

# Framing Effect in Medical Decision Making

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**Abstract.** In the century that the medical system is becoming more and more mature, there are more options interfering patients' eyes. Framing effect, known to be effective in one's decision-making process, can lead patients to certain options, misunderstandings and subsequent arbitrary decisions may take place. Therefore, in this study, four main factors, or effects, are discussed based on framing effect. People behave preferences according to words they hear. This 'words' include descriptive adjectives attached to one event or object, numerical descriptions like survival probability and whether it is described as an uncertainty or a risk. As a result of loss aversion, a negative description will lead to risk-taking behaviours, while a positive description will lead to risk aversion ones. At the same time, if the given probability level is considerably low, patients will turn to risk aversion and choose conservative treatments, weighing life quality more than quantity. Aside from numeric, people show consistent disbelief upon uncertainty to certain risk no matter the real probability level and will set a subjective probability for uncertain choices. Health state utility can also be another indicator when judging the patients' state because of the prospect theory. In conclusion, people with different health states put different anticipation on medical results. Ages and prior disease experience are the two main factors influencing the patients' own measurement of their health state utilities. The older the patients are, the more utility they will assign to. Those who have historical disease assign more utility than those who do not.

**Keywords:** Framing Effect; Medical Decision Making; Prospect Theory; Health State Utility.

## 1. Introduction

Nowadays, when medical level is continuously increasing, there still exist errors made by men facing a dilemma, for instance, whether to choose a safer conservative treatment with subsequent side effects or an effective operative treatment yet followed by a risk of death. Aside from that, human beings are born irrational. According to the Prospect Theory proposed by Tversky and Kahneman in 1979, people's decision making progress depends on their previous expectations and reference points set by themselves [1]. It is also closely linked to some individual factors such as cultural background and cognitive level, which will impact their ways of thinking therefore construct cognitive frames when making decisions. Thus, the so-called framing effect should make a significant difference in the medical decision making domain. This article aims to comb out all relevant factors amidst framing effect based on the application of prospect theory.

The increasingly popular prospect theory is a cornerstone in behavioral economics domain, which is a descriptive paradigm of decision making model. Kahneman proposed that the process of risk decision is made up of two parts, the reception and edition of information and the evaluation of risks. In the first part, specific presentations in positive or negative ways, namely, frames, together with reference point of the decision maker play an important role, as people show different preferences towards some objectively equivalent options and are prone to become irrational, that people show consistent preference for gains (considered by themselves with regard to reference points) and much more sensitive aversion to losses and assign value differently. There is a hypothetical value function created by Tversky and Kahneman, where the vertical and horizontal lines intersect lies the reference point, usually represents the status quo of the subject or outcomes they have anticipated initially. On the right side, words would be perceived as gains and left as losses. The value function does not presents as linear as Savage expected in 1954, known as subjective expected-utility theory which supposed that there is a normative paradigm for decision making [2]. People are supposed to make the most correct choice to maximize the utility of the choices. Allias and Ellsberg then described

some specific decision situations in which the majority of people violate the expected-utility theory [3,4]. Therefore, the real function actually emerges as an s-shaped curve. The further away from the central reference point, the plainer the slope will be, which means, a smaller psychological value is perceived among those different prospects on the horizontal line. It can be explained as marginal effect or decreasing sensitivity.

## 2. Framing Effect

Tversky and Kahneman's well-known Asian disease framing problem suggested a certain application of variations in framing [5]. In this experiment, respondents were given two programs to choose under a given scenario. They were told that US was going to suffer from a serious outbreak of an unusual Asian disease and 600 people are expected to lose their lives. Two groups of respondents were given alternative programs to deal with the disease in either positive descriptions or negative descriptions.

In Program A and B, subjects should choose either '200 people will live' or 'there is a 1/3 probability that 600 people will be saved and 2/3 probability no one will live.'

In Program C and D, options went like '400 people will die' or 'there is a 1/3 probability that nobody will die and 2/3 probability that 600 will die'

The results proved to be surprisingly 'irrational', that though the two groups are converting the same information, 72% of respondents preferred Program A to B but only 22% chose C to D. It means people have a consistent preference pattern: when exposed to gains (first group) people are risk averse while risk taking when facing losses.

This choice shift was also showed by Annette O'Connor integrating the cancer treatment preferences in the field of medical decision making [6]. Cancer patients were asked to choose between two different treatments, and two factors, probability level and framing were calculated and compared by 'preference score'.

## 3. Level of Probability

As is known to all that medical decision making is mainly about risk evaluation. Therefore, in the typology by Levin, Schneider and Garth, the topic can be classified into the first one [7]. According to them, framing effect has a much richer meaning and can be classified into three types: standard risky choice framing effect, attribute framing effect and goal framing effect. The first one is just mentioned above, which is the seminal concept initially related to monetary activity and measured by probability. The second one points to certain attributes adhered to the events or things, which will cause a subjective prejudice or give preconceived information. The third, however, is related to consequences of certain events by which people post an anticipation on. In this framing effect, positive or negative frames will impact people's consequence setting, and thus choose to take or not to take an action.

Though all three effects may have influence on patients' decision making, standard risk pattern takes the most account, and in the study by O'Connor, the standard effect was discussed and presented [6].

In this experiment, 129 healthy volunteers and 154 cancer patients were given two hypothetical treatments presented in different combination of frames: a positive frame, a negative frame, and a mixed frame. For example, if the survival probability is labeled, then it is a positive frame. If a death probability is labeled, then it belongs to negative frame. If the two probabilities are both labeled (for example, 100/0 or 40/60), then it is a mixed frame. Treatment A, which gave the probability of survival, was mild but had persistent side effects. It means that treatment A was "toxic", suggested by the author. Treatment B, which was negative frame, was non-toxic.

The preference level of cancer patients as well as healthy volunteers are calculated by ‘preference score’, which is a ratio that shows how much people prefer the positive frame over the negative frame. For example, a preference score of 0.9 means treatment A is strongly preferred than treatment B.

Regardless of what the real probability of survival is, the mean preference scores for both healthy volunteers and cancer patients are high, and those of patients are significantly higher compared to healthy volunteers. Differences between groups occurred no matter what level of probability they were given. That is, all subjects would like to hear a positive but “toxic” description than a negative description. To mention, when the real survival probability drops below 50%, the preference for positive treatment gradually decreases. The researcher suggests that at this moment, individual may have adopted a “dying mode” and give up the hope for survival, and they choose the treatment affording better quality, instead of quantity of life.

Another index called ‘deviation score’ was used to represent how much one deviates from the expected baseline survival. In this experimental group, probability level showed a great impact on people’s decision making under the three frames (positive, negative and mixed). When the probability of survival drops below 50%, there is an obvious decrease for subjects to violate and misjudge under the negative frame while the other two frames remain stable (close to the baseline line). When probability of survival lies between 20% to 50%, all three frames demonstrate a strong preference deviation. Degrees of the three from the least to the most are the positive frame, the mixed and the negative one relatively. The deviation score presents the maximum value when probability of survival reaches 10%, while that deviation of negative frame lags far behind the mixed and the positive, which nearly become the same to each other again.

It is easily observed from this research finding that, there exists an intersection of framing effect and probability level for patients. The lower the probability of survival is, the more subjects will deviate from original decisions (when 100% survival baseline). The negative frame does work on people’s attitude towards the situation (more sensitive and more ‘dying’), better than positive presentations. It also has something to do with their prior state of illness. Their values or utilities have shifted in the process of adapting to their illness, causing them to change their reference points upon which to base their judgements.

#### **4. Certainty Effect: Risk or Uncertainty**

Strictly speaking, the scenario given in the experiment above is invariable, where responds are explicitly matched to every probability value. However, there can be times when certainty cannot be ensured during medical decision making process. In addition, people show different preferences between risk and uncertainty (exact results and ambiguous results), which is called a certainty effect.

The famous Ellsberg Paradox explains this certainty effect using a straightforward gamble: there are two bags with respectively 100 balls either red or black, subjects are told there are 50 red balls in bag 2 and unknown quantity of red balls in bag 1 [4]. Subjects were asked to take a ball out of a bag and guess its color. If they guess it correctly, they would acquire 100 dollars. If incorrectly, then they would get nothing. To measure one’s subjective preference sequence, following questions should be answered:

- (1) Will you bet a red or black ball in bag1?
- (2) Will you bet a red or black ball in bag2?
- (3) Will you bet a red ball in bag1 or bag2?
- (4) Will you bet a black ball in bag1 or bag2?

Ellsberg found that people showed no preference between question 1 and 2, but were more apt to bet red in bag 2 and black in bag 2. This definitely violated from the rational person hypothesis because the probability of getting a red ball from bag 2 actually equals getting a black ball from bag 1. In this case, real probability is replaced by a ‘subjective probability’ and it occurs all the way when subjects are exposed to uncertainty.

In another gamble set by Ellsberg exclusively for certainty effect, subjects are asked to choose among these following actions. In a bag with 30 red balls and 60 balls either black or yellow (proportion not given), one should choose:

(1) A bet on red ball: if the ball taken out is red, then you will get \$100. If the ball is black or yellow then get nothing.

(2) A bet on black ball: if the ball taken out is black, then you will get \$100, if it is other colors, then nothing.

(3) A bet on red or yellow ball: if the ball taken out is red or yellow, then you will get \$100. If it is black, then nothing.

(4) A bet on black or yellow ball: if a black or yellow ball is taken out, then you will get \$100. If it is red, then nothing.

Though people are supposed to perform concordant preference between (1) and (2) as well as (3) and (4), people actually prefer (1) to (2) in scenario 1 and (4) to (3) in scenario 2. He concluded that people seem to assign numerical or even certain probability. This is what prospect theory supports later that people are less sensitive to known risks compared with unknown uncertainty.

## 5. Health State Utility Measurement

Taken the prospect theory into concern, Treadwell and Lenert discussed the differences between patients and community members weighing their health state utility [8]. In their experiment, prospect theory showed that patients' post-treatment utilities would be higher and there existed a great discrepancy between pre- and post-treatment utilities measurement. Patients showed more sensitivity to the shift from pre- to post-treatment utilities, and were more perceptive to improvements near the reference point during the shift. However, community members largely underestimated it.

In the analysis measuring factors that can influence the medical decision of the family members of patients (Xu, 2019), other exterior factors are measured [9].

There are four listed factors in this study and can be classified into two types: factors about patients themselves or from outer environment. As for patients themselves, age, state of illness and patients' own ideas are the three main factors. In terms of age, the figures show that the younger the patients are, the more actively they themselves or their family members respond to diagnosis while the older the more conservative their family members perform. This age-related preference is also described in Sackett and Torrance's study in terms of health utility [10]. As mentioned above, attributes labeled to some disease can lead to bias in the process patients perceive how ill they are and how much money and attention they should pay for, which can be simplified into the indicator 'utility'. It determines the final result of a medical diagnosis. As for the third, the patients' own idea, it is very easy to understand and needs no explanation.

In this part, the measurement of utility of health state will be discussed. According to Sackett and Torrance, they launched four questions about utility of different health state perceived by the public:

- (1) Do different ages, sexes or social classes affect people's perception for health state utility?
- (2) Does the duration of a health state affect its utility?
- (3) Do certain labels attached to a health state affect its utility?
- (4) Does patients' already in one of the health states affect its utility?

The answer to the first question is 'Yes, but not much'. Ages and social-economic status do have influence, but are not statistically significant. The variation occurs to all ages consistently. With age, the health state utility of certain disease goes higher and then falls after reaching the top (terminal stage). Elderly people show more preference in assigning utility to hospital confinement while people from high social class place low utility on it. At the same time, family income as another influencing factor shows no correspondence to social class gradients, but the utility measurement is more often correlated to the average family income of their census tract.

While the answers to the other questions are about outside elements: the medical level, culture background etc., the length of time presents dramatic impact on utility. There is a sharp decline of

mean daily health state utility when the length of time of a health state increases, both among general public and patients, thus the duration of time that patients will spend in specific health states must be considered when assessing the utility in a medical decision making.

Finally, as a supplement to the attribute framing effect mentioned above, Sackett and Torrance discussed how disease label affected one's health state utility. It does not appear in a consistent direction. For example, the ominous label 'cancer' gives a post-surgical state a far lower utility than the same state in the word 'injury', while 'tuberculosis' sounds relatively harmless, to be preferred over 'an unnamed contagious disease' according to their results.

Having been in a health state already can be seen as another inner factor about patients themselves' situation. In their sample, utilities of those various treatment state for renal failure are placed higher by home dialysis patients than the general public, which points out that prior state of disease will put an extra frame in utility measurement.

## 6. Conclusion

To be short, framing effect can alter patients' thoughts and preferences and in a medical decision making progress, it will let them perceive incomplete information then make suboptimal choices. Medical workers can refer to the following conclusions collected after researching into the achievements by predecessors in this domain.

(1) Framing effect: attributes attached to certain diseases mainly cause an inaccurate preperception or some prejudice towards the medical treatment. Though options appear to be objectively equivalent, patients will have irrational preferences.

(2) Probability level: People show a preference to trade off living quality for probability of survival and a reluctance to lose their probability of survival when it is below and above 50%, relatively. When the probability level drops in between 20% to 30%, they are more likely to deviate from their rational person hypothesis then enter a 'dying mode' at or below 10% probability of survival.

(3) Uncertainty versus risk: people are more apt to bet something with a certain numeric or a given probability interval, and the smaller the interval is, the more accurate results they will conclude.

(4) Health state utility: Utility can be another indicator, corresponding to objective factors. Ages, mean family income for the patients' tract matter, while sexes and social economic status do not. From an external view, medical level, duration of a health state and prior state of disease also put a frame in the medical decision making process. Medical workers should get to know deeper information of patients and their family members, by which they can decide in what way they consider the problem and what elements bother them, so that they can avoid misunderstanding and arbitrary decision.

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