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Where Does the Attribute Framing Effect Arise If a Pie Chart is Given Along With a Verbal Description?

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Abstract. The framing effect is a phenomenon in which differences in positive or negative verbal expressions change a person's decision. A recent study revealed that people made biased decisions, even when given a supplementary pie chart, thus demonstrating that the attribute framing effect is maintained. However, the stage of the process wherein the attribute framing effect arises remains an open question. In this paper, we conducted two investigations to determine whether differences in verbal expressions affect how people read and create pie charts. In Experiment 1, we investigated whether differences in verbal expressions positively or negatively affect reading a pie chart. In Experiment 2, we investigated whether differences in verbal expressions positively or negatively affect drawing a pie chart. As a result of the two experiments, subjects answered the pie chart values correctly. In other words, it was suggested that the framing effect occurs during the final decision-making step, not during the rate-drawing or rate-reading step.

Keywords: The framing effect, pie charts, reading, drawing.

1 Introduction

The framing effect is a phenomenon in which differences in descriptive expressions affect the evaluation or decision-making of a subject, despite being logically equivalent [1]. This phenomenon is classified into three different types: the risky-choice framing effect, the attribute framing effect, and the goal-framing effect. The attribute framing effect focuses on one of the attributes of an object, with the difference in descriptive expressions [2]. For example, about the identical beef, there are two different descriptions with a positive description such as "75% lean" or a negative description such as "25% fat". These different descriptions affect the evaluation of the beef, with the positive explanations rated higher than the negative ones [3].

Most studies on attribute framing effects focused on the verbal descriptions of objects. More recently, the effects of attributes by non-verbal means, such as graphs and sounds, have been investigated [4]. However, to the best of our knowledge, there are no studies on the effects of drawing or reading pie charts. In this paper, we investigate the attribute framing effect of a pie chart as supplementary non-verbal information in addition to the verbal description of attributes.

2 Related Works

There have been several research attempts that investigated how nonverbal information, such as voice and facial expressions [5, 6] and supplementarily added pie chart [7, 8, 9], influenced the framing effect.

Garelik et al. [5, 6] investigated the effects of emotional information by speech and facial expressions that are supplemented to task sentences in positive and negative descriptions. The results showed that the evaluation of the object changed in a positive or negative direction depending on the change of emotion in the voice and the facial expression. Furthermore, several recent studies have investigated the framing effect with a supplementary presentation of pie charts [7,8,9]. Gamliel and Kreiner showed that the risky-choice framing effect occurs even when the pie chart is supplementary added to the verbal descriptions [9].

However, there is still an open question remaining. The question is whether the difference in verbal description changes the way of reading the pie chart (e.g., more values are read in the positive description) which results in biased decision-making, or does not particularly influence the way of reading the pie chart and only the difference of the verbal description influence the bias of the decision-making. In other words, when different verbal descriptions are given, at which stage does the bias arise: in reading the pie chart or in making the final decision? This point is not yet revealed. Hence, in this study, by conducting two experiments described in Chapters 3 and 4, we attempt to identify at which stage of the decision-making process the attribute framing effect occurs when the pie chart is supplementarily provided to the verbal descriptions.

3 Experiment 1: Effect of Different Descriptions when Reading Values from Pie Charts

In the first experiment, we examined whether the attribute framing effect affects reading values from a pie chart.

3.1 Task and Procedure

In Experiment 1, we employed 38 experimental participants who were graduate students at our institute and their related people (18-39 years old). We showed them a task set that contains a sentence with a pie chart and asked them to read the sentence and pie chart and to answer the rate that the pie chart indicated.

We presented 12 task sets in total that consisted of tasks with positive descriptions, those with negative descriptions, and some dummy tasks for preventing the participants from inferring that this experiment is related to the attribute framing effect. For example, in a positive description task, the given sentence was such as “This pie chart illustrates the result of the effectiveness of a specific medication. The part of the graph filled

in black shows the rate of people whose disease has been made recovery by this medicine. Please estimate and answer the rate.” The black part of the pie chart showed a rate of 70%, but no numerical values were shown in the pie chart (see Fig.1). The participants were required to answer the rate of the pie chart in the range of 0-100%. In the case of the negative description task, a part of the presented sentence, “the rate of people whose disease has been made recovery by this medicine,” was replaced with the sentence, “the rate of people whose disease has not been made recovery by this medicine.”

Additionally, we also investigated cases where the participants had relations with the presented task set. For example, we showed a sentence, “Now you are suffering from a serious disease. You are told that a new medicine has recently been developed to treat it. This pie chart shows the results of a medication administration. The rate of people who benefited from the medication was shown in the black part of the pie chart. Please answer the rates of this pie chart numerically.” Like this, the task description used “you” to make the things his/her own problem. We hypothesized that the participants would answer with higher value in case the participants were related to the presented descriptions than in the cases not related to them.

This pie chart illustrates the result of the effectiveness of a specific medication. The part of the graph filled in black shows the rate of people whose disease has been made recovery by this medicine. Please estimate and answer the rate.

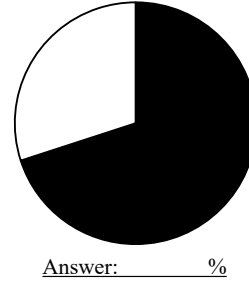


Fig. 1. An example of a task set in Experiment 1

3.2 Results

Table 1 shows the results of Experiment 1 in which the maximum, minimum and average values of the participants' answers are shown. For all conditions in Experiment 1, the average values were almost 70%: the estimated values were accurate. An analysis

Table 1. Results of Experiment 1

Description type	Relationship with the participants	Maximum value	Minimum value	Average	STDV
Positive description	Total	78	60	70.0	2.2
	Related to the participants	75	60	69.7	2.4
	Not related to the participants	78	68	70.4	1.9
Negative description	Total	78	63	70.2	2.2
	Related to the participants	78	65	70.3	2.4
	Not related to the participants	75	63	70.3	1.9

of variance was conducted for two factors i.e., description type and relationship with the participants; the main effect was not significant for either factor. Neither the difference in the description type presented nor the difference in the relationship with the participants affected the reading of the pie chart. Therefore, we can conclude that the attribute framing effect did not occur at the stage of reading the pie chart.

4 Experiment 2: Effects of Different Descriptions when Drawing Pie Charts

In the second experiment, we examined the effect of different descriptions on drawing pie chart proportions.

4.1 Tasks and Procedure

Experiment 2 was conducted with the same 38 participants as Experiment 1. We provided them with a task set that contains a sentence and a blank pie chart and asked them to read the sentence and draw a line in the blank pie chart to express the rate described in the sentence.

We presented 12 task sets in total that consisted of tasks with positive descriptions, those with negative descriptions, and some dummy tasks for preventing the participants from inferring that this experiment is related to the attribute framing effect. Each task set is printed on a paper sheet. For example, in a positive description task, the given sentence was such as “A certain medicine is effective for 70% of people. Please draw a line in the pie chart below to express the rate.” After reading this sentence, the participants drew a straight line in a blank pie chart on the paper sheet by hand (see Fig.2). In the case of the negative description task, a part of the presented sentence, “The medicine is effective” was replaced with the sentence, “The medicine is not effective.”

Additionally, we also investigated cases where the participants had relations with the presented task set. For example, we showed a sentence in the case of a task with a positive description, “You are suffering from a severe disease. You are told that a new medicine has recently been developed. The medication is effective for 70% of people. Please draw this rate on the pie chart below.” Like this, the task description used “you” to make the things his/her own problem. We hypothesized that the participants would answer with higher value in case the participants were related to the presented descriptions than in the cases not related to them in case of the positive descriptions. The value of the rate drawn in the graphs was calculated from the angle between the line drawn by the participants and the line initially drawn at the 0% position.

A certain medicine is effective for 70% of people. Please draw a line in the pie chart below to express the rate.

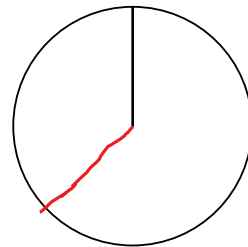


Fig. 2. An example of a task set in Experiment 2 and an answer

Table 2. Response values for pie chart drawing in each descriptive phrase

Description type	Relationship with the participants	Maximum value	Minimum value	Average	STDV
Positive description	Total	91	62	70.3	5.8
	Related to the participants	89.5	64.5	70.2	5.8
	Not related to the participants	91	62	70.3	5.9
Negative description	Total	91	60	70.1	6.2
	Related to the participants	91	61	70.2	6.5
	Not related to the participants	87.5	60	70.2	5.9

4.2 Results

Table 2 shows the results of Experiment 2 in which the maximum, minimum and average values of the participants' answers calculated from the drawn lines are shown. For all conditions in Experiment 2, the average values were almost 70%. This result indicates that the graphs are generally drawn accurately. An analysis of variance was conducted on two factors i.e., description type and relationship with the participants; the main effect was not significant for either factor. Neither the difference in the description type presented nor the difference in the relationship with the participants affected the drawing of the pie chart. Therefore, we can conclude that the attribute framing effect did not occur at the stage of drawing the pie chart.

5 Discussions

This paper investigated the impact of positive and negative descriptions on the reading (Experiment 1) and drawing (Experiment 2) of the pie charts. Those results indicated that neither description significantly impacted the accuracy of reading as well as drawing the pie charts. Additionally, we hypothesized that relating the tasks to the participants themselves may lead to egocentric judgments. However, even in this condition, no significant effects have been found and the hypothesis was not supported. These findings demonstrated that the attribute framing effect does not occur at the stage of estimating the rate in the pie chart; it occurs in the final decision-making step after the accurate estimation of the pie chart.

In a pie chart, even if you are only interested in one part of the information, other information is always presented at the same time. For example, in case of our experiments described in Chapters 3 and 4, the presented pie chart always shows both the positive description (e.g., the medicine is effective for 70% of the people) and the negative description (e.g., the medicine is ineffective for 30% of the people) at the same time. The pie chart shown in Fig. 1 highlighted the 70% area in black and presented it to the participants, while the remaining white area clearly shows the existence of the 30% counterpart. The attribute framing effect is a phenomenon that the evaluation of

the object (the effectiveness of the medicine in this case) is affected when a one-sided description is presented (positive or negative). However, if the rate is presented by using a pie chart, not only the focused part but also the counterparts are presented and probably recognized simultaneously, even if only the focused part is described in the verbal descriptions. Therefore, the attribute framing effect may not occur or is weakened when a pie chart is presented alongside a biased verbal description. This point should be studied in the future.

6 Concluding Remarks

In this paper, to identify at which stage of the decision-making process the attribute framing effect occurs when the pie chart is supplementarily provided to the biased verbal descriptions, we conducted two experiments to examine how people estimate the pie charts alongside a biased verbal description. The results are as follows:

- The attribute framing effect does not occur in the stage of reading the rate from the pie chart (Experiment 1),
- The attribute framing effect does not occur in the stage of drawing the pie chart based on the given rate in the verbal description (Experiment 2), and
- The results of Experiments 1 and 2 suggest that the attribute framing effect occurs in the final decision-making stage after the stage of reading or drawing the pie chart.

The pie charts always show the entire information regardless of whether each part is focused on or not, which may weaken the attribute framing effect. In contrast, there are some types of graphs such as a bar graph that can indicate only the focused part without explicitly showing the other parts. Such graphs may strengthen the attribute framing effect. Further experiments should be conducted on the other types of graphs on attribute framing effects.

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