

# Cognitive Mapping and Framing Bias on Decision Making

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# Cognitive Mapping and Framing Bias on Decision Making

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## ABSTRACT

The purpose of this study is to test and provide empirical evidence regarding causal cognitive mapping techniques in reducing framing bias in decision making. In this study, the bias that occurs can be measured through the risk preferences of decision makers, namely the tendency to be risk averse or risk seeking. This study used a 2x2 between subjects' experimental design. The results of the research show that both hypotheses are supported. When information is presented in positive framing, the decision maker's risk preference tends to be risk averse, whereas if information is presented in negative framing, the decision maker's risk preference tends to be risk seeking. The study shows that the causal cognitive mapping technique's ability to reduce or reduce bias due to framing (information framing) of available decision alternatives. The implication is that decision makers should think harder in processing the available information. Causal cognitive mapping technique can assist decision makers in connecting various factors that are considered relevant in a problem.

**Keywords:** Causal Cognitive Mapping, Framing, Decisions Making.

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## I. INTRODUCTION

A decision is a determination of several alternatives that can be compared, and the outcomes of each alternative can be evaluated (Eilon, 1969; as cited in Harrison, 1996). In terms of decisions making, these are important factors that determine the success of the organization in the future. The behavior of decision makers will be colored by judgmental and heuristic biases when facing alternative decisions (Maule and Hodgkinson, 2002). Uncertain or uncertain conditions also affect the choice of alternative decisions. This condition can make decision makers often only consider the risks that will be faced in the future. Managers who are risk-averse tend to make decisions that can avoid risk, while managers who are risk-seeking tend to invest large investments that can adapt to market developments quickly (Courtney *et al.*, 1997). Several studies related to decision making in the fields of economics, management, and accounting usually assume that decision makers are rational people. In other words, decision makers are considered to be able to process information perfectly in determining the best decisions (Morgan, 1986, as cited in Gudono & Hartadi, 1998). This is different from what was stated by Simon (1957; as cited in Maule & Hodgkinson, 2002) which states that someone will make a decision that satisfies them at the minimum level of the requirements that should be. The satisfaction is so simple in terms of operating their cognitive, that it requires fewer mental resources than it should. Many types of heuristics and cognitive biases affect decisions, including availability, selective perception, illusory correlation, conservatism, law of small numbers, regression bias, wishful thinking, illusion

of control, logical reconstruction and insight bias (Schwenk, 1988). Tversky and Kahneman (1981) suggest that, often inconsistent assumptions of rationality are caused by the type of information framing adopted by decision makers. In this case, framing has an influence on determining alternative decisions. This phenomenon indicates that the behavior of decision makers is crucially influenced by the alternative forms of decisions presented compared to the results of a systematic analysis of the outcomes to be obtained from these alternatives.

This research is focused on cognitive biases due to framing of information. The theory used in testing the bias due to framing is prospect theory. This theory suggests that the frame adopted by a person can influence his decision. In this case, when a decision maker is given a positive decision alternative, the decision taken will tend to be risk averse. Whereas when information is presented negatively, the decisions taken will tend to be risk seeking. Several studies in Indonesia have shown varying results in testing the prospect theory. Such as research conducted by Gudono and Hartadi (1998) which shows the behavior of Indonesians who tend to be risk neutral when the information presented is positive and shows the same behavior (risk takers) when information is presented negatively. Haryanto (2000) tested the effect of framing and position on investment information on individual-group decisions. The results show that framing and position affect individual-group decision making.

If information is presented with negative framing, group decisions will be more risky than individual decisions, whereas for positive framing, group decisions will be less risky than individual decisions.

The cognitive mapping technique was originally introduced by Tolman (1948) in the field of psychology which developed an alternative stimulus-response model for humans (Eden, 1992). This mapping implies that, map is a model of cognition, which is a model of thinking. Swan's research (1997) tested the use of cognitive mapping in making technological innovation decisions. In the context of strategic decision making, Hodgkinson *et al.* (1999) tested the impact of cognitive mapping techniques to overcome cognitive biases caused by the framing of information adopted by decision makers. The cognitive mapping technique used in this study is causal cognitive mapping, which is the mapping of causal relationships that describe patterns of interrelationships between variables that will influence decision outcomes (Hodgkinson *et al.*, 1999). Some literature supports that, the hard work of a person to think before making a choice from various decision alternatives, can eliminate bias that may occur (Huff, 1990). In other words, there is an increase in the quality of decisions taken.

Several things that distinguish this research from previous studies are the modifications to the research instruments and statistical analysis methods. Modifications to this research instrument were carried out based on various considerations and after conducting a pilot test first to see the weaknesses of the research instrument. While the selection of statistical analysis methods is carried out to find a test tool that can better answer the research hypothesis. There are two possibilities from the results of this study, namely a generalization of the findings of previous studies or opposing the results of previous findings.

## II. LITERATURE REVIEW AND HYPOTHESES

### A. Bias in Decision Making

Hambrick and Mason (1984) argue that a decision making can be influenced by the cognitive framework and decision processes of members of the "upper echelons" organization. The cognitive perspective on decision making has also been proposed by Schwenk (1988). In his writings, Schwenk (1988) suggests the importance of discussing cognitive and explaining research related to this cognitive perspective. Schwenk summarizes the cognitive heuristic biases and biases that often occur in strategic decision making as well as the effects of these biases, which can be seen in Table I.

Das and Tseng (1999) proposed four types of cognitive bias, namely (1) prior hypotheses and focusing on limited targets, in this case decision makers bring what they have

previously believed when making decisions in different situations; (2) exposure to limited alternatives, namely when decision makers tend to rely on limited alternatives and use their intuition in analyzing a decision; (3) insensitivity to outcome probabilities, in this case the decision maker does not trust, does not understand and does not use estimates of what will happen and usually compares past events which are no longer relevant; and (4) illusion on manageability, this bias can occur when decision makers are too confident about the success to be achieved without considering the risks inherent in the decision, they also believe that the consequences of the decision will be able to be overcome in the future. Bias that is also unavoidable in strategic decision making is 'hindsight bias', namely bias because decision makers tend to make decisions based on the information that has been provided about what actually happened (Bukszar & Connolly, 1988).

### B. Framing Bias in Decision Making

In the decision-making process, a person will try to identify the risks that will be faced so that the decisions taken will be in accordance with a person's risk preferences whether risk averse or risk seeking (Bazerman, 1994). By understanding the risks that will be faced, decision makers can improve their ability to make and evaluate decisions in uncertain conditions. This can result in a decision being more emphasized on the process than on the outcome of the decision. So that this perspective views that managers will make better decisions through acceptance of these uncertain conditions and by learning how to think systematically in a risky environment (Bazerman, 1994).

An explanation for this information framing is put forward by Kahneman and Tversky (1979) in prospect theory. Prospect theory states that the frame a person adopts can influence his decision. In prospect theory, decision outcomes (outcomes) are described as positive or negative deviations (gains or losses) from a neutral reference point that is assigned a value of zero. Tversky and Kahneman (1979; 1981) argue that the value function resulting from the decision maker's subjective judgment is S-shaped, in which the curve is concave when above the reference point and convex when below the reference point. From the shape of such a curve it can be seen that a person will feel as if the value of losing a certain amount of money in a bet is greater than the value of winning the same amount of money so that in a loss situation people tend to be more reckless in taking risks (risk-seeking). This theory explains that the frame adopted by decision makers can influence the results of their decisions.

TABLE I: HEURISTICS AND BIAS

	Bias	Effects
1	Availability	Judgements of probability of easily-recalled events distorted
2	Selective perception	Expectations may bias observations of variables relevant to
3	Illusory correlation	Encourages belief that unrelated variables are correlated
4	Conservatism	Failure sufficiently to revise forecasts based on new information
5	Law of small numbers	Overestimation of the degree to which small samples are representative of publications
6	Regression bias	Failure to allow for regression to the mean
7	Wishful thinking	Probability of desired outcomes judged to be inappropriately high
8	Illusion of control	Overestimation of personal control over outcomes
9	Logical reconstruction	Logical reconstruction of events which cannot be accurately recalled
10	Hindsight bias	Overestimation of predictability of past events

Source: Schwenk (1988)

Several studies in Indonesia have shown varying results in testing the prospect theory. Such as research conducted by Gudono and Hartadi (1998) which shows the behavior of Indonesians who tend to be risk neutral when the information presented is positive and shows the same behavior (risk takers) when information is presented negatively. Haryanto (2000) tested the effect of framing and position on investment information on individual-group decisions. The results show that framing and position affect individual-group decision making. If information is presented with negative framing, group decisions will be more risky than individual decisions, whereas for positive framing, group decisions will be less risky than individual decisions. Arifin (2004) tested prospect theory and fuzzy-trace theory to see the effect of framing on managerial accounting decisions from an individual and group perspective. The results show that the fuzzy-trace theory is superior in explaining the effect of framing compared to the prospect theory. However, testing of the prospect theory mentioned above still uses simple types of decisions. Thus, re-examination is needed for more complex types of decisions.

### C. Cognitive Mapping Techniques

Causal cognitive mapping is part of cognitive mapping which emphasizes cognitive presentation as a form of causal interaction (Jenkins, 1998). Of the five types of maps (Huff, 1990), causality is one of the most popular types of maps used in strategic management research. This is due to several advantages of the causality map type, especially in the context of understanding decision making. Causality provides great potential for procedural knowledge (how it works or how to do it) compared to other relationships such as associations, constructs or categories which emphasize more on other types of mapping (Jenkins, 1998).

The causal map shows the causal relationship between various concepts. Concepts considered by a decision maker have an interaction and then connected through arrows. This relationship can be a positive or negative relationship, so to indicate it is given a sign (+) and (-). Fig. 1 is an example of causal cognitive mapping.

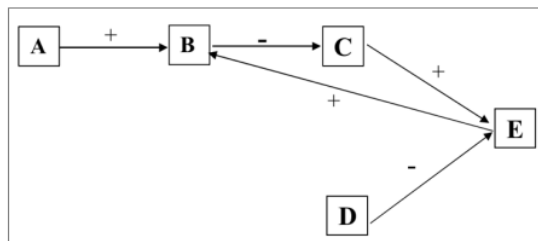


Fig. 1. Example Causal Maps.  
Source: Huff (1990)

A positive relationship in the diagram can mean that one variable or factor can cause, increase or produce other factors or variables. While a negative relationship can mean a factor or variable can eliminate, reduce or prevent the occurrence of other factors. The strength of this relationship can be indicated by a value, for example the number 1, 2 or 3 for both positive and negative relationships.

Number 3 indicates a very strong relationship, number 2 indicates a fairly strong relationship, while number 1 means

the relationship is slightly strong (Hodgkinson *et al.*, 1999). However, this presentation entirely depends on the way a person thinks about the factors that are considered relevant to the decision to be taken, so that each decision maker may differ in presenting their thinking map.

### D. Research Development

The results of Hodgkinson *et al.* (1999) support the prospect theory through testing participants who are given decision choices with positive and negative framing. Participants are given alternative presentations of information about identical problems in all respects except the emphasis on potential gains (positive version) or on potential losses (negative version). Using the chi-square test, evidence was found that when given positive framing, the proportion of preference between risk averse (22.7%) and risk seeking (27.3%) was not too different from each participant, but when given negative framing, participants tend to be more risk seeking (45.5%) than risk averse (4.5%). The results of this study indicate that framing bias is not only limited to simple problems but is a factor that can potentially affect strategic decision making in more complex conditions.

The following hypothesis is proposed to reexamine the effect of framing on strategic decisions under conditions of uncertainty as shown by Hodgkinson *et al.* (1999).

H1a: There is a cognitive bias decisions making, when decision makers determine alternative decisions that are presented with positive framing and negative framing.

H1b: When information is presented in positive framing, decision makers tend to choose less risky decisions (risk averse), whereas when information is presented in negative framing, decision makers tend to choose risky decisions (risk seeking).

Hodgkinson *et al.* (1999) offers a causal cognitive mapping procedure to determine whether this approach can reduce or eliminate framing bias. To overcome bias, decision makers are encouraged to adopt procedures that will convert equivalent versions of various problems into similar formal presentations. In other words, decision makers need to develop a model to ensure that trivial features do not unduly influence voting behavior. The model involves the development of mapping techniques that can capture the structure and content of decision makers' thought processes related to existing habits. It is possible to minimize the bias that occurs through the use of cognitive mapping techniques. Thus, the hypothesis proposed is:

H2: When decision makers use causal cognitive techniques before determining alternative decisions presented with positive framing and negative framing, it will reduce framing bias.

## III. RESEARCH METHOD

The subjects in this study were students in post graduate Accounting Departement. The demographic variables asked were age, gender, work experience. Accounting students are selected with the consideration that even though they have not all worked directly, they have got an understanding of work in the accounting field through the various courses that have been taken.

Students in accounting department selected as respondents are students who have taken and passed the class of (1) Management Accounting; (2) Strategic Management (3) Financial Management and (4) Behavioral Accounting. Participants were formed into four treatment conditions. Each participant received two treatment conditions. The assignment of experimental assignments was randomly assigned (randomly assigned) to two treatment conditions, namely the composition of the pair from the framing condition (positive; negative) and causal cognitive mapping (with; without). This study examined the risk preferences of decision makers. Risk preferences, both risk averse and risk seeking, can be seen in the decision to choose the company's product marketing objectives with the profits offered. Thus, researchers used Independent Sample T- Test to analysis hypothesis.

IV. RESULT AND DISCUSSION

A. Descriptive Statistics and Demographics

The demographic characteristics of the participants consist of three main parts, namely age, gender and work experience related to decision making. The results of data processing regarding the demographic characteristics of the participants as a whole can be seen in Table II.

TABLE II: PARTICIPANT DEMOGRAPHIC

Information	Min	Max	Mean	Mode	Std.Dev.
Age	23	54	30,72	27	5,9727
Gender	0	1	0,77	1	0,42
Experience in decision making	0	20	2,89	0	3,1931
TPA Score	450	645	544,36	500	36,7296

Next, an independent sample t-test was carried out to find out whether the four participant conditions had an identical mean. The test results can be seen in Table III.

B. Hypothesis Testing Results

Based on the normality test of the risk preference data above, the hypothesis testing of this study used a different t-test, namely the Independent Sample T-Test. Hypotheses 1a and 1b are hypothesis testing to test whether cognitive biases occur in decision makers in decisions making, when decision

makers determine alternative decisions that are presented with positive framing and negative framing. Hypothesis 2 is proposed to re-examine whether cognitive biases can be reduced when decision makers use causal cognitive mapping techniques before determining alternative decisions that are presented with positive framing (potential gains) and negative framing (potential losses). The results of the t test can be seen in Table IV.

Hypothesis 1a is tested by looking at the difference in the average risk preference of decision makers. As shown in Table IV, the results of the T-test = -7.802 with a p-value = 0.000 indicate that there are differences in the risk preferences of decision makers. The difference is statistically significant at the alpha level of 0.05. This result means that statistically it supports the alternative hypothesis, namely that there is an average difference in risk preference among strategic decision makers in conditions of uncertainty due to information framing adopted by decision makers; both positive and negative framing. Empirical findings indicate that there is a statistically significant difference in average risk preferences between decision makers who adopt information framed in positive and negative framing. This finding supports hypothesis 1a so that it can be concluded that there is a bias that affects decision makers due to information framing. These findings are consistent with the results of Hodgkinson *et al.* (1999; 2002) which shows that there are differences in decisions on risky choices when information on alternative decisions is framed with potential gains (positive framing) and potential losses (negative framing), this indicates a bias towards the decision.

To analyze hypothesis 1b, it can be seen from Means framing without mapping in Table IV. When information is presented in positive framing, the average decision maker's risk preference is 3.22. Meanwhile, when information is presented in negative framing, the average decision maker's risk preference is 8.67. This shows that the average risk preference of decision makers is smaller (tend to be risk averse) when information is presented in positive framing, compared to when information is presented in negative framing (tend to be risk seeking).

Hypothesis 1b was conducted to test the prospect theory that underlies the concept of framing (Kahneman & Tversky, 1979).

TABLE III: ANOVA TESTING PARTICIPANT DEMOGRAPHIC CHARACTERISTICS

Information	Sum of Squares	df	Mean Square	F	Sig.
Age	Between Groups	2,737	3	0,912	0,025
	Within Groups	4028,281	110	36,621	
	Total	4031,018	113		
Gender	Between Groups	0,405	3	0,135	0,755
	Within Groups	19,665	110	0,179	
	Total	20,07	113		
Experience	Between Groups	22,05	3	7,35	0,715
	Within Groups	1130,092	110	10,274	
	Total	1152,143	113		

TABLE IV: T TEST RESULTS-STRATEGIC DECISION MAKING UNDER CONDITIONS OF UNCERTAINTY

Framing	Causal Cognitive Mapping							
	Without Mapping				With Mapping			
	Means	St. Dev.	t-statistic	p-value	Means	St. Dev.	t-statistic	p-value
Positive	3,22	3,54	-7,802	0,000	7,28	3,17	1,008	0,476
Negative	8,67	1,73			5,41	4,62		

Variable: Risk Preference (1=Risk Averse; 10=Risk Seeking)

This is motivated by the various results of research on prospect theory in Indonesia (Gudono & Hartadi, 1998; Haryanto, 2000; Arifin, 2004). The results of testing this hypothesis indicate that, when information on alternative decisions is presented with positive framing (potential gains), the risk preferences of decision makers tend to be risk averse and when information is presented in negative framing (potential losses), the risk preferences of decision makers tend to be risk seeking. The significance of the results of this study can be seen from the average risk preferences of the participants. In positive framing, the decision maker's risk preference is lower (3.22) than in negative framing (8.67). This indicates support for prospect theory (Kahneman & Tversky, 1979). Thus, hypothesis 1b is supported.

Testing hypothesis 2 for framing conditions with mapping, namely when participants are given the task of carrying out cognitive mapping techniques first before determining alternative strategic decisions that are presented with potential gains (positive framing) and potential losses (negative framing). The mean value in table 6 is that when information is presented in positive framing, the average decision maker's risk preference is 7.28. Meanwhile, when information is presented in negative framing, the average decision maker's risk preference is 5.41. The results of the T-test = 1.008 with p-value = 0.476 indicate that there is no difference in the average risk preference of decision makers between the information presented with potential gains (positive framing) and potential losses (negative framing). Thus, these results support hypothesis 2 (H2).

This hypothesis was proposed to test the influence or role of causal cognitive mapping techniques in reducing framing bias. This reduced bias can be demonstrated by the absence of a significant average difference between the risk preferences of decision makers who adopt positive or negative framing. Statistical tests showed that there were no significant differences in the framing and mapping conditions. Thus, the statistical test results for hypothesis 2 (H2) are supported and consistent with the study of Hodgkinson *et al.* (1999; 2002). In other words, the causal cognitive mapping technique is a tool that can be used by strategic decision makers in processing information and making the best decisions.

### C. Discussion

This study aims to re-examine the presence of framing bias in decision making which can lead to less-than-optimal decisions. Thus, we need a technique that can eliminate or reduce this bias. The technique tested in this study is causal cognitive mapping. The results of testing the first hypothesis indicate that there is a bias due to framing in decision making. Information framed with potential gains (positive framing) and potential losses (negative framing) will encourage a decision maker to make a decision based on risk preference. This is indicated by the difference in the average risk preference of decision makers when information is presented with positive and negative framing. When information is presented in positive framing, the risk preferences of decision makers tend to be risk averse, whereas if information is presented in negative framing, the risk preferences of decision makers tend to be risk seeking. This shows support for the prospect theory, namely when in a condition of loss or

potential losses (negative framing), a person will tend to be more reckless in taking risks, because further failure will result in a lower subjective value than in conditions of gains or potential gains (positive framing). Thus, these results are consistent with the research of Hodgkinson *et al.* (1999; 2002).

The results of testing the second hypothesis show the ability of the causal cognitive mapping technique to reduce or reduce bias due to framing (information framing) of available decision alternatives. When a decision maker uses this technique before determining a decision alternative, the decision maker will process the available information by connecting various relevant factors that either strengthen or weaken an alternative. The various connected factors can be given a value for the strength of the relationship, both a positive relationship (causing, increasing or producing) or a negative relationship (eliminating, reducing or preventing). Because the available information has been carefully considered and presented in the form of a mind map, decision makers tend to make decisions based on thinking and not just based on alternative decision choices that have been framed positively and negatively. This result is consistent with the results of Hodgkinson *et al.* (1999; 2002).

### D. Recommendations

These results can be used as input for management or decision makers within the company. In an effort to prevent bias in decision making, the information presented should be more complex and cannot be easily summarized or simplified. Presentation of complete information can reduce the influence of framing effects (Kuhberger, 1995; Arifin, 2004). When the decision to be taken contains risks in the future, the decision maker should not only rely on the probability and results to be obtained, but try to control the risk by obtaining further information, finding other alternatives, waiting or handing over e responsibility to other parties (Wright & Goodwin, 2002). Another implication is that decision makers should think harder in processing the available information. One technique that can be used is causal cognitive mapping. This technique can assist decision makers in connecting various factors that are considered relevant in a problem. These various factors can be linked to each other both positive and negative relationships. This technique can also predict the strength of the influence of the relationship. Thus, it is expected that the decision taken is quite optimal.

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