In response to: **Subjective selection, super-attractors, and the origins of the cultural manifold**
Related commentaries (27) Author response

Behavioral and Brain Sciences

Article contents

Abstract
Financial support
Competing interests
References

From selection to surgery: Aesthetic chills bridge subjective functionalism and cognitive calibration

Published online by Cambridge University Press: **10 July 2026**

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Commentary Related commentaries Metrics

Abstract

In this commentary, we argue that aesthetic chills provide empirical evidence for Singh's subjective functionalism. These pleasurable and measurable somatic events mark dopaminergic-mediated validation when cultural artifacts resonate with cognitive architecture. Research demonstrates chills can be predicted, induced, and therapeutically deployed for depression. This transforms aesthetics from ornamental to functional, revealing how feeling drives cultural transmission while enabling interventions.

Information

Type	Open Peer Commentary
Information	Behavioral and Brain Sciences, Volume 49, 2026, e307 DOI: https://doi.org/10.1017/S0140525X25104457 Check for updates
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Why do all cultures, despite no direct contact, converge on remarkably similar aesthetic practices that consume substantial resources without overt adaptive value? Singh's "subjective functionalism" offers a compelling answer: cultural forms persist and converge because they feel good to individuals across our shared humanity, with positive epistemic emotions serving as a universal compass to navigate and shape the cultural manifold. Here, we review a decade of empirical research across affective neuroscience, psychology, and neurotechnology, providing direct evidence for this subjective functionalism: aesthetic pleasure acts as a reinforcement signal for culturally learned meaning.

Aesthetic chills (hereafter, chills) – the involuntary shivers or goosebumps that accompany moments of awe or transcendence in response to cultural devices such as art, science, and religious rituals – offer a precise model of how feeling encodes meaning with clear neurobiological correlates. Chills are discrete, measurable bodily events that occur when perception and cognition resonate along the cortical hierarchy (Schoeller & Perlovsky, 2016). Oftentimes, the experiences resulting in chills satisfy an inherent "knowledge instinct" (Schoeller et al., 2018) that drives humans to seek meaning through non-propositional pathways when conventional epistemic channels exhaust themselves, triggering somatic validation that confirms deep structural resonance between cultural artifact and cognitive architecture. Neuroimaging links chills to dopaminergic circuits of the ventral tegmental area, nucleus accumbens, and orbitofrontal cortex (Blood & Zatorre, 2001; Salimpoor et al., 2011) as well as synchronized theta and beta oscillations across prefrontal and limbic networks (Chabin et al., 2020). Dopamine release during chills signals not mere hedonic pleasure but the validation of high-level layers in a hierarchical world model (Schoeller et al., 2024a). The dopaminergic system whispers: "This fragment of the cultural manifold illuminates your position within it; integrate accordingly."

In machine learning, grokking occurs when an overfitted model suddenly achieves generalization after extended training with no visible progress, mirroring the

cognitive leap from rote memorization to comprehension. Physiologically, chills correspond to such a "grok" event, the moment when prediction error collapses, and learning saturates (Schoeller, Eskinazi, & Garreau, 2018). Subjectively, chills co-occur with insight, unity, meaning, and self-transcendence (Christov-Moore et al., 2024; Schoeller et al., 2024a). Interoceptive awareness mediates this relationship: individuals more attuned to bodily signals report stronger insight and positive affect (Christov-Moore et al., 2025). Together, these data demonstrate that aesthetic pleasure is a precision signal guiding model calibration – the mechanism by which Singh's "felt usefulness" shapes cultural transmission.

The same principles that explain how art transmits knowledge also enable its deliberate modulation. Once societies learn to evoke chills reliably, they gain leverage over the mechanisms of epistemic validation. Modern media already exploit this through music, film scores, and viral videos; we have compiled a validated database of such chill-eliciting stimuli: ChillsDB (Schoeller et al., 2023). Importantly, no stimulus universally evokes chills, with susceptibility systematically varying as a function of demographic, personality, and state factors (Schoeller et al., 2024b). Such resonance profiles define micro-cultures of aesthetic preference that may serve as the empirical substrate of Singh's cultural attractors.

In therapeutic settings, we have begun to recognize the potential for these aesthetic super-attractors to serve as precision technologies for recalibrating maladaptive beliefs. In a trial of patients diagnosed with major depressive disorder, conceptualized as disorientation within the cultural manifold, exposure to ChillsDB stimuli decreased shame and increased self-acceptance, mimicking key phenomenological aspects of psychedelic therapy (Schoeller et al., 2024c). Similar work showed improved reward learning in anhedonic depression (Jain et al., 2025). These findings suggest that chills re-engage mesolimbic reward circuits, offering a non-pharmacological path to belief revision and motivational restoration. Building on this, we developed "schema surgery," a generative-AI framework that produces personalized variants of ChillsDB stimuli to deactivate specific maladaptive schemas in depression (Schoeller et al., 2024). This system effectively engineers micro-cultural experiences that restore coherence and meaning – an applied realization of Singh's cultural functionalism within precision psychiatry.

If chills index the interoceptive signature of epistemic alignment, their mechanism can be targeted directly through neurotechnology. Indeed, it has been shown that

a device that generates cold and vibrotactile sensations along the spine of participants at specific chill-inducing moments from ChillsDB stimuli, the occurrence rate and intensity of chills significantly increase (Haar et al., 2020). With such success, it becomes sensible to consider augmenting chills using neurmodulattion (e.g., transcranial focused ultrasound (tFUS; Dell'Italia et al., 2022)) to modulate mesolimbic and insular networks, amplifying the bodily shiver and corresponding dopaminergic activation (Schoeller et al., 2024c). Alternatively, neurofeedback offers an interesting avenue to permit a shift from chills as a surprising event to a volitionally induced state; by displaying real-time indices of the neural signatures and the distance between current and expected (chills) neural states, individuals could learn to voluntarily control the onset of chills.

The ability to engineer chills carries profound ethical implications. Cultural technologies that harness chills can align or distort belief systems with equal power – a neurophysiological substrate for what Singh warns could become directed cultural evolution. Indeed, terrorist recruitment videos that emphasize shared humanity through martyrdom demonstrate how chills can be co-opted for ideological control. Yet, when used transparently and therapeutically, precision aesthetics can restore alignment in individuals "lost" in the manifold – those suffering from depression, anhedonia, or meaning crises (Jain et al., 2025; Schoeller et al., 2024a). In this sense, chills are both probes and promoters of meaning (as workouts are for fitness): they reveal and repair the coupling between world and self.

In line with a long tradition in aesthetics dating back to its foundation, aesthetics, as Singh proposes, is the interface where feeling meets cognition. Our findings extend this claim: aesthetic emotions are not decorative by-products but core cognitive calibration mechanisms that can now be measured, modeled, and modulated. The chills response bridges subjective conviction and objective neurobiology, transforming art from ornament into instrument. With neurotechnologies that allow humans to self-induce the very feelings art once evoked, culture may outgrow its artifacts. In the words of Konrad Lorenz (1974), humanity may "direct its own evolution" – not biologically but cognitively – by mastering the aesthetic mechanisms that once guided it "blindly."

Acknowledgments

The authors extend gratitude to Leonid Perlovsky for past discussions and collaborative writings that have contributed meaningfully to the conceptual

foundations and theoretical insights underpinning this work.

Financial support

This work was supported in part by a grant from the Yosef Innovation Fund.

Competing interests

N.R. and F.S. are co-founders and shareholders of Rewire Neurotechnologies, Inc., a company developing neurotechnology-based therapeutic interventions.

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