson 2016). Similarly, many CrossFit locations offer 10-visit passes at the approximate cost of an annual Planet Fitness membership, even though the more budget-friendly option offers more in traditional amenities (Oursler 2016). This type of pricing strategy, in part, attracts the 54 million enrollees of boutique gyms: these consumers enjoy the lack of commitment in joining, and many traditional gyms have started offering classes a la carte to regain this market segment (Shea 2016, White 2017).

Pricing Impact of Self-Signaling

In Propositions 2a and 2b, we observe how $f(\beta)$ and κ_t shape consumer self-signaling in resolution pursuit; however, these results do not examine the direct impact of self-signaling itself. We determine this direct effect in the following analysis, and to do so, we devise a comparative model in which self-signaling does not transpire.

In this alternate setup, the decision maker possesses the same level of uncertainty about β in 1.1; here, however, the consumer does not recall his prior implementation choices and does not update his prior belief in 2.1. The consumer's inability to update $\mu(\beta)$ implies that he cannot engage in self-signaling, as he cannot influence future self-control perceptions through his usage decisions. Consequently, the consumer's first implementation decision does not impact his future strategy—his entire self-improvement effort collapses into a sequence of static one-period optimization problems. We describe this consumption pattern below.

Consumer Timeline

The consumer purchases a contract in 1.1 if he expects to benefit from accepting $\{L, p\}$. Next, the decision maker enters 1.2 and observes both β and κ_1. He utilizes the program if $\beta\,\theta - \kappa_1 \geq 0$, or if he receives a net payoff directly attributable to implementation. Notably, the consumer does not factor any future payoffs into his 1.2 decision: given that he forgets his action in 2.1, the consumer will always arrive at the same belief $\mu(\beta)$ in 2.1.

The decision maker then enters 2.1. Where $\mu(\beta) = f(\beta)$, the consumer always continues his program whenever he accepted terms $L \geq 0$ and $p > 0$ in 1.1. Finally, the consumer arrives in 2.2 and uses if $\kappa_2 \leq \beta\,\theta$.

$$1.1:\ -L - p + \int_0^1 \int_0^{\beta\,\theta} (\theta - \kappa_1)\ f(\beta)\,d\kappa_1\,d\beta - p + \int_0^1 \int_0^{\beta\,\theta} (\theta - \kappa_2)\ f(\beta)\ d\kappa_2\ d\beta \geq 0 \tag{10a}$$

$$1.2:\ \mathrm{Max}\left\{\beta\ \theta - \kappa_1 - \beta\ p + \beta \int_0^{\beta\,\theta} (\theta - \kappa_2)\ d\kappa_2,\ -\beta\ p + \beta \int_0^{\beta\,\theta} (\theta - \kappa_2)\ d\kappa_2\right\} \tag{10b}$$

$$2.1:\ -p + \int_0^1 \int_0^{\beta\,\theta} (\theta - \kappa_2)\ \ f(\beta)\ d\kappa_2\ d\beta \geq 0 \tag{10c}$$

$$2.2:\ \mathrm{Max}\,\{\beta\ \theta - \kappa_2, 0\}. \tag{10d}$$

Accounting for the above timeline, we formalize the seller's optimization problem.

$$\{L^*_\neg, p^*_\neg\} = \underset{\{L,p\}}{\arg\max}\, L + 2\,(p - c) \tag{11}$$
$$\text{s.t. (10a) and (10c) are satisfied.}$$

The firm sets L such that (10a) binds, allowing us to restate the optimization problem.

$$p^*_\neg = \underset{\{p\}}{\arg\max} - 2\ c + \int_0^1 \int_0^{\beta\,\theta} (\theta - \kappa_1)\ f(\beta)\ d\kappa_1\ d\beta + \int_0^1 \int_0^{\beta\,\theta} (\theta - \kappa_2)\ f(\beta)\ d\kappa_2\ d\beta \tag{12}$$
$$\text{s.t. (10c) is satisfied.}$$

In the prior section, the decision maker employs self-signaling to manage his future beliefs about his impulse problem. The seller, in response, set its per-usage fee based on the informativeness of self-signaling: a low p where situational factors diminish informativeness; a high p where implementation decisions provide strong evidence of β. However, in the absence of self-signaling, the seller cannot use its per-usage pricing to guide the decision maker's future self-control perceptions. In effect, if self-signaling does not occur, per-usage fee p serves no strategic purpose not covered by upfront fee L; in other words, L and p operate as perfectly substitutable revenue sources, so long as constraints (10a) and (10c) are satisfied.

Proposition 3. *Where self-signaling does not transpire, the seller can set* $p^*_{\neg}$ *to any* $p \in [0, \int_0^1 \int_0^{\beta\,\theta} (\theta - \kappa_t)\, f(\beta)\, d\kappa_t\, d\beta]$.

The above model assumes no self-signaling to separate the strategic effects of signaling and mere uncertainty. Proposition 3 finds that mere uncertainty does not directly impact the firm's pricing scheme; that is, the shape of $f(\beta)$ does not determine the firm's selection of per-usage fees where self-signaling does not occur. Thus, in the absence of self-signaling, the seller views fixed upfront fees and per-use payments as interchangeable strategies. This result, though, does not correspond to evidence in the marketplace. Health clubs that employ high usage fees at minimal commitment (i.e., 10-visit pass, single-visit fee) systematically target particular demographic segments. First, these clubs target higher-income consumers, whose budgets typically eliminate the worry of linking p to a unit of usage (Henderson 2016). Second, these establishments heavily draw on millennials, who strongly prefer exercise variety relative to other generations (Shea 2016). Both groups, notably, can pursue fitness goals with fewer situational factors: compared with middle-class consumers, higher-income individuals can outsource errands and childcare to carve more personal time; likewise, contrasted with older consumers, fewer millennials have started families.

5. Quality Improvement

In the model outlined so far, the seller only uses its pricing strategy as a strategic response to the decision maker's self-control beliefs. Self-improvement providers, however, also select or alter the quality of their programs. Oftentimes, sellers increase the benefits of program use, offering features that aid consumers during resolution pursuit. Jenny Craig, for instance, has historically relied on in-person consultations for its dieting participants but eventually introduced telephone counseling as a convenient alternative (Callahan 2010). Their competitor Nutrisystem recently expanded its menu of weight-loss meals, in addition to improving the taste of its existing selections (Farnham 2011). Health clubs such as LA Fitness and Gold's Gym have started to offer small-group training for customers seeking a sense of community; similarly, these chains have widened their scope of fitness classes to include options like spinning, yoga, and martial arts (Masihy 2014). Other times, however, providers market self-improvement services featuring minimal benefits. Certain fitness programs, such as CrossFit, do not offer their consumers any of the amenities commonly found at large health club chains (Herz 2014). Similarly, many debt management programs do not provide users any savings allowances, a necessary benefit should an unforeseen emergency occur (Weston 2016).

We examine these issues in the following analysis, determining how the seller should structure its program frills. Specifically, the firm selects some quality level $s \in \{1, S > 1\}$ that influences the decision maker's preference for program use: at quality level s, the consumer ultimately earns benefit $s\,\theta$ for each period that he implements; when offering higher quality, the seller makes it easier for the consumer to exert effort cost κ_t, thus facilitating continued resolution progress. This support, however, entails greater expense for the firm; that is, the seller incurs marginal cost $s^2 c$ when marketing a program of quality level s.

To more fully illustrate the impact of s, we briefly outline the finisher's decision path and the firm's optimization problem.

Finisher

The finisher uses in both 1.2 and 2.2 by pulling $\kappa_1 \le K_1(\beta) = \beta\, s\, \theta - \beta\, p + \beta \int_0^{\beta\, s\, \theta} (s\ \theta - \kappa_2)\, d\kappa_2$ and $\kappa_2 \le \beta\, s\ \theta$.[15]

$$1.1: -L - p + \int_0^1 \int_0^{K_1(\beta)} \left(s\ \theta - \kappa_1 - p + \int_0^{\beta\, s\,\theta} (s\ \theta - \kappa_2)\ d\kappa_2\right) f(\beta)\, d\kappa_1\, d\beta \ge 0 \tag{13a}$$

$$1.2: K_1(\beta) - \kappa_1 \ge 0 \tag{13b}$$

$$2.1: -p + \left[\int_0^1 \int_0^{K_1(\beta)} f(\beta)\ d\kappa_1\, d\beta\right]^{-1} \cdot \int_0^1 \int_0^{K_1(\beta)} \int_0^{\beta\ s\ \theta} (s\,\theta - \kappa_2)\, f(\beta)\ d\kappa_2\ d\kappa_1\ d\beta > 0 \tag{13c}$$

$$2.2: \beta\ s\ \theta - \kappa_2 \ge 0 \tag{13d}$$

Similarly deriving the preference constraints for partials and quitters, we determine the seller's optimization problem.

$$\{\widehat{L}, \widehat{p}, \widehat{s}\} = \underset{\{L,p,s\}}{\arg\max}\, L + (p - s^2\ c) + \int_0^1 \int_0^{K_1(\beta)} (p - s^2\ c)\ f(\beta)\ d\kappa_1\ d\beta \tag{14a}$$

s.t. (13a) and (13c) are satisfied

$$\text{s.t.} -p + \left[\int_0^1 \int_{K_1(\beta)}^1 f(\beta)\, d\kappa_1\, d\beta\right]^{-1} \cdot \int_0^1 \int_{K_1(\beta)}^1 \int_0^{\beta\ s\,\theta} (s\ \theta - \kappa_2)\, f(\beta)\ d\kappa_2\ d\kappa_1\ d\beta < 0. \tag{14b}$$

Pricing Effects of Quality

Where the seller determines both its program quality and its contract pricing, two strategic tools influence resolution progress: an increase in per-usage fee p raises the likelihood that the consumer slips up midway; an improvement in quality s reduces this same probability. Accordingly, the seller sets both p and s depending on its objectives in guiding resolution pursuit.

When situational factors heavily influence decision making, the seller must minimize the chance that a high κ_t induces an initial slipup. The seller accordingly employs a low p when $f(\beta)$ lacks density near both 0 and 1, as discussed in Propositions 2a and 2b. The firm can similarly facilitate resolution progress by improving the quality of its program: at any given per-usage rate, a larger s helps the decision maker endure an unlucky draw of κ_t. The firm, when setting prices and quality jointly, offers a high-quality program at a minimal per-usage rate, in effect providing minimal impediments for the decision maker. On the other hand, situational factors deliver less impact when $f(\beta)$ gathers additional density in its extremes. Implementation decisions, in this scenario, do not shift easily, freeing the firm to both require higher per-usage rates and provide lower quality to the consumer.

These findings are formally presented in Proposition 4 below:

Define $\{\widehat{L}_f, \widehat{p}_f, \widehat{s}_f\}$ and $\{\widehat{L}_g, \widehat{p}_g, \widehat{s}_g\}$ as the optimal contracts where $\beta \sim f(\beta)$ and $\beta \sim g(\beta)$, respectively.

Proposition 4. *Suppose that $f(\beta)$ and $g(\beta)$ are beta probability density functions. As self-signaling becomes more informative, the firm increases its per-usage fee and weakly decreases its program quality. That is $\widehat{p}_f < \widehat{p}_g$ and $\widehat{s}_f \geq \widehat{s}_g$ whenever $g(\beta)$ is a mean-preserving spread of $f(\beta)$.*

Proposition 4 generalizes the results of the baseline model—where the seller chooses its program quality, its pricing strategy remains consistent with Proposition 2 and 3. The firm still employs low per-usage fees when situational factors possess greater influence; conversely, the seller requires higher usage rates when implementation decisions provide a more informative signal of β.

Beyond demonstrating the validity of our baseline model, Proposition 4 also reveals when the seller offers higher quality as a marketing strategy. The seller offers additional programs frills, in conjunction with a small p, when situational circumstances pose a lapse risk; in containing the probability of a slipup, the program reduces the likelihood that the decision maker becomes demoralized and gives up his resolution. In contrast, the seller offers marginal quality and higher usage rates when $f(\beta)$ contains density near 0 and 1. The firm, in this instance, makes program use relatively unattractive, in effect inducing an extremely strong signal of β to arise from successful implementation. These results help explain two extremes within the fitness sector. Outside of mass-market chains, two types of health clubs largely occupy the marketplace: (1) gyms such as Equinox offer conveniences like full spas, laundry service, and luxury bath products while generating revenue through fixed commitments (i.e., low p); (2) establishments like CrossFit charge significant usage fees, enabling users to work out in converted warehouses with amenities like tires, boxes, and ropes (Fumo 2014, Smith 2014).

6. Implementation Period Length

In Sections 4 and 5, the seller does not alter the time window covered by a payment of p. Nevertheless, a marketer may prefer to lengthen or shorten this window in different circumstances. An extended implementation period, for instance, helps the decision maker to commit for a longer time frame, potentially preventing enrollee attrition. Thus, a program may bolster its retention rate by assessing a monthly per-usage fee: credit counselors often use this tactic for debt management plans, ostensibly boosting the rate of debt repayment; similarly, health clubs like 24 Hour Fitness employ monthly rates as part of an overall strategy to combat enrollee apathy (Williams 2013). On the other hand, a shorter implementation window frees the decision maker from lengthy commitment, allowing him the flexibility to revise his plans as he obtains more information. Meal programs, such as Farm Fresh to You, My Fit Foods, and Home Bistro, offer shipping options ranging from per week to per meal. Similarly, boutique fitness studios like Pure Barre and CorePower Yoga often price their services per session or per week, or offer multiple-session packages (Dussault 2012, Hilmantel 2013).[16]

We address these issues in the following analysis, determining how the seller should set its implementation period length. In this setup, the firm decides on $w \geq 1$, the implementation time frame covered by a payment of p. A longer w, in this scenario, denotes a longer usage window: the decision maker ultimately receives payout $w\theta$ if he implements during a time frame spanning w; to implement during this window, though, the consumer must first expend an effort cost totaling $w\kappa_t$. The firm, too, incurs greater costs to provide service for a longer time frame: it expends marginal cost $w^2 c$ to run its program for a window of length w.

As in the last section, we briefly outline both the finisher's preference constraints and the seller's optimization problem.

Finisher

The finisher uses the program in both implementation periods, drawing $w\kappa_1 \leq K_1(\beta) = \beta w \theta - \beta p + \beta \int_0^{\beta\theta} w \cdot (\theta - \kappa_2)\, d\kappa_2$ and $w\,\kappa_2 \leq w\beta\theta$.

$$1.1: -L - p + \int_0^1 \int_0^{K_1(\beta)} \left(w\,(\theta - \kappa_1) - p + \int_0^{\beta\theta} w\,(\theta - \kappa_2)\, d\kappa_2 \right) f(\beta)\, d\kappa_1\, d\beta \geq 0 \qquad \text{(15a)}$$

$$1.2: K_1(\beta) - w\,\kappa_1 \geq 0 \tag{15b}$$

$$2.1: -p + \left[\int_0^1 \int_0^{K_1(\beta)} f(\beta)\,d\kappa_1\,d\beta\right]^{-1} \cdot \int_0^1 \int_0^{K_1(\beta)} \int_0^{\beta\,\theta} w\,(\theta - \kappa_2)\,f(\beta)\,d\kappa_2\,d\kappa_1\,d\beta > 0 \tag{15c}$$

$$2.2: \beta\,w\,\theta - w\,\kappa_2 \geq 0. \tag{15d}$$

Also determining the preferences of partials and quitters, we express the seller's profit maximization problem.

$$\{\overline{L}, \overline{p}, \overline{w}\} = \underset{\{L,p,w\}}{\arg\max}\, L + (p - w^2\,c) + \int_0^1 \int_0^{K_1(\beta)} (p - w^2\,c)\,f(\beta)\,d\kappa_1\,d\beta \tag{16a}$$

s.t. (15a) and (15c) are satisfied

$$\text{s.t. } -p + \left[\int_0^1 \int_{K_1(\beta)}^1 f(\beta)\,d\kappa_1\,d\beta\right]^{-1} \cdot \int_0^1 \int_{K_1(\beta)}^1 \int_0^{\beta\,\theta} w\,(\theta - \kappa_2) f(\beta)\,d\kappa_2\,d\kappa_1\,d\beta < 0. \tag{16b}$$

Pricing Effects of Implementation Period Length

By selecting program length, the firm possesses an additional strategic tool to steer resolution progress. This tool's ability to influence progress, however, varies across stages in the program. To see this, consider a change in length w: an increase in w raises the gross benefit to implementation; however, where the time frame of implementation is longer, the consumer also incurs greater effort costs in using the program. Thus, during 2.2, the decision maker uses the program if $w\,\kappa_2 \leq w\,\beta\,\theta$, or if $\kappa_2 \leq \beta\,\theta$, implying that w does not impact the consumer's propensity to slip up at this stage. In 1.2, on the other hand, the consumer implements whenever $w\,\kappa_1 \leq K_1(\beta) = \beta\,w\,\theta - \beta\,p + \beta \int_0^{\beta\,\theta} w\,(\theta - \kappa_2)\,d\kappa_2$, or $\kappa_1 \leq K_1(\beta) = \beta\,\theta - \beta\,\frac{p}{w} + \beta \int_0^{\beta\,\theta} (\theta - \kappa_2)\,d\kappa_2$. A larger w thus reduces the chance of slipping up at the beginning of resolution pursuit, as a longer time frame implies higher opportunity costs from lapse-activated misregulation; in other words, a bigger w induces early stage use by raising the consequences of self-signaling.[17]

As a larger w reduces the chance of an initial slipup, the seller selects a longer implementation window when it must control the risk of unlucky situational circumstances. The firm thus employs a large w when it charges a low per-usage rate: when $f(\beta)$ lacks density in its extremes or when temporary effort costs play a greater role in usage decisions. Conversely, when $f(\beta)$ is more spread toward 0 and 1, usage decisions send a clear signal of β, lessening the consumer's ability to manipulate his future self-control perceptions. In this scenario, the firm can set a shorter time frame and free the consumer of any lengthy commitment, should he learn that his β is too low to achieve his resolution.

We address these insights in Proposition 5:

Define $\{\overline{L}_f, \overline{p}_f, \overline{w}_f\}$ and $\{\overline{L}_g, \overline{p}_g, \overline{w}_g\}$ as the optimal contracts where $\beta \sim f(\beta)$ and $\beta \sim g(\beta)$, respectively.

Proposition 5. *Suppose that $f(\beta)$ and $g(\beta)$ are beta probability density functions. As self-signaling becomes more informative, the firm increases its per-usage fee and decreases its implementation window. That is $\overline{p}_f < \overline{p}_g$ and $\overline{w}_f > \overline{w}_g$ whenever $g(\beta)$ is a mean-preserving spread of $f(\beta)$.*

Proposition 5 further demonstrates the validity of the baseline model's results. Notably, this result holds despite some differences between this extension and that in the prior section: in Section 5, the seller increases its expenditures from improving program quality, but the consumer does not face any direct expense; here, both the seller and decision maker directly experience costs associated with a longer implementation time frame.

The results in Proposition 5 show an inverse relationship between per-usage fees and implementation period length. A longer implementation window complements a small p when temporary factors heavily affect decisions and self-control perceptions are more malleable. On the other hand, the firm employs a higher p and smaller w when the decision maker quickly updates his prior belief of β. This general relationship between p and w becomes most evident when sorting fitness clubs by their monthly rates: low monthly fees typically occur as part of an annual contract, as typically required of major chains such as Golds Gym and Planet Fitness; on the other hand, gyms with higher monthly rates tend to offer short-term contracts and no contract options—an effect seen at establishments like Pure Barre and SoulCycle.[18]

7. Concluding Remarks

Research has extensively documented the impact of marketing on a consumer's self-perception (Sirgy 1982, Belk 1988). Continuing in this tradition, our present model determines how a self-improvement program sets its marketing strategy to optimally induce self-signaling, a method to manage self-control beliefs. We ascertain that the firm's pricing strategy depends on the degree of noise within self-signaling: when the consumer learns little from his past use, the firm charges a low per-usage rate so that temporary situational factors do not create too much of a lapse risk; on the other hand, when past implementation reveals more about self-control, the seller assesses higher usage fees and strengthens the signal sent by program use. These findings elucidate pricing patterns in the health club market, where establishments with high per-use fees systematically target different market segments than firms that primarily rely on fixed fees for revenue. To further provide evidence for the strategic importance of self-signaling, we create a counterfactual market where consumers do not manage their self-control perceptions: in such an environment, the service provider views upfront and per-usage fees as equivalent sources of revenue, a finding inconsistent with the marketplace.

We further examine self-signaling with regard to product quality and contract length. We reveal that an informative self-signaling process allows the seller to offer minimal frills and little commitment; these strategies make it easier to quit and consequently reinforce the signal created by program use. On the other hand, the seller provides greater program benefits and requires lengthier commitment when temporary circumstances render greater influence on resolution pursuit.

Our paper suggests multiple avenues to induce perception management among customers. Beyond the approaches discussed in this paper, future work can examine the use of loyalty programs to incentivize self-signaling. For example, many small fitness chains employ the loyalty program Perkville, a software that tallies gym use and then allows earned points to be applied to membership costs (Miles 2012). Similar to loyalty reimbursements, some sellers and employers offer financial rewards to entice self-signaling behavior, such as when King County, WA, incentivized 2,000 workers to lose at least 5% body fat (Noguchi 2013).

Beyond these strategic options, future research can also investigate issues outside of our model's framework. For example, self-improvement participants typically rely on peer interaction, both as a source of emotional support and of competitive inspiration. Accordingly, future projects may explore social influences and their implications for program pricing. Additional research may analyze competition and its effect on both enrollee segmentation and targeting. Finally, other work can explore pricing issues outside of the domain of contract design. For instance, research may determine whether a firm should time its promotional policies to induce impulsive behavior.

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Appendix

Lemma 1a Proof. To determine the seller's expected demand, we first determine the self-signaling equilibria induced by each $\{L, p\}$. We restrict our analysis to equilibria where each implementation strategy in 1.2 is selected by a convex set of $\{\beta, \kappa_1\}$.

Case 1. Pooling Equilibrium where all $\{\beta, \kappa_1\}$ use the program in 1.2.

Suppose that all $\{\beta, \kappa_1\}$ pool on program use in 1.2: in this situation, the consumer does not update his prior belief in 2.1 if he observes implementation in 1.2. So that we do not miss any potential equilibria, suppose that the decision maker updates $\mu(\beta)$ to a unit mass near $\beta = 0$ if he observes an off-equilibrium message; that is, if the consumer does not use in 1.2, he believes that he possesses the lowest possible β in 2.1.

In this scenario, every $\{\beta, \kappa_1\}$ must satisfy

$$1.1: -L - p + \int_0^1 \int_0^1 \left(\theta - \kappa_1 - p + \int_0^{\beta\theta} (\theta - \kappa_2)\, d\kappa_2\right) \cdot f(\beta)\, d\kappa_1\, d\beta \geq 0 \tag{17a}$$

$$1.2: \beta\theta - \kappa_1 - \beta p + \beta \int_0^{\beta\theta} (\theta - \kappa_2)\, d\kappa_2 \geq 0 \tag{17b}$$

$$2.1: -p + \int_0^1 \int_0^1 \int_0^{\beta\theta} (\theta - \kappa_2)\, f(\beta)\, d\kappa_2\, d\kappa_1\, d\beta > 0 \tag{17c}$$

$$2.2: \text{Max}\,\{\beta\theta - \kappa_2, 0\}. \tag{17d}$$

However, for any $p \geq 0$, we find that there exists some $\kappa_1 > \beta\theta - \beta p + \beta\int_0^{\beta\theta}(\theta - \kappa_2)\, d\kappa_2$ that would not implement in 1.2. Thus, not all $\{\beta, \kappa_1\}$ can pool on program use in 1.2 and Case 1 cannot occur in equilibrium.

Case 2. Pooling Equilibrium where all $\{\beta, \kappa_1\}$ do not use in 1.2.

Suppose that all $\{\beta, \kappa_1\}$ pool on nonuse in 1.2. Here, the consumer does not update his prior belief in 2.1 if he observes prior nonuse; on the other hand, he updates $\mu(\beta)$ to a unit mass near $\beta = 0$ if he observes implementation in 1.2.

Here, every $\{\beta, \kappa_1\}$ must satisfy

$$1.1: -L - p + \int_0^1 \int_0^1 \left(-p + \int_0^{\beta\theta} (\theta - \kappa_2)\, d\kappa_2\right) \cdot f(\beta)\, d\kappa_1\, d\beta \geq 0 \tag{18a}$$

$$1.2: -\beta p + \beta \int_0^{\beta\theta} (\theta - \kappa_2)\, d\kappa_2 \geq \beta\theta - \kappa_1 \tag{18b}$$

$$2.1: -p + \int_0^1 \int_0^1 \int_0^{\beta\theta} (\theta - \kappa_2)\, f(\beta)\, d\kappa_2\, d\kappa_1\, d\beta > 0 \tag{18c}$$

$$2.2: \text{Max}\,\{\beta\theta - \kappa_2, 0\}. \tag{18d}$$

However, for any $p \geq 0$, we find there exists some $\kappa_1 < \beta\theta + \beta p - \beta\int_0^{\beta\theta}(\theta - \kappa_2)\, d\kappa_2$ that prefers an off-equilibrium strategy and uses in 1.2. Thus, not all $\{\beta, \kappa_1\}$ can pool on nonuse in 1.2 and Case 2 cannot occur in equilibrium.

Case 3. Partition Equilibrium where $\{\beta, \kappa_1\} \in (0,1) \times [0, K_1(\beta)]$ use in 1.2 to signal being a "low" type and $\{\beta, \kappa_1\} \in (0,1) \times (K_1(\beta), 1]$ decline use to signal being a "high" type.

Suppose that the decision maker faces the following choice in 1.2: (1) using the program in 1.2 and signal being a low type, prompting attrition in 2.1, or (2) declining use in 1.2 to signal being a high type, thus prompting himself to pay p and continue in 2.1. In this scenario, the consumer faces a trade-off between $\beta\theta-\kappa_1$, the discounted net payoff from implementing in 1.2, and $-\beta p+\beta\int_0^{\beta\theta}(\theta-\kappa_2)\,d\kappa_2$, the expected payoff from signaling a minimal impulse problem and continuing in period 2.

We show that the decision maker only chooses to use in 1.2 if $\kappa_1 \le K_1(\beta)=\beta\theta+\beta p-\beta\int_0^{\beta\theta}(\theta-\kappa_2)\,d\kappa_2$. Thus, we characterize the necessary preference constraints as follows.

Use in 1.2:

$$1.1: -L-p+\int_0^1\int_0^{K_1(\beta)}(\theta-\kappa_1)\,f(\beta)\,d\kappa_1\,d\beta + \int_0^1\int_{K_1(\beta)}^1\left(-p+\int_0^{\beta\theta}(\theta-\kappa_2)\,d\kappa_2\right)f(\beta)\,d\kappa_1\,d\beta\ge 0 \tag{19a}$$

$$1.2: K_1(\beta)-\kappa_1\ge 0 \tag{19b}$$

$$2.1: -p+\left[\int_0^1\int_0^{K_1(\beta)} f(\beta)\,d\kappa_1\,d\beta\right]^{-1}\cdot\int_0^1\int_0^{K_1(\beta)}\int_0^{\beta\theta}(\theta-\kappa_2)\;f(\beta)\,d\kappa_2\,d\kappa_1\,d\beta<0. \tag{19c}$$

Nonuse in 1.2:

$$1.2: K_1(\beta)-\kappa_1<0 \tag{20a}$$

$$2.1: -p+\left[\int_0^1\int_{K_1(\beta)}^1 f(\beta)\,d\kappa_1\,d\beta\right]^{-1}\cdot\int_0^1\int_{K_1(\beta)}^1\int_0^{\beta\theta}(\theta-\kappa_2)\;f(\beta)\,d\kappa_2\,d\kappa_1\,d\beta>0 \tag{20b}$$

$$2.2: \text{Max}\,\{\beta\theta-\kappa_2,0\}. \tag{20c}$$

In this scenario, the consumer forms the following posterior $\mu(\beta)$ in 2.1.

$$\text{use in 1.2: } \frac{K_1(\beta)\;f(\beta)}{\int_0^1 K_1(\beta)\,f(\beta)\,d\beta}\quad \textit{for}\ 1>\beta>0 \tag{21a}$$

$$\text{non-use in 1.2: } \frac{(1-K_1(\beta))\,f(\beta)}{\int_0^1(1-K_1(\beta))\,f(\beta)\,d\beta}\quad \textit{for}\ 1>\beta>0. \tag{21b}$$

Here, to compare (21a) and (21b), we see that $\frac{K_1(\beta)f(\beta)}{\int_0^1 K_1(\beta)f(\beta)d\beta}$ cannot exceed $\frac{(1-K_1(\beta))f(\beta)}{\int_0^1(1-K_1(\beta))f(\beta)d\beta}$ for all β, as this suggests that $\frac{\int_0^1 K_1(\beta)f(\beta)d\beta}{\int_0^1 K_1(\beta)f(\beta)d\beta}=1>\frac{\int_0^1(1-K_1(\beta))f(\beta)d\beta}{\int_0^1(1-K_1(\beta))f(\beta)d\beta}=1$; similarly, we know that $\frac{(1-K_1(\beta))f(\beta)}{\int_0^1(1-K_1(\beta))f(\beta)d\beta}$ cannot exceed $\frac{K_1(\beta)f(\beta)}{\int_0^1 K_1(\beta)f(\beta)d\beta}$ for all β. Moreover, $\frac{\partial}{\partial\beta}K_1(\beta)>0$ and $\frac{\partial}{\partial\beta}(1-K_1(\beta))<0$ for all $\beta\in(0,1)$. These facts, all together, imply that $\frac{K_1(\beta)f(\beta)}{\int_0^1 K_1(\beta)f(\beta)d\beta}>\frac{(1-K_1(\beta))f(\beta)}{\int_0^1(1-K_1(\beta))f(\beta)d\beta}$ for some $\beta\in(\beta',1)$ and $\frac{K_1(\beta)f(\beta)}{\int_0^1 K_1(\beta)f(\beta)d\beta}<\frac{(1-K_1(\beta))f(\beta)}{\int_0^1(1-K_1(\beta))f(\beta)d\beta}$ for some $\beta\in(0,\beta')$. Thus, if $\frac{K_1(\beta)f(\beta)}{\int_0^1 K_1(\beta)f(\beta)d\beta}$ contains relatively greater mass around $(\beta',1)$, then the consumer should possess a more optimistic posterior $\mu(\beta)$ after implementing in 1.2. This, however, contradicts (19c) and (20b) and establishes that Case 3 cannot occur in equilibrium.

Case 4. Partition Equilibrium where $\{\beta,\kappa_1\}\in(0,1)\times[0,K_1(\beta)]$ use in 1.2 to signal being a "high" type and $\{\beta,\kappa_1\}\in(0,1)\times(K_1(\beta),1]$ decline use to signal being a "low" type.

Suppose that the decision maker faces the following choice in 1.2: (1) using in 1.2 to signal self-control, inducing himself to continue his resolution in 2.1, or (2) slipping up in 1.2 and then quitting in 2.1 upon forming negative self-control perceptions. Here, the consumer faces the following tradeoff in 1.2: he expects $\beta\theta-\kappa_1-\beta p+\beta\int_0^{\beta\theta}(\theta-\kappa_2)\,d\kappa_2$ if he implements in 1.2 and induces himself to continue in 2.1; on the other hand, he receives 0 if he slips up in 1.2 and subsequently quits during the following planning period.

We determine that the consumer implements in 1.2 if $\kappa_1\le K_1(\beta)=\beta\theta-\beta p+\beta\int_0^{\beta\theta}(\theta-\kappa_2)\,d\kappa_2$ and establish the preference constraints in (3a)–(5b). Since $\frac{\partial}{\partial\beta}K_1(\beta)>0$ and $\frac{\partial}{\partial\beta}(1-K_1(\beta))<0$, it can be shown that there exists some p that satisfies (3a)–(5b).

Corollary 1b Proof. Suppose that the seller sets p low enough so that all consumers continue in 2.1. Here, self-signaling is rendered trivial: since the consumer's implementation decision in 1.2 does not impact his decision to pay $p\ge 0$ in 2.1, the model merely reduces to a series of one-period choices. Here, a consumer utilizes in 1.2 if he possesses a relatively high β and favorable effort cost κ_1:

$$1.1: -L-p+\int_0^1\int_0^{\beta\theta}(\theta-\kappa_1)\,f(\beta)\,d\kappa_1\,d\beta-p + \int_0^1\int_0^{\beta\theta}(\theta-\kappa_2)\,f(\beta)\,d\kappa_2\,d\beta\ge 0 \tag{22a}$$

$$1.2: \beta\theta-\kappa_1-\beta p+\beta\int_0^{\beta\theta}(\theta-\kappa_2)\,d\kappa_2 \ge -\beta p+\beta\int_0^{\beta\theta}(\theta-\kappa_2)\,d\kappa_2 \tag{22b}$$

$$2.1: -p+\left[\int_0^1\int_0^{\beta\theta} f(\beta)\,d\kappa_1\,d\beta\right]^{-1}\cdot\int_0^1\int_0^{\beta\theta}\int_0^{\beta\theta}(\theta-\kappa_2)\;f(\beta)\,d\kappa_2\,d\kappa_1\,d\beta>0 \tag{22c}$$

$$2.2: \text{Max}\,\{\beta\theta-\kappa_2,0\}. \tag{22d}$$

Conversely, the decision maker declines use in 1.2 if

$$1.2: \beta\theta-\kappa_1-\beta p+\beta\int_0^{\beta\theta}(\theta-\kappa_2)\,d\kappa_2<-\beta p +\beta\int_0^{\beta\theta}(\theta-\kappa_2)\,d\kappa_2 \tag{23a}$$

$$2.1: -p+\left[\int_0^1\int_{\beta\theta}^1 f(\beta)\,d\kappa_1\,d\beta\right]^{-1}\cdot\int_0^1\int_{\beta\theta}^1\int_0^{\beta\theta}(\theta-\kappa_2)\,f(\beta)\,d\kappa_2\,d\kappa_1\,d\beta>0 \tag{23b}$$

$$2.2: \text{Max}\,\{\beta\theta-\kappa_2,0\}, \tag{23c}$$

where the seller sets $L\ge 0$ and $p\ge 0$ in accordance with (22a), (22c), and (23b), total profits amount to $-2c+\int_0^1\int_0^{\beta\theta}(\theta-\kappa_1)\,f(\beta)\cdot d\kappa_1\,d\beta+\int_0^1\int_0^{\beta\theta}(\theta-\kappa_2)\;f(\beta)d\kappa_2\,d\beta=-2c+2\theta^2E[\beta]-\theta^2E[\beta^2]$.

We compare $-2c+2\theta^2E[\beta]-\theta^2E[\beta^2]$ to the profits in Case 4, the self-signaling equilibrium in our paper. We note that Case 4 profits, obtained from solving (7), amount to $\pi(p^*)=-c+(-\theta p^*+c\,p^*-\theta c+\theta^2)\,E[\beta]+\left(-\frac{p^{*2}}{2}+\theta p^*-\theta^2p^*-\theta^2\right.$

$c - \frac{\theta^2}{2} + 2\,\theta^3)\,E\,[\beta^2] + \left(\frac{3\,\theta^2 p^*}{2} + \frac{\theta^2 c}{2} - 2\,\theta^3 + \theta^4\right) E\,[\beta^3] + \left(-\frac{\theta^2 p^*}{2} + \frac{\theta^3}{2} - \frac{3\,\theta^4}{2}\right) E\,[\beta^4] + \frac{3\,\theta^4}{4}\,E[\beta^5] - \frac{\theta^4}{8}\,E\,[\beta^6]$, where $p^* = (-\theta + c)\,\frac{E[\beta]}{E[\beta^2]} + (\theta - \theta^2) + \frac{3\,\theta^2}{2}\,\frac{E[\beta^3]}{E[\beta^2]} - \frac{\theta^2}{2}\,\frac{E[\beta^4]}{E[\beta^2]}$.

To compare $-2\,c + 2\,\theta^2\,E\,[\beta] - \theta^2\,E\,[\beta^2]$ to $\pi\,(p^*)$, we exploit three properties of $f\,(\beta)$. First, a positive variance implies that $E\,[\beta^2] > E\,[\beta]^2$. Second, $\beta^k > \beta^{k+1}$ for all $\beta \in (0,1)$, meaning that $E\,[\beta^k] > E\,[\beta^{k+1}]$ for any $k \geq 0$. Finally, $\beta^k\,(1-\beta) > \beta^{k+1}\,(1-\beta)$ for all $\beta \in (0,1)$, necessitating that $E\,[\beta^k] - E\,[\beta^{k+1}] > E\,[\beta^{k+1}] - E[\beta^{k+2}]$ for any $k \geq 0$. Utilizing these three properties, we show that $\frac{\partial}{\partial c}\,[\,\pi\,(p^*) - (-2\,c + 2\,\theta^2 E\,[\beta] - \theta^2\,E\,[\beta^2])] > 0$. We then confirm that there exists some $\{\theta, c \in (0, \frac{1}{2}\theta^2], f\,(\beta)\}$ in which $\pi(p^*)$ exceeds $-2\,c + 2\,\theta^2\;\;E\,[\beta] - \theta^2\,E\,[\beta^2]$. Accordingly, we deduce that the seller prefers to induce self-signaling (i.e., Case 4) where marginal costs are sufficiently high.

We note that a profit comparison between Case 4 and this case is appropriate for our model. Traditional equilibrium refinement is not necessary: the seller is neither the sender nor the receiver in our signaling game; rather, the seller induces a signaling game in the manner that "nature" assigns the conditions of a game.

Proposition 2b Proof. To show that $p_f^* < p_g^*$, assume instead that $p_f^* \geq p_g^*$. As a result of (8) and (9), $p_f^* \geq p_g^*$ implies that

$$\int_0^1 \left(-(\beta - \beta^2)\left(\theta - p_f^* + \beta\,\theta^2 - \frac{\beta^2\,\theta^2}{2}\right) - \beta\,(p_f^* - c)\right) g(\beta)\;d\beta \leq \int_0^1 \left(-(\beta - \beta^2)\left(\theta - p_f^* + \beta\,\theta^2 - \frac{\beta^2\,\theta^2}{2}\right) - \beta\,(p_f^* - c)\right) \cdot f(\beta)\,d\beta = 0. \tag{24}$$

We rearrange this as

$$\int_0^1 \left(-(\beta - \beta^2)\left(\theta - p_f^* + \beta\,\theta^2 - \frac{\beta^2\,\theta^2}{2}\right) - \beta\,(p_f^* - c)\right) \cdot (g(\beta) - f(\beta))\,d\beta \leq 0. \tag{25}$$

Twice performing integration by parts on the LHS of (25), we restate (25) as the following:

$$\int_0^1 \frac{\partial^2}{\partial\beta^2}\left[-(\beta - \beta^2)\left(\theta - p_f^* + \beta\,\theta^2 - \frac{\beta^2\,\theta^2}{2}\right) - \beta\,(p_f^* - c)\right] \cdot \left(\int_0^\beta G(\beta')\,d\beta' - \int_0^\beta F(\beta')\,d\beta'\right) d\beta \leq 0. \tag{26}$$

However, $\frac{\partial^2}{\partial\beta^2}\;[-(\beta - \beta^2)(\theta - p_f^* + \beta\theta^2 - \frac{\beta^2\theta^2}{2}) - \beta\;(p_f^* - c)] > 0$ for all $\beta \in (0,1)$. Moreover, if $g\,(\beta)$ is a mean-preserving spread of $f\,(\beta)$, then $f\,(\beta)$ second-order stochastically dominates $g\;(\beta)$—this amounts to the condition that $\int_0^\beta G\,(\beta')\,d\beta' \geq \int_0^\beta F(\beta')\,d\beta'$ for all $\beta \in (0,1)$, with some strict inequality. Contradiction.

Proposition 2a Proof. We first note that first-order stochastic dominance implies second-order stochastic dominance. Hence, $f(\beta)$ second-order stochastically dominates $g(\beta)$ and $p_f^* < p_g^*$ by Proposition 2b. Next, we show that $L_g^* = -p_g^* + \int_0^1 \frac{2\beta - \beta^2}{2}\left(\theta - p_g^* + \beta\,\theta^2 - \frac{\beta^2\theta^2}{2}\right)^2 g(\beta)\,d\beta < -p_f^* + \int_0^1 \frac{2\beta - \beta^2}{2}\left(\theta - p_f^* + \beta\,\theta^2 - \frac{\beta^2\,\theta^2}{2}\right)^2 g(\beta)\,d\beta$ where $p_f^* < p_g^*$.

Finally, we need to demonstrate that $-p_f^* + \int_0^1 \frac{2\beta - \beta^2}{2}\,(\theta - p_f^* + \beta\,\theta^2 - \frac{\beta^2\theta^2}{2})^2\,g(\beta)\,d\beta < -p_f^* + \int_0^1 \frac{2\beta - \beta^2}{2}\left(\theta - p_f^* + \beta\,\theta^2 - \frac{\beta^2\theta^2}{2}\right)^2 f(\beta)\,d\beta = L_f^*$. To show this, assume instead that $-p_f^* + \int_0^1 \frac{2\beta - \beta^2}{2}(\theta - p_f^* + \beta\,\theta^2 - \frac{\beta^2\theta^2}{2})^2\,g(\beta)\;d\beta \geq -p_f^* + \int_0^1 \frac{2\beta - \beta^2}{2}\;(\theta - p_f^* + \beta\,\theta^2 - \frac{\beta^2\,\theta^2}{2})^2\,f(\beta)\;d\beta$.

We rearrange this as

$$\int_0^1 \frac{2\,\beta - \beta^2}{2}\left(\theta - p_f^* + \beta\,\theta^2 - \frac{\beta^2\,\theta^2}{2}\right)^2 (g(\beta) - f(\beta))\;d\beta \geq 0. \tag{27}$$

We then perform integration by parts on the LHS of (27) and restate it as the following:

$$\int_0^1 \frac{\partial}{\partial\beta}\left[\frac{2\,\beta - \beta^2}{2}\left(\theta - p_f^* + \beta\,\theta^2 - \frac{\beta^2\theta^2}{2}\right)^2\right](F(\beta) - G(\beta))\,d\beta \geq 0. \tag{28}$$

However, $\frac{\partial}{\partial\beta}\left[\frac{2\beta - \beta^2}{2}\left(\theta - p_f^* + \beta\,\theta^2 - \frac{\beta^2\theta^2}{2}\right)^2\right] > 0$ for all $\beta \in (0,1)$. Moreover, $F(\beta) \leq G(\beta)$ for all $\beta \in (0,1)$, with some strict inequality. Contradiction.

Proposition 3 Proof. Where the seller selects L s.t. (10a) binds, we determine that $L \geq 0$ and (10c) require $p \in [0, \int_0^1\int_0^{\beta\,\theta}(\theta - \kappa_t)\,f(\beta)\,d\kappa_t\,d\beta]$. Next, we show $\frac{\partial}{\partial p}[-2c + \int_0^1\int_0^{\beta\theta}(\theta - \kappa_1)\,f(\beta)\,d\kappa_1\,d\beta + \int_0^1\int_0^{\beta\,\theta}(\theta - \kappa_2)\,f(\beta)\;d\kappa_2\,d\beta] = 0$.

Proposition 4 Proof. We define our beta pdf as $Beta(A, b\,A)$ so that $E\,[\beta] = \frac{A}{A + b\,A} = \frac{1}{1+b}$ for all A. Here, $g(\beta) = Beta(A', b\,A')$ is a mean-preserving spread of $f(\beta) = Beta(A'', b\,A'')$ for any $A' < A''$.

Next, we select $\widehat{L}$ so that (13a) binds and rearrange (14a) to solve for $\widehat{p}$. Where $\beta \sim Beta(A, b\,A)$, $E\,[\beta^k] = \prod_{k=0}^{k-1} \frac{A+k}{A+b\,A+k}$ and we yield the following set of FOC for p.

$$\frac{A}{A + b\,A}(-s\,\theta + s^2 c) + \prod_{k=0}^{1} \frac{A + k}{A + b\,A + k}(s\,\theta - \widehat{p}\; - s^2\,\theta^2) + \prod_{k=0}^{2} \frac{A + k}{A + b\,A + k}\left(\frac{3\,s^2\,\theta^2}{2}\right) + \prod_{k=0}^{3} \frac{A + k}{A + b\,A + k}\left(-\frac{s^2\,\theta^2}{2}\right) = 0. \tag{29}$$

Solving for $\widehat{p}$, we find that $\frac{\partial\widehat{p}}{\partial A} < 0$ for any s. Here, a decrease in A implies a mean-preserving spread and necessitates that $\widehat{p}_f < \widehat{p}_g$.

Then, we determine $\widehat{s}$ by comparing $\pi\,(s = S, \widehat{p}(S))$ to $\pi\,(s = 1, \widehat{p}(1))$ and establish that $\frac{\partial}{\partial A}\,[\pi\,(s = S, \widehat{p}(S)) - (s = 1, \widehat{p}(1))] > 0$. We then confirm that there exists some $\{\theta, c, A, b\,A\}$ in which $\pi\,(s = S, \widehat{p}(S))$ exceeds $\pi\,(s = 1, \widehat{p}(1))$ and vice versa. As a result, we conclude that the seller prefers to set $\widehat{s} = S$ where A is sufficiently high, or that $\widehat{s}_f \geq \widehat{s}_g$.

Proposition 5 Proof. Again, we define our beta pdf as $Beta(A, b\,A)$ so that $E\,[\beta] = \frac{A}{A + b\,A} = \frac{1}{1+b}$ for all A. Here,

$g(\beta) = Beta(A', bA')$ is a mean-preserving spread of $f(\beta) = Beta(A'', bA'')$ for any $A' < A''$.

Next, we select $\overline{L}$ so that (15a) binds and restate (16a) to solve for $\overline{p}$ and $\overline{w}$. Where $\beta \sim Beta(A, bA)$, $E[\beta^k] = \prod_{k=0}^{k-1} \frac{A+k}{A+bA+k}$ and we yield the following set of FOCs.

$$p : \frac{A}{A+bA}(-\theta + \overline{w}\, c) + \prod_{k=0}^{1} \frac{A+k}{A+bA+k}\left(\theta - \theta^2 - \frac{\overline{p}}{\overline{w}}\right) + \prod_{k=0}^{2} \frac{A+k}{A+bA+k}\left(\frac{3\theta^2}{2}\right) + \prod_{k=0}^{3} \frac{A+k}{A+bA+k}\left(-\frac{\theta^2}{2}\right) = 0 \tag{30a}$$

$$\begin{aligned} w : -2\overline{w}\, c &+ \frac{A}{A+bA}(\theta^2 + c\overline{p} - 2\theta\overline{w}c) \\ &+ \prod_{k=0}^{1} \frac{A+k}{A+bA+k}\left(-\frac{\theta^2}{2} + 2\theta^3 + \frac{\overline{p}^2}{2\overline{w}^2} - 2\theta^2\,\overline{w}\,c\right) \\ &+ \prod_{k=0}^{2} \frac{A+k}{A+bA+k}(-2\theta^3 + \theta^4 + \theta^2\,\overline{w}\,c) \\ &+ \prod_{k=0}^{3} \frac{A+k}{A+bA+k}\left(\frac{\theta^3}{2} - \frac{3\theta^4}{2}\right) \\ &+ \prod_{k=0}^{4} \frac{A+k}{A+bA+k}\left(\frac{3\theta^4}{4}\right) + \prod_{k=0}^{5} \frac{A+k}{A+bA+k}\left(-\frac{\theta^4}{8}\right) = 0. \end{aligned} \tag{30b}$$

Explicitly solving for $\overline{p}$ and $\overline{w}$, we find that $\frac{\partial\overline{p}}{\partial A} < 0$ and $\frac{\partial\overline{w}}{\partial A} > 0$, where a decrease in A implies a mean-preserving spread. We consequently conclude that $\overline{p}_f < \overline{p}_g$ and $\overline{w}_f > \overline{w}_g$.

Endnotes

[1] We use "decision maker" and "consumer" interchangeably. We also use "self-control" and "self-restraint" interchangeably.

[2] We assume that all payoffs transpire after the program's conclusion for timeline clarity (Figure 1). However, we only require that usage benefits (i.e., θ) occur after usage costs (i.e., κ_t) for our baseline results to hold.

[3] We employ a quasi-hyperbolic discounting model (Phelps and Pollak 1968) where the exponential factor $\delta = 1$ in all states. If we relax this assumption, our baseline model's qualitative results do not change. Furthermore, the assumption of β being deterministic has found support in the literature. In the famous Stanford marshmallow tests (Mischel et al. 1988), preschool kids who resisted immediate gratification were found to be more competent, both academically and socially, years later.

[4] Burger and Huntzinger (1985) find evidence that individuals often attribute self-control failures to situational factors, opting to selectively forget the impact of their own internal disposition. Nordgren et al. (2006) find that individuals attribute past self-control failures to their own impulse problem (what they refer to as a "visceral drive") when actively experiencing momentary duress; when not actively experiencing duress, individuals downplay the impact of their impulses on past self-control failures.

[5] This self-signaling model is similar to the planner-doer framework in Bénabou and Tirole 2004.

[6] In our baseline model, we assume that planning periods are equal in length to implementation periods. However, we relax this assumption in Section 6: in this extension, we examine implementation length as a strategic variable set by the seller. We are grateful to the review team for suggesting this useful extension.

[7] For brevity, we henceforth omit the label "period." For instance, we refer to "period 2.2" as "2.2."

[8] So that each β possesses some probability of becoming a quitter, we set $\overline{\theta} = \frac{2}{3}$. Thus, even if $\beta \to 1$, the consumer may decline implementation in 1.2 if κ_1 is sufficiently high. This captures the notion that any individual can lapse when faced with extremely difficult circumstances.

[9] To reiterate, the LHS of (3a) does not amount to $-L - p + \int_0^1 \int_0^{K_1(\beta)} \cdot \beta(\theta - \kappa_1 - p + \int_0^{\beta\theta}(\theta - \kappa_2)\, d\kappa_2)\, f(\beta)\, d\kappa_1\, d\beta$. When the consumer acts as a planner, he possesses a discount factor of 1. He does not discount future transactions by an expectation of β, instead only using β to calculate his future implementation probabilities.

[10] To avoid redundancy, we omit the 1.1 preference constraint for both the partial and quitter.

[11] The seller cannot charge $L \geq 0$ where $p > \frac{1}{2}\theta^2$.

[12] Proofs for all lemmas and propositions are located within the appendix.

[13] Market failure transpires where $c > \frac{1}{2}\,\theta^2$.

[14] While we focus on the higher-profit strategy, we note that traditional equilibrium refinement strategies are not necessary. The signaling game in our paper is entirely conducted by the consumer: the decision maker is both the sender and the receiver. The seller is not an active participant in the signaling game; rather, the seller induces a signaling game, in the manner that "nature" traditionally assigns the conditions of a traditional signaling game.

[15] So that each β possesses some probability of becoming a quitter, we require that $S < \frac{2/3}{\theta}$.

[16] We note that both full-service gyms and boutique fitness studios face capacity constraints– capacity constraints cannot explain the difference in strategy between the two types of services.

[17] It is possible that a longer time frame may increase the chance of a slipup due to willpower depletion effects (Baumeister et al. 1994). This is outside the scope of our current paper but presents an opportunity for future research.

[18] As in Section 5, we utilize an assumption of quadratic marginal costs. This assumption seems intuitive in many circumstances. For instance, due to equipment depreciation, a health club spends higher marginal costs maintaining a machine in its second year, relative to similar costs in the first year. Similarly, a weight loss program will encounter difficulty smoothing its production if it sends larger shipments of food: if customer shipment dates are clustered, a longer implementation window raises the prospect of production bottlenecks and periods of unused capacity. Also, linear costs imply that profits equal $w[-c + \int_0^1 \int_0^{K_1(\beta)}(\theta - \kappa_1 - c + \int_0^{\beta\theta}(\theta - \kappa_2)\, d\kappa_2)\, f(\beta)\, d\kappa_1\, d\beta]$, where the bracketed term is the objective function in the baseline model; thus, a linear cost assumption does not comply with a finite implementation length, as is expected to occur in the marketplace.

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