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The Influence Mechanism of Villagers' Behavior on the Effect of Rural Living Environment Improvement: A Research Framework from the Perspective of Neuromanagement

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ABSTRACT

Improving the rural living environment constitutes a critical mission in building a modern socialist country and advancing ecological civilization. As the core actors of rural environmental governance, villagers' individual traits, attitudes toward policy implementation, and consequent behaviors jointly shape the final policy outcomes. Adopting the theoretical lens of neuromanagement, this study develops a set of analytical hypotheses regarding the feedback loop between villagers' behavioral decisions and governance effects, and proposes an empirical pathway using event-related potential (ERP) and functional magnetic resonance imaging (fMRI) techniques. This research provides evidence-based support for policymakers to refine interventions and advance high-quality rural revitalization.

Keywords: rural living environment improvement; villagers' behavior; decision-effect feedback; neuromanagement; cognitive neuroscience

1. Introduction

Rural living environment improvement is a core component of rural construction and a key pillar of the rural revitalization strategy. It bears directly on farmers' well-being, agricultural prosperity, and rural social harmony. The 19th National Congress of the Communist Party of China identified "ecological livability" and "effective governance" as central goals of rural revitalization. As a major dimension of ecological civilization, improving the rural living environment embodies a people-centered development philosophy and carries both theoretical and practical significance for building ecologically friendly villages, boosting rural revitalization, and sustaining social stability.

To ensure effective linkage between poverty alleviation and rural revitalization, the *Outline of the*

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14th Five-Year Plan for National Economic and Social Development and the Long-Range Objectives Through 2035 emphasizes strengthened rural planning, upgraded infrastructure and public services, and improved rural living environments. During the 13th Five-Year Plan period, comprehensive environmental improvement was completed in 150,000 administrative villages, covering solid waste and sewage treatment, the "toilet revolution," and village greening. Nevertheless, substantial regional disparities persist in governance effectiveness, which are closely associated with villagers' behavioral responses. As the primary stakeholders and direct beneficiaries, villagers differ in lifestyle, education, and geographic context, leading to heterogeneous attitudes toward policy implementation. Their behavioral decisions thus exert profound impacts on policy outcomes. It is therefore essential to uncover the internal logic linking villagers' behaviors to the effectiveness of rural environmental governance.

Neuromanagement, an emerging interdisciplinary field integrating management science and cognitive neuroscience, enables researchers to reveal the neurophysiological foundations of individual and group decision-making. In recent years, advances in neuroscience have been increasingly applied to behavioral and decision studies, overcoming limitations of conventional management approaches. From a neuromanagement perspective, this study examines how villagers' behavioral decisions influence rural living environment improvement, constructs an integrated analytical framework, and provides insights for policy design and rural development.

2. Literature Review

Existing research confirms that villagers' willingness to participate in environmental governance either facilitates or hinders policy implementation. Wang et al. (2011) found that income and education shape villagers' willingness to participate in waste management. Miao et al. (2012) documented that personal health behaviors and attitudes significantly affect household toilet renovation. However, such studies focus largely on behavioral intention rather than the causal mechanisms linking actual behaviors to governance outcomes. Li (2018) conceptualized individual behavior as volitional action reflecting internal states, wherein perception, attitude, and intention jointly shape responses to public policies. Perception underpins attitude, and attitude predisposes behavior. In rural environmental governance, villagers' participation is correlated with intention but not fully determined by it.

Rural communities represent micro social-ecological systems. Individual behaviors aggregate into collective actions, which in turn generate feedback in response to external policy stimuli. When policies are disseminated by village cadres, villagers' perceived policy relevance and satisfaction with local governance motivate endogenous behavioral responses. As highlighted by social relation theory, aggregated collective behaviors reflect shared norms and collectively shape policy outcomes. Cai et al. (2021) showed that divergent compensation schemes in urban-

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village renewal generate gaps in villagers' policy satisfaction. In practice, top-down enforcement and asymmetric information transmission erode trust and satisfaction, indicating that villagers form context-dependent motives and behaviors that feed back into governance performance. Jiang (2021) observed that policy information and political participation occur in localized settings, often triggering tensions between public goals and private interests. Villagers rely on cadres for localized interpretation and iterative communication to reach consensus, underscoring that villagers' feedback behaviors directly determine policy implementation.

Current studies on villagers' policy impacts are predominantly empirical or qualitative, and analyses of decision-behavior-policy linkages remain confined to traditional management frameworks. Drawing on cutting-edge neuromanagement and cognitive neuroscience, this study introduces ERP techniques to capture the neural underpinnings of villagers' decisions and to establish a causally identifiable influence mechanism.

3. A Neuromanagement Framework for Villagers' Behavior

3.1 Neurophysiological Foundations of Villagers' Behavioral Decisions

A core postulate in neuroscience holds that sensation, motor function, instinct, and cognition arise from neural processing. Human neural information processing encompasses two distinct modes: controlled processing and automatic processing. Controlled processing involves deliberate, effortful, and relatively slow reasoning susceptible to emotional influence, typically triggered by novelty or challenge. Automatic processing is intuitive, habitual, and less cognitively demanding, reflecting innate predispositions such as approach-avoidance tendencies.

In rural environmental governance, villagers exhibit both automatic responses—such as intuitive resistance to unfamiliar policies—and controlled deliberation over costs and benefits. Their bounded rationality, self-interested motives, and social interactions jointly produce integrated affective and cognitive appraisals that guide behavior. Cognitive neuroscience tools thus enable precise measurement of decision processes.

Common neuromanagement methods include brain imaging techniques such as MEG, MRI, fMRI, EEG, ERP, and PET. Among these, ERP is an endogenous evoked potential closely tied to cognitive functions including recognition, comparison, memory, judgment, and choice. It captures rapid neuroelectrophysiological changes by averaging signals across repeated stimuli to enhance signal-to-noise ratio. The N1 component (peaking 100–150 ms post-stimulus over anterior scalp regions) reflects early attentional resource allocation; greater experience reduces N1 amplitude. The P300 component (300–1000 ms post-stimulus) indexes stimulus evaluation and decision-making effort: higher decision resource demand corresponds to lower P300 amplitude.

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3.2 Framework Development and Hypotheses

Integrating insights from cognitive neuroscience, this study establishes a three-system neuromanagement model of villagers' decision-making and policy feedback.

Villagers continuously process environmental governance information via **System 1: Neural Perception and Processing**, which filters inputs based on individual characteristics and social interactions. In the early stage, education, income, age, and relationships with village cadres and peers shape policy perception and filtering.

Hypothesis 1 (H1): Individual differences moderate villagers' neural perception and processing of rural living environment improvement policies.

Hypothesis 2 (H2): Interpersonal relationships moderate villagers' neural perception and processing of rural living environment improvement policies.

In the intermediate stage, perceived information activates **System 2: Automatic Processing**, which relies on intuition and prior experience to generate fast, low-effort affective decisions.

Hypothesis 3 (H3): Neural perception activates the automatic system, leading to intuitive/affective decisions.

Simultaneously, motivated by self-protection, villagers engage in **System 3: Controlled Processing**, which involves deliberate cost–benefit analysis and rational decision-making. Outcomes of controlled processing update the knowledge base of the automatic system.

Hypothesis 4 (H4): Neural perception activates the controlled system, leading to deliberative/rational decisions.

Hypothesis 5 (H5): The automatic system and prior experience jointly activate the controlled system to support rational decisions.

Hypothesis 6 (H6): The controlled system reciprocally activates the automatic system to shape intuitive decisions.

Collectively, individual decisions form aggregate behavioral forces that either facilitate or impede policy implementation, thereby determining governance effectiveness. Because environmental improvement is long-term and iterative, current outcomes form the context for subsequent rounds of policy–behavior interaction.

Hypothesis 7 (H7): Villagers' behavioral decisions and responses significantly affect the effectiveness of rural living environment improvement policies.

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Hypothesis 8 (H8): The feedback loop between villagers' behavioral decisions and governance outcomes is cyclical.

4. Empirical Strategy Using ERP and fMRI

This study employs a multi-experiment neuromanagement design combining **ERP** and **fMRI** to trace external behaviors and internal neural activities.

Experiment 1 (Test of H1) Holding interpersonal similarity constant, compare groups differing in age, education, and economic status. Measure neural responses to policy stimuli using ERP/fMRI. Inconsistent neural changes across groups support H1.

Experiment 2 (Test of H2) Holding demographic characteristics constant, compare villagers in simple vs. complex social networks. Inconsistent neural activation patterns support H2.

Experiment 3 (Test of H3 & H4) Using standardized ERP/fMRI protocols, detect activation of automatic and controlled systems following policy stimuli. Significant changes in diagnostic neural components support H3 and H4.

Experiment 4 (Test of H5 & H6) Compare villagers with and without prior policy experience. Earlier activation of the automatic system among experienced villagers supports H5. Reciprocal or reversed activation supports H6.

Experiment 5 (Test of H7) Define and classify behavioral responses; construct a governance performance index. Use large-sample regression to verify the causal effect of villagers' behaviors on policy outcomes.

Experiment 6 (Test of H8) Implement repeated measurement across policy phases using time-series and longitudinal designs to confirm cyclical feedback between decisions and effects.

5. Discussion and Implications

This study develops a **neuromanagement-based decision–policy feedback framework** to explain variations in rural living environment improvement. Enhancing villagers' environmental awareness and encouraging proactive engagement are critical to improving governance quality. A villager-centered, government-led model is essential for sustainable environmental governance and Beautiful China initiatives.

With advancing interdisciplinary integration, neuroscientific tools offer unprecedented opportunities to unpack motivational, cognitive, and behavioral mechanisms in management settings. Although neuromanagement is still evolving, its applications in environmental and rural governance demonstrate high potential. Further neuromanagement research can improve

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organizational efficiency, refine policy instruments, and strengthen evidence-based decision-making in public management.

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