The Neuroeconomics of Fear: How Arousal Hijacks Attention, Memory, and Choice

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Abstract

Fear operates as a physiological control layer over cognition. When threat is perceived, the LC-NE system increases neural gain and the HPA axis releases glucocorticoids; the resulting arousal narrows attention, prioritizes high-salience cues, tags memory for threat-congruent material, and shifts choice policies toward loss avoidance, ambiguity aversion, and authority default. We synthesize evidence across affective neuroscience, behavioral economics, and media systems, define a taxonomy of fearcraft (threat priming, temporal compression, moral panic loops, contamination cues, ambiguity flood, variable-ratio alerts), and map each tactic to mechanistic levers. We then specify falsifiable experiments (lab + sleep + field A/B) with preregistered kill-criteria, and propose counter-protocols (nervous-system tools, narrative audits, and friction-in-design) that measurably reduce arousal capture while preserving legitimate warnings. The goal is a testable framework for how fear drives masses—and how to reclaim agency.

1. Introduction

Fear outperforms neutral information in capturing attention and propagating through networks. Popular accounts frame this culturally; here we develop the physiological computation: arousal shifts the brain's optimization from model accuracy to signal detection, compressing deliberation and biasing valuation functions. We ask:

- RQ1. Through which neural and hormonal pathways does fear modulate attention, memory encoding/consolidation, and choice?
- RQ2. Which message and interface tactics reliably exploit those pathways?
- RQ3. Which countermeasures—at the individual, group, and platform levels—reduce arousal capture without suppressing useful alerts?

2. Mechanisms: Circuits & Hormones

LC-NE gain modulation

- Phasic NE boosts signal-to-noise for salient inputs; tonic NE elevates scanning/hypervigilance.

• Consequences: enhanced orienting, distractor suppression, working-memory fragility at high tonic levels; PFC control degrades.

HPA axis & cortisol dynamics
• Acute cortisol facilitates amygdala-hippocampal encoding for arousing items; chronic elevation impairs PFC regulation and promotes habit.

Amygdala–PFC–Hippocampus loop
• Amygdala: threat valuation & prioritization.
• Hippocampus: binds context; arousal-biased competition stores threat-congruent details.
• PFC (dlPFC/vmPFC): regulation and reappraisal—weakened under arousal and time pressure.

Mechanistic prediction: Arousal (pupil↑, HRV RMSSD↓) → attention narrowing (d′↑ for threat, ↓ for neutral) → preferential memory for threat-congruent items → choice shift to loss-averse, ambiguity-averse policies.

3. Neuroeconomic Levers

Neuroeconomic levers
• Loss aversion: losses weigh more than gains; magnified under arousal.
• Ambiguity aversion: preference for known risks; authority default increases.
• Present bias: temporal compression → myopic, heuristic choices.
• Availability/representativeness: vividness warps priors; base rates vanish.
• Social contagion: synchronized arousal (voice tempo, posture, posting cadence) amplifies polarization.

4. Fearcraft: Tactics → Levers

Fearcraft tactics → levers
1) Threat priming (red palettes, danger verbs, alarming faces) → LC phasic bursts, orienting reflex.
2) Temporal compression (countdowns, “breaking” tickers) → present bias; dlPFC load.
3) Moral panic loops (identity threat + virtue signaling) → in-group conformity; out-group derogation.
4) Contamination cues (pathogen/disgust) → disgust circuits; dehumanization risk.
5) Variable-ratio alerts (irregular crisis pings) → intermittent reinforcement; compulsive checking.
6) Ambiguity flood (conflicting info) → uncertainty aversion; authority default.

5. Formal Models (testable)

Formal models (testable)
Drift–Diffusion under arousal
$dx = v\,dt + \sigma\,dW$; thresholds $a \to a(1-\kappa\_urgency)$, drift $v \to v - \eta\_loss \cdot loss\_frame$.

Predictions: faster, more conservative/authority-default choices; more errors on base-rate problems.

Arousal-biased competition
Representations R_i compete with bias $b_i \propto$ arousal × salience. Threat-congruent R_T wins storage, neutral R_N suppressed → better recall of threat items; poorer source memory.

6. Measurement Plan

Measurement plan
Physiology: HRV (RMSSD, LF/HF), EDA, pupil dilation, EEG (LPP, beta/gamma; frontal-midline theta), salivary cortisol (baseline + 20/40 min).
Attention & memory: Eye-tracking d′, dwell time, immediate & 24-h recall; source memory.
Choice: Loss/ambiguity lotteries, authority-default tasks, share/comply intentions.
Sleep substudy: PSG; spindle density; SO–spindle coupling; REM theta.

7. Hypotheses & Kill-Criteria (preregistered)

Hypotheses & kill-criteria (preregistered)
H1 Arousal capture: Threat-framed vs. neutral content increases arousal markers and narrows attention.
Kill: $|d|<0.20$ and $\Delta AIC \leq 2$ vs. null across two replications.

H2 Memory tagging: Threat-framed items show higher 24-h recall; mediated by NREM spindle metrics when exposure precedes sleep.
Kill: mediation β non-sig after FDR; or no recall edge with adequate power.

H3 Policy shift: Under time-limited threat frames, participants choose more loss-averse and authority-default options and share more.
Kill: no shift after friction (10-s delay + context card) or effects <0.20 SD.

H4 Platform friction: Context cards + share-delay reduce arousal and fear-sharing without harming comprehension.
Kill: comprehension drops ≥0.2 SD or arousal unchanged.

8. Experimental Program

Experimental program
Lab Study: Within-subjects; neutral vs. threat blocks (matched topics). Measures: eye-tracking, ECG/HRV, EDA, EEG, cortisol. Tasks: memory (immediate+delayed), lotteries, authority-default choice, share/comply. N≈80 (d=0.35).

Sleep Substudy: Evening exposure → overnight PSG → next-day recall. Prediction: spindle density & SO–spindle coupling ↑ for threat items; mediation of recall advantage.

Field A/B (Platform): Interventions—10-s share delay + base-rate card; uncertainty label; notification batching. Outcomes: share rate, dwell, belief calibration. Cluster-randomized; detect 10–15% share reduction. Safeguard: critical alerts exempted.

9. Media Ecology & Incentives

Media ecology & incentives
Engagement markets reward arousal because it predicts sharing. Algorithmic salience amplifies threat cues, creating feedback: more threat → more clicks → more threat. UX choices (auto-play, push pings, red badges) act as arousal actuators.

10. Counter-Protocols: Restoring Agency

Counter-protocols: restoring agency
Individual: 90-second reset (long exhale, cold splash, open posture), “BASE” card (Base rates • Alternatives • Sources • Emotions), threat-curfew for sleep hygiene.
Group: Rumor triage cells; 2-min breath/voice toning before decisions.
Platform: Friction-first UX (share delay + context), uncertainty badges, notification hygiene, arousal audits with opt-in panels.

11. Ethics

Ethics
Non-weaponization; consent & privacy (encrypted physiology); equity checks across demographics; preserve legitimate warnings.

12. Limitations

Limitations
Lab vs. real-world gap; cortisol latency; cross-cultural variability; fear can be adaptive. Replicate across languages/platforms.

13. Conclusion

Conclusion
Fear reallocates neural resources: attention narrows, memory tags threat, and choice tilts toward loss- and ambiguity-averse policies. Precision countermeasures can cool arousal without blinding the public to real danger—shifting the crowd from reflex to agency.

14. Figures & Tables (placeholders)

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Fig. 1: LC-NE & HPA pathways and cognitive effects.
Fig. 2: Framing → arousal markers → behavior (mediation).
Fig. 3: DDM schematic with arousal-modulated thresholds & drift.
Fig. 4: Sleep substudy timeline; SO–spindle coupling.
Table 1: Fearcraft tactics → physiological levers → outcomes.
Table 2: Interventions & KPIs.
Table 3: Kill-criteria & stopping rules.

15. References

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