

A Review of the Concepts, Theories, and Research Methods of Psychological Bias

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Abstract: *Objective:* This paper aims to systematically review and comment on the concepts, theories, and research methods in the field of psychological bias, with the goal of integrating the existing knowledge system and framework, and pointing out future research and development directions. *Methods:* Through literature review and retrospective analysis, key studies on psychological bias across multiple disciplines, including cognitive psychology, clinical psychology, and neuroscience, were summarized and evaluated. *Results:* Conceptually, psychological bias is regarded as a cognitive pattern that systematically deviates from rational judgment criteria; theoretically, it can be primarily explained by dual-process theory, heuristic-systematic model, and cognitive neural mechanisms; research methods encompass experimental paradigms, neuroimaging techniques, and computational modeling. *Conclusion:* Research on psychological bias necessitates further integration of theory and clinical practice, in-depth exploration of the concept of psychological bias, comprehensive evaluation of theories, combination of research methods with modern high-tech, development of scientific intervention programs, and exploration of the guiding role of psychological bias classification in clinical interventions, to promote precise and efficient development in the field of clinical intervention for mental health.

Keywords: Psychological bias; Concept; Theory; Research method

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1. Introduction

Psychological bias is a term that has been discussed relatively little in China's clinical psychology community, yet it represents an exceptionally vast field. It encompasses a broad "spectrum" ranging from normalcy to psychosis, involving individuals who are not mentally ill but still exhibit abnormal behavior. The number of such individuals in the population is, understandably, enormous. Psychological bias refers to a systematic deviation from rational, logical, and probabilistic thinking patterns under specific circumstances, driven by psychological factors, cognitive limitations, or motivational influences^[1]. These biases are not random errors but rather the result of "mental shortcuts" employed by the brain to make rapid judgments amid information overload and uncertainty^[2].

As a core characteristic of clinical psychological phenomena that deviate from rational standards, psychological bias is a focal point of interdisciplinary research between behaviorism and cognitive science,

profoundly influencing a wide range of fields from clinical psychological intervention to mental health ^[3]. Since its inception in the 1970s by pioneers such as Daniel Kahneman and Amos Tversky, this concept has become a central research topic in fields including behavioral economics, cognitive psychology, management, and finance. This article will delve into this issue, which has not yet received widespread attention in China, through a review format, providing a clear framework for clinical psychological intervention. It aims to establish a platform for the standardization and normalization of mental health, psychological counseling, and psychological supervision in China. Is there an identifiable and judgable psychological bias between normalcy and psychosis? This article seeks to answer and explore this highly challenging question. It is believed that an in-depth analysis of this issue will significantly enhance the level of clinical intervention in China and meet the public's expectations for quality mental health services.

2. The origin, development, and research context of the concept of psychological bias

The history of research on psychological bias has transformed our understanding of human decision-making and problems in various fields. The developmental stages of psychological bias research include: (1) early beginnings (before the 20th century), (2) behaviorism-dominated period (early 20th century to the 1950s), (3) cognitive revolution (1950s–1970s), (4) heuristic research (1950s–1970s), and (5) neuroscience applications (2000s to present).

Key figures and theoretical perspectives in psychological bias research include: Wolfgang Köhler and others' "perceptual bias", which laid the foundation for subsequent cognitive bias research ^[4]; Herbert Simon's "bounded rationality" ^[5]; Amos Tversky and Daniel Kahneman's prospect theory (1979) ^[6]; Richard Thaler's "mental accounting" and other concepts, which utilized techniques such as fMRI to reveal the neural mechanisms of bias and proposed that loss aversion is related to insular activation ^[7-8].

The history of theoretical research on psychological bias represents a cognitive science revolution from the periphery to the core. It began with questioning rational assumptions, deepened through experimental psychology, and ultimately revealed the complexity and plasticity of human decision-making through neuroscience and interdisciplinary applications. This field not only explains the roots of irrational behavior but also provides tools for improving decision-making, continuously influencing various aspects of social functioning.

There are still differing voices regarding the concept of psychological bias. In the pioneering work of Kahneman and Tversky, psychological bias is typically defined as "cognitive patterns that systematically deviate from rational judgment standards, arising from limitations in heuristic information processing." Bazerman and Moore further clarify its characteristics, noting that psychological bias is systematic, not random errors, but predictable patterns of deviation; it is universal, transcending individuals, cultures, and contexts; and it is persistent, difficult to eliminate through mere knowledge transmission.

Subsequently, differing voices and challenges emerged regarding the concept of psychological bias. This is exemplified by Gigerenzer's critique of ecological rationality: Gigerenzer and his research team fundamentally questioned the concept of "bias" itself, arguing that "bias" is a laboratory artifact and that many classic biases only appear in specific experimental contexts. They contend that using probability theory as the sole standard of rationality is "mathematical imperialism."

Cosmides and Tooby redefined bias from an evolutionary perspective, arguing that psychological bias has domain specificity, meaning that human cognitive mechanisms have evolved to solve specific adaptive problems; it

also has environmental mismatch, meaning that many “biases” are adaptations to ancient environments that appear “abnormal” in modern contexts; and it has a functional perspective, meaning that seemingly irrational patterns may have hidden adaptive functions. The debate over the concept of “psychological bias” ultimately concerns how people understand human rationality itself. Different conceptualizations represent different views of rationality: rationality as logical consistency, rationality as ecological adaptation, and rationality as goal achievement. These dialogues on rationality will continue to shape the trajectory of behavioral science development.

3. Theoretical framework, hotspots, and debates on psychological bias

Research on psychological bias has led scholars from various perspectives to propose different viewpoints, forming distinct theoretical schools.

3.1. Core theories of psychological bias

The following are the most representative schools in the study of psychological bias:

- (1) **Dual-System Theory (Core Framework):** This is the foundational model and school for understanding most psychological biases, popularized by Daniel Kahneman in his book “Thinking, Fast and Slow.” Its main points are as follows: System 1 (Fast Thinking): Characterized by automaticity, speed, intuition, emotionality, and low cognitive effort, relying on associations, experiences, and heuristics, and serving as the source of most psychological biases; System 2 (Slow Thinking): Characterized by control, slowness, rationality, high cognitive effort, and logicity, capable of complex calculations and reasoning. Analysts from this theoretical school argue that psychological biases typically stem from System 1’s “autopilot” mode, which is efficient and effective in most situations but prone to errors in specific contexts. System 2, on the other hand, may be suppressed (e.g., when fatigued or distracted) or may simply accept System 1’s erroneous answers without intervention or correction.
- (2) **Heuristic Bias Theory (Pioneering Paradigm):** Developed by Amos Tversky and Daniel Kahneman in the 1970s, this theory posits that when faced with complex and uncertain problems, people rely on simple rules of thumb (heuristics), which, while improving efficiency, can lead to predictable systematic biases. This theory includes three major biases: (1) Representativeness Heuristic Bias: Judging the probability of an event based on its similarity to typical examples, leading to biases such as ignoring base rates and misinterpreting randomness; (2) Availability Heuristic Bias: Estimating the frequency or probability of an event based on how easily it can be recalled from memory, leading to biases influenced by media exposure, recent experiences, and vividness; (3) Anchoring and Adjustment Heuristic Bias: Over-relying on initially obtained information (anchor) when making judgments, even if adjustments are made, they are insufficient, which is an important bias in negotiation, pricing, and other fields.
- (3) **Prospect Theory (Descriptive Decision Theory):** This is an alternative theory proposed by Kahneman and Tversky to the expected utility theory (rational model), explaining people’s irrationality in risk decision-making. Its main biases include: (1) Reference Point Dependence Bias: People’s judgments of gains and losses are based on a reference point (e.g., current status, expectations) rather than absolute wealth; (2) Loss Aversion Bias: The pain of losses is far greater than the pleasure of equivalent gains (typically estimated at around 2:1); (3) Diminishing Sensitivity Bias: The psychological effect of wealth changes weakens as

the absolute value increases, leading to a concave value function in the gain region (risk aversion) and a convex value function in the loss region (risk seeking); (4) Framing Effect: Different descriptions of the same problem (framed as gains or losses) can alter people's choices, violating the "description invariance" principle of rational decision-making.

(4) Social Cognition and Motivation Theory (Emotional and Social Dimensions): This theory posits that biases stem not only from cognitive limitations but also from emotions, desires, and social motivations.

Its main biases include: (1) Self-Serving Bias: Attributing success to internal factors (one's own abilities) and failure to external factors (environment or others); (2) Confirmation Bias: Tending to seek, interpret, and remember information that confirms one's existing beliefs while ignoring or distorting disconfirming information; (3) Overconfidence: Overestimating one's knowledge, abilities, and predictive accuracy; (4) Conformity Effect/Groupthink: Aligning one's opinions with the group to fit in or avoid conflict, leading to erroneous decisions.

(5) Ecological Rationality Theory (Defending Heuristics): Proposed by Gerd Gigerenzer and others, this theory supplements the view that "biases are errors" ^[9]. They argue that in appropriate environmental structures, simple heuristics can leverage environmental information to make rapid, frugal, and equally or even more accurate decisions, termed "ecological rationality." This balances the view that heuristics are solely sources of error and has become one of the hotspots in psychological bias theory.

3.2. Main classifications of psychological bias

The five major theories collectively form a powerful toolkit for understanding human irrational behavior and are widely applied in almost all fields involving human judgment, including behavioral economics, finance, marketing, public policy (nudging), medical decision-making, judicial judgment, and clinical psychology. Their core insight is that to make better decisions, one must not only learn logic and probability but also understand the inherent, systematic flaws in our brains. As for how to classify these flaws, there is currently no authoritative classification system worldwide that can accurately summarize them. In their book "Research on Psychological Bias", the authors of this article propose a rough framework that has garnered some social attention and can be considered a small contribution and a bold scientific attempt by Chinese scholars. The book classifies psychological biases into 14 directions: comprehensive, life development, life events, cognitive processes, social life, self/individual, family life/relationships, school/education, career/work, interpersonal relationships, entertainment/culture and tourism, marriage/sex, AI/big data, and life/death, encompassing a total of 153 biases.

Among them, several common classifications and representative biases include: Confirmation Bias: Tending to seek, interpret, and remember information that confirms one's existing beliefs while ignoring or devaluing contrary evidence ^[10]. Anchoring Effect: Over-relying on initially obtained information when making decisions ^[11]. Availability Heuristic: Estimating the likelihood of an event based on its ease of recall from memory, often distorted by media reports, recent experiences, and other factors. Hindsight Bias: Believing after an event that one "knew it all along" ^[12]; Framing Effect: Different descriptions of the same problem leading to different decision choices ^[13]; Loss Aversion: The pain of equivalent losses far outweighs the pleasure of equivalent gains ^[14]; Sunk Cost Fallacy: Continuing to adhere to an unwise decision due to the significant investment already made in terms of time, money, or effort; Status Quo Bias: Tending to maintain the current state and resist change; Endowment Effect: Overvaluing items one already possesses compared to those not owned ^[15]; Halo Effect: A person's overall impression, such as appearance or social status, influencing evaluations of their specific traits.

3.3. Debates on psychological bias theory

Debates on psychological bias theory mainly manifest in the following perspectives:

- (1) From the critical perspective of situationalism: Schwarz et al. (2007) emphasize that situational factors are often overlooked in bias research. Their viewpoints include: (1) Participants' understanding of experimental tasks may differ from researchers' assumptions; (2) Laboratory environments strip away the social dimensions of real-world decision-making; (3) Incentives in real-world decisions differ significantly from those in laboratory settings.
- (2) From the critical perspective of evolutionary psychology: Cosmides and Tooby (1996) question certain conclusions of bias research from an evolutionary standpoint. Their viewpoints include: (1) Human cognitive mechanisms are domain-specific rather than universally heuristic; (2) Many "biases" may be optimal solutions to specific adaptive problems; (3) Certain biases reflect traits that were adaptive in ancient environments but perform poorly in modern contexts.

3.4. Research methods for psychological bias and their advantages and disadvantages

The research methods for psychological bias are diverse and rich, ranging from highly controlled laboratory experiments to the observation of massive amounts of real-world data, forming a multi-layered and complementary methodological framework^[16]. These methods aim to reveal, quantify, and understand systematic and predictable deviations in human judgment and decision-making.

The following are the main research methods, from the most classic to the cutting-edge:

- (1) Controlled Behavioral Experiments (Core Method): This is the most classic and direct approach, conducted in laboratories or online platforms (e.g., Amazon Mechanical Turk, Prolific)^[17]. The operational procedure involves researchers manipulating one or more independent variables (e.g., information presentation format, anchor values, task framing), randomly assigning participants to different experimental conditions, and measuring their dependent variables (e.g., estimates, choices, confidence levels).

A typical example is the anchoring effect: One group of participants is asked to judge whether "the proportion of African countries in the United Nations is greater than 65%", while another group is asked whether "it is greater than 10%." Subsequently, all participants are asked to estimate the specific percentage. The estimates of the two groups will differ significantly and will be closer to their respective "anchors."

The advantages of such behavioral experiments include the ability to establish causal relationships, control confounding variables, and precisely measure the magnitude and conditions of biases. However, their disadvantages include potentially low ecological validity (due to differences between laboratory environments and the real world) and overly simplified tasks.

- (2) Questionnaire Surveys and Scales: These are used to measure relatively stable cognitive tendencies or bias propensities. The operational procedure involves using standardized scales to assess individual differences in specific biases. A typical example is the Cognitive Reflection Test, which measures an individual's tendency to rely on intuition (System 1) or engage in deep reflection (System 2). The advantages of this method include ease of administration and the ability to collect large-sample data. However, its disadvantages include potential inaccuracies in self-reports (due to factors such as social desirability bias).
- (3) Process-Tracing Techniques: These aim to open the "black box" of decision-making and understand the cognitive processes underlying biases^[18]. The main techniques include think-aloud protocols, where

participants verbalize their thoughts in real-time while completing tasks ^[19]; eye-tracking, which records the location and sequence of gaze fixations to reveal which information is attended to or ignored ^[20]; and mouse-tracking/information board techniques, which record how participants search for and integrate information (e.g., which attributes they click on to view) ^[21]. The advantages of these techniques include providing rich process data. However, their disadvantages include the potential for think-aloud protocols to interfere with normal thinking processes.

- (4) Neuroscience Methods (Neuroeconomics/Decision Neuroscience): These explore the neurobiological foundations underlying psychological biases. The main techniques include functional magnetic resonance imaging (fMRI), which identifies brain regions associated with specific biases (e.g., the amygdala, nucleus accumbens, prefrontal cortex) related to loss aversion or immediate gratification; electroencephalography (EEG), which provides millisecond-level temporal resolution to study the temporal dynamics of neural processes underlying biases; and transcranial magnetic stimulation (TMS)/direct current stimulation (DCS), which temporarily inhibit or enhance activity in specific brain regions to examine the causal relationship between that region and a particular bias. The advantages of this method include providing biological evidence. However, its disadvantages include the extremely high cost of equipment.
- (5) Field experiments and natural experiments: These involve testing psychological biases and their intervention measures in real-world environments. The main operational approaches are as follows: Field experiments actively manipulate variables in real-world settings (such as supermarkets, schools, or official websites). For example, changing the default option of a pension plan (from “opt-in” to “opt-out”) leverages the status quo bias to significantly increase participation rates. Natural experiments utilize changes in real-world conditions that resemble experimental settings for research purposes. For instance, studying the consumption behavior of lottery winners (who unexpectedly receive substantial gains) to test the mental accounting theory. The advantages of this method include extremely high ecological validity. However, its drawback lies in the difficulty of controlling variables.
- (6) Computational modeling and big data analysis: Computational modeling involves constructing formal mathematical models (such as the value function in prospect theory or reinforcement learning models) to quantitatively describe and predict biased behaviors, and comparing them with rational benchmark models (such as expected utility theory). Big data analysis utilizes vast amounts of real-world data (such as financial transaction records, social media behavior, and search engine queries) to detect biases in large-scale behavioral patterns. For example, analyzing stock trading data to find evidence of the disposition effect (selling winning stocks too early and holding onto losing stocks for too long). The advantage of this method is that modeling provides precise quantitative predictions. However, its drawback is that while big data reveals many correlations, establishing causality is challenging.
- (7) Chinese scholars have made certain innovations in research methods for psychological biases: For instance, Li Shu and his team have developed culturally contextualized experimental methods in risk decision-making research ^[22]. The characteristics of their approach include transforming classical decision-making tasks into a Chinese cultural context, testing differences in biases between collective and individual decision-making, and examining decision-making biases within interpersonal networks. In summary, research methods for psychological biases constitute a comprehensive toolkit that progresses from “phenomenon description” to “mechanism analysis” and then to “real-world application and prediction.” The choice of method depends on the specific research question: whether it asks “does it

exist” (behavioral experiments), “how does it arise” (process tracing/neuroscience), or “to what extent does it affect us in reality” (field experiments/big data).

4. Future directions in psychological bias research

Despite the significant achievements in psychological bias research, numerous challenges and opportunities for development remain: (1) Bias or adaptive tool? Some argue that many “biases” are evolutionarily adaptive mechanisms for rapid decision-making in certain environments. The issue lies not in the biases themselves but in their inappropriate application in modern contexts. (2) Individual and cultural differences: Individuals with varying personality traits, cognitive abilities, and cultural backgrounds exhibit differences in susceptibility to biases and the degree to which they manifest, necessitating more nuanced research. (3) Bias correction and intervention: Effectively helping individuals identify and overcome biases presents a significant challenge. Mere “notification” is often ineffective, requiring the design of more sophisticated intervention strategies. (4) Ecological validity: How to more effectively extend laboratory findings to the complex and dynamic real world ^[23]. (5) Intersection with artificial intelligence: Future research will increasingly focus on the mutual influence between human psychological biases and AI algorithm decision-making, such as how to prevent AI from learning and amplifying human social biases.

Psychological bias research profoundly reveals the “irrational” aspects of human thinking, challenging the “rational agent” assumption in traditional economics. It demonstrates that people’s judgments and decisions are not always optimal but are predictable and understandable. By systematically studying these biases, researchers can not only gain a more accurate understanding of ourselves but also design more human-centered systems, products, and services to help individuals and society make better choices in a complex world. In the future, this field will continue to deeply integrate with neuroscience, data science, and artificial intelligence, providing a broader perspective for understanding the human mind and thereby enhancing the clinical intervention efforts.

A comprehensive analysis of the future directions in integrating psychological bias research reveals several core trends: (1) Re-examination of the concept of “bias”: Psychological bias must be understood within a continuous, multidimensional spectrum. At one end lie pathological distortions that impair social functioning, while at the other end are positive illusions that promote adaptation and well-being. (2) Cultural inclusivity in psychological bias research: Existing theoretical frameworks primarily originate from Western cultures. Research under traditional Chinese cultural contexts reveals that “relational rationality” may produce unique and significant cognitive patterns. (3) Enhanced methodological rigor: Research needs to improve the psychometric quality of experimental tasks. Large-scale field studies and digital trace analysis are promising directions for bridging this gap.

In summary, psychological bias research is moving towards a more nuanced, integrated, and culturally aware stage. Future breakthroughs will depend on interdisciplinary collaboration, developing innovative frameworks that respect both the commonalities of human cognition and cultural diversity while effectively translating into inclusive psychological services. The most crucial goal is to excel in clinical work, improve intervention quality, and enhance mental health services for the general public.

Disclosure statement

The authors declare no conflict of interest.

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