

The Signaling Game: Unraveling the Surprising Revenue Surge and User Engagement in “KEEP’s” Revised Medal Events Model

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Abstract: Keep, the popular fitness platform on China's fitness platform, improved its marketing strategy by transforming medals from being earned unconditionally to being earned after exercise. Previous studies have stopped at examining the equilibrium Keep company's business model for the signaling game, with the gap of the signaling game to analyze the company's business strategy. This paper presents a novel theoretical model aimed at elucidating the operational dynamics that attract a higher user base under improved conditions for Keep medal acquisition. Drawing from the foundation of signaling game theory, the model categorizes users into distinct groups and observes the ensuing public responses. The study culminates in a discerning conclusion that Keep highlights the inclination of health-conscious users to engage in medal acquisition, thus signaling their commitment, in contrast to the reluctance of more indolent individuals to participate. Companies can leverage this mechanism to entice health-oriented individuals, ultimately expanding their customer base. The implications of this research extend directly to real-world scenarios, offering strategic insights for companies.

Keywords: fitness platform, signaling game, company strategy, user engagement

1. Introduction

In 2022, China has the world's largest fitness population of 374.0 million people. However, the average annual expenditure of the Chinese fitness population in 2022 will be 2,518.3 yuan per person, much lower than the 16,425.2 yuan in the United States, indicating strong growth potential. So, recently, there has been renewed policy about new technology application in virtual sports including fitness applications to meet the needs of different groups of people. As a platform that provides users with a comprehensive fitness solution, Keep offers a wide range and professional fitness content through AI-assisted personalized training programs. ¹Keep has two main charging systems, online memberships and smart fitness equipment sales. One of the services featured in Keep, on the other

¹ See Important Decisions in the 14th Five-Year Plan for Sports Development published on October 25, 2021, at: <https://www.sport.gov.cn/zfs/n4977/c23655706/part/23656158.pdf>

hand, is virtual races, which was launched at the end of 2018 and its inclusion in the membership subscription program. Virtual events refer to allow users to register for and participate in by completing a fitness goal such as running, within a specified period of time. Revenue from such events is generated from event entry fees, and participation in an event earns event memorabilia such as medals.

In 2021, users will be able to earn medals without having to complete an event. And in 2022, Keep changed the rules to force users to successfully complete fitness goals in order to earn event souvenirs. One of the largest increases in revenue from 2022 to 2023 is the increase in revenue from virtual sporting events. From the marginal utility theory of Jenvos [1], when it is necessary to run and pay in order to earn a medal, participants have to put in more effort and additional costs in order to reach their goal. Participants are supposedly experiencing a gradual decrease in the marginal satisfaction of earning a medal, which reduces interest in the activity and leads to a decrease in the number of users.² However, the facts contradict this and more clients are opting for this service, albeit with some effort.

At present, prior research suggests that most of scholars have studied the operating mechanism of Keep's innovative business model, and explored the iterative innovation latitude of the software business model without exploring the psychology of users. Wang [2] suggests that high growth and high elimination is the main theme of the current fitness software market, and the iterative innovation model of small steps can help to improve user stickiness and the willingness to continue to use. Based on this, a part of scholars tried to analyze the user psychology with the media perspective. Jia [3] explores how the per-session provisioning technology of the fitness app "Keep" affects users' daily exercise practices, analyzing its impact on body perception and social interactions from the perspectives of mobility and sociability.

However, few studies have focused on application of game between two players for companies' strategies. Scholars have only studied the points that can be drawn upon as a business model or the reasons for the high point of customer stickiness in the form of media communication, which is a limited perspective and lacks the ability to analyze the psychological effects among customers.

This paper focuses on the psychological game between customers to explore the medallion system in Keep platform, which is the problem of customers putting more efforts and the number of people rising instead of decreasing. This paper will use the method of signaling game to explore the signaling and game psychology between customers. In the practical part, such models can help the company to develop better strategies to utilize the psychological game among consumers, so as to come to convert new consumers. In the academic part, the theoretical model provided in this dissertation can fill in the missing areas of previous scholars, about how adopting company decisions that demand more from consumers affects customer behavior.

This paper will start with the second part of the literature review, the third part of the main body, for constructing a theoretical framework to solve the problem, and the fourth part of the paper will be the conclusion.

2. Literature Review

This paper will explore how firms can use the psychological game between consumers to increase the number of customers by increasing the cost paid by consumers from the perspective of signaling game. Most of the current academic discussions are on some of the uses of signaling games, as well as analyzing Keep's business model. The scope of the review will range from the influencing factors to the applications of signaling games, as well as the analysis of Keep's business model and user behavior. Many recent studies have focused on the application issues of signaling games, but still have not integrated them with business-to-consumer decision making, and have mostly stayed in the

² See Keep 2023 Prospectus, at: https://manager.wisdomir.com/files/676/2023/0630/20230630064502_00419409_tc.pdf

pricing game between firms. For the study of Keep, most scholars only stay in the business model of the explosion of the fire is because of the media publicity and other factors, and did not take into account the company's use of consumer psychology for decision-making.

2.1. Signaling Games

2.1.1. Model Building

The earliest signaling game was proposed by Spence [4], which introduced the classical meritocracy model and investigated how employers could solve the problem of information asymmetry by using the education level of job applicants as a signal.

Subsequently, more scholars took note of this model and derived other models by adding certain assumptions based on the core of this model. Crawford & Joel [5] developed a model of strategic communication that describes the process by which a more well-informed sender sends signals to receivers and parses out the form and nature of equilibrium signals. In addition, it was shown that the equilibrium signal is more valuable to the receiver's message under certain conditions.

Since then, more and more scholars have begun to study the equilibrium points between signaling games in order to find out how to stabilize signaling games. Cho & Kreps [6] explored the fact that there are usually many sequential equilibria in a game where one party transmits private information to the other party. By restricting unbalanced beliefs, we can eliminate non-intuitive equilibria. This study proposes a formalization of restrictions and relates it to the notion of stability. At the same time, Banks & Sobel [7] similarly studied sequential equilibria and stable equilibria for signaling games. The concept of divine equilibrium was introduced and the set of sequential equilibria was refined. Irrational equilibria were ruled out by restricting signals on nonequilibrium paths. The existence of sacred equilibria was proved and a characterization of stable equilibria was given.

In summary, in addition to the initial model, the next model makes the following two types of improvements to the original model. One is to add assumptions to study the benefits of both sides of the game in different situations. The other one is to explore the equilibrium point to stabilize the signaling game.

2.1.2. Applications

Over a long period of model refinement and research, some scholars have shifted their attention to applications, particularly of companies. Milgrom & Roberts [8] proposed a signaling model, based on Phillip Nelson, to use price and advertising to signal new product quality. Repeated purchases play a key role in the model and a method for refining the equilibrium set of a signaling game with multiple potential signals is shown.

Subsequently, for some time, scholars have focused on the issue of firm-to-firm decision-making. Gal-Or [9] suggests that in oligopolistic markets, firms face uncertain demand. Each firm has private signals that it can choose whether to share with other firms. The study shows that regardless of the relevance of the private signal, the optimal strategy is not to share any information, which is the only Nash equilibrium.

In addition to this, a part of scholars began to study the effect of signaling games on individual decision-making. Hurkens & Vulkan [10] endogenized the information structure by incorporating information acquisition into the game. The results show that the Nash equilibrium under exogenous information structure can be transformed into the endogenous information acquisition. This is important for analyzing the application of stable equilibrium under different information structures.

Immediately after, scholars have not only improved the model based on reality, but also have examples of applications. Spiegel [11] proposed a framework for analyzing the decision-making process with incomplete understanding of correlation structure and causality. It evaluates and distorts

probability distributions through subjective causal modeling and Bayesian network publicizations. The study also shows examples of applications of the framework in different domains.

To summarize, in terms of application, most scholars have studied the strategy of signaling game from the perspective of firms and individuals, and how to achieve the optimality for firms and individuals.

2.2. Keep

2.2.1. Business Model

In recent years, a group of scholars began to study the strategy development for consumers in the Keep platform with consumers as the main focus. Zhang et.al. [12] conducted research from the perspective of consumer scenario construction and investigated the brand building strategy of sports apps using Keep as a case study. Through data collection from various publishing platforms, they identified the importance of leveraging advantages, increasing online and offline user contact points, and reconfiguring consumer connections to promote healthy behaviors among users.

Subsequently, expanding the focus of consumers to the whole business operation system, some scholars made research on business model of Keep in detail. Xing [13] conducted a comprehensive study on Keep, focusing on market environment and development stage. Their findings led to the proposal of content strategy and technology strategy, offering valuable insights for the development of other sports and fitness applications.

Further, with the development of technology, some scholars have shifted to the issue of business transformation trends. Shang [14] focused on summarizing the industry penetration and user scale of fitness applications and classified them into different types based on their functions. They also explored the four new trends in fitness app service development in the big data environment, conducting an empirical analysis of Keep's exercise platform.

Finally, based on the development trend, some scholars put forward the dilemma for the development of this type of business model, giving certain opinions. Song [15] took Keep App as a research object and explored its marketing strategy problems, including homogenization of functions and system loopholes. Optimization suggestions of marketing strategies based on STP marketing theory and new 4P marketing management theory are proposed.

Overall, these studies shed light on various aspects of Keep and offer valuable insights for the broader field of sports and fitness app development and marketing strategies. Most of them used marketing and management analysis tools to make a research on future development of fitness applications.

2.2.2. Factors to Influence Customers' Behaviors

Recently, some scholars have shifted from the business model to the study of consumer behavior, and analyzed the impact of media on consumer behavior with respect to consumer satisfaction. Wang [16] utilized the satisfaction theory to analyze Keep users' media contact behavior, motivation, and satisfaction degree with different features in order to derive the communication effect of Keep. The intensity and satisfaction of different use motivation dimensions of Keep users were further statistically analyzed. The role attributes of users were clarified, and suggestions for improvement were made. He & Liang [17], based on market research, concluded that the number of users of exercise and fitness software is growing rapidly, especially during the epidemic, and the "cloud fitness" industry is booming. Taking Keep software as an example, the relationship between user experience value and behavioral intention was investigated, and suggestions and strategies were provided to optimize the software's functions and services.

Subsequently, some scholars have shifted their attention to the symbolic effects of groups to explore the influence of the outside world on consumer behavior. He & Mou [18] studied the interactive behaviors of Keep user communities by observing mobile fitness apps and explored the reasons and mechanisms for their development. Based on Collins' chain theory of interaction rituals, the results of the study showed that users join the group to open interaction rituals and realize interaction through symbol exchange and common actions. Fang [19] chooses Keep as a case study to reveal the ways in which online fitness platforms achieve capital accumulation by commoditizing user information and social behavior, by examining the logic of endogeneity of user participation in digital labor.

Collectively, these studies provide valuable insights into different aspects of, ranging from user behavior and satisfaction to community interactions to study economics of online fitness platforms.

2.3. Research Gap

For the consensus in the above literature, signaling games provide insights on how to address information asymmetry and reach equilibrium points in different contexts. And, there is a general consensus among scholars that it is important to study the applications of signaling games, especially in business and individual decision making. For studying different aspects of the Keep platform, scholars see a focus on business models and consumer behavior. They emphasize playing to strengths, increasing user touchpoints, promoting healthy behaviors, and addressing homogenization.

While there is a consensus on the importance of studying signaling games and their various aspects, scholars may debate specific assumptions in the model or the exact methodology for deriving equilibria. These debates may involve discussions about the validity and applicability of assumptions, the choice of equilibrium concepts, or the interpretation of empirical evidence. And, in terms of application, there may be debates among scholars about the specific assumptions in the model or the particular strategies identified as optimal. This controversy may revolve around the relevance and effectiveness of the proposed strategies and equilibrium solutions. In research on the Keep platform, there may be debate among scholars about specific strategies. For different strategies focus on the effectiveness of advantages and optimal content strategies, there may also be controversy regarding the classification of fitness applications, identified trends in the development of fitness app services, and recommendations for optimizing marketing strategies. Controversy may center around Keep improvement recommendations and the formation and development of user communities.

Models and applications on signaling games are often based on specific points in time and contexts, and may not be able to adapt to changes in different stages of development and market environments. Moreover, some of the literature is somewhat dated, and the effectiveness of current information technology delivery can have an impact on the signaling game. Although research on user behavior and satisfaction has been accumulated, the exploration of more in-depth theoretical issues related to fitness applications is still limited. Current research only focuses on the influence of media direction on unilateral consumer behavior, without mentioning the interactions between the two parties.

Future research could focus on gaining a deeper understanding of user behavior and needs, how they are affected by signaling, and further studying the behavioral patterns, needs, and motivations of users of fitness apps in relation to their social environments. Future scholars could focus on user group interactions, user sharing and collaborative behaviors, and the role of social factors in user satisfaction and retention of fitness behaviors.

This paper will describe the signaling game between users and social media and how companies can use the game to increase their consumers. This paper will look at consumer behavior and the effects on consumer behavior depending on the type of consumer and the public's reaction to it, which can lead to an influx of more healthy type consumers into the market.

3. Model

Our model unfolds across two distinct stages: the pre-change period and post-change period. Building on previous literature, we utilize signaling effects and signaling game theory to capture the post-change period I mechanism.

In the pre-change period, the absence of both signaling and network effects prevails. Medals remain unable to transmit ownership information, and users' utility remains uncoupled from user quantity.

The post-change period introduces a nuanced signaling game involving KEEP users and the broader public. The users emerge as the senders, while the public takes on the role of receivers. Nature divides users into two discernible categories: the Sportive type (S) and the Lazy type (L). Each type is keenly aware of their inherent predisposition toward either industriousness or lethargy, referred to as 'b.' Based on their self-awareness, users make a pivotal decision between two actions: donning a Medal or opting for No Medal. Choosing the Medal entails an investment of effort 'e,' while the No Medal choice signifies inaction. Notably, for our modeling purposes, 'e' is typically set at 0. The public, in this context, remains privy only to the Medal outcome 'm,' unaware of the underlying type. Simultaneously, the public has the choice to either provide enhanced treatment 't' or remain inactive ('t = 0'). Importantly, the quality of the medal, denoted as 'm,' corresponds to the magnitude of exerted effort 'e.'

Our model assumes an identical utility function for each user, characterized by a fundamental base utility level 'U₀,' augmented by a sensitivity factor 'β' (where 'β' ∈ (0, 1]). This 'β' represents users' responsiveness to social treatment, with those more sensitive to social dynamics experiencing a proportionately amplified impact on their utility. Additionally, we posit the potential for users' marginal utility to shift in tandem with social treatment. This intricate relationship hinges upon the parameter 'γ,' a pivotal determinant that shapes the connection between treatment and utility. Specifically, when 'γ' exceeds unity, a concave utility curve emerges, illustrating diminishing marginal utility. In practical terms, as the public's treatment escalates, the incremental enhancement in utility gradually diminishes.

The underlying cost 'C' associated with each medal intertwines with users' inherent laziness level 'b' and their invested effort 'e.' It's noteworthy that our model emphasizes that, for medals of identical quality, the Lazy type incurs a higher marginal cost compared to the Sportive type. Accordingly, user payoff stands as the difference between their utility and the cost expended in obtaining a medal.

The public's payoff 'α' pivots on users' classification. When the public chooses to provide superior treatment to the Sportive users, a more favorable payoff ensues compared to a stance of inaction. Conversely, when the public remains inactive with respect to the Lazy type, a more favorable payoff results compared to providing them with elevated treatment.

4. Analysis

We first present users' utility function U(t). Users care about better treatment. Given base utility level, sensitivity to treatment and the shape of utility curve, the utility function is written as:

$$U(t) = U_0 + \beta \times t^\gamma \quad (1)$$

Based on users' laziness level and their effort, the cost function of each medal is given by:

$$C(b_i, e) = \beta_1 \cdot b_i + \beta_2 \cdot e + \beta_3 \cdot b_i \cdot e \quad (2)$$

b_i is the laziness level for user i . β with footnotes 1,2 and 3 represent the effect of factors on the cost, which are all positive. The influence of effort on cost is regulated by laziness level.

The payoffs for users are established by:

$$U_0 + \beta \times t^\gamma - \beta_1 \cdot b_i - \beta_2 \cdot e - \beta_3 \cdot b_i \cdot e \quad (3)$$

i.e.

$$U(t) - C(b_i, e) \quad (4)$$

The payoff for public is a constant, we assume that the public payoff can either be $\alpha(\alpha>0)$ or 0. If user plays No Medal and Medal' (denoted as NM'), then public plays Nothing' and Better Treatment (denoted as N'B). The sportive type would deviate to Medal because Sportive type find it better to gain a medal. So, there is no equilibrium here. If user plays Medal and No Medal' (denoted as MN'), then public plays Better treatment' and Nothing (denoted as B'N). The sportive type would not deviate to N, because Sportive type find it better to gain a medal.

KEEP's goal is ensuring the medal is a signal of sportive type, so the sportive type is constrained from deviating to choosing No Medal, i.e.:

$$U_0 + \beta t^\gamma - C(b_s, e) > U_0 \quad (5)$$

By reconstructing the function, we obtain a constraint:

$$t > \sqrt[\gamma]{\frac{C(b_s, e)}{\beta}} \quad (6)$$

For lazy type, KEEP assure they choosing No Medal:

$$U_0 + \beta t^\gamma - C(b_s, e) < U_0 \quad (7)$$

The constraint is:

$$t < \sqrt[\gamma]{\frac{C(b_L, e)}{\beta}} \quad (8)$$

Figure1 diagrams the game.

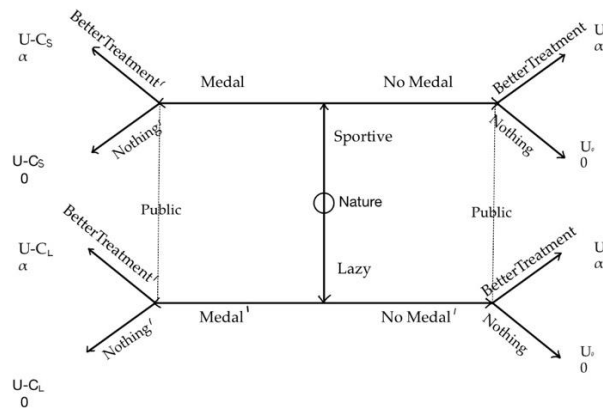


Figure 1: Users-Public signaling game.

5. Conclusion

This paper establishes a theoretical model to explore the operational mechanism that attracts more users after the conditions for Keep medal acquisition become more favorable. It utilizes the signaling game as a base model, divides users into two categories, and observes the public's feedback on users. Finally, it is concluded that the healthy type of users tends to participate in medal acquisition to show their personal signals. On the contrary, lazy people tend not to participate in medal acquisition. Therefore, the company utilizes this mechanism to attract healthy people into the market to gain more customers.

The findings of this paper can be directly applied to real-world problems and provide strategic guidance to companies. When a company utilizes consumer psychology and sends signals to play the game, it can attract higher quality users and thus achieve the effect of growing users. In addition, the research results of this paper can be applied not only to company operations, but also to research in other fields, such as education.

Based on the job signaling game, this paper deepens the existing theory, combines it with corporate decision-making, and proposes a new direction of theoretical deepening. Through the deepening of the model, it can be better adapted to new problems and situations and provide more accurate explanations and guidance. By describing and analyzing the key mechanisms in corporate decision-making, it provides a basis for further research in the future.

However, the generality and generalization of the paper's conclusions are insufficient. The conclusions of the paper may be applicable only to specific contexts, samples, or situations. It lacks of consideration of broader applications, which limits the generalization and application of the research results. In future research, scholars can be more attuned to realistic logic through the use of multi-layer signaling games or by reducing assumptions.

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