Evolutionary Origins of Mental Accounting and Its Impact on Operational Processes

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Abstract

Mental accounting theory posits that individuals often establish separate accounts for different decisions, with non-fungible funds accounted for independently, which is considered an economic anomaly that reduces efficiency and deviates from "rationality." However, the fundamental question arises: if it is merely an inefficient "bias," why has it been universally preserved through evolution? From an evolutionary psychology perspective, this study hypothesizes that mental accounting is a product of human adaptation to evolutionary historical environments, serving to achieve evolutionary goals. This research aims to verify the evolutionary origin hypothesis of mental accounting through a series of studies, proposing that triple evolutionary goals (survival, reproduction, and pleasure) shape the operating mechanisms of mental accounting. On the one hand, evolutionary goals influence the typical categorization of mental accounts; on the other hand, the importance and activation level of goals determine the management strictness of corresponding accounts, which manifests as priority in budget allocation, priority in budget supplementation, and intensity of budget constraints. If the hypothesis holds, it would indicate that although mental accounting appears detrimental to utility maximization in contemporary contexts, it can actually be understood as an expression of "ecological rationality" with adaptive value, whose existence is rooted in deep evolutionary goals and whose essence should be understood beyond the traditional "rationality" framework.

Full Text

Preamble

The Evolutionary Origins of Mental Accounting and Their Influence on Account Operation Processes

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Abstract: The theory of mental accounting posits that individuals create separate mental accounts for different decisions, with non-fungible funds managed independently. This phenomenon is viewed as an economic anomaly that reduces efficiency and deviates from "rationality." However, a fundamental question remains: if mental accounting is merely an inefficient "bias," why has it been universally preserved through evolution? From an evolutionary psychology perspective, this research proposes that mental accounting is an adaptive product shaped by our evolutionary history, serving to achieve fundamental evolutionary goals. Through a series of studies, we aim to test the evolutionary origins hypothesis of mental accounting—that three core evolutionary goals (survival, reproduction, and hedonic well-being) shape the operational mechanisms of mental accounts. On one hand, evolutionary goals influence the typical categorization of mental accounts; on the other, the importance and activation level of these goals determine the rigidity of corresponding account management, manifested as priorities in budget allocation, budget reinforcement, and budget constraint strength. If supported, this hypothesis suggests that although mental accounting appears to hinder utility maximization in contemporary contexts, it can be understood as an expression of "ecological rationality" with adaptive value. Its existence is rooted in deep evolutionary goals and should be understood beyond the traditional framework of "rationality."

Keywords: decision-making, irrational bias, mental accounting, evolutionary goals, evolutionary psychology

1. Problem Statement

Traditional economic theory assumes that individuals are rational agents who wisely choose optimal options to maximize their own interests (Smith, 1776/2015; Becker, 1976; Doucouliagos, 1994). However, numerous studies in behavioral economics and economic psychology demonstrate that human decision-making often systematically deviates from rational standards (Kirchler & Hölzl, 2018/2023; Xin, 2014).

A classic experiment illustrates this point: (1) Imagine you plan to attend a performance tonight with a ticket price of 100 yuan. Just as you are about to leave, you realize you have lost 100 yuan in cash. Would you still purchase a ticket to attend the performance? (2) Imagine you purchased a ticket for tonight' s performance yesterday for 100 yuan. Just as you are about to leave, you suddenly realize you have lost the 100-yuan ticket. If you still want to attend the performance, you must spend another 100 yuan to buy a new ticket. Would you still purchase a ticket?

Results showed that in the first scenario, 88% of 200 participants chose to purchase a ticket, whereas in the second scenario, only 46% were willing to repurchase (Kahneman & Tversky, 1984). From an economic perspective, the financial loss is identical in both situations, yet participants' behaviors differ significantly. This behavioral discrepancy reveals that people mentally compart-

mentalize ticket funds into a separate account distinct from other money (e.g., cash), demonstrating the existence of "mental accounting." This anomalous behavior challenges the traditional economic assumption that money should be managed uniformly and is fungible—that any one yuan can be freely substituted for another. Proposed and systematically validated by Thaler (1985, 1999), mental accounting refers to the psychological process of categorizing, coding, and evaluating income and expenditures during economic decision-making (Li & Ling, 2007; Thaler, 1999).

Despite over three decades of rich research findings, most studies follow the paradigms established by Thaler (1985) and Kahneman (Kahneman & Tversky, 1984), focusing on discovering fragmented behavioral anomalies without achieving systematic breakthroughs. We identify two fundamental issues.

First, the classic paradigm confounds the underlying sources of mental accounting. Using the theater ticket task as an example, the observed differences may stem from either budget control through categorization strategies or hedonic associations triggered by account labels. In other words, whether behavioral differences arise from account boundaries themselves or from the content of account labels remains unresolved. If theater tickets were replaced with daily necessities or medical expenses, the effect might weaken or disappear, suggesting that semantic labels could be crucial to mental accounting phenomena.

Second, existing research rarely questions the fundamental origins of mental accounting. If mental accounting is merely an irrational bias, why has it not been eliminated through natural selection but instead persists universally? This suggests it may possess adaptive value. If semantic labels are indeed key, how did humans evolve relatively typical and stable mental account categories? How do the fund management rules within these categories serve evolutionarily relevant goals? Only by placing mental accounting within an evolutionary perspective can we unify explanations of its formation and operation mechanisms.

Based on these considerations, this research adopts an evolutionary psychology perspective (Griskevicius & Kenrick, 2013; Saad, 2007, 2021), proposing that mental accounting and its associated anomalies actually possess evolutionary value. Mental accounting emerged as an adaptive psychological function to address challenges in ancestral environments (typically assumed to be hunter-gatherer societies), helping to achieve goals such as survival and reproduction. For modern humans, manipulating these evolutionary goals may reveal the deep mechanisms underlying mental accounting phenomena. Ultimately, this research will construct an evolutionary origins hypothesis of mental accounting and explore its influence on mental accounting operation processes.

2.1 Five Core Research Themes in Mental Accounting

We have reviewed current developments in mental accounting research and identified five core themes: anomaly discovery, theoretical exploration, practical application, neural mechanism analysis, and individual differences investigation

(Figure 1 [Figure 1: see original paper]). From a disciplinary development perspective, anomaly discovery represents the starting point. This line of research aims to identify economic behaviors that systematically deviate from the rational agent assumption, thereby establishing the universality and characteristics of mental accounting. Building on this foundation, research advances along two pathways: a theoretical pathway that abstracts principles from phenomena to construct models describing specific operational aspects of mental accounting, and an applied pathway that applies theories to consumption, investment, and other domains to test external validity and explanatory power. Recent academic research has also introduced new tools to expand explanations of behavioral anomalies: on one hand, using eye-tracking, EEG, fMRI, and other techniques to reveal emotional arousal, attentional preferences, and brain activation patterns underlying anomalies; on the other hand, scaling mental accounting characteristics to examine individual differences.

Figure 1 Logical diagram of the five core research themes in mental accounting

First, anomaly revelation. This theme focuses on identifying and explaining systematic deviations from the traditional "rational agent"assumption in individual economic decision-making (Liu et al., 2019). Such research fundamentally challenges the basic economic assumption of money fungibility (Thaler, 1999) and provides empirical support for non-fungibility. Non-fungibility refers to individuals' tendency to mentally categorize money based on its source, storage method, and expenditure type, resulting in differential value perception and accounting rules across accounts. In essence, money is endowed with internal labels—this is the core characteristic of mental accounting and its most prominent research focus. This research tradition follows the experimental paradigms established by Thaler (e.g., Thaler, 1985) and Kahneman (e.g., Tversky & Kahneman, 1981), revealing that individuals do not always follow utility maximization principles but are constrained by mental accounting structures. Typical examples include the "labeling effect" (different sources of funds such as windfall gains versus earned income lead to differential consumption) (Pan et al., 2014), as well as the "decoupling effect" and "flypaper effect" (Liu et al., 2019). Such anomaly-focused research represents not only the starting point for mental accounting studies but also a central focus of behavioral economics.

Second, theoretical exploration. Building on identified behavioral anomalies, researchers have constructed theoretical models to explain specific operational aspects of mental accounting. Existing models address account classification rules, resource allocation processes, and internal gain-loss accounting mechanisms. Specifically, Thaler and Shefrin (1981) integrated the life-cycle hypothesis with the non-fungibility concept, proposing a mental accounting classification framework based on income timing and storage methods. Their behavioral life-cycle hypothesis suggests that individuals' willingness to consume from "current income accounts" is significantly higher than from "current asset accounts" and "future income accounts." Heath and Soll (1996) proposed mental budgeting theory, focusing on resource allocation and control mechanisms

across accounts. They divided the budgeting process into "setting"and "tracking" stages: the former refers to individuals' pre-allocation of resources to different expenditure categories (e.g., food, clothing) (Cheema & Soman, 2006), while the latter emphasizes monitoring and adjusting actual expenditures, with efficiency influenced by the typicality of matches between expenditure items and budget categories (Heath & Soll, 1996). Prelec and Loewenstein (1998) proposed the double-entry mental accounting model, describing internal gain-loss accounting mechanisms. They posited that economic transactions involve positive utility from consumption and negative utility from payment, linked by an α coefficient (the degree to which consumption pleasure is diminished by payment pain) and a β coefficient (the degree to which payment pain is alleviated by consumption pleasure) (Li et al., 2012; Prelec & Loewenstein, 1998). Overall, existing theories tend to focus on specific aspects of mental accounting rather than forming an integrated, unified theoretical framework.

Third, practical application. Based on mental accounting anomalies and theoretical mechanisms, numerous studies have applied these concepts to real-world domains such as consumption, marketing, and finance. In consumption and marketing contexts, research focuses on designing more effective promotional strategies using mental accounting principles. For example, the "refund effect" reveals that consumers label returned funds with both consumption and windfall tags, resulting in lower perceived psychological loss and greater likelihood of re-spending (Lee & Morewedge, 2023). In investment and finance, research integrates mental accounting with behavioral portfolio theory (Shefrin & Statman, 2000) to explore how investors construct non-fungible asset hierarchies (e.g., safety accounts versus risk accounts) to build reasonably risky personal financial portfolios (Zhan & Wu, 2022). These applied studies demonstrate how established principles can generate value and intervention strategies, further expanding mental accounting' s real-world explanatory power.

Fourth, neural mechanism analysis. Using various techniques (eye-tracking, EEG, fMRI, transcranial direct current stimulation), researchers have begun decoding the neural basis of mental accounting, focusing on emotional arousal, attentional preferences, and brain region responses. For instance, studies have found that money source labels elicit specific EEG responses: hard-earned funds more readily activate P300 (associated with motivation and arousal), while windfall gains activate LPC (associated with positive emotions and pleasant memories), thereby validating differential emotional responses to funds with different source labels (Pan et al., 2014; Schacht & Sommer, 2009). Amasino (2019) further used eye-tracking experiments to find that high mental budgets shorten gaze duration on products while increasing purchase intention. Additionally, the right dorsolateral prefrontal cortex (DLPFC) directly regulates commitment escalation in sunk cost scenarios. Activating this region via high-definition transcranial direct current stimulation (HD-tDCS) increases exit likelihood, while inhibiting activity strengthens continued investment, establishing a causal link between DLPFC and the sunk cost effect (Wang & Li, 2022). While these studies appear to probe internal cognitive processes, they essentially provide

physiological-level supplementary evidence for known mental accounting characteristics such as non-fungibility and related behavioral anomalies—that is, they merely extend the dependent variable from behavioral performance to neural signals without breaking free from the anomaly discovery paradigm.

Fifth, individual differences research. This theme primarily uses scales to examine individual differences in mental accounting and their influencing factors (Habibah et al., 2018; Muehlbacher & Kirchler, 2019). Rather than adopting a binary perspective on whether mental accounting exists, some researchers prefer to conceptualize mental accounting characteristics as behavioral tendencies or habits from psychometric and personality psychology perspectives, examining the degree to which individuals set and enforce budgets according to mental accounting principles. For example, Antonides et al. (2011) pioneered a self-developed scale measuring consumers' degree of organization and tracking of account usage through four items: "budgeting for different expenditure domains," "not exceeding budgets," "saving on other expenditures when large expenses occur," and "reducing next month' s expenses if this month' s are exceeded." Subsequently, Muehlbacher and Kirchler (2019) used this scale to examine demographic and psychological trait effects, finding that women, less educated individuals, highly conscientious individuals, and low-impulsivity individuals are more inclined to establish and adhere to budgets.

However, such research primarily yields exploratory results and lacks theoretical guidance in selecting relevant factors. Inconsistent conclusions exist regarding many variables such as gender and age. For instance, Antonides et al. (2011) found that women are more inclined to adhere to budgets, whereas Olsen et al. (2019) found no gender differences. More critically, most individual differences research employs correlational designs, making it difficult to provide causal evidence and failing to address the fundamental reasons for mental accounting' s existence.

Overall, from anomaly discovery and theoretical exploration to practical application, these three themes have remained relatively central since mental accounting' s inception, aligning well with the behavioral economics research tradition. Rather than exploring the precise principles and underlying logic of mental accounting' s formation, these studies emphasize discovering anomalies that contradict mainstream economic expectations, constructing theories to advance the discipline, or directly serving practice by pursuing intervention value and market returns. In contrast, cognitive neural mechanism and individual differences research represent more extended explorations and subsequent supplements from psychology researchers using their own tools and perspectives. Temporally, these latter themes emerged later and hold a more supplementary rather than core disciplinary status.

2.2 Key Limitations of Mental Accounting Research

Although existing research has examined mental accounting from five dimensions, these advances essentially remain extensions of Thaler' s initial theory and paradigm, focusing on accumulating evidence, strengthening explanatory and predictive power, and expanding application scenarios across different levels. Despite abundant results, the field exhibits fragmentation and has not achieved systematic theoretical breakthroughs, particularly lacking fundamental transcendence of Thaler's framework. Overall, three main limitations persist.

First, methodological singularity and explanatory ambiguity in paradigms. Regardless of whether the research aims to discover anomalies, expand applications, or explore neural mechanisms, most studies directly follow or only slightly modify the classic experimental paradigms proposed by Thaler and Kahneman & Tversky. These methods typically establish two decision scenarios with identical economic outcomes but different descriptions, observing decision differences. For example, comparing consumption decisions after losing a 100-yuan theater ticket versus 100 yuan in cash (Kahneman & Tversky, 1984), or contrasting spending patterns of windfall gains versus earned income of the same amount (Li et al., 2014), repeatedly validating the core assumption of money non-fungibility. While such paradigms effectively reveal mental accounting' s existence and behavioral manifestations, they fail to distinguish between two possible mechanisms: whether decision differences stem from the control behavior of resource categorization itself or from semantic associations triggered by category labels. Using the theater ticket experiment as an example, participants' different behaviors may originate from self-constraint through budget categorization or from hedonic associations triggered by the "theater ticket" label. Existing research has not clearly distinguished and investigated the influences of account boundaries versus label content.

Second, constrained theoretical perspectives lacking "first-principles" explanations of origins and processes. Since its inception, mental accounting research has adhered more closely to economics and behavioral economics traditions, with psychological methods serving as instrumental supplements. The field emerged by identifying anomalies systematically deviating from rational agent assumptions and emphasizes practical value and market applications. Consequently, research has remained largely limited to describing mental accounting phenomena and making local modifications, failing to deeply explore its cognitive origins and adaptive value. As Medin and Bazerman (1999) noted, the economics tradition often settles for identifying deviations from optimality while ignoring the essence of psychological processes. This leads to several problems. On one hand, research fails to question mental accounting' s evolutionary basis. If mental accounting leads to suboptimal decisions, why has it been preserved through natural selection? Do these seemingly irrational cognitive "flaws" possess adaptive functions? On the other hand, research relatively neglects the psychological definition, goal associations, and execution mechanisms underlying decision-making (Medin & Bazerman, 1999). Even when studies attempt

to refine the boundary conditions of non-fungibility principles (e.g., discovering unidirectional fund flows between accounts), these represent only local modifications without systematically explaining the essential origins of management rules across different accounts. Fundamentally, this reflects a lack of operational definitions of mental accounting processes and examination of deeper motivations. Moreover, if the key to mental accounting non-fungibility lies in account labels—that is, if semantic associations are central to decision differences—we must further ask: How did humans evolve several typical and stable mental account categories? How do their fund management rules serve evolutionary goals?

Third, insufficient explanatory power in applications. Although mental accounting research has been widely applied in consumption, finance, and other domains, methodological and theoretical perspective issues have rendered these applications largely dependent on specific phenomena or local empirical findings, lacking unified theoretical integration. This fragmentation makes it difficult to attribute findings across different contexts to stable psychological mechanisms. For example, fund performance may differ between luxury goods accounts and daily necessities accounts (Gou et al., 2013). The absence of a generalizable framework limits existing research' s predictive power, often allowing only post-hoc verification rather than prospective inference about mental accounting' s role in new contexts. In other words, lacking evolutionary causal explanations, applications rely more on empirical accumulation than theoretical deduction based on unified principles. Therefore, the field urgently needs to develop a universal framework that can operate across contexts and domains to support theoretical deepening and application expansion.

In summary, existing research has not effectively answered three core questions: First, to what extent do mental accounting phenomena stem from semantic label activation versus mere categorization behavior? Second, if mental accounting causes individuals to deviate from utility maximization, does its existence have evolutionary roots and adaptive value? Third, how has evolution shaped mental accounting' s operational mechanisms? In other words, how did humans form relatively stable and typical mental account categories? How do the fund management rules within these categories serve evolutionarily relevant goals? Failure to answer these core questions directly limits mental accounting research' s explanatory and predictive power in general contexts.

2.3 Insights from Evolutionary Psychology for Mental Accounting Research

Specific preferences and decision-making patterns in human economic behavior are likely adaptive products formed through long evolutionary processes to suit environmental demands. Since the 1990s, evolutionary psychology (Saad & Gill, 2000), integrating biology, cognitive science, and social psychology, has provided new perspectives for interpreting economic behavior. It represents a way of thinking about psychological problems and has given rise to evolutionary

economic psychology.

Evolutionary psychology' s core proposition suggests that today' s economic psychology may reflect "Stone Age" selection pressures (Lea, 2008)—that historical environments shaped adaptive behavioral patterns in humans. These behaviors can typically be explained by psychological functions or modules. Currently, four main modules are used to explain economic behavior: reproduction, survival, kin selection, and reciprocal altruism (Saad, 2007). Each module contains a set of strategies for solving specific problems our species faced historically. In short, selection pressures in evolution constitute another "invisible hand" behind economic behavior, influencing today' s economic decisions through various functional modules. For example, reproduction can explain why men favor conspicuous consumption, as it serves mate selection and sexual signaling functions (Sundie et al., 2011).

Although human behavioral patterns result from adaptation to historical environments, they may not align with modern society, potentially generating many seemingly irrational anomalies. Mental accounting manifestations such as labeling effects (e.g., distinguishing between hard-earned money and windfall gains) are classic examples: they appear to violate economic rationality but may actually represent expressions of ecological rationality. In other words, humans need not pursue absolute optimal solutions but only make sufficiently adaptive decisions under environmental constraints (Gigerenzer & Selten, 2002/2016). Ecological rationality research reflects the interaction between human psychology and environment in decision-making, attempting to strip away irrelevant interfering factors to uncover the essential origins of human psychological processes. For example, organ donation rates in France far exceed those in the United States. Traditional approaches exploring personality, attitude, and value differences between the two populations would only analyze the problem' s "surface" while ignoring its "depth." The root of donation differences may lie in an evolutionarily formed common mechanism—people' s tendency not to change default options: in the U.S., the default is non-donation and requires active application to donate, whereas France has the opposite default, showing that diametrically opposed decisions can be traced to the same psychological mechanism (Todd & Gigerenzer, 2007). Evolutionary psychology promises to provide a unified explanatory framework for various psychological anomalies.

Researchers have begun reinterpreting cognitive biases in human economic decision-making from an evolutionary psychology perspective. For example, the "lipstick effect" (increased consumption of beauty products like lipstick during economic recessions) can be analyzed through this framework. The evolutionary psychology perspective suggests this behavior aligns with adaptive strategies for women to maintain physical attractiveness during resource scarcity, potentially representing an evolved psychological mechanism for preserving reproductive value in adverse conditions (Hill et al., 2012).

Focusing on mental accounting, its core characteristics also possess profound evolutionary significance. The classic case of Su Dongpo "taking hanging money

daily" after being demoted represents an adaptive strategy for avoiding survival risks through hard budget constraints in resource-scarce environments. Mental accounting is a psychological tool that internalizes objective budgets and accounts. The non-fungibility principle of this psychological tool (the psychological boundary internalized from objective account boundaries) can effectively prevent individuals from falling into serious financial difficulties when funds are tight (Sui et al., 2020), enhancing survival probability in fluctuating resource environments. Although this ecological rationality mechanism may cause modern consumption biases (e.g., excessive earmarking), it was a key innovation for ancestors to ensure survival. Unfortunately, current research rarely systematically explains mental accounting' s origins from an evolutionary perspective. This research will fill this gap by tracing mental accounting' s adaptive value in human evolution.

3.1 Basic Approach and Research Hypotheses

This research attempts to address three scientific questions from an evolutionary psychology perspective: (1) Do mental accounting effects stem from categorization behavior itself or from content associations triggered by semantic labels? (2) How has evolution shaped the classification structure of mental accounts? (3) How has evolution influenced the management rules of different mental accounts?

We aim to systematically analyze and improve classic research paradigms to distinguish whether mental accounting phenomena originate from categorization behavior or from content associations triggered by semantic labels. Without clarifying this fundamental mechanism, we cannot deeply understand the essence of different mental accounts and their influence mechanisms on individual economic decisions. Existing literature provides some support for both explanatory mechanisms. Categorization, as an automatic cognitive process (Rosch, 1978), can effectively save cognitive resources and improve decision efficiency (Henderson & Peterson, 1992), especially when facing complex information or options (Mormann et al., 2014). From an evolutionary perspective, categorization is a fundamental ability for environmental adaptation, and the division of fund uses can be seen as an efficient manifestation of resource management. Therefore, even without relying on the semantic connotations of labels, simple categorization might produce mental accounting effects.

More evidence supports the role of semantic label content. For example, Kivetz and Simonson (2002) noted that individuals often suppress excessive spending on hedonic items. Life experience also shows that people may refuse to pay extra for repurchasing theater tickets but tend to add expenditures for necessities like food or medicine. Empirical research also shows that consumers are more likely to transfer funds originally planned for luxury goods to daily expenses, while the reverse transfer is less common (Gou et al., 2013). This indicates that labels are not merely categorization markers but also carry specific values and social meanings. We tend to believe that mental accounting phenomena primarily stem

from semantic processing of labels rather than mere categorization processes. Based on this, this research will improve experimental paradigms to separate the effects of categorization and label semantics to test **Hypothesis 1: Mental accounting phenomena primarily originate from individuals' semantic processing of account category label content.**

If semantic label processing is indeed the core mechanism, it further raises questions: Why has this differentiated label semantics been preserved during evolution, and what is the basic form of this label structure? We propose that evolutionary goals shape how mental accounts manage funds and make economic decisions—a process collectively termed mental accounting operation. According to the classic definition of mental accounting, people mentally categorize and evaluate funds (Li & Ling, 2007; Thaler, 1999). Thus, mental accounting operation consists of two interconnected core components: account classification and account management.

First, mental account classification is influenced by evolutionary goals. Existing research often infers account divisions from product attributes. For example, Thaler (1999) proposed a dichotomy of daily expenses versus luxury expenses. Li et al. (2007) used exploratory factor analysis to propose four categories: "living necessities," "family building and personal development," "emotional maintenance," and "hedonic leisure." We argue the former is too narrow, while the latter, though comprehensive, lacks clear internal distinctions, particularly since "family building and personal development"and "emotional maintenance"both essentially involve social relationship investment. Therefore, we merge them and propose three more distinctive mental accounts: living necessities, emotional maintenance, and hedonic leisure.

Mental account divisions can be seen as psychological mappings of resource competition among different goals (Brendl et al., 1998). What goals do humans pursue? Based on Bentham' s utilitarian philosophy, hedonic theory posits that pleasure is the ultimate purpose of human behavior, rather than self-interest maximization or Pareto optimality. However, pleasure must be premised on survival and reproduction. According to evolutionary theory, survival and reproduction are the most basic challenges in human evolutionary history, with motivations deeply inscribed in genes as instinctive and unconscious drives (Saad, 2007, 2021). Accordingly, we assume humans have three evolutionary goals: survival, reproduction, and hedonic well-being. The survival goal ensures basic individual and family subsistence; the reproduction goal serves gene continuation and social relationship maintenance; the hedonic goal represents further pursuit of pleasure after basic needs are met.

In modern consumption contexts, these three evolutionary goals correspond to three typical mental accounts: the survival goal manifests as the living necessities account (basic guarantees like food, housing, medical care); the reproduction goal manifests as the emotional maintenance account (investment in children, partners, and relatives to maintain relationships and social support networks); the hedonic goal manifests as the hedonic leisure account (pursuit of pleasure

through entertainment, travel, luxury consumption).

Thus, mental account classification is not merely a superficial division of expenditure content but likely a psychological projection of deep evolutionary goals. Therefore, we propose **Hypothesis 2: The three evolutionary goals shape mental account classification—namely, living necessities, emotional maintenance, and hedonic leisure accounts.**

Second, mental account management is regulated by evolutionary goals. Although existing research has separately examined expenditure preferences (Li et al., 2014) and payment willingness (Gou et al., 2013), there remains no holistic definition of account management. We argue that if mental account classification answers "where funds are stored," management answers "how funds are allocated in actual situations." Drawing on mental budgeting theory (Heath & Soll, 1996), this research further subdivides account management into three interconnected components: budget allocation, budget reinforcement, and budget constraint. This division is based on the logic that individuals face three fundamental questions at different stages of resource management: how to initially allocate resources, whether to add inputs when accounts are insufficient, and whether to allow transfers from this account when other accounts lack funds. Decomposing account management into these three components can comprehensively reveal the processual complexity of mental accounting.

The rigor of mental account management varies. For example, people may refuse to add budget for theater tickets (Kahneman & Tversky, 1984) but are willing to overspend for necessities; similarly, funds in luxury accounts are more easily diverted to subsidize other accounts, while daily expense accounts are less likely to be reappropriated (Gou et al., 2013). We speculate that the more important the evolutionary goal behind an account, the stronger its internal resource protection, manifested as stricter account management. Combining Maslow' s hierarchy of needs with evolutionary priorities (Buss, 1998/2007; Maslow, 1948), we believe the survival goal is most important, followed by the reproduction goal, with the hedonic goal at the lowest level. Accordingly, we propose **Hypothesis 3: The importance of evolutionary goals determines the rigor of mental account management, manifested in three aspects.** (1) **Budget allocation priority:** Living necessity accounts receive the largest quotas in budget formulation, while hedonic leisure accounts are the primary targets for reduction. (2) **Budget reinforcement priority:** When living necessity accounts face shortages, individuals are more inclined to use funds from other accounts for supplementation, whereas willingness to add funds to hedonic leisure accounts is lower. (3) **Budget constraint strength:** Accounts with more important goals are more difficult to reappropriate, with budget constraint strength decreasing sequentially across living necessity, emotional maintenance, and hedonic leisure accounts.

3.2 Research Design

We designed four studies to test the evolutionary origins hypothesis of mental accounting (Figure 2 [Figure 2: see original paper]). Study 1 aims to clarify the underlying logic of mental accounting phenomena by testing whether they stem from semantic processing of mental account label content rather than mere categorization operations, addressing scientific question 1 and testing Hypothesis 1. Study 2 adopts an evolutionary perspective to examine whether typical mental account classifications match the three core evolutionary goals of survival, reproduction, and hedonic well-being, revealing how evolutionary goals shape account classification, addressing scientific question 2 and testing Hypothesis 2. Studies 3 and 4 address scientific question 3 and test Hypothesis 3 from the perspectives of goal importance and goal activation, respectively. Study 3 examines the role of semantic labels in account management, testing whether different account types show systematic differences in budget allocation, budget reinforcement, and budget constraint, and deducing their priority sequence. Study 4 focuses on the causal effects of evolutionary goals by manipulating different goals to test the management rigor of corresponding accounts in actual operation.

Figure 2 Research conceptual framework for the evolutionary origins hypothesis of mental accounting

3.2.1 Study 1: The Underlying Logic of Mental Accounting Phenomena

Study 1 reveals the underlying logic of mental accounting phenomena by deconstructing the two confounded mechanisms in Kahneman and Tversky' s classic "theater ticket" task (Kahneman & Tversky, 1984). This task found that 88% of participants still purchased tickets after losing 100 yuan in cash, while only 46% were willing to repurchase after losing an already-purchased ticket. Although this difference confirms mental accounting' s non-fungibility, it cannot distinguish whether the phenomenon stems from budget control through categorization strategies or from semantic associations that hedonic consumption is not worth additional expenditure.

To clarify the mechanism, this research manipulates the meaningfulness of account labels by establishing two conditions: semantic labels versus meaningless labels, with the dependent variable being participants' repurchase intention. In the meaningless label condition, we adapted the original paradigm by replacing "theater ticket" with the meaningless category "Product A" to strip away hedonic semantic associations. Participants read and responded to two scenarios: (1) Imagine you plan to purchase Product A (priced at 100 yuan) tonight, but before buying, you discover you have lost Product B worth 100 yuan. Would you still purchase Product A? (2) Imagine you purchased Product A yesterday for 100 yuan, but when using it, you suddenly discover it is lost. If you want to continue using it, you must spend another 100 yuan to purchase it. Would you still purchase Product A?

If the repurchase rate difference significantly weakens or disappears in the meaningless label condition, we can infer that semantic association is an important cause of mental accounting phenomena.

3.2.2 Study 2: Evolutionary Goals Shape Mental Accounting Categories

Study 2 aims to verify the evolutionary characteristics underlying mental accounting by testing the correspondence between the three typical mental accounts and the evolutionary goals of survival, reproduction, and hedonic well-being.

Study 2a uses a questionnaire method, developing a consumption purpose questionnaire based on the three evolutionary goals. Participants are asked to identify the primary reason people purchase certain product categories. The higher the proportion selecting a particular goal, the more central that goal is in that mental account category, providing explicit evidence for the correspondence between account classification and evolutionary goals.

Study 2b uses the Implicit Association Test combined with EEG indicators to explore the correspondence between mental account labels and evolutionary goals from an implicit cognitive perspective. The experiment uses mental account label words and evolutionary goal words as concept and attribute words, designing compatible tasks (account labels match evolutionary goals: living necessities correspond to survival, emotional maintenance to reproduction, hedonic leisure to hedonic goals) and incompatible tasks (mismatched), while recording reaction times, accuracy rates, and relevant EEG indicators. Expected results are shorter reaction times, lower error rates, and lower activation of EEG components related to cognitive conflict and expectancy violation for compatible tasks.

In summary, Study 2 will establish correspondences between mental account categories and evolutionary goals at both explicit and implicit levels, verifying evolutionary goals' shaping role in mental account classification.

3.2.3 Study 3: Hierarchical Rigor in Mental Account Management

Study 3 tests differences in mental account management rigor across different semantic labels, verifying whether mental accounts exhibit an importance hierarchy. Based on the aforementioned three-component framework of budget allocation, budget reinforcement, and budget constraint, Study 3 comprises three sub-studies.

Study 3a tests the hierarchy of budget allocation priority in mental accounts. Participants are asked to allocate monthly income among living necessity, emotional maintenance, and hedonic leisure expenditures (including specific items such as dining, medical care, social gifts, clothing, travel, pets) and verbally

report their allocation logic. Expected results are that living necessity expenditures are considered first and receive the largest allocation, followed by emotional maintenance, with hedonic leisure having the lowest priority.

Study 3b tests the hierarchy of budget reinforcement priority in mental accounts. We adapted the theater ticket task, replacing the product with items belonging to living necessity, emotional maintenance, and hedonic leisure categories. We recorded repurchase intentions after losing items to reflect reinforcement tendencies. Expected results are that repurchase rates are highest for living necessity expenditures and lowest for hedonic leisure expenditures.

Study 3c tests the hierarchy of budget constraint strength in mental accounts. We adapted the mental budget constraint task (Xin et al., 2023), asking participants to judge whether they would reappropriate funds to purchase non-category items when living necessity, emotional maintenance, and hedonic leisure accounts have surplus budgets. Expected results are that surplus budgets in living necessity accounts are most difficult to reappropriate, followed by emotional maintenance, with hedonic leisure being easiest to reappropriate.

In summary, Study 3 attempts to verify the hierarchical pattern of mental account management rigor: living necessity accounts are managed most strictly, emotional maintenance moderately, and hedonic leisure most loosely. This hierarchy aligns with the importance order of the three evolutionary goals of survival, reproduction, and hedonic well-being.

3.2.4 Study 4: Evolutionary Goals Shape Mental Account Management Processes

Study 4 focuses on the causal effects of evolutionary goals by manipulating different goals to test the management rigor of corresponding accounts in actual operation. According to query theory (Johnson et al., 2007), decision-makers follow an ordered information query sequence when making judgments. Information queried first dominates cognition and consumes resources, thereby inhibiting subsequent queries. Consequently, information entering the query sequence earlier accumulates more evidence and receives greater weight.

Based on this, we infer that the activation status of evolutionary goals can regulate mental account management processes. Building on Study 3' s paradigm, Study 4 activates participants' different evolutionary goals and detects changes in account management across budget allocation, budget reinforcement, and budget constraint components. The research methods remain consistent with Study 3. We expect that when an evolutionary goal is activated, its corresponding account will receive higher priority in the query sequence, thereby exhibiting stricter account management—higher budget allocation priority, budget reinforcement priority, and budget constraint strength.

4. Theoretical Construction and Research Value

Through literature review and logical deduction, combined with empirical research, we attempt to construct an evolutionary origins model of mental accounting to explain the possible hypothesis that mental accounting phenomena represent adaptive cognitive mechanisms formed through extensive evolution.

In summary, facing survival challenges from resource fluctuations in the Stone Age and growing pursuit of psychological values like hedonic well-being, natural selection shaped a resource management mechanism oriented by three evolutionary goals (survival, reproduction, hedonic well-being): the survival goal protects basic resources through high-intensity management, shaping the living necessity expenditure account; the reproduction goal drives mate selection and parental investment, forming the emotional maintenance expenditure account; the hedonic goal activates when resources are relatively redundant, making the hedonic leisure expenditure account a pathway for obtaining positive psychological value after satisfying survival and reproduction goals. This system constructs mental account boundaries through cognitive isolation. Its surface irrationality (e.g., dedicated medical savings) is actually an ecologically rational strategy for preventing resource depletion in ancestral environments (Gigerenzer & Selten, 2002/2016).

Modern humans inherit this cognitive mechanism, with account management matching and regulated by evolutionary goal priorities. As shown in Figure 3 [Figure 3: see original paper], this evolutionary origins model follows strict value hierarchy principles: survival goals have the highest value priority, followed by reproduction goals, with hedonic goals at the lowest level. This hierarchy directly shapes corresponding mental account management rigor, manifested as living necessity accounts having the highest budget allocation priority, budget reinforcement priority, and budget constraint strength, followed by emotional maintenance accounts, with hedonic leisure accounts being the least strict.

Figure 3 Theoretical schematic diagram of the evolutionary origins hypothesis of mental accounting
Note: Black arrows indicate budget formulation; black curved arrows indicate budget reinforcement; gray curved arrows indicate budget constraint.

This research proposal demonstrates significant theoretical innovation. As Thaler himself stated in *Misbehaving* (Thaler, 2015/2016, p. 66), "···mental accounting···is like a lens that can help me understand the world more deeply." To date, this "lens" has successfully revealed the cognitive origins of many behavioral anomalies. Now, we polish this "lens" and integrate it into dual perspectives of "telescope" and "microscope."

First, this research begins with Kahneman and Tversky' s classic theater ticket study (Kahneman & Tversky, 1984), stripping away the two confounded explanatory mechanisms in this phenomenon to deeply analyze mental accounting' s underlying logic, demonstrating that it stems not merely from categorization

strategies but is rooted in profound semantic association mechanisms.

Second, we adjust the lens to a broader evolutionary scale, systematically tracing mental accounting' s evolutionary logic and adaptive value as an underlying mechanism, thereby seeking more fundamental explanations in the biological and cultural roots of human decision-making anomalies. Specifically, this research hypothesizes that mental accounting' s essence is a cognitive resource allocation system evolved to solve three levels of evolutionary goals: survival, reproduction, and hedonic well-being. By establishing mapping relationships between account types and evolutionary goals (i.e., living necessity accounts match survival goals, emotional maintenance accounts match reproduction goals, hedonic leisure accounts match hedonic goals), we reveal for the first time that so-called decision anomalies are actually explicit manifestations of "ecological rationality" with deep adaptive value.

Finally, we focus the "microscope" precisely on mental accounting' s internal operation process. We operationally define mental accounting operation as two major components—classification and management—then subdivide management into three interconnected sub-components: budget allocation, budget reinforcement, and budget constraint. This decomposition directly corresponds to core problems repeatedly encountered by individuals in real resource regulation contexts, helping to comprehensively reveal mental accounting' s internal operational logic. Furthermore, this research uses the value hierarchy of evolutionary goals to characterize and explain mental accounting patterns and their differences, proposing that evolutionary goal activation enhances value perception of corresponding mental accounts, causing them to exhibit stricter management in actual operation, specifically manifested as higher budget allocation priority, budget reinforcement priority, and budget constraint strength.

By integrating macro-level evolutionary origins with micro-level operational mechanisms, and theoretical deduction with empirical evidence, this research constructs an evolutionary origins hypothesis of mental accounting that bridges the complete chain from the ultimate question of "why mental accounting exists" to the process mechanisms of "how mental accounting operates," bridging the core theoretical gap in this field and avoiding the fragmentation dilemma caused by recent mental accounting research' s excessive focus on specific components. Through this two-way mutual verification of macro origins and micro mechanisms, we provide a profound adaptive, ecologically rational interpretation for mental accounting' s "irrationality" between ancient human wisdom and contemporary minds.

This research' s practical value lies in providing a systematic "theoretical key" for economic decision-making. On the marketing side, businesses can precisely design appeals based on evolutionary goal semantics. For living necessity accounts (e.g., insurance), highlight crisis defense labels to activate ancient survival protection mechanisms; for emotional maintenance accounts (e.g., gifts), embed gene inheritance imagery to evoke parental investment instincts; for hedonic leisure accounts, avoid semantic conflict with survival frameworks (e.g., avoid

packaging luxury goods as necessities) to prevent triggering cognitive dissonance. On the consumption side, individuals can use evolutionary goal value priorities for personal resource management. Assign clear survival value labels to living consumption and lock funds through separate accounts or physical isolation to reduce impulsive reappropriation risks; use flexible budgets for hedonic accounts (e.g., monthly floating entertainment funds). Thus, both marketing and self-management no longer confront economic rationality but achieve fine-tuned interventions that work with evolutionary logic.

This research proposes an evolutionary origins model of mental accounting, revealing its adaptive value under three goals of survival, reproduction, and hedonic well-being, and explaining its operation through mechanisms of account classification, budget allocation, reinforcement, and constraint. To further verify the theory' s scientific validity and practical guidance, future research can introduce typical application scenarios such as medical savings, parental investment, or leisure consumption to test the role of mental accounts based on different evolutionary goals in real economic decisions. By observing mental accounting classification and management patterns in specific contexts, we can not only deepen understanding of its evolutionary nature but also enhance the theory' s application value, providing empirical support for economic behavior intervention, market strategy, and individual resource management.

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Note: Figure translations are in progress. See original paper for figures.