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The Attribute Framing Effects That Influence Decision Making Are Altered by Gestures

Kaede Takamune [*], Kazushi Nishimoto [*]

Abstract

People make satisfying decisions based on biased choices. The attribute framing effect is a type of cognitive bias in which logically equivalent but different verbal expressions influence decision making. Most studies of the attribute framing effect to date have clarified which verbal expressions cause framing bias in decision making. However, it has not been determined whether the attribute framing effects occur even when a gesture is presented with verbal expressions or only when only verbal expressions are presented. We conducted experiments to investigate how gestural stimuli affect the attribute framing effect. As a result, we found that the attribute framing effect occurs, but is reduced, when a gesture expressing quantitative information is presented with a verbal expression compared to when only a verbal expression is presented. Our findings make a practical contribution to the research on the attribute framing effects by providing insight into the extent to which the attribute framing effects occur when people view nonverbal information alongside verbal expressions.

Keywords: cognitive bias, attribute framing effect, gesture.

1 Introduction

From what to eat for breakfast to what kind of house to live in, we are faced with many decisions every day. To achieve the best results, we should make rational decisions based on all our options. However, we humans have irrational traits called cognitive biases. It is difficult for us to make decisions without being subject to cognitive biases. To address this issue, we need to at least be aware that cognitive biases exist and how they affect our judgments. By being aware of cognitive biases, we can take steps to mitigate them. To support rational decision making, cognitive biases need to be the focus of research. Further research into cognitive biases is needed to support rational decision-making. We have been investigating how cognitive biases influence decision making. At present, we focus on the attribute framing effect, which is a cognitive bias. Specifically, we investigate how the interaction between the attribute framing effect and gestures affects decision-making. The attribute framing effect is a phenomenon in which logically equivalent but different verbal expressions induce different decisions [1,2]. For example, consider the following two verbal expressions that describe identical ground beef [3]: one is a positive phrase, "80% lean ground beef," and the other is a negative phrase, "20% fat ground beef." When people are given the first positive phrase, they rate the ground beef higher than the second negative phrase [3]. Most previous studies of the attribute framing effect have focused only on the verbal expressions of objects.

[*] Japan Advanced Institute of Science and Technology, Ishikawa, Japan

In this paper, we report the results of an investigation into whether and how the attribute framing effect changes when linguistic information is accompanied by gestures. Everyday decision-making in the real world is done by referring to various information in face-to-face communication. For example, when considering whether to buy beef, people seek advice and reactions from friends. In everyday decision-making situations, such as whether to buy beef, text information is rarely the only information conveyed. In fact, most face-to-face communication involves some form of gesture. Hence, it is important to clarify the relationship between gestures and attribute framing effect.

2 Types of Gestures Related to Quantity

In this section, we explain the types of gestures used in the experiment that will be described in section 4. We used three types of gestures: Exaggerated gestures, Accurate gestures, and Standing still as shown in Figure 1. In the experiments, we used real video footage of a human presenter who is the first author of this paper, not avatars or CG animations, to show the gestures. This is because we would like to investigate the effects of the gestures as naturally as possible. However, in the real video of human gestures, the presenter's facial expressions will affect the experimental participants' decision-making. Therefore, to prevent participants from being influenced by the facial expressions of the presenter as much as possible, the presenter's mouth was covered with a mask.

2.1 Exaggerated Gesture

The exaggerated gesture is a movement that emphasizes the degree of a quantity as greater or less than the actual value. There are two kinds of exaggerated gesture. One is the oversized gesture (see Figure 1 (1)). The oversized gesture is a gesture in which both hands are spread as wide as the arms can stretch (about 130 cm), with the intention of emphasizing a large quantity. The other is the undersized gesture (see Figure 1 (2)). The undersized gesture is a gesture in which both hands are spread very narrowly (about 5 cm) with the intention of emphasizing a small amount.

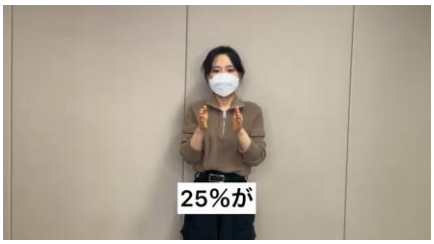
2.2 Accurate Gesture

The accurate gesture is a movement to express an accurate percentage of the amount expressed in the verbal expressions by setting the maximum spread of the gesture presenter's hands (set to 110 cm in this experiment) to 100%. In our experiment, we expressed 75% by spreading the hands to 82.5 cm and 25% by spreading the hands to 27.5 cm. Furthermore, the accurate gesture is divided into two types of movements by the difference in preliminary movement. One is the accurate gesture (0). The ac-curate gesture (0) starts with both palms together in front of the body. Then the hands are spread horizontally to indicate the final value (75% or 25%). The other is the accurate gesture (100). The accurate gesture (100) starts with both hands spread to the 100% position. Then the hands are narrowed horizontally to indicate the final value (75% or 25%).

(1) Exaggerated gesture：oversized gesture

(2) Exaggerated gesture：undersized gesture

(3) Accurate gesture：75%



(4) Accurate gesture：25%

(5) Standing still

Figure 1: Types of non-verbal information related to quantity

2.3 Standing Still

Standing still refers to a state in which a person is simply standing without making any gestures. Both hands and arms are simply hanging down.

3 Hypotheses

In this study, we made the following two hypotheses regarding the verbal expressions that induce the framing effect and the associated gestural expressions.

- H1: All conditions in which the gesture expression is presented together with the verbal expression induce the framing effect.
- H2: The degree to which the attribute framing effects occur depends on the type of gesture. The hypothesized order of magnitude is as follows:
  Exaggerated gesture > Accurate gesture (0) ≒ Accurate gesture (100) > Standing still ≒ Verbal expression only.

Basically, we expect that the additional presentation of gestures would increase the attribute framing effect, and that the more exaggerated the gesture, the stronger the magnitude of the attribute framing effect. However, the standing still case does not show any additional quantitative information. Therefore, this case would not affect the magnitude of the attribute framing effect compared to the verbal expression-only case.

4 Experimental Procedure

Each participant was required to perform tasks on a PC in which he/she watched pairs of videos explaining how much people want to buy a certain pen, and compared and rated which video made him/her feel more like buying the pen. Each video presented in the experiment contained one type of gesture shown in Section 2 and one type of verbal expression as text data (either positive or negative expression), which induces the attribute framing effect (see Figure 2). Each pair of videos consisted of two videos showing logically identical but opposite verbal expressions and gestures. For example, in a given pair, the positive verbal expression in the text is accompanied by the oversized gesture in one video, while the negative verbal expression in the text is accompanied by the undersized gesture in the other video. Each participant was asked to compare and rate each pair of videos on an 11-point Likert scale ranging from "5: I would like to buy the pen in the first video" to "-5: I would like to buy the pen in the second video". The order of the video pairs presented to participants was randomized, as was the order of the positive and negative videos in each pair. A dummy task was also provided. The video in the dummy task required participants to respond with a value of 3 anyway, to ensure that participants were responding after actually watching the videos.

An example of a task is as follows. In this example, a pair of videos consists of the first video with the positive text "75% of people who bought the pen found it easy to use" and the oversized gesture, and the second video with the negative text "25% of people who bought the pen found it difficult to use" and the undersized gesture. After viewing and comparing these two videos, participants answered the question "Which video made you more likely to purchase the pen?" on a -5 to 5 Likert scale.

5 Results

We employed a total of 46 experimental participants who were graduate students at our institute and their related people. The data of 5 participants were excluded due to incomplete responses. Finally, we used data from 41 participants for the analysis (Age: 22-31, Av. of age = 24, STDV of age = 2.29, Male = 32, Female = 9). Figure 3 shows the evaluation results of the participants

EX pair: Videos with oversized/undersized gestures and positive/negative text.

AC-0 pair: Videos with accurate gestures (0) showing 75%/25% and positive/negative text.

AC-100 pair: Videos with accurate gestures (100) with 75%/25% and positive/negative text.

Still pair: Videos with standing still gesture and positive/negative text.

Text pair: Videos with only positive/negative text.

Figure 2: The pairs of videos used in the experiment

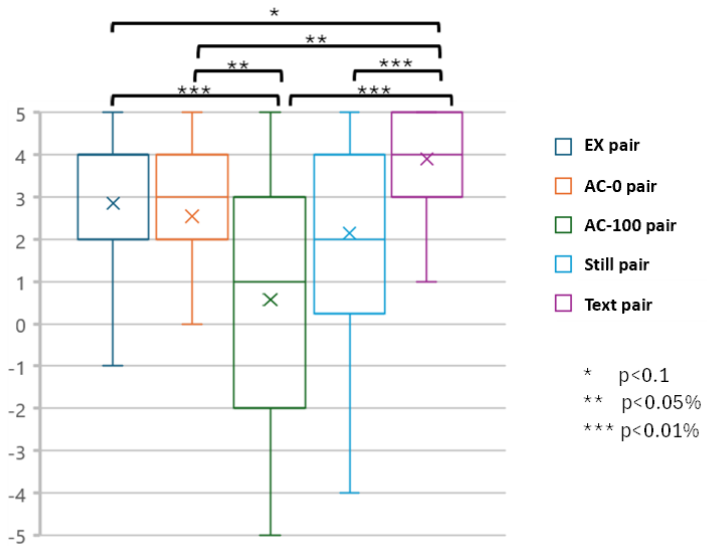


Figure 3: Participants' preference value for each combination of non-verbal information

regarding the preference for the video pairs show in Fig.2. The vertical axis in Fig. 3 shows the + side if a positively represented video was selected for each pair, and the - side if a negatively represented video was selected for each pair. Please note that the participants rated the videos in each pair based on the order in which they were presented, but the results in Fig.3 are not based on the order in which they were presented. We performed a Kruskal-Wallis test to examine whether there were differences in the distribution of these five evaluation results. The results of the Kruskal-Wallis test were significant at the 1% level. Therefore, we next analyzed whether there were differences between each task by performing the Steel-Dwass method, which is one of the multiple comparison tests. The following results were obtained from the Steel-Dwass method.

- The scores of all pairs with gestures (including the standing still case) are lower than those of the text pair.
  - ➢ Significant differences were found at the 1% or 5% level between the text pair and all pairs with the gestures except the EX pair.
  - ➢ Although no significant difference was found between Text pair (Mean = +3.9) and EX pair (Mean = +2.9), there was a significant trend ($p < 0.1$) between them.
- Significant differences were found at 1% or 5% level between AC-100 pair (Mean = +0.6) and EX/AC-0 pairs: AC-100 pair had lower value than EX/AC-0 pairs.
- The distribution tendency of the AC-100 pair is different from the others. Although most of the scores are distributed in the + range for EX, AC-0, Still and Text pairs, they are distributed in the whole range only for AC-100 pair and its average is almost 0, which means that the participants evaluated both videos in AC-100 pairs equally.

6 Discussions

This section discusses whether or not the two hypotheses presented in Section 3 are supported by the experimental results.

6.1 About H1: Whether the Attribute Framing Effect Induces Even When Gesture Expression is Presented Together with the Verbal Expression

Based on the experimental results shown in Fig. 3, H1 was partially supported. The attribute framing effect occurred even when the verbal expressions were accompanied by the gestures in cases of EX, AC-0, and Still pairs. However, in the case of AC-100 pair, the attribute framing effect was cancelled: the experimental participants evaluated both videos in the AC-100 pair equally. To investigate how the participants evaluated the videos in the AC-100 pair, Figure 4 shows the distribution of all the participants' ratings. As shown in Fig.4, although the highest peak is found at +4, the scores are widely distributed from -5 to +5. Thus, only in the case of AC-100 pair, H1 is not supported. The reason for this result is discussed in section 6.2.3.

6.2 About H2: Whether the Magnitude of the Attribute Framing Effect Depends on the Type of Gestures

Based on the experimental results shown in Fig. 3, we can conclude that the magnitude of the attribute framing effect depends on the type of gesture. However, the hypothesized order of magnitude (Exaggerated gesture > Accurate gesture (0) ≒ Accurate gesture (100) > Standing still ≒ Verbal expression only) was quite different.

In particular, for all pairs in which gestures were shown (including Still pair), the rating scores were lower than those of Text pair, which is the completely opposite results of H2. One possible reason why the attribute framing effect is attenuated when the gestures are presented together is that the presence of a person and his/her gestures broadens the interpretation range of the expression. The simple verbal expression presented in the videos of this experiment conveys its meaning directly and does not offer such a wide range of interpretations. However, the presence of the person and the gestures in the video convey not only the quantitative meanings, but also various additional unexpected non-verbal information whose ambiguity allows different interpretations.

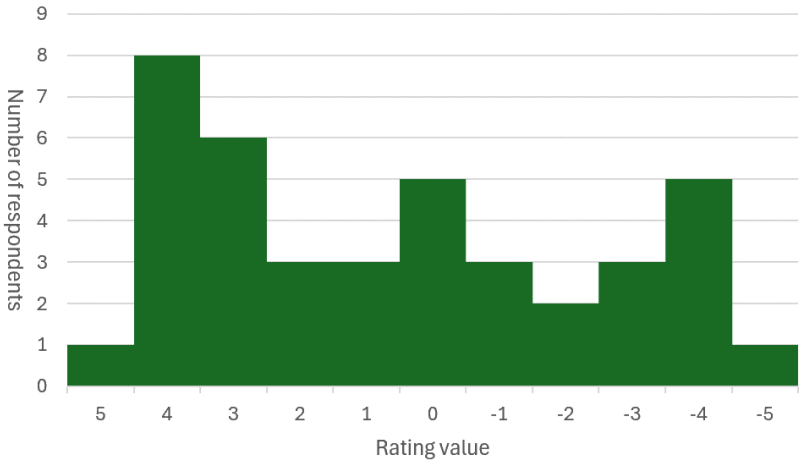


Figure 4: Number of respondents for each rating in AC-100 pair

Therefore, even though one person watching the same video may find reinforcing intention from the gestures, others may find, for example, hesitation in recommending the pen from them. As a result, the average evaluation results would be lower than that of the verbal expression alone. In the following sections, we would like to discuss each pair more in detail.

6.2.1 About the standing still case

As shown in Fig. 3, in case of the standing still case, many of the evaluation results distributed in the positive area. Therefore, we can conclude the attribute framing effect occurred in the standing still case. However, a few of the results distributed in the nega-tive area different from the other results (except for the EX-pair result). This means that the attribute framing effect is weaken by showing a person without motions. We also hypothesized that the attribute framing effect of the standing still case would be the same as the text only case. However, the result of Still-pair (Mean = +2.15) was significantly lower at 1% level than that of Text-pair (Mean = +3.9).

This result suggests that mere presence of a person affects the decision. Moreover, in all pairs in which a person was presented in the video, not only for Still pair, the evaluated results tended to be significantly lower than that in Text pair. The reason why such an effect is given is currently unknown. But one possible reason is that when a person ap-pears, an unconscious cognitive activity occurs that tries to guess the intention of the person, which may make the evaluation results ambiguous. In the standing still case, unclarity of the person's intention is further unclear than those with gestures. Therefore, even if showing "75% positive" in verbal expression, it gives room for doubt as to whether the person really wants to recommend the pen. However, the interpretation of the situation of standing still will vary greatly from person to person. As a result, there is a possibility that the distribution of evaluation values by the participants in the experi-ment was wide as shown in Fig. 3.

6.2.2 About the exaggerated gesture case

We hypothesized that the attribute framing effect would be strongest when using the ex-aggerated gestures. However, experimental results did not support this hypothesis. A sig-nificant trend ($p < 0.1$) was found between EX pair (mean = +2.9) and Text pair (mean = +3.9). Therefore, although the attribute framing effect occurred even for EX pair, the effect tends to be weaker than for the Text pair. In other words, the exaggerated gesture does not reinforce the human cognitive bias.

Inaccurate quantitative information expressed by the exaggerated gestures may cause this result. The oversized gesture represented a percentage that was clearly too large for a 75% representation, while the undersized gesture represented a percentage that was clearly too small for a 25% representation. Both gestures were inaccurate and incon-sistent with the numerical values presented in the text information. Such inaccurate and inconsistent information may suggest the intervention of subjective values of the gesture presenter as well as the unreliability of the presented information, which may have in-fluenced the experimental participants' judgments and cognitive biases (i.e., the attribute framing effect) that should be based solely on purely objective and quantitative infor-mation. However, on the other hand, the clearly shown presenter's subjective values might alleviate the ambiguity derived from the presence of the presenter. This may be the reason that the attribute framing effect in EX-pair was stronger than that of Still-pair.

6.2.3 About the accurate gesture cases

We hypothesized that the magnitudes of the attribute framing effects for both of the accurate gesture (0) and (100) cases are almost the same, and that they are stronger than that of the text only case. However, these hypotheses were not supported by the experi-mental results: the magnitude of the attribute framing effect in AC-0 pair (Mean = +2.55) was significantly lower (at the 5% level) than that of Text pair (Mean = +3.9), and, fur-thermore, the attribute framing effect did not induce in AC-100 pair. The accurate ges-tures show the accurate quantitative information different from the exaggerated gestures. Therefore, the inaccuracy and inconsistency occurred in the exaggerated gesture case did not occur in the accurate gesture cases. Some different factors should cause the results.

Preliminary motions in the accurate gestures may cause these unexpected results. In the accurate gestures, the preliminary motions are shown before showing the target val-ues (75% or 25%). Not only the static information of the target values but also the dy-namic information towards the target values would have cognitive effects and the differ-ence in the dynamic information between the accurate gestures (0) and (100) would in-duce different effects. In case of the accurate gesture (100), the gesture starts with both hands spread to the 100% position and then the hands are narrowed horizontally to indi-cate the target values. In this case, the preliminary motions show supplemental infor-mation about the opposite side. For example, when showing 75%, the gesture starts at 100% position and shows 75% by narrowing the width of the hands 25%. Thus, the pre-liminary motion narrowing the hands shows the supplemental information about the op-posite side, which would affect to reduce the attribute framing effect. In contrast, in case of the accurate gestures (0), the gesture starts with both palms together in front of the body (showing 0%) and then the hands are spread horizontally to indicate the target val-ues (75% or 25%). Therefore, in the accurate gesture (0), the additional information by the preliminary gestures is consistent with the gestures to show the target values as well as the verbal expressions and the preliminary motions do not show the supplemental information about the opposite side.

Like the accurate gesture (100) cases, some kinds of graphical expressions also show the supplemental information about the opposite side. For example, if a pie chart shows “75% is positive”, the rest part of the chart automatically shows “25% is negative.” We have already investigated how the pie chart affects the attribute framing effect and found that the attribute framing effect is reduced by showing the pie charts along with the verbal expressions [6]. Thus, we may be able to newly hypothesize that a type of non-verbal expressions showing supplemental information about the opposite side attenuates the at-tribute framing effect if it accompanies with the verbal expressions.

However, there is a still one problem to conclude that the results of the accurate ges-ture (100) case derive from only the supplemental information hypothesis. In usual ex-periments of the attribute framing effect, only one side information (positive or negative) is presented to the evaluators. However, in our experiments, both side information is presented to the experimental participants. For example, even in the Text pair case, both the positive expression video and the negative expression video are presented. By watch-ing these videos at the same time, the experimental participants can easily understand that “75% positive” means “25% negative” and that both videos show the same infor-mation in different expressions. If so, they should evaluate both videos equally, or at least the attribute framing effect should be weaken much more. However, the results showed

that the attribute framing effect induced after watching the video pairs except for AC-100 pair. There should be another reason in addition to the provision of the supplemental information.

We now hypothesize that the preliminary motions of the accurate gestures would have another cognitive effect. Namely, the preliminary motions may indicate whether the presenter's intention is positive or negative. In case of the accurate gesture (0), the hands start 0% position to the final values by increasing the width between the hands, which indicates the positive intention of the presenter. In contrast, in case of the accurate gesture (100), the hands start 100% position to the final values by decreasing the width, which indicates the negative intention. For example, when showing 75% by the accurate ges-ture (100), it may be negatively interpreted that "ONLY 75% people recommend the pen." On the other hand, when showing 25% by the accurate gesture (100), the originally neg-ative value "25%" may come to be interpreted as "ONLY 25%": the meaning is reversed and comes to be understood positively. Thus, it can be assumed that the experimental participants might evaluate that the presenter wanted to basically recommend the pen in AC-0 pair, while their evaluation becomes unstable about whether the presenter wanted to recommend the pen or not in AC-100 pair.

6.3 Summary of Discussions

Now, we would like to summarize the effect of the gestures to the attribute framing effect.

- Even if gestures showing quantitative information are additionally presented with verbal expressions, the attribute framing effect essentially induces.
- The presence of someone communicating the verbal expressions reduces the attribute framing effect.
- Gestures of the person communicating the verbal expressions also communicate the person's (hidden) intentions (the value senses).
- Preliminary motions of the gestures unintentionally show the person's positive/negative intentions.

Thus, additional gestures by a person who communicates the verbal expression complicatedly affect the attribute framing effect. Our naïve hypotheses that the additional gestures simply reinforce the attribute framing effect were completely not supported.

Such effects of the gestures probably affect differently person by person. Let us investigate this point by exemplifying the results of AC-100 pair, the most complicated case. Please refer to Fig. 4 again. Fig. 4 shows the distribution of the evaluation results for AC-100 pair. The positive video in AC-100 pair, the verbal expression recommends to buy the pen while the gesture (and its preliminary motion) does not recommend to buy it: showing contradict meanings. Three peaks can be found at -4, 0 and +4 in Fig. 4. Therefore, we can say that there are three groups of experimental participants: Group 1) ones who prioritized objective and quantitative information and hence who were affected by the attribute framing effect by the verbal expression (around peak at +4), Group 2) ones who prioritized the presenter's real intentions and hence who were affected by the

gestures communicating the presenter's intentions rather than the attribute framing effect based on the verbal expressions(around peak at -4), and Group 3) ones who did not prioritize either information, or who consider both information equally and hence who were not affected by either factors (around peak at 0).

7 Conclusion and Limitations

In this paper, we investigated whether the attribute framing effect is induced if a verbal expression inducing the attribute framing effect is accompanied by a gesture expressing quantitative information referred to in the verbal expression. In addition, we also investigated how the types of gestures affect the magnitude of the attribute framing effect. We initially hypothesized that additional presentation of the gestures would reinforce the attribute framing effect, and the magnitude of the attribute effect would be stronger than that of the text-only presentation case. However, our hypotheses were overturned. The results of the experiments demonstrated that the attribute framing effect was induced in cases of the exaggerated gesture, the accurate gesture (0), and the standing still. However, the magnitudes of the attribute framing effect in these cases were reduced compared to the text-only case. Furthermore, in case of the accurate gesture (100), the attribute framing effect disappeared. We discussed why such unexpected results were obtained. At present, we have concluded that the ambiguity of the gestures and the gesture presenter's implicit hidden intentions that can be supposed from the presenter's presence and gestures probably affect the decision-making of the experimental participants. However, these influences are different person-by-person, which caused the wide distribution of the evaluation results particularly in the case of the accurate gesture (100). It is necessary to conduct further experiments and investigations to reveal the real effect of the gestures on the attribute framing effect and its reasons.

There is the following limitation in the experimental results. Although the presenter of the gestures in the video wore a mask to hide her mouth, the upper part of the face, such as the eyes and eyebrows, was still visible, which may show some non-verbal information independent from the gestures, and the experimental results could not eliminate this side effect. To purely evaluate the effects of the gestures, we should use the videos where the presenter's face is not in-frame of the video. However, on the other hand, such a video is unnatural. We would like to consider how to show pure gestures without unnaturalness in the future.

This study has brought new insight into the decision-making bias in more actual conversation situations due to the attribute framing effect. This research is expected to be applicable to supporting decision-making through communication that includes the presenter's intentions, such as product advertising. For example, our findings are useful for reinforcing willingness to purchase. Namely, when a salesperson sells a pen, which type of gesture is adequate and inadequate in explaining it like "This pen is rated by 75% of users as easy to use." Thus, based on our findings, adequate gestures may be applicable as a kind of nudge [7] that moves human decision-making in the appropriate direction.

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