dreammachine

SYSTEMS ARCHITECTURE FOR THE HUMAN MIND

HALLUCINATION AUDIT

EMPIRICAL TRACEABILITY LOG

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LOG ID	BOOK REFERENCE	RCT FILTER	CONFIDENCE TIER
SEC 4.3	CHAPTER 4: SECURITY AUDITING (Shadow Work)	**OFF**	**CONSENSUS**

AUDITED CLAIM

DISPLAY MAPPING ERRORS (AR PROJECTION)

SYSTEMS MODEL — AS STATED IN THE BOOK

If the hippocampus fails to properly contextualize the current environment as safe, your brain overlays the **historical threat** onto the present moment. It initiates an **autonomic defense sequence** against the past.

VALIDATION QUERY

Do trauma-related sensory cues trigger rapid amygdala-driven threat responses while the hippocampus provides contextual memory comparison, leading to stress responses in objectively safe environments?

EMPIRICAL FINDING

Clinical neurobiology literature verifies that trauma-related sensory cues trigger rapid autonomic threat responses due to a **regulatory mismatch**: the amygdala appraises the cue as a danger, while the hippocampus fails to properly regulate the **context**, causing an exaggerated stress response.

PRIMARY ANCHORS

→ Keller et al., 2021, Frontiers in Psychiatry

→ Denny et al., 2015, Psychological Science

ABOUT THIS RECORD

Each claim in the book is decompiled from its IT metaphor into a naked, falsifiable scientific claim, then anchored to a **primary peer-reviewed source**. Claim and anchor are queried against the Consensus academic database (200M+ papers) under a fixed protocol — top-tier **Q1/Q2 journals only**, preprints excluded, human studies only. If a hypothesis fails the audit, the build is rejected: the AI generates the syntax; the peer-reviewed grid validates the physics.

CONFIDENCE TIERS

- **CONSENSUS ◀ this log** — broadly established, highly replicated mechanics.
- **EMERGING** — plausible, actively researched; no universal consensus yet.
- **EXPERIMENTAL** — contested, extrapolated, or purely theoretical.

RCT FILTER — Controlled Studies is ON for interventions (a forced action must beat a control) and OFF for mechanisms (so foundational neuroscience isn't blocked).

Yes, **cognitive reappraisal engages prefrontal cortex** and **often reduces amygdala reactivity**, but autonomic down-regulation is less consistent.

1. Introduction

Cognitive reappraisal does engage prefrontal control systems, and a substantial body of human neuroimaging work links that engagement to reduced amygdala responses during downregulation of negative emotion. Healthy and clinical studies repeatedly implicate **dlPFC**, **vlPFC**, **dmPFC**, **OFC**, and **ACC** during reappraisal, with many studies also reporting inverse or inhibitory fronto-amygdala coupling or reduced amygdala activation during successful regulation (Keller et al., 2021; Fitzgerald et al., 2017; Ball et al., 2012). Dynamic-causal and connectivity studies strengthen the mechanistic case by showing top-down cortical models or weaker inhibitory PFC→amygdala modulation when regulation is impaired in obesity, depression, bipolar disorder, panic disorder, and anorexia nervosa (Maturana-Quijada et al., 2023; Kung et al., 2023; Zhang et al., 2018).

The evidence is less uniform than a simple "PFC inhibits amygdala" slogan suggests. Several studies found successful subjective reappraisal without significant amygdala attenuation, including PTSD, functional neurologic disorder, depressed adolescents, and math-anxiety paradigms (Rabinak et al., 2014; Hassa et al., 2021; LeWinn et al., 2018). Autonomic effects are even more mixed: early behavioral work found reappraisal reduced subjective disgust without the sympathetic cost seen with suppression (Gross, 1998), but recent psychophysiology studies report selective effects on heart rate or pupil diameter rather than consistent reductions in skin conductance, respiration, or all stress markers (Coelho et al., 2025; Hamza et al., 2024; Yu et al., 2023).

Does cognitive reappraisal engage the prefrontal cortex to inhibit amygdala reactivity and down-regulate autonomic stress responses? N = 21

Yes 81% · Possibly 10% · Mixed 0% · No 10%

FIGURE 1 Consensus on reappraisal, prefrontal control, and stress regulation

2. Methods

The search ran over more than 170 million research papers indexed in Consensus, drawing from Semantic Scholar, PubMed, and other sources. The workflow identified 7,240 directly matching papers, expanded through citation crawling and targeted follow-up searches, screened 240 papers with machine-learned relevance filtering, retained 131 eligible records after deduplication and thresholding, and included the 50 most relevant human controlled studies for synthesis.

Search Strategy

1.5M Retrieved → **2.1K** Eligible → **50** Included

22 searches

1 citation graph use

All papers retrieved from 22 searches and 1 citation graph use.

Papers meeting relevance and quality criteria, after deduplication

Top papers selected to be included in the final analysis

FIGURE 2 Deep search paper screening and inclusion flow

Searches combined foundational theory, causal circuit studies, null findings, related regulation strategies, and developmental-clinical frontolimbic research.

3. Results

3.1 Key Papers

A few papers anchor the corpus because they directly test reappraisal-related PFC recruitment, amygdala modulation, or fronto-amygdala control under healthy and clinical conditions. Foundational and highly cited studies establish the canonical network, while newer causal and connectivity work refines when that model holds and when it breaks down (Keller et al., 2021; Denny et al., 2015; Kung et al., 2023).

Paper	Summary
(Keller et al., 2021)	Repeated reappraisal yields lasting **amygdala attenuation** without sustained PFC recruitment (Denny et al., 2015)
(Pulopulos et al., 2020)	Remitted depression shows impaired **amygdala downregulation** despite control-network recruitment (Kanske et al., 2012)
(Sandner et al., 2021)	Healthy adults show robust **PFC activation** during reappraisal (Ball et al., 2012)

FIGURE 3 Key papers anchoring the reappraisal literature

3.2 Fronto-Amygdala Mechanisms

Across the corpus, reappraisal consistently recruits lateral and medial prefrontal regions involved in cognitive control, semantic selection, monitoring, and goal maintenance (Fitzgerald et al., 2017; Benzait et al., 2022; Keller et al., 2021). Several studies go beyond co-activation and support top-down control: a dynamic causal modeling study in higher-weight women found a top-down cortical model best fit the data, and lower BMI was associated with stronger excitatory dlPFC→amygdala modulation while higher BMI was associated with less effective cortical inhibition of the amygdala (Maturana-Quijada et al., 2023). In youth depression, weaker inhibitory vlPFC→amygdala modulation during reappraisal predicted diagnostic status (Kung et al., 2023). In bipolar disorder, reappraisal specifically weakened DLPFC→amygdala effective connectivity relative to controls, consistent with insufficient prefrontal control (Zhang et al., 2018).

3.3 Boundary Conditions

Dimension	Support For Amygdala Reduction	Null Or Opposite Findings	Citations
Healthy/typical samples	Reduced amygdala during reappraisal is common	Not universal across tasks	(Keller et al., 2021; Van Dam & Chrysikou, 2021)
PTSD	Less dlPFC recruitment can appear	Some studies show no amygdala attenuation	(Rabinak et al., 2014)
Depression	Often blunted amygdala modulation	Some adolescent samples show no amygdala difference	(Stephanou et al., 2017; LeWinn et al., 2018)
FND/ASD	Impaired downregulation expected	Increased or absent amygdala downregulation observed	(Hassa et al., 2021; Pitskel et al., 2014)
Task type	Social pain and anxious-event tasks support control models	Math-anxiety paradigm found no amygdala change	(Tsujimoto et al., 2023; Pizzie et al., 2019)

FIGURE 4 When amygdala attenuation appears or fails

These inconsistencies are not random. Null findings cluster in clinical groups with frontolimbic dysfunction, in tasks emphasizing performance or self-referential anxiety rather than simple aversive pictures, and in studies where subjective benefit can occur without strong amygdala change (Rabinak et al., 2014; Fitzgerald et al., 2017; Pizzie et al., 2019).

3.4 Autonomic Stress Responses

Autonomic down-regulation appears real but narrower than the neural effect. Reappraisal reduced sympathetic burden relative to suppression in an early laboratory study, because suppression increased sympathetic activation whereas reappraisal did not (Gross, 1998). More recent studies show selective autonomic benefits: acute reappraisal improved emotion ratings but not psychophysiological markers in one stress experiment (Hamza et al., 2024), whereas rVLPFC stimulation during reappraisal reduced pupil diameter during social pain regulation (Yu et al., 2023). A 2025 tDCS study found **dlPFC stimulation plus reappraisal** lowered heart rate late in emotional clips, but did not produce reliable skin-conductance or respiratory effects (Coelho et al., 2025). Stress-system experiments further suggest the PFC can regulate endocrine stress responses, as excitatory left DLPFC rTMS lowered cortisol responses to a social stressor, although HRV did not change (Pulopulos et al., 2020).

Results Timeline

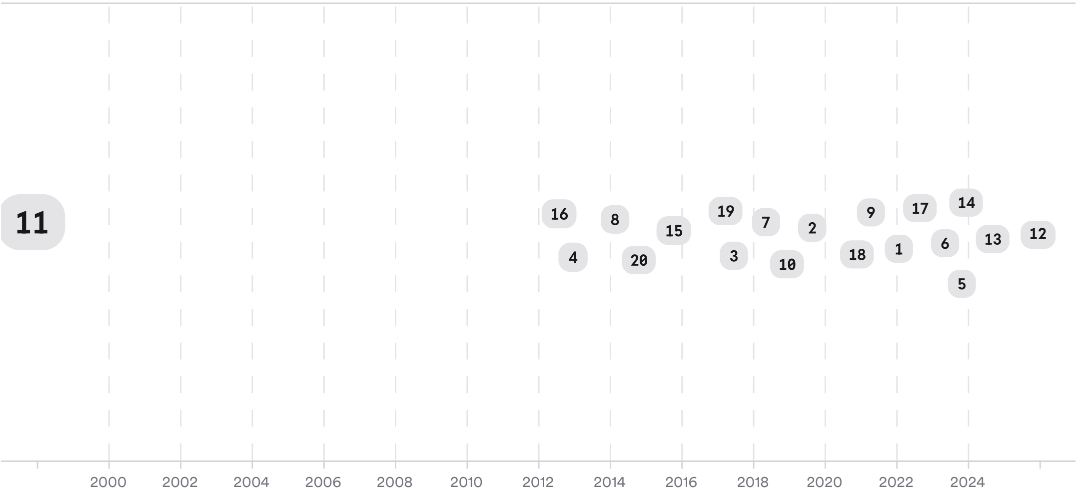

FIGURE 5 Timeline of reappraisal research; larger markers indicate more citations

Top Contributors

Type	Name	Papers
Author	T. Steward	[66decb949b99599e820912d2ec362a4f][1f34ded6d07b51629b1214ebe494eb12][2d17ba7a6f665e5397f762129feae8db][42f75eed56c657c6ad78effab67d0f6d]
Author	K. Mathiak	[17552f8f01c653c8ae916018230f6229][8d83549dc2095e7b808f2e601548af3f][b293c8fb9def50f28ba6b0b065bc4131]
Author	Dandan Zhang	[5923c97ec17b5364bf24829d163e76ad][0242d252c8b45475b466ae7e3db1972a][63efa69ad2a55c36aed08534ff78dc49]
Journal	*Human Brain Mapping*	[6c6e0d3f03fe5a8d9e5850cd64fed7ac][0242d252c8b45475b466ae7e3db1972a][fcee1e4422695f6a8003af06f58dac05][63efa69ad2a55c36aed08534ff78dc49]
Journal	*Journal of Affective Disorders*	[0d77e51a658a5953821aef7542223da2][e2d033f28aa451fca8c8b92e8f33b6a1][f6b6d98f13d85d33ae65a3c4bc23451b]

Type	Name	Papers
Journal	*Psychological Medicine*	[1f34ded6d07b51629b1214ebe494eb12][a56fa8bdf8cf55249efc6c7c8d08145b][9a634bd2d4115359b5d304eaffc425a9]

FIGURE 6 Authors and journals appearing most in included papers

4. Discussion

The strongest conclusion is that reappraisal reliably engages a distributed prefrontal control network. This finding is replicated across healthy, developmental, and clinical studies, supported by meta-analytic summaries quoted within the corpus, and reinforced by stimulation and neurofeedback studies showing that increasing vlPFC, dlPFC, or DLPFC-VLPFC synchrony improves reappraisal success (Fitzgerald et al., 2017; Keller et al., 2021; Tang et al., 2025). The mechanistic claim that these regions inhibit the amygdala is also well supported, but not universal. Effective-connectivity work and studies of impaired populations argue for a real top-down pathway (Maturana-Quijada et al., 2023; Kung et al., 2023; Steward et al., 2020), yet multiple well-conducted studies still find no amygdala attenuation despite reduced negative affect (Rabinak et al., 2014; Hassa et al., 2021; LeWinn et al., 2018).

The autonomic part of the question has the weakest evidence base. There are credible findings for lower heart rate, lower pupil-linked arousal, lower cortisol, and preserved sympathetic efficiency relative to suppression (Coelho et al., 2025; Yu et al., 2023; Pulopulos et al., 2020; Gross, 1998). But these effects are heterogeneous across measures and timing, and some studies find subjective improvement without skin-conductance, respiration, or broad psychophysiological change (Coelho et al., 2025; Hamza et al., 2024). For personal mental health decisions, a licensed clinician should interpret how these group-level findings apply to an individual.

Claim	Evidence Strength	Reasoning	Papers
Reappraisal engages lateral and medial prefrontal cortex.	Strong	Replicated across many healthy and clinical imaging studies.	(Keller et al., 2021; Ball et al., 2012; Hortelano et al., 2023)
Reappraisal often reduces amygdala reactivity.	Strong	Strong but not universal; several direct demonstrations and meta-analytic support.	(Fitzgerald et al., 2017; Kanske et al., 2012; Van Dam & Chrysikou, 2021)
PFC-to-amygdala top-down inhibition is a core mechanism.	Moderate	Effective-connectivity and causal modulation studies support it, but task and population effects remain.	(Maturana-Quijada et al., 2023; Kung et al., 2023; Zhang et al., 2018)
Reappraisal down-regulates autonomic stress responses.	Moderate	Supported for some measures like HR, pupil size, and cortisol, but inconsistent across SC, HRV, and respiration.	(Coelho et al., 2025; Yu et al., 2023; Pulopulos et al., 2020)
Amygdala attenuation is necessary for successful reappraisal.	Weak	Contested because some studies show subjective success without amygdala reduction.	(Rabinak et al., 2014; Pizzie et al., 2019; Hassa et al., 2021)

FIGURE 7 Key claims and supporting evidence in corpus

5. Conclusion

Taken together, the 50-paper corpus supports a qualified yes. Cognitive reappraisal robustly recruits prefrontal control regions, and in many paradigms that engagement coincides with weaker amygdala responses or stronger negative fronto-amygdala coupling (Tsujimoto et al., 2023; Kanske et al., 2015; Pitskel et al., 2014). The model is strongest for neural recruitment, somewhat weaker for direct amygdala inhibition, and weakest for broad autonomic down-regulation across all stress markers.

Research Gaps

The main gap is not whether reappraisal recruits PFC, but when that recruitment translates into amygdala and autonomic change across populations, tasks, and timescales.

Topic/Outcome	Neural recruitment	Amygdala modulation	Autonomic measures	Long-term follow-up
Healthy adults	10	8	4	2
Clinical disorders	10	8	3	2
Developmental samples	6	4	1	1
Neuromodulation studies	7	4	5	1
Real-world stress outcomes	3	2	3	1

Open Research Questions

Future work needs to link circuit-level findings to peripheral physiology and durable stress resilience.

Question	Why
When does prefrontal recruitment during reappraisal produce measurable autonomic down-regulation across heart rate, skin conductance, HRV, respiration, and cortisol?	Current studies show selective effects by measure and timing, leaving the peripheral signature of successful reappraisal unresolved.
Which prefrontal subregions causally drive amygdala inhibition during reappraisal across different tasks and psychiatric disorders?	dlPFC, vlPFC, OFC, and vmPFC findings vary by paradigm and diagnosis, suggesting multiple partially distinct control routes.
Do repeated reappraisal training and neuromodulation create lasting reductions in stress reactivity without continued top-down effort?	One-week amygdala attenuation and stimulation studies are promising, but long-term autonomic and clinical durability remain under-tested.

In sum, cognitive reappraisal does engage the prefrontal cortex and often dampens amygdala reactivity, but evidence for consistent autonomic stress down-regulation remains moderate rather than definitive.

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