The Role of the Ventromedial Prefrontal Cortex (vmPFC) in Changing Personal Beliefs or Attitudes

1. Introduction

The ventromedial prefrontal cortex (vmPFC) is a central hub in the brain for integrating affective, social, and value-based information, playing a pivotal role in the formation, maintenance, and updating of personal beliefs and attitudes. Research shows that the vmPFC encodes the subjective value of beliefs, mediates optimism and self-enhancement biases, integrates social feedback, and supports flexible adaptation of attitudes in response to new information or changing contexts (Kuzmanovic et al., 2018; Kuzmanovic et al., 2016; Will et al., 2017; Benoit et al., 2019; Elder et al., 2023; Hiser & Koenigs, 2017; Roy et al., 2012; Koban et al., 2021; Lieberman et al., 2019; Chang et al., 2018; Geuter et al., 2017; Asp et al., 2012; Schneider & Koenigs, 2017; Kim & Johnson, 2015; Cristofori et al., 2015). The vmPFC interacts with other prefrontal and limbic regions to filter, evaluate, and update beliefs, often in a way that promotes coherence, positivity, and self-relevance. Damage or dysfunction in the vmPFC can lead to increased credulity, impaired doubt, and maladaptive social or moral judgments (Asp et al., 2012; Schneider & Koenigs, 2017; Taber-Thomas et al., 2014; Cristofori et al., 2015). This review synthesizes evidence from neuroimaging, lesion, and computational studies to clarify the vmPFC's role in belief and attitude change.

2. Methods

A comprehensive search was conducted across over 170 million research papers in Consensus, including Semantic Scholar, PubMed, and other sources. The Deep Search process involved 20 targeted queries grouped into 8 thematic clusters, focusing on foundational theories, mechanistic specificity, alternate terminology, contrasting perspectives, interdisciplinary expansion, adjacent constructs, and citation graph exploration. In total, 1,031 papers were identified, 563 were screened, 328 were deemed eligible, and the top 50 most relevant papers were included in this review.

Search Strategy

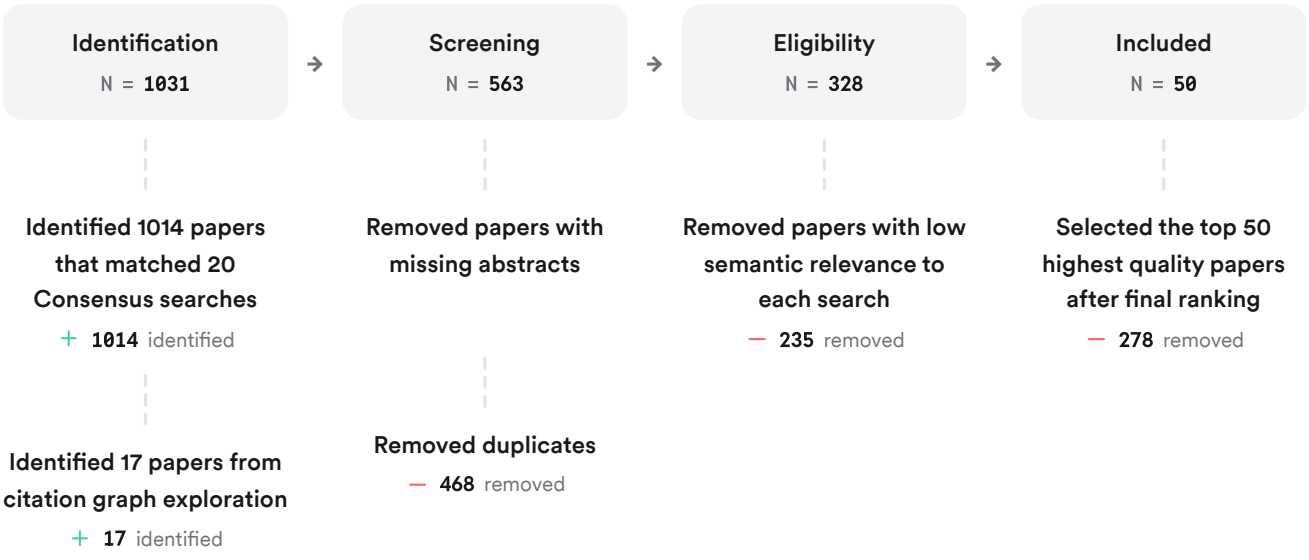

FIGURE 1 Flow diagram of the literature search and selection process.

3. Results

3.1. Value-Based Updating and Optimism Bias

- The vmPFC encodes the subjective value of belief updates, especially favoring information that supports desirable or optimistic beliefs about oneself and the future (Kuzmanovic et al., 2018; Kuzmanovic et al., 2016; Will et al., 2017; Benoit et al., 2019; Elder et al., 2023; Koban et al., 2021; Lieberman et al., 2019; Kim & Johnson, 2015; Cristofori et al., 2015). This valence-dependent filtering leads to an optimism bias, where positive information is more readily incorporated into beliefs than negative information (Kuzmanovic et al., 2018; Kuzmanovic et al., 2016; Will et al., 2017).
- The vmPFC's influence on other prefrontal regions (e.g., dorsomedial PFC) predicts the magnitude of this bias and the tendency to form beliefs that maximize psychological well-being (Kuzmanovic et al., 2018; Kuzmanovic et al., 2016; Will et al., 2017; Benoit et al., 2019).

3.2. Self-Referential and Social Feedback Integration

- The vmPFC is highly engaged during self-referential belief updating, integrating social feedback and supporting the maintenance of a coherent and positive self-concept (Will et al., 2017; Benoit et al., 2019; Elder et al., 2023; Pfeifer & Berkman, 2018; Koban et al., 2021; Lieberman et al., 2019; Chang et al., 2018).
- It tracks the affective value of belief changes, especially when updating self-related beliefs in response to social evaluation or feedback (Will et al., 2017; Benoit et al., 2019; Elder et al., 2023; Pfeifer & Berkman, 2018; Koban et al., 2021; Lieberman et al., 2019; Chang et al., 2018).
- The vmPFC also acts as a gatekeeper, modulating the recruitment of cognitive resources for belief revision under uncertainty (Wang et al., 2023; Trudel et al., 2020).

3.3. Simulation, Imagination, and Attitude Change

- The vmPFC supports the simulation of hypothetical or future events, allowing individuals to imagine alternative scenarios and transfer affective value between elements, which can change attitudes toward people, places, or ideas (Benoit, 2019; Benoit et al., 2019; Konu et al., 2020; Chang et al., 2018).
- Episodic simulation and affective meaning generation in the vmPFC facilitate attitude change even in the absence of direct experience (Benoit, 2019; Benoit et al., 2019; Konu et al., 2020; Chang et al., 2018).

3.4. Doubt, Credulity, and Moral Judgment

- Lesion studies show that damage to the vmPFC impairs the ability to doubt or "false tag" misleading information, leading to increased credulity and susceptibility to persuasive or deceptive messages (Asp et al., 2012; Schneider & Koenigs, 2017; Taber-Thomas et al., 2014; Cristofori et al., 2015).
- The vmPFC is necessary for integrating emotional and utilitarian appraisals in moral judgment, and for opposing personal moral violations by mediating anticipatory, self-focused emotional reactions (Hutcherson et al., 2015; Taber-Thomas et al., 2014; Cristofori et al., 2015).

Key Papers

Paper	Methodology	Key Focus	Key Results
(Kuzmanovic et al., 2018)	fMRI, computational modeling	Optimism bias in belief updating	vmPFC encodes valence of updates, biases beliefs toward desirable outcomes
(Kuzmanovic et al., 2016)	fMRI	Self-referential belief updates	vmPFC tracks subjective value of self-related belief changes, especially for positive updates
(Benoit et al., 2019)	fMRI, behavioral	Simulation-induced attitude change	vmPFC codes affective value transfer during imagined scenarios, changing attitudes
(Asp et al., 2012)	Lesion study	Credulity and doubt	vmPFC damage increases credulity for misleading information, impairs doubt mechanism
(Taber-Thomas et al., 2014)	Lesion study	Moral judgment	Early vmPFC lesions impair development of moral judgment beyond self-interest

FIGURE 2 Comparison of key studies on vmPFC and belief/attitude change.

Top Contributors

Type	Name	Papers
Author	M. Koenigs	(Hiser & Koenigs, 2017; Schneider & Koenigs, 2017; Taber-Thomas et al., 2014)
Author	B. Kuzmanovic	(Kuzmanovic et al., 2018; Kuzmanovic et al., 2016)
Author	R. Benoit	(Benoit, 2019; Benoit et al., 2019)
Journal	*The Journal of Neuroscience*	(Kuzmanovic et al., 2018; Elder et al., 2023; Hutcherson et al., 2015)
Journal	*NeuroImage*	(Kuzmanovic et al., 2016; Harrison et al., 2017)
Journal	*Nature Communications*	(Benoit et al., 2019; Rouault et al., 2019)

FIGURE 3 Authors & journals that appeared most frequently in the included papers.

4. Discussion

The vmPFC is a central integrator of affective, social, and value-based information, shaping how personal beliefs and attitudes are formed and updated. Its role in encoding the subjective value of belief updates explains why people are more likely to adopt beliefs that are desirable or self-enhancing, contributing to optimism and self-coherence biases (Kuzmanovic et al., 2018; Kuzmanovic et al., 2016; Will et al., 2017; Benoit et al., 2019; Elder et al., 2023; Koban et al., 2021; Lieberman et al., 2019; Chang et al., 2018; Geuter et al., 2017; Kim & Johnson, 2015; Cristofori et al., 2015). The vmPFC's involvement in integrating social feedback and simulating hypothetical scenarios allows for flexible adaptation of attitudes, even in the absence of direct experience (Benoit, 2019; Benoit et al., 2019; Konu et al., 2020; Chang et al., 2018). Lesion studies highlight the vmPFC's necessity for doubt, skepticism, and moral reasoning, with damage leading to increased credulity and impaired moral development (Asp et al., 2012; Schneider & Koenigs, 2017; Taber-Thomas et al., 2014; Cristofori et al., 2015).

The vmPFC's functions are not isolated; it interacts with other prefrontal and limbic regions to balance motivational, emotional, and cognitive demands during belief and attitude change (Kuzmanovic et al., 2018; Kuzmanovic et al., 2016; Will et al., 2017; Benoit et al., 2019; Elder et al., 2023; Hiser & Koenigs, 2017; Roy et al., 2012; Koban et al., 2021; Lieberman et al., 2019; Chang et al., 2018; Geuter et al., 2017; Asp et al., 2012; Schneider & Koenigs, 2017; Kim & Johnson, 2015; Cristofori et al., 2015). However, the precise mechanisms and subregional specializations within the vmPFC remain areas of active investigation.

Claims and Evidence Table

Claim	Evidence Strength	Reasoning	Papers
vmPFC encodes subjective value of belief updates, biasing beliefs toward desirable outcomes	Strong	fMRI and computational studies show valence-dependent updating	(Kuzmanovic et al., 2018; Kuzmanovic et al., 2016; Will et al., 2017; Benoit et al., 2019; Elder et al., 2023; Koban et al., 2021; Lieberman et al., 2019; Chang et al., 2018; Kim & Johnson, 2015; Cristofori et al., 2015)
vmPFC integrates social feedback and supports self-referential belief updating	Strong	Neuroimaging and behavioral studies link vmPFC to self-concept and social feedback	(Will et al., 2017; Benoit et al., 2019; Elder et al., 2023; Pfeifer & Berkman, 2018; Koban et al., 2021; Lieberman et al., 2019; Chang et al., 2018)
vmPFC supports simulation-induced attitude change via affective value transfer	Moderate	Imagination and simulation studies show vmPFC codes for affective value transfer	(Benoit, 2019; Benoit et al., 2019; Konu et al., 2020; Chang et al., 2018)
vmPFC is necessary for doubt and skepticism; damage increases credulity	Strong	Lesion studies show impaired doubt and increased credulity with vmPFC damage	(Asp et al., 2012; Schneider & Koenigs, 2017; Taber-Thomas et al., 2014; Cristofori et al., 2015)
vmPFC integrates emotional and utilitarian appraisals in moral judgment	Moderate	fMRI and lesion studies show vmPFC integrates multiple value signals in moral decisions	(Hutcherson et al., 2015; Taber-Thomas et al., 2014; Cristofori et al., 2015)

FIGURE Key claims and support evidence identified in these papers.

5. Conclusion

The ventromedial prefrontal cortex is a key neural substrate for changing personal beliefs and attitudes, integrating affective value, social feedback, and self-relevance to guide belief updating, attitude change, and moral reasoning. Its function supports psychological well-being, coherence, and adaptive social behavior, while its dysfunction can lead to maladaptive credulity and impaired moral judgment.

5.1. Research Gaps

Despite strong evidence for the vmPFC's role in belief and attitude change, gaps remain in understanding subregional specializations, developmental trajectories, and the interplay with other brain networks in complex, real-world belief updating.

Research Gaps Matrix

Topic/Attribute	Value-Based Updating	Social Feedback	Simulation/Imagination	Doubt/Credulity	Moral Judgment
Adult neuroimaging	12	10	8	7	9
Lesion studies	6	4	3	8	7
Developmental studies	3	2	2	2	4
Computational modeling	5	3	2	2	3
Real-world/clinical	4	3	2	5	4

FIGURE Matrix of research topics and study attributes, highlighting areas with limited research coverage.

5.2. Open Research Questions

Question	Why
How do subregions within the vmPFC differentially contribute to belief and attitude change?	Clarifying subregional roles could refine models of belief updating and inform interventions for maladaptive beliefs.
How does the vmPFC interact with other brain networks during real-world, complex belief updating?	Understanding network dynamics is crucial for translating lab findings to real-life contexts.
What are the developmental trajectories of vmPFC involvement in belief and attitude change?	Developmental studies can inform prevention and intervention strategies for maladaptive belief systems.

FIGURE Open research questions for future investigation on vmPFC and belief/attitude change.

In summary, the vmPFC is a core neural hub for changing personal beliefs and attitudes, integrating affective, social, and value-based information to guide adaptive belief updating and attitude change.

These papers were sourced and synthesized using Consensus, an AI-powered search engine for research. Try it at https://consensus.app

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