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A Study on the Correlation Between Cognitive Bias and Logical Reasoning Ability

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Abstract

This article explores the correlation between cognitive bias and logical reasoning ability, analyzes the role of cognitive bias in the process of logical reasoning, and its impact on reasoning results. This article classifies and discusses different types of cognitive biases, revealing how these biases interfere with the logical reasoning process, and proposes corresponding intervention strategies to mitigate the negative impact of cognitive biases. The research results indicate a significant correlation between cognitive bias and logical reasoning ability, and targeted training and cognitive strategies can effectively improve individuals' logical reasoning ability. This article provides a new perspective for understanding the relationship between cognitive bias and logical reasoning, and provides reference for practical applications in related fields.

Keywords: cognitive bias, logical reasoning, correlation, intervention strategy, cognitive training

1. Foreword

In the era of information explosion, logical reasoning ability has become an important tool for individuals to analyze and solve problems. However, people are often influenced by cognitive biases in the process of reasoning, which may stem from prior knowledge, beliefs, emotions, or socio-cultural backgrounds. The existence of cognitive bias complicates the logical reasoning process and may lead to incorrect decisions and judgments. Although logical reasoning ability plays a central role in personal development and social progress, research on how cognitive biases affect logical reasoning is still insufficient. This study aims to explore the correlation between cognitive bias and logical reasoning ability, analyze the specific impact of different types of cognitive bias on the logical reasoning process, and explore how intervention measures can reduce these biases to improve the accuracy and efficiency of logical reasoning. As a result of these studies, we attempt to contribute to the theoretical background and applications for the development of educational interventions and training, and decision-making aids.

2. Overview of Cognitive Bias

2.1 Definition of Cognitive Bias

Cognitive bias may be defined as a systematic distortion of perception, judgement and recall of information subject to biases from the psychological, social and cultural process during information processing. At this, it is often unintended, making people have a tendency of preferring information that supports this belief,

attitude or expectations they have when making a decision, while discarding or downgrading information considered to be irrelevant given such expectation. Bias is one of the exciting topics in cognitive psychology because it establishes that people are not always rational in their thinking patterns. Other cognitive errors include confirmation bias, anchoring effect, availability heuristic and representativeness heuristic (Sauerwald et al., 2025). It is the act of selectively gathering, interpreting and remembering information in regards to a certain belief held by an individual while disregarding information which shows otherwise. The anchoring effect refers to the inappropriate influence of initial received information (anchor) when making estimates or decisions. Availability heuristic means individuals overly rely on easily recalled information when assessing the probability of events occurring. Representativeness heuristic involves making judgments based on the typicality of things while neglecting fundamental probabilities. These cognitive biases not only affect individuals' daily decisions but can also lead to misunderstandings and prejudices at the societal level. Therefore, understanding and identifying cognitive biases is crucial for improving the quality of individual decision-making and promoting social justice (Yu, 2024).

2.2 Types of Cognitive Bias

Cognitive biases come in many forms and play different roles in an individual's thinking and decision-making processes. Here are some common types of cognitive biases, totaling about 600 words:

Confirmation Bias (Confirmation Bias): One of the most famous cognitive biases, this refers to the tendency of individuals to seek out, interpret, and remember information that confirms their beliefs or assumptions while ignoring or devaluing information that contradicts them (Xiao et al., 2024).

Anchoring Effect: When an individual makes an estimate or decision, the initial received information (anchor) is improperly influenced, leading to subsequent judgment that relies too much on this initial value.

Availability heuristic (Availability Heuristic): Individuals rely on the ease of access to an event in memory when evaluating its likelihood, rather than on actual probability.

Representative heuristic (Representativeness Heuristic): individuals rely too much on the typicality of things in a category when making judgments, while ignoring basic probabilities or other relevant information.

Emotional heuristic (Affect Heuristic): When individuals make decisions, their emotional and emotional responses have a greater impact on judgment than logic analysis.

Overconfidence bias (Overconfidence Bias): individuals are overly confident in their knowledge, judgment or ability, leading to an overestimation of the accuracy of their predictions (Ji & Wang, 2024).

Self-Serving Bias: Individuals tend to attribute success to their own ability or effort and failure to external factors.

Blind spot of bias (Bias Blind Spot): Individuals can recognize cognitive biases in others, but often fail to realize that they themselves have these biases.

Groupthink: In the process of group decision-making, individuals may ignore their doubts and follow the opinions of the group in order to pursue consistency.

Base rate neglect (Base Rate Neglect): individuals ignore or underestimate the overall probability (base rate) when making judgments and pay too much attention to information about specific cases (Zhu & Peng, 2024).

Framing Effect: The individual's response to information is influenced by the way it is presented (Framing Effect), and different ways of expression can lead to different decisions.

Long-term deviation (Hyperbolic Discounting): individuals tend to overemphasize immediate rewards and ignore long-term benefits.

Gambler's Fallacy: The fallacy that individuals mistakenly believe there is a correlation between a series of random events, such as the belief that a series of heads on a coin will necessarily result in a series of tails.

Functional Fixedness: Individuals tend to see only the traditional function of an object when solving a problem and ignore other possible uses.

These cognitive biases not only affect individuals' personal decisions, but also have a wide range of effects in social, economic and political fields. Understanding these biases helps us think and act more rationally and reduce the occurrence of wrong decisions (Goubault et al.,

2024).

3. Logical Reasoning Ability Foundation

3.1 Definition of Logical Reasoning

Logical reasoning is a thought process based on logical rules involving deriving new conclusions or assertions from known premises or assumptions through a series of reasoning steps. Logical reasoning is the core of rational thinking, requiring that the reasoning process must adhere to certain logical forms and principles to ensure the validity and reliability of conclusions. The definition of logical reasoning can be elaborated from the following aspects:

Firstly, logical reasoning is a form of deductive reasoning that relies on logical necessity. If the premise is correct, the conclusion drawn through logical reasoning must also be correct. This reasoning model does not rely on experience or observation, but is based on the rigor of logic. For example, everyone will die (premise 1), and Socrates is a human (premise 2), so Socrates will also die (conclusion).

Secondly, logical reasoning can also be inductive reasoning, which is based on specific observations or instances and extends to broader generalizations or principles. Inductive reasoning itself cannot guarantee that results are necessary but they offer a probability factor to the same. For instance, if one observes that all swans are white it, it can be deduced that all swans are white.

In addition, it is the tool of critical thinking that assists people in the clear analysis of the various choices open to them in resolving a dilemma and the ability to differentiate between facts and opinion and determine if there… As a result of which logical thinking is conducted in the manner of systematically analyzing problems, hypothesizing probable causes based on rationale and documenting convincing arguments.

Last but not least, the concept found under investigation is that logical reasoning is a cognitive process, as well as a communication/ expression ability. In argumentation and debate, logic makes individuals to be in a position to present their standings adequately so as to justify their conclusions to other persons.

To sum up, logical reasoning means thinking using logic that starts from certain premises and arrives at a conclusion by deduction or induction. For it is the basis of logical operations of the mind as well as the crux of critical evaluation and of successful discourse. The practical application of the ability to think logically is the ability to recognize the patterns in the world, make rational choices, and be a productive communicant.

3.2 Basic Principles of Logical Reasoning

Consistency principle: Logical reasoning has to make sense, and therefore, the conclusion cannot have contradictory statements within the reasoning process (Silva, 2024). There can be no reasoning scenario if there is an antinomy of the premises, as has been explained.

The principle of sufficiency: The conclusion of reasoning must be based on sufficient premises, that is, the authenticity of the premises is sufficient to support the authenticity of the conclusion. If the premise is not sufficient to prove the conclusion, then the reasoning is invalid.

The principle of validity: Logical reasoning must be valid, that is, the form of reasoning must be correct. An effective form of reasoning ensures that if the premise is correct, then the conclusion must also be correct. Validity does not involve the authenticity of premises, but rather focuses on the structure of the reasoning itself.

Principle of Necessity: In deductive reasoning, the conclusion must be the inevitable result of the premise. In other words, if the conclusion is incorrect, then at least one premise is also incorrect.

Inductive principle: Inductive reasoning relies on observed examples to derive general conclusions. The principle of this reasoning is that if a series of specific instances exhibit a certain characteristic, it can be reasonably inferred that all similar instances have this characteristic.

The following provides a detailed explanation of the basic principles of logical reasoning:

Consistency principle: In logical reasoning, there can be no logical contradiction between premises. For example, we cannot simultaneously accept the contradictory premise that ‘all cats are afraid of water’ and ‘all cats love water’.

The principle of sufficiency: A premise of reasoning must provide sufficient evidence to support the conclusion. For example, if we infer that ‘all students have completed their

homework', then the premise that 'all students have completed their homework' is not sufficient; We also need the premise that 'all students have submitted their assignments'.

The principle of validity: The validity of logical reasoning is the correctness of its structure or form. For example, if the premises are "all A is B" and "this C is A", then the conclusion "this C is B" is valid because it is a correct form of reasoning.

The principle of necessity: In deductive reasoning, the conclusion must follow the necessary premise. For example, a reasoning having the form of the first order syllogism: If it rains today, then the ground will be wet, we know the ground is wet, but it does not mean it is raining today, because there are other reasons.

Inductive principle: Induction is the type that deals with concrete items with a view of drawing something general on the basis of such items. For instance if I notice that all the swans seen are white I can make a conclusion that all swans are white.

The general formal logic rules of inference make up the foundations of logical research as a discipline, allowing us to build arguments and analyse them so that the process and result of human thought and interpersonal communication have a stable foundation. If we follow these principles, knowledge becomes more accurately grasped by human perceptions, reasonable ways of thinking can be determined, and logical judgment and thinking applied (Chen & Tao, 2024).

3.3 Evaluation Methods of Logical Reasoning Ability

The evaluation method of logical reasoning ability is one of the fundamental research focuses in psychology and education to measure the quantitative logical thinking ability of the subject. The following are some commonly used evaluation methods:

Standardized tests: Such tests generally include a sequence of well-developed questions which can be answered by forming proper conclusions of the given facts. Standardized tests typically encompass the logical reasoning subtest in the Wechsler Intelligence Scale, the Mensa test, and the based analytical writing and quantitative reasoning elements of college admission tests including GRE and GMAT.

Logical reasoning tasks: These tasks may require use of deductive reasoning techniques, inductive reasoning techniques or analogical reasoning techniques. For example, participants may need to analyze different premises, make conclusions or apply general rules to specific examples. Numeracy or word problems, quick/thinking games such as Sudoku, prose, and self-esteem tests are classic modes of determining logical mindset.

Experimental Research: In the consummation of research activities in laboratories, researchers may plan particular experiments to measure participants performance when faced with particular logical tasks. Such tasks may be cognitive tasks, decision making tasks or problem solving tasks to measure the participants logical reasoning using the reaction time and accuracy parameters.

Daily Behavior Observation: Another form of evaluation is to look at and document people's daily activities and choices within their ordinary contexts. This method offers more attention to the appreciation of problem solving procedures in real life but its effectiveness can be skewed by variable factors which makes quantification of the same hard.

Self-report: Participants are requested to fill in questionnaires or to be interviewed about the logical reasoning they practice in their everyday life. This means that this method relies on how well the participant understands himself or herself and the net honesty that comes with it which may not be completely true.

Expert Evaluation: Sometimes it is possible to comprehend an individual's logical thinking ability practically, through test results. This is typically applicable in specialized fields such as law, medicine, or scientific research where the expert's judgment can serve as an evaluation standard.

Metacognitive assessment: By assessing an individual's understanding and control of their cognitive processes, their logical reasoning ability can be indirectly inferred. Metacognitive strategies include planning, monitoring, and evaluating their own thinking processes.

The evaluation methods for logical reasoning abilities are diverse, each with its own advantages and limitations. In practical applications, researchers typically combine multiple methods to obtain more comprehensive and accurate assessment results. Through these evaluations, a better understanding of an individual's logical reasoning abilities can be

achieved, providing a basis for educational interventions, career choices, and cognitive science research.

4. Discussion on the Relationship Between Cognitive Bias and Logical Reasoning

4.1 Theoretical Influence of Cognitive Bias on Logical Reasoning

Cognitive bias refers to the systematic deviation from rationality that individuals exhibit during information processing; these biases can have a significant theoretical impact on logical reasoning. Below are the potential effects of cognitive bias on logical reasoning abilities:

The heuristics of availability can distort logical reasoning. Individuals tend to rely on the easiest examples or information when evaluating information. This heuristic approach may lead individuals to overemphasize information that is easily recalled or dramatic while neglecting more important but less prominent information, thereby affecting the accuracy of reasoning.

Representative heuristic reasoning can also influence logical reasoning. Individuals may overly rely on the similarity between things and the typical characteristics of a certain category when making inferences, while neglecting fundamental probabilities or actual possibilities. For example, if a person focuses only on information that aligns with their typical examples when considering a problem, their reasoning may deviate from reality.

In addition, there is the possibility that the anchoring effects may restrict the freedom of logical reasoning. When some people make judgments, overemphasizing initial information or "anchors," people use this sort of reasoning at the end despite the actual fact that the certain fact is not relevant to solving the problem or has become out-of-date.

Cognitive bias is also present in the framing effect which is connected with the way information is presented and can have impact on an individuals understanding of it or decision making in logical reasoning if the way of putting a question is different people may give totally different answers although the matter asked about is of similar nature.

The third type of mental distortion is connected with an overconfidence of an individual that distorts the logical thinking process. People can become excessively conceited in their experience and skills making them provide premature arguments when solving difficult tasks or to repeat their findings without appropriate facts.

Last but not the least, minor social cognitive biases like groupthink and social identity may also influence logical reasoning. The idea here is that coherence takes precedence over all, hence logical reasoning.

Concisely, cognitive biases have theoretical interactions with logical reasoning in various ways in the process and interpretation of information. It remains important for increasing the effectiveness of individual rationality, for tailoring educational instruction and then for the amelioration of decision making.

4.2 Theoretical Manifestations of Cognitive Bias in Logical Reasoning

In applying logic, the three main cognitive biases show up in some form distorting the truths and meanings of what is being reasoned out. First of all, causal bias comes to improper attribution of cause-and-effect relationship to two events and ignoring the rest. Secondly, Attribution errors, for example Fundamental Attribution Error cause individuals to focus on the degree of personality while explaining someone's behavior as opposed to paying attention to other factors such as circumstances. One of the assumptions of AVT is availability bias, which causes people to fall for easy information for thinking instead of going for more inclusive data. Moreover, G is responsible for representativeness bias when it leads people to reason from typicality neglecting basic probabilities. The proportion of confidence is relevant to the anchoring effect when reasoning can make the set judgments rigid over the initial information. The logical fallacies discussed here as the theoretical expressions of styles of cognitive bias show such patterns that people may have in handling information and decision making, therefore, calling for self- awareness and dismantling of these styles of cognitive biases in order to enhance logical conduct.

5. Conclusion

The present research provides an extensive review of empirical literature concerning the link between cognitive bias and logical reasoning ability and provides insights into different forms of manifestation of cognitive bias while reasoning and how this influence affects the quality of logical reasoning performed. The study showed that people have a disposition to different biases and that, for that matter, biases

are critical factors in the logical thinking process, which is flawed and can lead to invalid interpretations. At the same time, by discussing nature and the methods for assessing the basic concepts and the application of logical reasoning, we have acquired more profound insights into the nature of, and the uses for, logical reasoning. Although cognitive biases are the factors that distort logical thinking they can be diagnosed and mitigated through cognitive training and educational programs. Thus, it is necessary to continue studying the problem of rational and efficient logical thinking in students and teachers, as well as to implement corresponding intervention programs. Overall, the current paper offers a theoretical background for analyzing the connection between cognitive bias and logical thinking.

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