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 8.1.1	CHAPTER 8: COGNITIVE DOWNCLOCK (10 Bits vs. 1 Billion)	**OFF**	**CONSENSUS**

AUDITED CLAIM

SYSTEM SPECIFICATION (TOTAL PERIPHERAL ABSORPTION)

SYSTEMS MODEL — AS STATED IN THE BOOK

> Clinically, human sensory systems encode massive, parallel streams of information outside of explicit awareness, while **conscious cognitive access** acts as a severe, late-stage **bottleneck** that relies on hierarchical **sensory gating** to prevent cognitive overload.

VALIDATION QUERY

Do human sensory systems process massive, parallel streams of data while conscious cognition functions as a severe, late-stage bottleneck requiring sensory gating?

EMPIRICAL FINDING

Evoked potential data confirms that human sensory networks absorb massive, concurrent streams of environmental data completely outside of conscious awareness. Reportable conscious cognition instead functions as a late-stage attentional bottleneck, relying on hierarchical, multi-layered sensory gating to prevent informational overload.

PRIMARY ANCHORS

→ Dehaene & Changeux, 2011, Neuron

→ Wyart et al., 2015, The Journal of Neuroscience

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, **human sensory systems process in parallel**, while **conscious access** is a **late bottleneck** shaped by gating.

The literature supports the broad claim, but not in an overly simple "all gating is late" form. Human studies consistently show that sensory inputs can be processed widely, rapidly, and sometimes quite deeply without entering awareness, while conscious report depends on later selection, integration, and global availability mechanisms (Dehaene & Changeux, 2011; Sanchez et al., 2017). At the same time, gating occurs at multiple levels—brainstem, thalamic, primary sensory cortex, frontoparietal cortex, and working memory—so the bottleneck is late relative to initial sensory encoding, but it is supported by earlier filters rather than replacing them (Sörqvist et al., 2012; Fang et al., 2025; Grunwald et al., 2003).

1. Introduction

A large human literature converges on a two-part picture: sensory systems can encode multiple inputs in parallel, but only a small subset reaches conscious report, decision, or working memory. Foundational models explicitly describe initial perceptual processing as parallel and nonconscious, followed by a serial, limited-capacity stage of conscious access or working-memory consolidation (Dehaene & Changeux, 2011). Empirical work supports this architecture across paradigms. Under divided attention, humans can encode information from two visual streams without interference, yet lose information later during integration into action-related signals (Wyart et al., 2015). In the attentional blink, missed stimuli still activate high-level visual cortex, but frontal activation appears only when they are consciously reported (Marois et al., 2004).

Conscious access also has a characteristic late neural signature. Across paradigms, reportable perception is associated with late amplification, long-range synchronization, and large-scale frontoparietal "ignition" around or after 200–300 ms (Dehaene & Changeux, 2011; Sanchez et al., 2017). Yet early and intermediate gating mechanisms also matter: unattended or subthreshold inputs can be filtered in primary sensory cortex, by alpha- and beta-mediated gain control, by thalamofrontal loops, and by sensory gating mechanisms indexed with paired-stimulus or prepulse paradigms (Nierhaus et al., 2015; Yang et al., 2023; Fang et al., 2025; Gómez-Nieto et al., 2020).

Do human sensory systems process massive, parallel streams of data while conscious cognition functions as a severe, late-stage bottleneck requiring sensory gating?
Requires at least 5 papers that directly answer your question. Try adjusting your query to find more papers.

FIGURE 1 Research consensus on parallel processing and conscious bottlenecks

The consensus is closer to "yes, with qualifications" than to a pure early-filter or pure late-filter model. Early sensory processing is broad and partly parallel, but conscious cognition depends on recurrent integration and multiple gating layers rather than one single bottleneck site (Sikkens et al., 2019; Noorman et al., 2025).

2. Methods

This Deep Search ran over more than 170 million research papers indexed in Consensus, spanning Semantic Scholar, PubMed, and related sources. The workflow identified 49,445 initially relevant papers for the exact query, expanded through targeted searches and citation crawling, screened 240 high-relevance candidates, retained 169 after relevance filtering and deduplication, and included the top 50 ranked human studies for synthesis.

The search strategy combined six strands: foundational theories of conscious access, neural mechanism studies on gating circuits and oscillations, alternate terminology around bottlenecks and filtering, contrasting papers challenging strict bottleneck accounts, adjacent work on information routing and control, and decomposed searches separately targeting sensory parallelism and conscious limits.

Search Strategy

17.6M 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 screening and inclusion workflow

Searches combined theory, mechanism, contradiction, and decomposition queries to test both the parallel-processing claim and the bottleneck claim.

3. Results

3.1 Key Papers

A few papers anchor the corpus because they directly connect parallel sensory processing, conscious access, and gating. Dehaene and Changeux provide the core serial-access framework (Dehaene & Changeux, 2011), Wyart and colleagues show intact parallel encoding but impaired late integration under divided attention (Wyart et al., 2015), and Huang and colleagues localize a cortical gate for conscious access in anterior insula (Huang et al., 2021).

Paper	Summary
(Jones et al., 2016)	Parallel nonconscious processing, serial conscious access (Dehaene & Changeux, 2011)
(Shen et al., 2020)	Two streams encoded, late integration leaks (Wyart et al., 2015)
(Dehaene & Changeux, 2011)	Anterior insula gates conscious access (Huang et al., 2021)

FIGURE 3 Foundational papers anchoring the literature

3.2 Parallel Sensory Processing

Several studies directly support extensive preconscious sensory processing. Near-threshold MEG work across tactile, visual, and auditory tasks states that the brain can process an enormous amount of sensory information in parallel, while only some of it becomes consciously accessible (Sanchez et al., 2017). In divided-attention decisions, sensory and momentary decision information from two independent visual streams were encoded without interference, and the performance loss emerged downstream during accumulation toward response (Wyart et al., 2015). During attentional blink, unreported scenes still activated category-specific medial temporal cortex, showing that high-level stimulus categorization can occur without conscious report (Marois et al., 2004).

Recent EEG work sharpens this distinction. When perceptual strength was reduced by masking, late integration of complex features at ~200–250 ms was impaired, but early local-contrast decoding around ~80 ms remained largely intact (Noorman et al., 2025). When attention was absent instead, complex feature processing was relatively spared despite reduced conscious access, implying that some recurrent sensory processing can proceed without full global ignition (Noorman et al., 2025).

3.3 Gating Levels

Dimension	Early/Local Gating	Late/Global Gating	Citations
Brainstem/thalamus	Working memory load reduces precortical auditory response	High-order thalamus drives PFC during conscious perception	(Sörqvist et al., 2012; Fang et al., 2025)
Primary sensory cortex	Subthreshold somatosensory sweep terminates in SI	Frontoparietal disconnection blocks conscious access	(Nierhaus et al., 2015)
Cortical access gate	Alpha/beta shape local sensory suppression	Anterior insula regulates access-related network switching	(Yang et al., 2023; Huang et al., 2021)
Working memory	Alpha blocks unwanted input during presentation	Beta tracks transition to retention and proactive control	(Liljefors et al., 2023)
Task switching	Early P1 attenuation after attention switches	Reduced sensory weighting after rule switches	(Verschooren et al., 2021; Luo et al., 2023)

FIGURE 4 Multiple gating levels across sensory-cognitive hierarchy

The key difference is that early gates suppress or weight incoming signals, while later gates determine whether information becomes globally available for report, decision, or memory.

3.4 Boundary Conditions

The corpus does not support a single, unitary gating mechanism. Sensory gating varies by component and circuit: P50 is often framed as pre-attentive filtering, whereas N100 and P200 reflect later attention-triggering and allocation processes (Shen et al., 2020). Intracranial work suggests a multistep process, with neocortical gating near 50 ms and hippocampal involvement later around 250 ms (Grunwald et al., 2003). Reviews likewise conclude that multiple gating subtypes exist and depend on different circuits and organismal states (Cromwell et al., 2008).

There are also targeted challenges to strong late-bottleneck claims. Expectations can accelerate visibility-related signatures from about 300 ms to about 200 ms, showing that top-down priors shift the timing of conscious access (Melloni et al., 2011). Dopamine manipulation with cabergoline did not change masking or attentional blink performance, so not every proposed gating neuromodulator has a clear causal role in these tasks (Boonstra et al., 2020).

Results Timeline

Sensory-gating and conscious-access research has moved from bottleneck theory to multilevel circuit models.

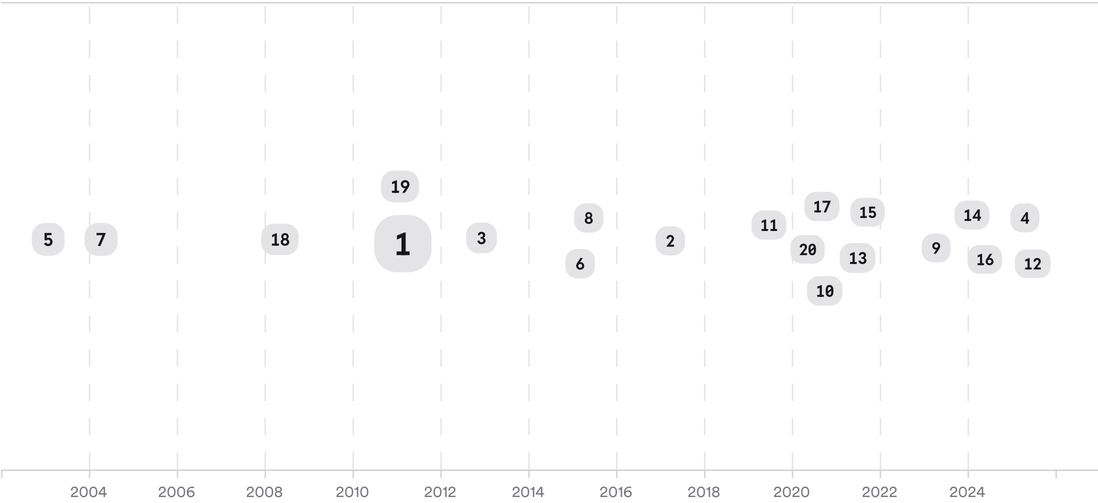

FIGURE 5 Research timeline with larger markers indicating more citations

The arc runs from classic capacity-limit theories and attentional-blink evidence, through modality-specific gating paradigms, to contemporary models of thalamocortical, oscillatory, and supramodal access mechanisms (Marois & Ivanoff, 2005; Marois et al., 2004; Sanchez et al., 2017).

Top Contributors

Across this corpus, **S. Dehaene**, **R. Marois**, and **T. Wilson** appear repeatedly, and **Neuron**, **NeuroImage**, and **Journal of Neuroscience** are the most recurrent journals.

Type	Name	Papers
Author	S. Dehaene	[c9c22cf09ae35f3691c016590c2e9f43][0dc03e9b82875361b133165f8750a5ed] [4f27bedf87205000b42cedcee3ec0736]
Author	R. Marois	[560343344c64500e8c9f3e551a33ab38][4582a2d2bc0d5bae99c2d72f5d4fc567]
Author	T. Wilson	[dbf65ee23eb25c3190703901d62fabeb][6ac68029ac5555e7803bc4209da11f41]
Journal	*Neuron*	[c9c22cf09ae35f3691c016590c2e9f43][4582a2d2bc0d5bae99c2d72f5d4fc567]
Journal	*NeuroImage*	[dbf65ee23eb25c3190703901d62fabeb][553f8ec8f66c5e6fac35be9bd0340de1] [e6d2a5739bde5ae798b1ebef5ca1ff60][6ac68029ac5555e7803bc4209da11f41] [a6118394342659e8934425b976009bef]
Journal	*Journal of Neuroscience*	[cf30644abc7a564bbe88310b4c9c1e3a][39234f54e8d153eaac8d2cb6c9dc7d06] [8f8a4836bd375de1b311fdc53ec44078][8b9e333c399a58339ccc15af3444a239]

FIGURE 6 Authors and journals appearing most frequently

4. Discussion

The strongest part of the evidence is the repeated dissociation between substantial sensory processing and limited conscious access. Foundational reviews, divided-attention EEG, attentional-blink fMRI, and supramodal near-threshold MEG all point in the same direction: the brain can encode or categorize more information than can be consciously reported at once (Dehaene & Changeux, 2011; Wyart et al., 2015; Marois et al., 2004; Sanchez et al., 2017). This supports the “parallel inputs, late bottleneck” half of the question strongly.

The weaker part is the idea that one severe late-stage bottleneck alone explains everything. The corpus instead shows layered filtering. Early gating occurs in brainstem responses under cognitive load, in primary sensory cortex for subthreshold stimuli, and in alpha- or beta-mediated gain control for attention and working memory (Sörqvist et al., 2012; Nierhaus et al., 2015; Liljefors et al., 2023). Later gating involves anterior insula, thalamofrontal synchrony, frontoparietal ignition, and working-memory consolidation (Huang et al., 2021; Fang et al., 2025; Dehaene & Changeux, 2011).

Study quality is mixed but informative. Some claims rest on broad theoretical reviews or classic paradigms with strong replication, whereas many mechanistic claims rely on small intracranial, MEG, or EEG studies and should be read as plausible circuit models rather than final localization (Dehaene & Changeux, 2011; Yang et al., 2023; Micoulaud-Franchi et al., 2019). Clinical studies in schizophrenia, ADHD, autism, and sensory over-responsivity show that when gating fails, distractibility, sensory flooding, or cognitive inefficiency often increase, but these populations also introduce confounds in diagnosis, medication, and symptom heterogeneity (Shen et al., 2020; Micoulaud-Franchi et al., 2019; Crasta et al., 2020; Wood et al., 2021).

Claim	Evidence Strength	Reasoning	Papers
Conscious access is later and more capacity-limited than initial sensory encoding	Strong	Supported by converging theory, EEG, MEG, and fMRI across paradigms	(Dehaene & Changeux, 2011; Wyart et al., 2015; Marois et al., 2004)
Multiple sensory streams can be encoded in parallel before report	Strong	Directly shown in divided-attention and supramodal consciousness studies	(Wyart et al., 2015; Sanchez et al., 2017)
Sensory gating operates at multiple hierarchical levels	Strong	Evidence spans brainstem, cortex, thalamus, and working memory control	(Sörqvist et al., 2012; Fang et al., 2025; Grunwald et al., 2003)
A single anatomical gate fully explains conscious bottlenecks	Weak	Candidate loci differ across tasks and modalities	(Huang et al., 2021; Mayer et al., 2008; Fang et al., 2025)
Alpha/beta oscillations implement sensory gating and routing	Moderate	Repeated correlational support, but causal evidence remains partial	(Gundlach et al., 2016; Yang et al., 2023; Limanowski et al., 2020)

FIGURE 7 Key claims and supporting evidence

5. Conclusion

Overall, the answer is yes: human sensory systems appear to process multiple streams in parallel, while conscious cognition is constrained by a later bottleneck. But the evidence favors a layered architecture, where early filtering and late global access work together rather than a single final gate (Dehaene & Changeux, 2011; Sörqvist et al., 2012). Conscious access seems to depend on recurrent, large-scale integration, whereas unattended, weak, or redundant inputs can still be processed substantially without reaching report (Dehaene & Changeux, 2011; Noorman et al., 2025).

Research Gaps

The biggest open issue is not whether gating exists, but how its levels interact across tasks, modalities, and brain states.

Topic/Outcome	Human causal manipulation	Cross-modal generalization	Intracranial timing	Longitudinal/clinical translation
Early sensory gating	4	5	2	6
Conscious access threshold	3	6	3	2
Thalamocortical gating	2	2	3	1
Oscillatory routing mechanisms	5	4	2	2
Clinical sensory flooding	6	3	1	7

Open Research Questions

Future work needs to connect classical bottleneck paradigms with modern circuit measures.

Question	Why
Which gating stage best predicts whether parallel sensory representations become reportable consciousness?	This would distinguish early filtering from late broadcast as the decisive step for conscious access.
Do common thalamic or insular mechanisms gate access similarly across visual, auditory, and somatosensory tasks?	Current evidence is suggestive but fragmented across modalities and paradigms.
How do alpha, beta, and gamma mechanisms interact during switching, divided attention, and working-memory selection?	Oscillatory accounts are promising, but still split across tasks and frequency bands.

The literature therefore supports the user's core claim, with one important correction: conscious cognition is a severe late bottleneck, but it is enforced by multiple distributed gating mechanisms from early sensory stages through global access.

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