New Service's Expectation Positioning by Applying Cumulative Prospect Theory

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Abstract. In the context of service innovation, the question of when to assess a new service by customer and how to achieve personalized assessment are yet to be explored. This is especially true under the situations of uncertainty when it comes to bringing the effectiveness of new service's promotion and decision making, i.e., for service provider to attain service competitiveness and for potential service customer to decide whether to try the new service. Accordingly, an appropriate expectation positioning method proposed in this study aims to collect and analyze psychological information from potential service customer in order to make service promotion decisions capable of achieving service provider's purpose as well as satisfying service customer, utilizing Cumulative Prospect Theory.

Keywords: New service expectation positioning · Cumulative prospect theory · Customer expectation · Behavior economics · Behavior change · Psychological value

1 Introduction

The service business environment nowadays faces challenges as the quantity of new services keeps rising. In Service Profit Chain, if service providers want to let customer satisfy, they should have attractive service designed and delivered to meet targeted customers' needs [1]. There are some critical questions to which service businesses should respond. First, it is to let potential customers or target market know the new service can increase their utility value that they really concern. Second, it is imperative to find a more effective way to assist potential customers who need to decide whether or not to try the new service. From the view of customers, when individuals make decision whether to try a new service after receiving the new service's information, it will trigger a cycle of stages of change addressed in the transtheoretical model [2]. This model proposes changing behavior as a process of five stages. The five stages include pre-contemplation (no desire to change behavior and ignoring problem), contemplation (conscious of problem but not yet to change behavior), preparation (ready and committed to change behavior), action (changing behavior) and maintenance (maintaining the change).

On the way from the second step to the third step of the behavioral change cycle, it is contemplation step to preparation step; by analogy, it is customer's new service decision making that takes place during the time before they have the willingness to try

a new service and intend to take action in the immediate future. At this period of time, individuals must be aware of the pros of changing but also can identify the cons. The stage with longest time (as possibly long as six months) is the contemplation stage [3, 4]. This study aims to improve the effectiveness of individuals decision evaluation at this stage.

Another factor to inference individuals' decision making and assess the trying of a new service is "unfit expectation" that attributes to they not feeling worth trying the new service. We argue that individuals can have a more appropriate expectation by deducting some bias when considering the potential benefits and the possibly increased utility of using the new service.

In addition, individuals make decisions relying on their psychological activities, system 1 or system 2, i.e., thinking fast or slow [5]. This can also be applied to the situation of making the decision of positioning expectation of using a new service. We apply existing knowledge of psychological activities to design an IT artifact to cope with individual's possible thinking bias, illusion, *etc.* and achieve new service's proper expectation positioning. This study focuses on how to attain an appropriate expectation through individuals' system 2 psychological activities (consideration, analysis and comparison) on judging whether new service could bring in increased utility value.

To this end, our study presents a method of new service expectation positioning that applies Cumulative Prospect Theory (CPT) [6] of which the underlying philosophy is to help individuals make decision toward their maximum utility. CPT computes the utility value of decisions according to personal perception (psychological value and probability weight). According to an individual's perception, it is able to figure out what the individual really concerns and what phenomena would possibly occur. The method can then find a more appropriate expectation, suggest the individual to re-position the expectation, let the individual feel gaining more benefits and be willing to try the new service.

The paper is organized as follows. Section 2 presents the basic concepts of our method. Section 3 describes the method's IT artifact, its component modules and an illustrating scenario. Section 4 provides some preliminary evaluations, followed by the discussion. Finally, the conclusion is provided in Sect. 5.

2   Basic Concepts

In Cumulative Prospect Theory (CPT), an individual has a reference point which is influenced by the individual's expectation, environment and society and so on [7]. It is used synonymously with the term "current reference point" to mean reference point that is generated by the individual's intuition. Taking the current reference point as the balance point, it is able to compute the gain and loss for a decision. But, current reference point usually is not appropriate enough to represent a decision maker's status quo. When individuals face an uncertainty event, fast thinking (system 1) usually leads individuals to jump to a conclusion and affect their decision [8]. There exist thinking bias that makes individuals be not able to properly assess the utility value. The examples include the focusing effect as the tendency to place too much importance on one attribute and the impact bias as the tendency to overestimate the length or the

intensity of the impact of future feeling status, and so on. Because of thinking bias, decision makers usually overestimate or underestimate the expectation of decision outcome.

As depicted in Fig. 1, CPT has two functions (value function and weight function) that are generated from interacting with an individual, and the two functions represent the psychological value and the attitude of probability weight of the individual [6]. The psychological value refers to the subjective value of each attribute for each individual. The attitude of probability weight refers to the subjective cumulative probabilities about how people tend to overweight extreme/unlikely events but underweight average/common events. Therefore, these two functions (value function and weight function) solve the weakness of expected utility theory. In addition, the functions can manifest the personal perception of the individual.
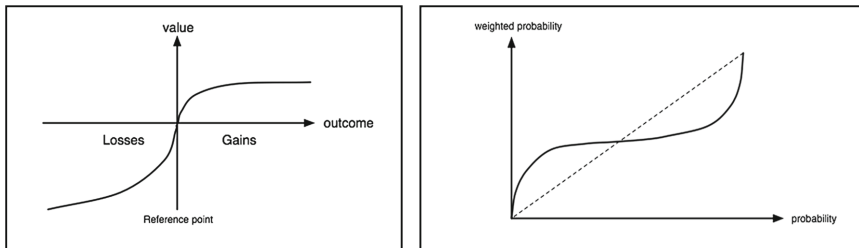

Fig. 1. Value function and weighted cumulative probabilities function in CPT (Source: [6])

Our method aims to pick up the high-weight attributes through a series of steps in order to find out a more proper reference point with system 2. This new reference point is generated based on the decision maker's psychological value, psychological behavior and the other issues the decision maker concerns. We anticipate it can reflect the individual's real situation, and it can help the decision maker position a suitable expectation. Letting decision making under a suitable expectation will bring decision maker more utility value.

On the other hand, there are lots of attributes that should be considered in the moment at which individuals are making decisions upon uncertainty event, such as the amount of monetary, the cost of wasting time, material, self-principles or regulations and the others dependent on the encountered events. Most weight, priority and level of loss aversion are changing and affect individuals' value and behavior over time. Individuals usually care different things, someone care money more than time, or vice versa. Individuals may focus on different aspects (attributes) on the same event, thence they have different levels of loss aversion on different attributes. In addition, the attributes that an individual concerns depend on the event. How to generate the right value function for the right attribute to the right person in order to properly assess the utility value is a critical issue.

This study aims at assisting service providers (businesses) to promote their new service and help service receivers (individual customers) to improve their assessment. It not only helps businesses deliver advantages of their services to potential customers,

but also helps potential customers have an appropriate and fit expectation on the uncertainty event. This study assumes the category of "new service" to be the services classified as major innovation, start-up business and new services for the market presently (ones regarded as radical innovation as addressed in Johnson et al. (2000)'s work [9]).

In short, according to the Transtheoretical (stages of behavior change) Model [2], individuals usually spend a lot of time on assessing whether the pro's utility value being more than that of the con's utility value. Our method intends to make individuals have a more effective changing cycle and make them create more utility value from the changing cycle. After getting the positive consequence from the assessment, individuals would be able to move to the next step of behavior change.

3   Method of New Service Expectation Positioning

The purpose of this study is to provide a method to resolve the problem of unfit expectation of a new service that would lead individuals not to try the new service. This method is designed as an IT artifact that facilitates individuals' decision making of trying new service and assessing the benefit. In other words, individuals could improve their decision making strategy, find the appropriate expectation and avoid information distorted through the use of our method. Figure 2 then shows the method's framework.
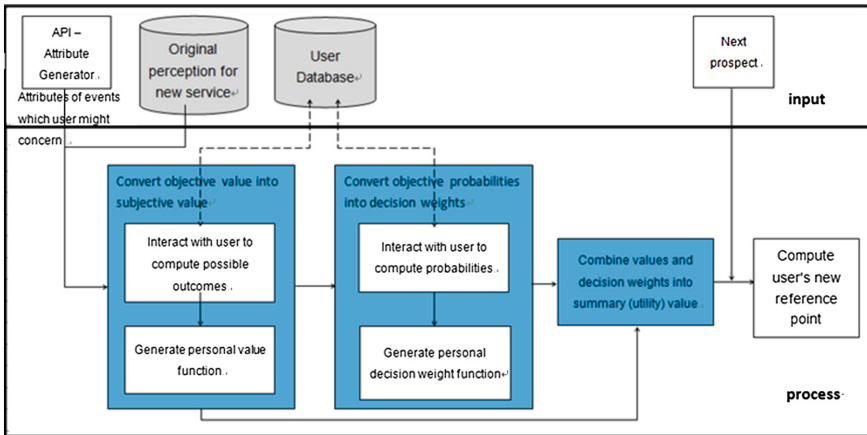

Fig. 2. Framework for the method of new service expectation positioning

An individual action of deciding whether to try a new service is regarded as an event. The method will start from the insight of an event at the API-Attribute Generator in the beginning. The insight of the event refers to the descriptions of the core features of a new service. The method will also attain additional feature information that the individual might concern by mining some on-line resources via the Attribute Generator API. The method also receives next prospect of service provider, in order to

compare with the final utility to guarantee the effectiveness of our method. This study regards each attribute being associated with its value function and decision weight function.

After receiving specific attribute and an individual's original reference point, the method starts to interact with the individual to collect data (original expectation of new service, attitudes of risk aversion) from User Database. The method will convert the objective value into subjective value, and convert objective probabilities into decision weights, and then generate the value function and the decision weight function respectively. Combining the value function and the weight function, the method will then compute the utility value for the new service. After computing the utility value that the individual concerns, a new reference point will be passed down to the individual in order to provide a better expectation positioning of the new service. Finally, it would compare the utility value and the next prospect, in order to guarantee that the utility value corresponds to the next prospect.

3.1 Generate Personal Value Function Module

In order to evaluate the psychological value from user who desires to make decision of trying a new service, this module is for converting objective value into subjective value in order to generate the personal value function. The procedure of this module is as follows:

(1) Receive the information: including attribute information which an individual might concern, original reference point, attitudes of risk aversion, from the original perception of a new service. The definition of receiving information are as follows:

- Attribute information that an individual might concern: the new service has its own attributes related to the core features. Some of these attributes are signification to the individual. The method would focus on these attributes to generate the value function, such as the attribute of success match ratio for an online dating service.
- Original reference point: The expectation of the new service when the individual receives the information of new service at the first time, such as the success match ratio being 75 % of an online dating service.
- Attitudes of risk aversion (λ): The attitude of facing an uncertainty or risky decision such as the individual whose attitude of risk aversion is 0.88.

(2) Interact with the individual: In order to acquire several outcomes of the new service from the individual, apply the original reference point (original expectation of new service) to design customized questions to interact with the individual. The method will automatically generate binary questions according to the individual's original reference point. The method applies the approach of Certainty Equivalent (CE) to elicit possible outcomes [10]. With the chaining CE approach, it can pick probabilities p_i first and elicit the outcomes of certainty equivalent [11]. The midpoint chaining is a special case of the chaining CE approach, when only one probability $p_1 = 0.5$ is used [12]. The following example takes the monetary attribute as an exemplar question.

> Q: You have an opportunity of gaining 100 dollars with 50%. Are you willing to exchange with a gain of 75 dollars for certainty?

If the individual answers "yes", the method will modify $75 to become lower (i.e., $37.5, the medium point within the range which is lower than 75: $0 \sim 75$). It is represented at the left side of Fig. 3. On the contrary, if the individual answers "no", the method will modify $75 to become higher (i.e., $87.5, the medium point within the range which is higher than 75: $75 \sim 100$). It represents at the right side of Fig. 3. After the method progresses five rounds of interactions and gets the sixth outcome, it achieves convergence (e.g., Fig. 4) and stop the interactions, moving to next procedure.
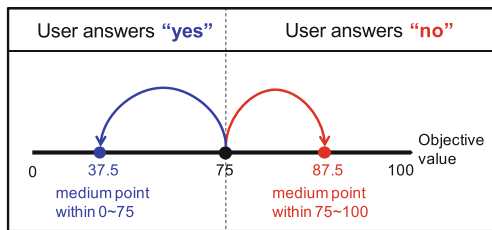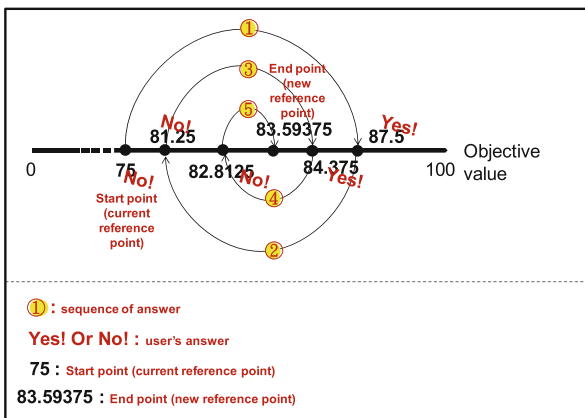

Fig. 3. Rule of interacting.

Fig. 4. Exemplar process diagram of step-by-step operations

(3) Demonstrate the new reference point: With the outcomes of the previous step, the method demonstrates the new reference point, which is generated in the last

round of the previous step. The last outcome undergoes the most operations of system 2, and the method interprets it as the most appropriate new reference point. Regarding the new reference point as the origin, the remaining outcomes are then converted relative to the origin.

(4) Generate the value function: Substitute the variables (including x, λ that are illustrated as the followings) to the value function of Formula (1), and then compute the utility of the new service.

The equation and definition of variables as following.

$$v(x) = \begin{cases} x^\alpha \ if \ x \geq 0 \\ -\lambda(-x)^\beta \ if \ x < 0 \end{cases} \tag{1}$$

v(x): Personal value function of new service for the individual (decision maker) and referring to the psychological value of the outcome x that is a possible outcome of an uncertainty decision.

α **and** β: Power for gains/losses. Both approximately equal to 0.88.

λ: The attitude of facing an uncertainty decision.

(5) Pass down the outcomes: pass down the outcomes to next module (Generate Personal Decision Weight Function Module).

3.2   Generate Personal Decision Weight Function Module

In view of CPT, researches proposed that the weak point of Prospect Theory can be resolved by cumulative functional [13]. It means to cumulate probability, instead of using pure probability to assign weight to outcomes. This module generates the entire cumulative distribution function, instead of each probability separately. The purpose of this module is also converting objective probabilities to decision weights to generate the decision weight function. The procedure of this module is as follows:

(1) **Receive the information:** receive the outcomes value from previous module (Generate Personal Value Function Module).
(2) **Interact with the individual**: assign the probability to each outcome by interacting with the individual. The method applies different levels of probabilities to design the question, in order to recognize the risk attitude of each outcome. Different levels of probabilities will be illustrated and exemplified below.

The method will automatically generate a question according to the standard sequence of outcomes from Generate Personal Value Function Module. Each outcome should be assigned a probability weight; therefore, this module will progress a number of times (the number is equal to the number of outcomes). In every round the method will ask the individual a question and get a response.

> Q: Imagine you own a gamble which either pays $100 or $0. Someone offers you a sure payment of $75 in exchange for this gamble. Would you accept the sure payment if the chance of winning the gamble were ____% (Hershey, 1985)?
>   ☐ 10% ☐ 50% ☐ 90%

Three options are offered to choose by the individual, 10 %, 50 % and 90 %, represent small-probability, indifferent and large-probability, respectively. This is because the existing researches address that individuals have distorted perception about extreme probability (extremely small or extremely large) [14].

(3) **Generate weight function:** substitute the variables (including p, γ, δ, that are illustrated as follows) to the weight function, and then compute the probability weight of the outcome. The method applies the Formula (2) to compute the probability weight of the outcomes including gains and losses (e.g., 75, 87.5, 81.25, 84.375). The output of this module is the probability weights of outcomes.

The equation and definition of variables as following.

$$W^+(p) = \frac{p^\gamma}{\left(p^\gamma + (1-p)^\gamma\right)^{1/\gamma}}, \ W^-(p) = \frac{p^\delta}{\left(p^\delta(1-p)^\delta\right)^{1/\delta}} \tag{2}$$

w(p): Personal decision weight function of a new service for an individual (decision maker) and referring to the decision weight of the probability of outcome *p* of an uncertainty decision.
γ **and** δ: Probability weighting parameter for gains/losses. Typically, the value of γ is 0.61 and δ is 0.69 [6].

3.3 Compute Utility Value Module

Before individuals are willing to try the new service, they usually have "expectation" in their mind. Then, the individuals usually compare their "expectation" with the value of the new service which they really receive. The method applies the CPT to assess the expectation of the new service for an individual. This method can achieve personal psychological value and personal probability weight. Therefore, the method takes the format of CPT to demonstrate the expectation (it is also called utility value) of new service for user. In order to combine the psychological value and probability weight to let individual try the new service, the method computes the expectation (utility value) through Formula (3) of utility value. Based on the core concept to compute the utility value for a decision, the equation assumes for the assessment phase in simplest form and definition of variables are shown below [15].

$$U = \sum_{i=1}^{n} w(p_i)v(x_i). \tag{3}$$

U: Utility value of new service.

i: All of possible outcomes of the new service for an individual.

w(p$_i$): This value is from Generate Personal Decision Weight Function Module and is the Personal decision weight function of new service for the individual (decision maker). refers to the decision weight of the probability of outcome i.

v(x$_i$): This value is from Generate Personal Value Function Module and refers to the Personal value function of new service for the individual (decision maker). $v(x_i)$ is the psychological value of the outcome x_i.

To multiply each outcome value of new service and weight of outcome of new service, it is to summarize all results. The final value is the utility value (expectation) of current attribute for current decision. The method will use this result (expectation) to compare with the Next Prospect and recommend to try or not to try the new service. The aforementioned is using one specific attribute of new service to describe the operation of the method.

Assuming there are more than one attributes of new service which the individual concerns, the method will repeat above process several rounds. The method will get specific utility value (expectation) from different attributes of new service in every round. Thus, the method will use these utility values (expectation) to compute the weighted means. The final weighted means is regarded as the utility value (expectation) of new service in the current decision.

3.4 An Application Scenario

Taking a new service of online dating service i-Part as an example, i-Part was established in 2003, and it is the biggest online dating platform in Taiwan. In the online dating service industry, i-Part was known as a radical innovation service for it proposing a virtual way of making friends with high success match ratio. Although i-Part is already the industry leader, they must think about how to sustain their competitive advantage in light of the other competitors such as iMatchBox and DateMe-Now, and how to make more potential customers change their behavior by having the willingness of trying their service. Our method hopes to help those potential customers to cognize the really expected service and help service provider to deliver the features of new service that the potential customers really concern.

For example, single Johnny receives an advertisement banner of i-Part showing the success match ratio of 70 %. However, Johnny thinks that i-Part should have a success match of 90 % (i.e., current expectation). The method will apply the current mental state (current expectation) to find out his other psychological state (psychological value, probability weigh) through interacting with Johnny. The method will compute the new expectation (assumed as 75 %) and then compare with next prospect (i.e., the expected utility value assumed by i-Part that declares having the 70 % success match ratio).

In above situation, our method hopes to adjust Johnny's expectation via the interactions with his mental system (system 1 and system 2). Our method is to provide him with an appropriate expectation of i-Part with the graph of value function which

can let him understand his real psychological value. This can also make Johnny more understand the maximum benefit of i-Part based on Johnny's true psychological state.

4   Evaluation

In this study, we implemented our method into a service system and used a set of experiments to evaluate whether our method proposed in Sect. 3 can make individuals proceed the behavioral change cycle (i.e., willingness of trying new service) and gain more utility from a new service. In addition, the method intends to help new service providers do service promotion. The underlying assumption is that those potential customers are in their contemplation stage of behavior change. That is, they are aware that their problems and would like to verify if their needs can be achieved and create more utility through using a new service. There are 30 experiment subjects; 11 of them are graduate students and 19 of them are founders of service providers, experimenting with two scenarios of encountering new services (Online Shopping Service and Music Streaming Services). Figure 5 depict the experiment process journey.
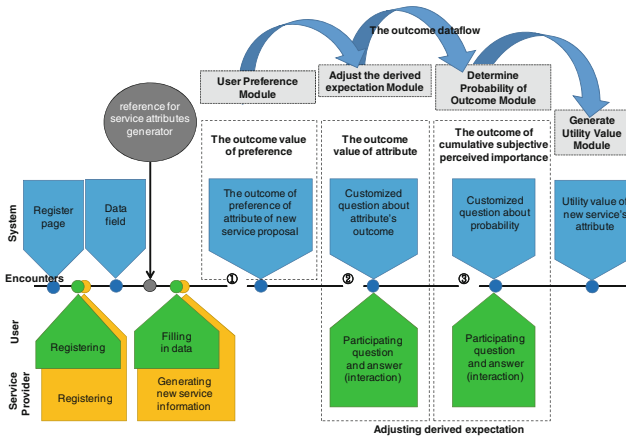

Fig. 5. The subject's journey of the experiment process

The propositions that are to be investigated include:

- **Proposition 1:** Provide a derived expectation of new service (by adjusting individuals' expectation positioning) based on real-time interactions could be used to change individuals' behavior intention.
- **Proposition 2:** People who are in the contemplation step of behavior change cycle can gain more utility through our method than those who are in the pre-contemplation step (i.e., they are yet to be aware of their problems).

Based on Cumulative Prospect Theory, our method adjusts an subject's reference point of an attribute of new service with the interacting questions and answers, using

the 30 experiment subjects to do the preliminary test. Subjects can choose if they are to willing to exchange or not based on the options prompted by our system by "Yes" or "No" button and all the interactions will be recorded. The starting value is a subject's current reference point about an attribute of the service. If the subject moves on the next section, the value will be adjusted by the subject's answer. (it will progress 5 times to record 6 outcome values and the value will range in $0 \sim 100$).

After adjusting the subject's expectation, the system will compute the utility value of willingness to try the new service. We observe the results of utility values of each new service's attribute, in order to verify if the utility is increased by the adjusting of our system.

We will describe the evaluation results in following two subsections in details. In Sect. 4.1, we explain the utility value which is computed by our system for each experimental subject. In Sect. 4.2, we focus on the URICA score and experimental subjects' behavior change. In addition, we will interpret the results and give some managerial discussion.

URICA questionnaire [16] is a scorecard to distinguish the stage of behavioral change cycle which an individual is situated in.

4.1 Proposition 1 - Utility Value

When individuals perceive that utility is increased, it will prompt individuals to move to the next step of behavioral change. We analyze the utility of new service's attribute. In order to verify the utility is a certainty increase after interacting with our system. The results show this modification is effective, and there are about 66.67 % subjects will gain more utility and have the willingness to try new service (see the Utility (modified) bar of Fig. 6). That is, we can say that the adjusting by interacting and generating a derived expectation of new service in terms of calculating the utility of new service could be used to change the individuals' behavior intention.
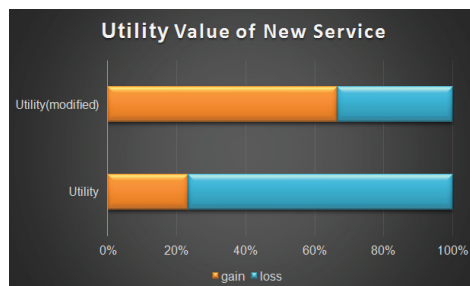

Fig. 6. Proportion of utility value (gain or loss) of new service

In addition, we collected the data about the perception and the confidence of adjusting, and there are five levels. To verify whether the adjusting of derived expectation is perceived (and whether there is confidence about the derived expectation

of attribute provided by the system) after interacting with the system five-round respectively, we asked subjects to choose the level of perceived adjusting. The score 1 and 2 point mean negative consciousness of adjusting (and negative confidence of adjusting), score 3 point means they don't have specific consciousness (and confidence) about adjusting, score 4 and 5 point mean positive consciousness (and confidence) of adjusting. Therefore, we want to justify that the subjects' consciousness is larger than score 3 point, and it means our system can result in positive consciousness of adjusting. On the other words, the score larger than 3 point means our system can successfully adjust subjects' derived expectations with their cognitive perception. We used One-Sample T test with 95 % confidence interval and verified that mean of conscious (and confidence) of adjusting is significant larger than score 3 point.

Meanwhile, individuals' ability to make decisions by mental activity can be categorized into two types. To verify whether these two types (system 1, system 2) would alternately operate to assess decisions, we asked the subjects to assign the proportion of their decision ways after they interact with our system. We found that subjects use both system 1 and system 2 (mental activity) to make decision (answer the customized questions provided by our system). We also found subjects who use system 2 no less than (equal or more than) system 1 would be more effectively to have their expectation adjusted.

4.2   Proposition 2 - URICA Score

The Proposition 2 investigates the effect of the interaction way to progress behavioral change. We calculated the 30 experiment subjects' URICA score, including before and after interacting with our system. We classify subjects' evolution of URICA scores (behavioral change state) into two categories (See Fig. 7), including precontemplation stage and contemplation stage, and then we interpret their reasons as follows. The result of descriptive statistic shows that among the 30 subjects, 11 of them are in precontemplation stage and 19 of them are in contemplation stage.
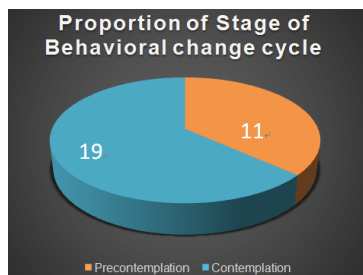

Fig. 7.   Proportion of behavioral change cycle

We break down both of the two categories in order to observe which situated stage of subjects can make URICA score increase. Figure 8 shows the evolution of URICA score of each stage category.
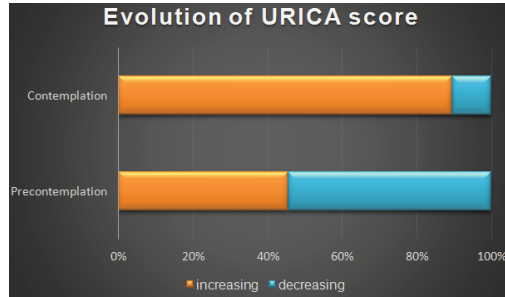

Fig. 8. Evolution of URICA score

The result of descriptive statistic shows that in precontemplation stage there are 11 experimental subjects and there are 5 subjects' URICA score being increased. The proportion of increased URICA score population is about 45.45 %. In contemplation stage, there are 19 experimental subjects and there are 17 experimental subjects' URICA score being increased. The proportion of increased URICA score population is about 89.47 %. Based on the statistic results we found that subjects in contemplation stage interacting with our system is more effective to change their behavior intention than subjects in precontemplation stage.

4.3 Discussion

The purpose of our method is to incite some intrinsic motivation of individuals and let them have the willingness to try a new service (i.e., a behavioral change). After adjusting the derived expectation and receiving the increased utility, the subjects might express that they have willingness to try new service. It brings sufficient intention to stimulate them to do behavioral change. At least from the psychological aspect, they want to do behavioral change and it's a good beginning.

It is a novel way to promote a new service for new service provider. It is very different from existing marketing approaches for this way of utilizing the psychological data to promote the new service. Through figuring out the subjects' preferences and provide proper derived expectations of the new service to make them have the willingness to try new service. In addition, the detailed mental activity (the sequence, proportion and so on) can also bring some aspirations to service provider. This is an occasion to take advantage of the adjusting that can encourage the subjects to think what they really need and concern to stimulate their willingness of trying the new service.

Since our method can help the subjects to adjust their unfit expectation with their mental activities, the analysis data and performance of our system can help new service provider to redesign their new service and marketing plan so as to make individuals

have the willingness to try their new service. Our method can also make most subjects have the consciousness and the confidence on the adjusting and stimulate them to do behavioral change. In addition, subjects who spend more time on surfing internet are easier to use our system and complete the operations and have the willingness to try new service. In the group of spending more time on surfing internet such as the founders and co-workers of service providers much appreciate this research's originality and performance.

5 Conclusion

In this paper, we address the problem how to motivate to progress behavioral change (during contemplation stage and preparation stage) for new service's promotion and decision making in terms of the psychological method of adjusting unfit expectation. By leveraging the mental activity and attitude of loss aversion, the method assembles them within the structure of Cumulative Prospect theory, and construct the utility function to achieve the motivation purpose. Through this method, individuals can be stimulated to have the willingness to try a new service, and providers are able to get some inspiration about adjusting their service and marketing promotion.

However, we also note several limitations in our study besides using a limited number of experiment subjects. First, the limited scope of "new service" of radical innovation are more appropriate to apply our method. This is because individuals usually make progress on the procedure of behavioral change when they assess whether or not to adopt a discontinuous technological change (radical innovations). Second, the numerical presentation of derived expectation could be re-designed to become more intuitive and clear to individuals. In this study, we regard the utility value as the role of a KPI for whether customers being willing to try a new service. The future work can extend the role of such a KPI in a broader context of firm's strategy; for example, when there are several alternative new service candidates to be selected, or when there are differences between segments of customers and some new services may be more adequate to a certain segment than others. In addition, the method could further incorporate additional information (e.g., cultural traditions and other aspects) to characterize customer's behavior.

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