

Configurational Analysis of Factors Influencing Users' Willingness to Pay for Knowledge in Online Q&A Communities from a Rationality and Bias Perspective: Postprint

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Abstract

[Purpose/Significance] Users' knowledge payment behavior is a complex decision-making process synergistically influenced by multiple factors. Investigating the joint effects of factors influencing users' knowledge payment intention under the condition of free knowledge access is of great significance for deepening the understanding of user knowledge payment behavior and promoting the sustainable development of paid Q&A communities.

[Method/Process] Based on status quo bias theory and rational choice theory, latent variables influencing users' knowledge payment intention are constructed. Fuzzy-set qualitative comparative analysis (fsQCA) is employed to analyze the asymmetric multiple concurrent causal relationships among variables and to explore the configurations of knowledge payment intention.

[Results/Conclusion] The study finds that, in the presence of free information access channels, users' knowledge payment intention in paid Q&A communities results from the interaction of multiple factors at both rational and bias levels. Perceived benefit is the most critical factor for high-level knowledge payment intention, while personal free-consumption orientation is an important factor influencing low-level knowledge payment intention. From the perspective of condition combinations, four configurations affecting knowledge payment intention are identified. Targeted strategies to promote user knowledge payment are proposed based on the analysis of these configuration results.

Full Text

Preamble

Research on the Configuration of Factors Influencing Users' Knowledge Payment Willingness in Online Q&A Communities from the Perspective of Rationality and Bias

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Abstract: [Purpose/Significance] Users' knowledge payment behavior is a complex decision-making process influenced by multiple synergistic factors. Exploring the combined effects of factors influencing users' knowledge payment willingness in the context of free knowledge acquisition is crucial for deepening the understanding of user knowledge payment behavior and promoting the sustainable development of paid Q&A communities. [Method/Process] Based on status quo bias theory and rational choice theory, this study constructs latent variables affecting users' knowledge payment willingness and employs fuzzy-set qualitative comparative analysis to examine the asymmetric multiple concurrent causal relationships among variables and explore the configurations of knowledge payment willingness. [Result/Conclusion] The study finds that, in the presence of free information acquisition channels, users' knowledge payment willingness in paid Q&A communities results from multi-factor interactions at both rational and bias levels. Perceived benefit is the most critical factor for high-level knowledge payment willingness, while personal free mentality is an important factor influencing low-level knowledge payment willingness. From the perspective of condition combinations, four configurations affect knowledge payment willingness, and targeted strategies to promote user knowledge payment are proposed based on the analysis of configuration results.

Keywords: knowledge payment; status quo bias theory; rational choice theory; qualitative comparative analysis; influencing factor configuration

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Over the past decade, online Q&A communities designed to facilitate knowledge exchange and accumulation have provided users with a free channel to access high-quality knowledge, gaining widespread acceptance and use among internet users. Mainstream platforms include Quora, Yahoo! Answers, Zhihu, and Baidu Knows. In 2016, the rise of the sharing economy concept drove innovation in the business models and operational mechanisms of online Q&A communities, giving birth to a series of emerging paid knowledge Q&A models derived from traditional free platforms. Paid knowledge Q&A models hold significant value; however, current research has focused more on rational triggers of knowledge payment, with relatively less analysis of knowledge payment willingness factors from a perspective that incorporates both bias and rationality. User knowledge payment behavior is a complex decision-making process

influenced by multiple synergistic factors, and users exhibit bounded rationality phenomena that unify rational factors and rational constraints in their payment decision-making. However, related research has neglected the inherent interactions between the configurations formed by influencing factors and user behavioral outcomes. Qualitative comparative analysis (QCA) adopts a holistic perspective, viewing outcomes as products of systematic interactions among causal conditions that should be explained through differential arrangements and combinations of multiple causal conditions. QCA is suitable for exploring the complexity of antecedent configurations and has become an important tool for addressing the complexity, globality, and causal asymmetry of user behavior in digital environments. Therefore, this study employs fuzzy-set qualitative comparative analysis to explore the mechanisms influencing user knowledge payment willingness in online Q&A communities from rational and bias perspectives. This research aims to address two questions: (1) How do status quo bias factors and rational cognitive factors combine to influence knowledge payment willingness in paid Q&A communities when many free internet resources are available? (2) Which factors and paths can more effectively activate or inhibit users' knowledge payment willingness? Theoretically, this paper constructs a research framework for the configuration of factors influencing user knowledge payment willingness in online Q&A communities from rational and bias perspectives, extending the application of rational choice theory and status quo bias theory in Q&A communities as typical social media and providing new research perspectives for knowledge payment studies. Practically, using QCA to analyze the configuration of factors influencing user knowledge payment willingness can help knowledge payment platforms better understand user behavior and provide targeted management strategies for promoting user knowledge payment in paid Q&A communities.

2 Related Concepts and Literature

2.1 Knowledge Payment and Knowledge Payment Willingness

The concept of knowledge payment originates from content payment and knowledge sharing. As this is a relatively new topic, a unified definition of knowledge payment has not yet been established. Scholars have defined it from multiple perspectives including communication models, economic phenomena, knowledge exchange, and consumer behavior. Zou Bohan et al. [7] point out that knowledge payment is an iterative form of knowledge sharing 3.0, a communication model where individuals provide relevant content services to the online public on a paid basis, relying on open content communities. Zhang Shuai et al. [8] define knowledge payment as an economic phenomenon where the public uses internet platforms to share cognitive surplus such as experience, knowledge, and information to obtain income. Fang Aihua et al. [9] consider knowledge payment as a knowledge exchange behavior characterized by monetary transactions and knowledge monetization. Du Zhitao et al. [10] view online knowledge payment behavior as users' paid acquisition of knowledge in internet environments, in-

cluding paid Q&A, paid subscriptions, knowledge tipping, paid consultations, micro-lectures, and paid knowledge communities. Guo Yu et al. [3] note that knowledge payment describes and judges consumers' transactional activities of using their material wealth to acquire knowledge, rather than monetary expenditure as emphasized in online transaction theory.

Based on relevant research, this paper defines knowledge payment as user behavior involving the paid purchase of online knowledge services and products, encompassing pre-consumption knowledge payment decision-making, mid-consumption knowledge transaction behavior, and post-consumption knowledge internalization. In mobile internet environments, knowledge payment based on mobile terminal platforms exhibits characteristics of vertical segmentation, high operability, diversification, personalization, and specialization on the foundation of content payment. Current research on factors influencing knowledge payment willingness primarily focuses on individual characteristics, product content, and payment contexts. Regarding individual characteristics, consumers' age and gender [11], personality traits [12], income, social media usage, paid experience with other digital products, moral standards, and payment attitudes [2,13] affect payment willingness. Regarding product content, users form final payment intentions based on perceived benefits and value of product content, such as information quality [14], price [2], service quality of knowledge payment platforms [15], reputation and capability of knowledge contributors [16], and users' perceived value of knowledge payment products [9]. Regarding payment contexts, scholars believe that specific contexts where consumers are situated constitute important factors causing differences in knowledge payment willingness, such as other consumers' reviews and word-of-mouth [2], social interaction [17], reciprocity, group norms, and property rights protection [3].

2.2 Paid Online Q&A Communities

Paid online Q&A communities refer to platforms where users engage in knowledge production, interaction, and practice through paid Q&A methods, driven by their own needs and interests [18]. These include vertically segmented platforms like Weiyi and Zhiliaowenda, as well as horizontally integrated platforms like Zhihu Live and Weibo Q&A. Their main characteristics are audio-based Q&A formats and paid knowledge transaction models. The audio Q&A format reduces the sense of distance among community users, making the interaction process more engaging and infectious, while the paid transaction model enables participants' cognitive surplus to realize its value [19]. Paid online Q&A communities operate in two modes: question-payment and onlooker-payment [20]. Question-payment involves questioners paying respondents a certain amount for one-on-one questions, with respondents answering within a limited time. Onlooker-payment involves onlookers paying to view content previously answered by respondents.

Due to the development of mobile communication technology and the rise of the

sharing economy concept, paid online Q&A communities have emerged from traditional free online Q&A communities. These two types of communities provide users with different information interaction scenarios that can meet differentiated information needs, and they differ significantly in platform models, pricing rules, interaction objects, interaction forms, and incentive mechanisms [21]. Zhao Yuxiang et al. [1] identify five different features between paid and traditional free online Q&A communities: business model, answer format, answer attributes, operation mode, and user roles. Some scholars have conducted research based on these differences. For example, Z.Y. Li et al. [22] explored a model of factors influencing consumers' switching intention from free to paid online content, explaining the complementary and substitutive relationships among influencing factors and providing suggestions for online content providers. Qi Yunfei et al. [21] used contingency table analysis and negative binomial regression to analyze the characteristics of user participation behavior in free and paid online Q&A communities, exploring optimization methods to highlight the service features of the two types of communities. Liu Zhouying et al. [23] used propensity score matching to examine the impact of user personal characteristics such as personal certification and excellence awards on respondents' switching behavior from free to paid.

Digital environment user behavior exhibits complexity, globality, and contextualization characteristics, and qualitative comparative analysis provides a new research perspective for exploring user behavior in new research contexts [5]. Knowledge payment behavior is a complex nonlinear process involving multiple interactive and variable influencing factors at different levels, and QCA has advantages in addressing such complexity and globality. Therefore, this study selects the mixed qualitative and quantitative research method QCA to observe the antecedent configurations that trigger or inhibit the outcome variable of "knowledge payment willingness," analyzing the importance and interconnections of antecedent variables at both rational and bias levels, and exploring the combined relationships of factors influencing user knowledge payment willingness in online Q&A communities when many free internet resources are available.

3 Theoretical Foundation and Research Framework

3.1 Rational Choice Theory

Rational choice theory (RCT) posits that individuals evaluate the potential benefits and costs of all alternative options before making decisions, then select the best outcome based on the principles of maximizing benefits and minimizing costs [24]. This theory is widely used in individual behavior research in psychology, economics, political science, and information systems. RCT includes three basic assumptions [25]: (1) People are rational and self-interested; (2) Human decisions are rational; (3) People attempt to obtain optimal decision outcomes through cost-benefit analysis. RCT explains individual decision-making behavior when facing different choices from both negative and positive influencing

factors. In knowledge payment behavior, users' cognitive processes of judging knowledge value satisfaction and price rationality can be viewed as cost-benefit calculation processes for payment decisions [26], and knowledge payment willingness is the psychological outcome after consumers weigh the positive and negative aspects of knowledge products or services [27]. Perceived benefits and perceived costs correspond to the positive and negative aspects considered by users in purchase decisions. Therefore, this paper identifies antecedent variables at the rational level based on rational choice theory analysis.

Perceived benefits refer to consumers' expected personal gains from using knowledge payment products or services, while perceived costs refer to consumers' expected all costs from using knowledge payment products or services. According to rational choice theory [25], individual behavioral decisions result from comparing and weighing potential costs and benefits. Fang Aihua et al. [9] found that perceived gains significantly positively influence user knowledge payment willingness, while perceived losses significantly negatively influence it. Li Wu et al. [27] showed that both perceived benefits and perceived sacrifices can effectively explain and predict users' perceived value of online paid Q&A platforms. Z.Y. Li et al. [22] noted that perceived sacrifice and perceived benefits significantly influence consumers' switching intention from free to paid online content. Specifically regarding paid Q&A platforms, perceived benefits include content benefits that questioners obtain by using paid Q&A to meet information needs, as well as potential dividends from subsequent onlooker payments and resulting economic benefits. Perceived costs generally include transaction monetary costs and non-monetary costs such as time and effort.

3.2 Status Quo Bias Theory

Status quo bias theory (SQBT) describes a behavioral tendency where individual decision-making deviates from rational decision models, leading individuals to prefer choices already made or options that maintain the status quo [28]. When individuals make decisions about new behaviors, SQBT provides a useful theoretical perspective for explaining the influence of previous states. In recent years, this theory has been widely applied in information systems and IT adoption, public policy formulation, and consumer purchase decision analysis. W. Samuelson et al. [28] argue that status quo bias influencing factors can be explained from three dimensions: rational decision-making, psychological commitment, and cognitive misperception. First, status quo bias is a rational decision made after individuals recognize switching costs and uncertainty costs, with both types of costs affecting individual cost-benefit evaluations. Second, maintaining the status quo is caused by psychological commitment from sunk cost effects and regret avoidance, where the more costs individuals invest in existing situations, the more likely they are to continue current commitments. Finally, status quo bias is caused by cognitive misperceptions such as loss aversion, where individuals assign more weight to losses than to equivalent gains in decision-making, and this individual specificity at the cognitive misperception

level is an important factor causing status quo bias.

The bias-level influencing factors in this research framework all derive from these three dimensions, with some variables eliminated based on research object characteristics, resulting in final bias-level antecedent variables. Specifically, rational decision-making dimension influencing factors include switching costs and uncertainty costs. Related scholars have used variables such as fear [29] and privacy [24] to represent uncertainty costs. However, this paper categorizes users' perception of uncertainty-related negative factors in online transactions under perceived costs, thus eliminating variables like fear and privacy at the bias level and only selecting switching costs as the antecedent variable for the rational decision-making dimension. Psychological commitment dimension influencing factors include sunk costs and habit variables. In the cognitive misperception dimension, this paper selects personal free mentality as the antecedent variable based on research object characteristics. Paid Q&A is a new form of information acquisition, and switching costs from free to paid, psychological investment in original free information acquisition channels, and cognitive misperceptions about new-generation paid Q&A communities can cause status quo bias toward paid Q&A [30], thereby influencing users' decisions on whether to adopt paid Q&A. In summary, this paper selects switching costs, sunk costs, personal free mentality, and information acquisition habits as bias-level antecedent variables based on status quo bias theory.

3.2.1 Switching Costs Switching costs refer to costs incurred when consumers change the status quo due to using knowledge payment products or services. From the user perspective, users face not only the transition from free to paid but also the shift to new knowledge payment platforms, such as learning unique operational models and payment rules of knowledge payment platforms. X.F. Zhang et al. [24] found that switching costs significantly positively influence perceived costs, thereby affecting users' intention to use online medical services. R. Potter et al. [31] verified that switching costs significantly negatively influence service switching intention among web browser users. Lu Heng et al. [30] confirmed that switching costs significantly influence user knowledge payment willingness, with perceived costs mediating this relationship. Specifically regarding paid Q&A platforms, switching costs may negatively influence knowledge payment willingness, including both temporary costs for consumers to learn how to use knowledge payment products or services and potential permanent costs such as privacy leakage and monetary loss.

3.2.2 Sunk Costs Sunk costs refer to time or effort invested by individuals in free knowledge acquisition strategies or tools. According to status quo bias theory [28], sunk costs are resources invested in previous decisions and belong to the psychological commitment dimension. When making decisions about current or future matters, people typically consider historical costs and unrecoverable costs incurred in the past, thus previous investments motivate people to continue current decisions. Lu Heng et al. [30] found that sunk costs

significantly influence user knowledge payment willingness, with perceived benefits mediating this relationship. X.F. Zhang et al. [24] showed that sunk costs are negatively correlated with perceived benefits in users' online medical service usage intention studies. For free online Q&A communities, internal motivations such as altruism, sense of belonging, and social satisfaction, and external motivations such as reputation, reciprocity, and platform rewards drive user participation [21], with users investing time, effort, and other potential opportunity costs in community interaction activities, thus generating sunk cost effects.

3.2.3 Personal Free Mentality Personal free mentality refers to the degree to which users are unwilling to pay for valuable content or services. Individual specificity at the cognitive misperception level in status quo bias theory can also cause status quo bias [28], where individual specificity amplifies perceived losses when facing changes, leading to status quo bias. Since its inception, the internet industry seems closely connected with “free,” producing various free products and services such as antivirus software, news websites, and Baidu Search. This has created a lagging consumption concept among the public, and coupled with the virtual and replicable nature of online products and resources, makes payment models difficult to implement. Li Wu et al. [20] showed that free mentality significantly moderates the relationship between content quality and user payment willingness—although content quality is considered the most important factor in online knowledge payment, people care more about price factors when making payment decisions. Li Yazheng [32] believes that personal payment consciousness reflects users' willingness to pay for valuable internet digital content or services, with users having higher payment consciousness more easily recognizing the value of paid courses on online education platforms.

3.2.4 Information Acquisition Habits Information acquisition habits refer to individuals' tendency toward original information acquisition methods compared to new channels like knowledge payment. Li Wu et al. [20] found that although knowledge payment behavior has characteristics of fan economy, it is essentially still knowledge-driven information consumption behavior, with “acquiring information and knowledge” being the main reason users are willing to pay. However, acquiring information and knowledge from the internet has become a habit. Status quo bias theory suggests that habits are automatically repeated behaviors due to specific cues that may cause status quo bias [28]. Z.Y. Li et al. [22] found that cognitive habits positively influence cognitive lock-in, which significantly negatively influences users' switching intention from free to paid. Lu Heng et al. [30] found that information acquisition habits significantly influence user knowledge payment willingness. Specifically regarding paid Q&A platforms, users' original information acquisition habits consciously maintain their original information search methods, thereby influencing user knowledge payment willingness.

3.3 Knowledge Payment Willingness

Knowledge payment willingness refers to the likelihood that virtual community users are willing to purchase knowledge payment products or services, i.e., the degree of subjective tendency to purchase knowledge payment products or services. Scholars generally believe that payment willingness is highly correlated with payment behavior. For example, Du Zhitao et al. [10] found that behavioral intention is an important indicator for predicting users' online payment behavior. Xie Xuemei et al. [33] confirmed that payment intention significantly influences consumers' knowledge payment behavior. Zhou Tao et al. [17] directly used knowledge payment willingness as the outcome variable in their model to explore the mechanism of social interaction's effect on knowledge payment behavior.

3.4 Research Framework for the Configuration of Factors Influencing User Knowledge Payment Willingness in Online Q&A Communities from Rational and Bias Perspectives

Although knowledge payment has rapidly emerged, it cannot completely replace free knowledge sharing models, and numerous free knowledge resources and free knowledge acquisition platforms and tools will continue to exist on the internet. The existence of this "free acquisition" situation affects users' knowledge payment willingness. User knowledge payment behavior is a complex decision-making behavior influenced by both rational cognitive factors and status quo bias factors, especially under the influence of free knowledge acquisition tools [30]. Previous literature on knowledge payment willingness has focused on the isolated effects of single influencing factors, neglecting the combined effects of all factors. Although moderation mechanisms can analyze the joint effects of two or three variables, they cannot cover the overall effect of all factors.

This paper focuses on the combined effects of antecedent variables of knowledge payment willingness, attempting to answer the research question of "rationality or bias" regarding user knowledge payment willingness in online Q&A communities under the influence of free knowledge acquisition. Drawing on rational choice theory and status quo bias theory, problem cognition is categorized into rational and bias condition variables. At the rational level, perceived benefits and perceived costs are selected as antecedent variables; at the bias level, switching costs, sunk costs, personal free mentality, and information acquisition habits are selected as antecedent variables. User knowledge payment willingness is treated as the outcome variable, and the generation mechanism of knowledge payment willingness outcomes is explained through the synergistic 联动 of these factors. Based on this, this paper constructs a research framework for the configuration of factors influencing user knowledge payment willingness in online Q&A communities from rational and bias perspectives, shown in Figure 1 [Figure 1: see original paper].

4 Research Design

4.1 Research Method and Steps

Qualitative comparative analysis is a research method based on Boolean algebra and set theory, aiming to study the complex causal relationships between combinations of multiple cause variables and outcomes. Configuration is an important concept in QCA, referring to the logical combination of a set of causal conditions [34]. QCA adopts a holistic and systematic analytical approach, focusing on revealing the “chemical effects” among variables rather than independent effects. It emphasizes that the impact of antecedent variables on outcome variables is not independent; their effects depend on conditional combinations with other antecedent variables, featuring multiple concurrent causality, equifinality, and asymmetry [35]. QCA values the organizational attributes of independent variables—their interdependent and interactive relationships—assuming that causal relationships of social phenomena are complex, diverse, and nonlinear. Equifinality among configurations means multiple paths may lead to the same outcome simultaneously. Asymmetry means the condition configurations leading to high and low levels of outcome variables are different. QCA combines the advantages of qualitative and quantitative methods, and its advantages in analyzing complex configuration problems have attracted scholars’ attention, making it an important tool for addressing multiple concurrent causality in management, sociology, economics, political science, and other disciplines [36]. Especially in library and information science, this method has been applied to user information behavior [37], government open data [38], and network public opinion heat [39].

QCA can be subdivided into fsQCA (fuzzy-set qualitative comparative analysis), csQCA (crisp-set qualitative comparative analysis), and mvQCA (multi-value qualitative comparative analysis) based on variable types. csQCA can only handle binary variables, mvQCA can handle multi-categorical variables, while fsQCA can address both categorical issues and degree changes and partial membership problems. fsQCA converts fuzzy-set data into truth tables, retaining the advantages of truth tables in handling qualitative data, limited diversity, and simplified configurations, giving fsQCA dual attributes of qualitative and quantitative analysis [40]. Therefore, this paper selects the fsQCA method and uses fsQCA 3.0 software for analysis. The research steps [40] are: (1) Determine antecedent and outcome variables based on theoretical analysis, including six antecedent variables (perceived cost, perceived benefit, switching cost, sunk cost, information acquisition habit, and personal free mentality) and knowledge payment willingness as the outcome variable. (2) Collect data through questionnaires. (3) Conduct reliability and validity tests on sample data. (4) Set collection membership values to calibrate sample data. (5) Perform necessity testing for single antecedent variables. (6) Select case frequency and consistency thresholds, construct truth tables to identify asymmetric multiple concurrent causal relationships among variables, and represent research results with QCA symbols.

4.2 Data Collection and Reliability and Validity Testing

This study uses the questionnaire survey method to collect data, targeting Zhihu users who are aware of but have not used paid voice Q&A services. At the beginning of the questionnaire, two yes/no questions were set: “Are you aware of knowledge payment products in voice Q&A communities? (such as Fenda and Zhihu)” and “Have you used knowledge payment products in voice Q&A communities? (such as Fenda and Zhihu)”. These questions filter out users who have already used or are unaware of paid voice Q&A services. The measurement items in this study’s scale primarily reference previous research results and are adjusted according to this study’s specific perspective. Item descriptions are clear and unambiguous, with 7 latent variables measured by 3-4 items each. The questionnaire uses a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). The questionnaire includes basic information and variable items. For measurement scale items and sources of latent and dependent variables, please refer to the authors’ previous research [30]. Scale scores are calculated using the mean method.

First, a pilot test was conducted with 28 participants, and some questionnaire items were improved and modified based on pilot results to ensure reliability and scientific validity. The formal survey was launched in March 2018 through the Wenjuanxing platform, inviting participants via social media. A total of 226 questionnaires were collected, with invalid questionnaires eliminated, resulting in 217 valid questionnaires. SmartPLS 2.0 M3 software was used for reliability analysis and validity testing. The Cronbach’s Alpha values for each variable ranged between 0.85 and 0.931, indicating good scale reliability. The average variance extracted (AVE) values for the seven variables ranged between 0.769 and 0.831, all greater than 0.50, indicating good convergent validity. The square root of each latent variable’s AVE value was higher than its correlation coefficient with other latent variables, indicating good discriminant validity.

4.3 Data Calibration

Since the original data are numeric from 5-point Likert scales, fuzzy-set qualitative comparative analysis requires calibrating raw data of antecedent and outcome variables to fuzzy values between 0 and 1. Variable calibration typically requires manually setting three critical values in the set: full non-membership, full membership, and crossover point [40]. There are no fixed standards for setting critical values; they should be determined based on classical theory and sample data characteristics. Since directly selecting 1, 0.5, and 0 as thresholds may provide meaningless results, many studies use percentiles to calibrate Likert scale data [41]. Different studies employ different percentile calibration standards, with full membership and non-membership thresholds commonly determined using the upper and lower quartile method proposed by P.C. Fiss [42], while the crossover point can be the mean, median, etc.

For this study, considering sample data distribution characteristics and referenc-

ing P.C. Fiss's [42] research results, the upper and lower quartiles were adopted as full membership and full non-membership thresholds. Since sample data distribution is unbalanced and the mean may be significantly affected by extreme values, the median was selected as the crossover point. The calibrate function in fsQCA software was used to complete calibration calculations. Variable calibration thresholds are shown in Table 1 .

Table 1 Variable Calibration Thresholds

Variable	Fully Non-membership	Crossover Point	Fully Membership
Perceived Cost	2.5	3.25	4
Perceived Benefit	2.333	3.333	4
Switching Cost	2.333	3.333	4
Sunk Cost	2.333	3.333	4
Information Acquisition Habit	2.333	3.333	4
Personal Free Mentality	2.333	3.333	4
Knowledge Payment Willingness	2.333	3.333	4

5 Analysis and Discussion

5.1 Necessity Analysis

The purpose of necessity analysis is to determine whether individual antecedent variables can alone lead to outcome occurrence. Results are measured by two indicators: consistency and coverage of antecedent variables on outcome variables. Consistency reflects the degree to which a single antecedent condition explains the outcome variable, calculated as shown in Formula (1). Coverage reflects how many cases can explain the necessity of this antecedent variable, calculated as shown in Formula (2). If the consistency in necessity testing is greater than or equal to 0.9, the antecedent condition is a necessary condition for the outcome.

Formula (1): $\text{Consistency}(X_i \ll Y_i) = \Sigma \min(X_i, Y_i) / \Sigma X_i$

Formula (2): $\text{Coverage}(X_i \ll Y_i) = \Sigma \min(X_i, Y_i) / Y_i$

Necessity testing results are shown in Table 2 . The results show that the consistency coefficients for both the presence and absence of antecedent variables are below 0.9, indicating that user knowledge payment behavior in the presence of free Q&A communities is not triggered or inhibited by single factors. Therefore, condition combination analysis is necessary to extract antecedent configurations.

Table 2 Necessity of Single Antecedent Variables

Antecedent Variable	Outcome Variable: Knowledge Payment Willingness	Outcome Variable: ~Knowledge Payment Willingness
	Consistency	Coverage
Perceived Cost	0.564	0.578
~Perceived Cost	0.654	0.543
Perceived Benefit	0.698	0.698
~Perceived Benefit	0.423	0.423
Switching Cost	0.534	0.534
~Switching Cost	0.587	0.587
Sunk Cost	0.567	0.567
~Sunk Cost	0.612	0.612
Information Acquisition Habit	0.589	0.589
~Information Acquisition Habit	0.623	0.623
Personal Free Mentality	0.534	0.534
~Personal Free Mentality	0.678	0.678

5.2 Condition Combination Analysis

Condition combination analysis can measure the impact of different combinations of conditional variables on outcomes. Based on truth table construction, configuration analysis results are obtained and measured by consistency and coverage. By running the “fuzzy truth table algorithm” in fsQCA software, three solutions for outcome variables can be obtained: complex solution, intermediate solution, and parsimonious solution. The complex solution is the result without counterfactual analysis, the intermediate solution is the result with only simple counterfactual analysis, and the parsimonious solution is the result after both simple and difficult counterfactual analyses. Simple counterfactual analysis refers to removing a definitely redundant causal condition from a set of causal conditions, while difficult counterfactual analysis removes a possibly redundant causal condition. Therefore, this paper selects the better intermediate solution

for analysis, combining parsimonious and intermediate solutions to determine whether conditions are core conditions. Analysis results are shown in Tables 3 and 4 . To visually report research results, this paper adopts the symbolic expression method proposed by Ragin and Fiss: “ ” indicates core condition presence, “ ” indicates peripheral condition presence, “ ” indicates core condition absence, “ ” indicates peripheral condition absence, and blank indicates the condition is irrelevant [35].

Tables 3 and 4 show that under the combined effect of rationality and bias, there are three conditional combination paths for high-level knowledge payment willingness: (1) Perceived Benefit • ~Perceived Cost • ~Information Acquisition Habit • ~Sunk Cost; (2) Perceived Benefit • ~Personal Free Mentality • Switching Cost • ~Information Acquisition Habit • ~Sunk Cost; (3) Perceived Benefit • ~Personal Free Mentality • ~Switching Cost • ~Information Acquisition Habit • ~Sunk Cost. There are three paths leading to low-level knowledge payment willingness: (1) ~Perceived Benefit • Perceived Cost • Switching Cost • Information Acquisition Habit • Sunk Cost; (2) ~Perceived Benefit • Personal Free Mentality • Switching Cost • Information Acquisition Habit • Sunk Cost; (3) ~Perceived Benefit • ~Perceived Cost • Personal Free Mentality • ~Switching Cost • ~Information Acquisition Habit • Sunk Cost. The study identifies different paths to user knowledge payment willingness, proving the “different paths to the same goal” characteristic of the configuration perspective. Results show that each configuration’s consistency score for both knowledge payment willingness levels is above the acceptable threshold of 0.75, indicating good reliability of these configurations. Total coverage rates are 0.476 and 0.437 respectively, indicating strong explanatory power of condition combinations for outcomes.

Table 3 Antecedent Configurations for High-Level Knowledge Payment Willingness

Configuration	Perceived Benefit	Perceived Cost	Switching Cost	Sunk Cost	Information Acquisition Habit	Personal Free Mentality	Raw Consistency	Coverage	Unique Coverage
Ha1							0.898	0.419	0.129
Ha2							0.917	0.281	0.115
Hb							0.884	0.309	0.026
Overall Solution Consistency							0.794		

Configuration	Perceived Custom	Perceived Benefit	Switching Cost	Sunk Cost	Information Acquisition Habit	Personal Free Mentality	Raw Consistency	Unique Coverage
Overall Solution Coverage							0.476	

Table 4 Antecedent Configurations for Low-Level Knowledge Payment Willingness

Configuration	Perceived Custom	Perceived Benefit	Switching Cost	Sunk Cost	Information Acquisition Habit	Personal Free Mentality	Raw Consistency	Unique Coverage
La							0.932	0.328
Lb1							0.901	0.286
Lb2							0.851	0.101
Overall Solution Consistency							0.892	
Overall Solution Coverage							0.437	

5.3 Analysis of Antecedent Configurations of Knowledge Payment Willingness

Importing data into fsQCA 3.0 software and conducting fuzzy-set necessity testing, truth table analysis, and standardized analysis yielded antecedent configurations of user knowledge payment willingness in the presence of existing free information acquisition platforms. Configurations reveal multiple equivalent

causal paths to high and low levels of user knowledge payment willingness. Results show that core conditions causing high and low user knowledge payment willingness are not identical, and antecedent configuration combinations are not opposite, reflecting the asymmetry of user knowledge payment willingness.

5.3.1 Antecedent Configurations for High-Level Knowledge Payment Willingness Table 3 shows three paths to high-level knowledge payment willingness: Ha1, Ha2, and Hb, which can be summarized into two configurations: (1) Ha1 and Ha2 emphasizing perceived benefits; (2) Hb with perceived cost absence and switching cost as peripheral conditions.

The Ha configuration uses perceived benefits as a peripheral causal condition and sunk cost absence as a core causal condition, with two paths emerging due to differences in other conditions. Ha1 uses information acquisition habits and perceived costs as auxiliary causal conditions absent, meaning that when users are less affected by the status quo of using free Q&A communities, they perceive higher visible and invisible benefits from knowledge payment products or services without considering costs or being influenced by sunk costs and free information acquisition habits, resulting in higher knowledge payment willingness. Ha2 uses information acquisition habits, switching costs, and personal free mentality as auxiliary causal conditions absent, meaning that when users are less affected by status quo bias from existing free Q&A communities and only consider the high perceived value of paid Q&A communities, their knowledge payment willingness is higher. This conclusion aligns with Li Wu et al. [27], who confirmed that compared to users with strong personal free mentality, perceived value has stronger explanatory power for user payment willingness among users with weak personal free mentality.

The Hb configuration uses sunk cost absence as a core causal condition and switching costs as auxiliary causal conditions, meaning that when users are uncertain about perceived benefits of knowledge payment products, they are still willing to use paid Q&A products if they perceive minimal costs and fees, even with certain switching costs. This reflects users' curiosity and "early adopter" psychology toward knowledge payment platforms in their initial development stage.

From the high-level knowledge payment willingness antecedent configuration results, sunk cost absence is the common core causal condition across all three configurations. When users are less affected by sunk cost effects from free Q&A communities, they are more willing to try paid online Q&A. Perceived benefits are the common core condition in configurations Ha1 and Ha2, reflecting that knowledge payment is essentially a purchase behavior of knowledge products, where content value is the core element of consumers' knowledge payment decisions. This result aligns with utility theory in economics, where consumers typically make payment decisions based on maximizing their utility under limited resources, aiming to obtain maximum benefits at minimum cost.

5.3.2 Antecedent Configurations for Low-Level Knowledge Payment Willingness

Table 4 shows three different paths leading to low-level knowledge payment willingness: La, Lb1, and Lb2, which can be summarized into two configurations: (1) La type with perceived cost and switching cost as core causal conditions; (2) Lb type with personal free mentality as core causal condition and perceived benefit absence as core causal condition, including Lb1 and Lb2.

The La configuration uses perceived costs at the rational level and switching costs at the bias level as core causal conditions, meaning that users accustomed to free Q&A communities with high sunk cost investment perceive that the costs of using paid Q&A products exceed benefits. From both rational choice and status quo maintenance perspectives, users' knowledge payment willingness is low. This indicates that user knowledge payment decisions result from the combined effect of rational and irrational processes, where different status quo bias factors can combine with users' rational perception factors to influence behavior, demonstrating users' bounded rationality in knowledge payment decisions—a deviation from fully rational behavior.

The Lb configuration includes two paths with identical core causal conditions but different auxiliary conditions. Lb1 uses sunk costs, information acquisition habits, and switching costs as auxiliary conditions, meaning that users with strong personal free mentality, influenced by information acquisition habits and sunk cost effects from using free Q&A communities, perceive large switching costs from free to paid Q&A and low perceived benefits from paid Q&A communities, leading to unwillingness to adopt paid Q&A services. Lb2 emphasizes sunk cost effects, meaning that without considering perceived benefits and costs of knowledge payment products or services, users with strong personal free mentality who have invested heavily in free Q&A communities exhibit low knowledge payment willingness. This shows that without considering rational factors, users are easily influenced by status quo bias, choosing to maintain the status quo by using original free Q&A communities, resulting in low knowledge payment willingness.

From the low-level knowledge payment willingness antecedent configuration results, perceived benefit absence is the common condition across all three configurations, indicating that users attach importance to benefits brought by knowledge payment products or services in their decision-making and are unwilling to pay for knowledge when perceived benefits are low. This confirms the customer perceived value theory [43], where customers weigh perceived benefits against costs of obtaining products or services before making purchase decisions. Personal free mentality is a core condition in both Lb1 and Lb2 configurations, reflecting users' cognitive misperceptions about knowledge payment as a major reason why most users are unwilling to pay for internet content. Prospect theory [44] suggests that compared to equivalent gains, individuals are more sensitive to losses in decision-making. The long-standing free content acquisition model on the internet has created a “zero reference price,” where any decision above

the reference price may be perceived as costs exceeding benefits, leading to loss aversion and low knowledge payment willingness.

6 Conclusions and Implications

6.1 Research Conclusions

From Web 1.0 to Web 2.0 eras, many online Q&A communities that pool collective wisdom and knowledge innovation have emerged under user-generated content and collaborative creation models. People are accustomed to using these platforms to share and acquire knowledge for free. New-generation knowledge Q&A platforms have opened up paid transaction models, where user knowledge payment willingness is key to the success of knowledge payment models, and users' attitudes toward knowledge payment behavior are easily influenced by habitual concepts and psychological characteristics of acquiring internet content for free. This study focuses on factors influencing knowledge payment willingness when users already have numerous free internet resources, using voice-paid Q&A services as the research object, combining status quo bias theory and rational choice theory to construct antecedent variables of user knowledge payment willingness, and using fsQCA to analyze asymmetric multiple concurrent causal relationships among variables and identify four logical condition configurations of knowledge payment willingness levels.

The study finds that antecedent configurations for high-level knowledge payment willingness are: (1) When users are not affected by the status quo of using free Q&A communities and perceive high benefits from paid Q&A, they exhibit high knowledge payment willingness; (2) Even when users are affected by switching costs at the status quo bias level, they are more willing to use paid Q&A communities when they perceive that benefits exceed costs. Antecedent configurations for low-level knowledge payment willingness are: (1) Users with habits and sunk cost effects from using free Q&A communities, under the combined influence of rational choice and status quo maintenance, prefer free Q&A communities over paid ones; (2) When users do not conduct benefit-cost analysis of paid Q&A communities at the rational level but are heavily influenced by status quo bias from original free Q&A communities, they find it difficult to generate high-level knowledge payment willingness.

6.2 Practical Implications

Research on factors influencing knowledge payment in online Q&A communities helps understand users' psychological characteristics, comprehensively understand user knowledge payment behavior, and assists knowledge payment platforms in optimizing paid products and services to promote user knowledge payment. Based on this study's results, knowledge payment in online Q&A communities can be promoted through the following approaches:

- (1) **Adopt trial strategies to attract community members to experience knowledge payment.** The study found that when costs and fees

are minimal, users' curiosity and early adopter psychology drive them to try knowledge payment products. Chen Hao et al. [26] found that trial experience strategies play a crucial role in knowledge payment, where trial satisfaction influences consumers' payment willingness through price rationality mediation. Therefore, paid Q&A platform providers can adopt trial strategies from marketing to provide users with opportunities to experience paid Q&A, reducing uncertainty about knowledge payment products and services, thereby enhancing user knowledge payment willingness.

- (2) **Reduce users' learning costs for knowledge payment platforms.** The study found that users with large switching costs from free to paid processes have low knowledge payment willingness. New-generation paid Q&A platforms are derived from free online Q&A platforms, inheriting their characteristics while innovating Q&A formats and transaction models [1]. Therefore, knowledge payment platform developers should fully utilize the feature of paid products being nested in existing online Q&A communities, learn from user interaction designs in existing Q&A communities to optimize payment rules, and reduce users' switching costs for using knowledge payment platforms. Simultaneously, they should improve affordance design in physical, cognitive, emotional, participation, and control aspects of paid platforms to enhance users' immersive experience in new-generation Q&A communities, thereby increasing platform user stickiness and encouraging knowledge payment.
- (3) **Balance product price and content quality.** The study shows that user knowledge payment willingness is influenced by both rational choice and status quo maintenance, with personal free mentality still existing among community members, but users with high perceived benefits are more positive toward knowledge payment. Therefore, knowledge payment product technology developers and service providers must both adhere to "content is king" and implement reasonable pricing. On one hand, they should examine product value and drawbacks to create products that users highly value. On the other hand, they should develop reasonable pricing strategies that avoid discouraging content creators with prices that are too low while also avoiding deterring users with prices that are too high.

6.3 Research Contributions and Limitations

The innovations and significance of this study are: (1) It explains factors influencing user knowledge payment willingness in the context of numerous free internet resources based on status quo bias theory and rational choice theory, expanding the explanatory scope and applicability of these theories and providing new perspectives for knowledge payment willingness research in different contexts. (2) It analyzes the configuration among factors influencing user knowledge payment willingness from a configuration perspective, confirming the applicability of qualitative comparative analysis in knowledge payment behavior research and enriching the theoretical system of knowledge payment research. (3) The

development suggestions based on research results provide helpful guidance for knowledge payment platforms to promote user knowledge payment, thereby positively impacting the sustainable development of knowledge payment in online Q&A communities, with strong application value and practical significance.

This study has certain limitations: First, it only uses online voice-paid Q&A communities as research objects, and whether the results apply to other online knowledge payment communities with different functions and characteristics requires further research to revise and enrich conclusions. Second, it focuses on potential users without knowledge payment experience; future research could supplement data from users with payment experience to compare the knowledge payment decision-making processes of the two groups.

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