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Thinking Outside the Box: Experiencing and Visualizing Default Space Theory of Mind

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Abstract

DST reframes consciousness as a three-dimensional, oscillatory framework continuously updated via thalamo-cortical, brainstem, and visceral rhythms. This spatial field precedes and organizes sensory content, enabling the integration of multisensory and interoceptive inputs into a unified perceptual stage. We outline core experiential phenomena, the neurophysiological underpinnings of default space formation, and visual metaphors that make the theory accessible for empirical investigation. DST offers a compact, testable model for bridging phenomenology with neuroscience, and invites interdisciplinary research to validate and refine its predictions.

Keywords

Reticular Activating System; Consciousness; Attention Executive Network; Sleep-Wake Transitions; Default Space Theory; Thalamocortical Loops; Cardiorespiratory Coherence.

Significance Statement

Default Space Theory (DST) proposes that consciousness is the rapid construction of an internal, oscillatory space integrating sensory and interoceptive signals. This spatial scaffold bridges subjective experience with objective neuroscience, offering testable predictions for empirical research.

Introduction

Most prevailing models of consciousness emphasize cortical activation patterns or neural correlates associated with discrete sensory events [1,2,3]. DST challenges this sensory-first paradigm, proposing instead that the brain's primary task is to generate a coherent internal spatial framework—a default space—before populating

it with perceptual content. This space integrates visual, auditory, somatosensory, and visceral information into a unified, continuously updated field within tens of milliseconds, forming the basis for perception, thought, memory, and imagination.

Experiential Windows into Default Space

DST becomes more tangible when anchored in common yet revealing experiences:

- **Vestibular mismatch:** After spinning and stopping, the sensation of continued rotation persists. This reflects a temporally stable spatial scaffold maintained by the vestibular nuclei and integrated in the thalamus and parietal cortex, even without ongoing sensory input [4]. It demonstrates that internal spatial maps are not mere reflections of current stimuli but actively maintained predictive models.
- **Visual afterimages -**When one stares at a bright shape and then looks away, the afterimage appears fixed in space, despite the absence of retinal stimulation. fMRI studies show such afterimages are encoded retinotopically in early visual areas but stabilized against the larger allocentric spatial framework [5]. This highlights DST's claim that spatial coordinates pre-exist and anchor percepts.
- **Auditory "Om" resonance -**Prolonged low-frequency chanting creates a sense of expanded auditory space and altered self-boundaries [6]. This may involve coupling between auditory cortex rhythms and slow cardiorespiratory oscillations, directly demonstrating brain–body synchrony central to DST.
- **Memory scene reconstruction-**Recalling a familiar place instantly evokes an immersive, stable spatial field, even without visual input. This recruits hippocampal place and grid cells, along with retrosplenial and parahippocampal cortex [7]. The DST perspective is that this reconstructed space is functionally identical to the "default" space in waking perception.
- **Dreaming -** During REM sleep, full-scale environments emerge, complete with depth, movement, and coherent sensory blending. These are generated internally through hippocampal–thalamo–cortical loops, without exteroceptive input [8]. This shows that the brain can construct a functional default space entirely endogenously.

Neural Basis of the Default Space

In DST, the construction of consciousness begins not with sensory feature analysis but with an oscillatory framework:

- **Fast sensory oscillations** (~30–100 Hz gamma) from sensory cortices converge in the thalamus, where they are integrated with slower background rhythms from the brainstem and cortical default mode network [9].
- **Visceral integration** occurs via cranial nerves (e.g., vagus, trigeminal, glossopharyngeal), providing continuous feedback on cardiovascular, respiratory, and gastrointestinal states [10].
- **Spatial coding** is maintained by hippocampal and entorhinal place/grid cells, ensuring coordinate stability across sensory modalities [11].
- **Temporal precision:** Integration cycles close within ~10–25ms, enabling near-instantaneous updating of the spatial scaffold with each perceptual moment.

Figure 1: Stylized brain highlighting neural activity and connectivity.

Neural Basis

Gamma-band sensory oscillations converge in the thalamus, synchronizing with slower cortical and brainstem rhythms [9]. Cranial nerves deliver continuous sensory streams, while vagal afferents and brainstem autonomic centers integrate interoceptive states [10]. Grid and place cells in the hippocampal–entorhinal network maintain spatial coherence [11]. Multisensory integration occurs within ~10–25ms, allowing near-simultaneous spatial updating.

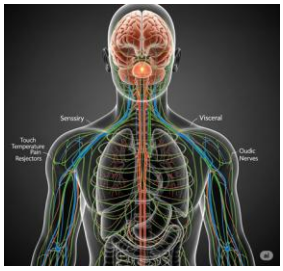

Figure 2: Semi-transparent human anatomy showing sensory and visceral pathways converging at the thalamus.

Conclusion

DST conceptualizes consciousness as an actively maintained, spatially unified field that organizes sensory and interoceptive information before it reaches awareness. This model bridges subjective phenomenology and objective neuroscience, offering a concise yet testable framework for advancing the science of consciousness.

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