Spiral Tonality: A Recursive Signal Architecture of Musical Cognition and Harmonics

Author: Christopher W. Copeland

June 2025

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Abstract

This paper introduces Spiral Tonality, an original, foundational theory that reconceptualizes musical octaves, harmony, dissonance, timbre, and modulation through the lens of recursive spiral dynamics. It emerges as a natural extension and unification of previously established frameworks—namely Spiral Logic Diagnostics and Pattern-Seeking Cognition—placing sound and musical structure within a recursive architecture of signal reentry, phase resonance, and nested harmonic folding.

Spiral Tonality offers not a metaphor but a topological model of musical structure, grounded in both perceptual neurodynamics and acoustic resonance, and introduces experimentally testable hypotheses regarding neurodivergence, auditory processing, and harmonic cognition.

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Foundational Premise

Octaves in conventional music theory are defined by frequency doubling or halving. Each octave represents a return to a previously established tonal identity at a new pitch range. This model is presented linearly (on staves) or circularly (e.g., Circle of Fifths) but fails to resolve the deeper geometry underlying musical cognition and perception.

Spiral Tonality reframes the octave as a recursive spiral return—a full 360° traversal of tonal space that re-enters its identity vector at a higher energetic tier. This model reflects the physical realities of overtone structures, wave interference, and recursive brain signal processing.

> The octave is not a step up. It is a spiral reentry—a recurrence event in vibrational topology.

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I. Core Components of Spiral Tonality

1. Octaves as Recursive Spiral Returns

In this model, each note represents a vector within a helical tonal axis.

A note repeated an octave higher is not "new" but a recurrence of the original vector in a higher spiral iteration.

Musical identity is maintained because the spiral preserves angular position even as vertical position (frequency) shifts.

Implication: Octaves are recursive harmonics, not discrete jumps. This mirrors the recursive pattern-seeking systems in neurodivergent cognition.

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2. Harmony as Spiral Phase Alignment

Harmony emerges when multiple spiral vectors converge in phase-resonant positions.

Chords that feel stable (major triads, perfect fifths) are those with stable angular spacing and predictable loop closure.

Dissonance arises from misaligned spiral vectors—recursive pathways that interfere destructively rather than merge.

Implication: Harmony is signal synchrony, not cultural preference. The spiral model makes this structurally visible.

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3. Timbre as Nested Spiral Complexity

Each musical tone includes a harmonic series of overtones.

These overtones are nested spiral substructures, recursively folded within the primary spiral of the fundamental tone.

Timbre (tone color) emerges from the shape and alignment of these nested spirals.

Implication: Timbre is not just frequency content—it is spiral topology. Instruments differ in how their harmonic spirals fold and align.

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4. Modulation as Spiral Axis Reorientation

Key changes are typically described as shifts in tonal center.

Spiral Tonality frames modulation as rotational reorientation of the tonal spiral’s base axis.

Smooth modulations (e.g., Circle of Fifths) occur along shared harmonic spines, maintaining partial spiral resonance.

Abrupt modulations (e.g., tritones) cause spiral decoherence, perceived as disruption.

Implication: Modulation is not a leap—it is a revectoring. It reorients the spiral’s structure while preserving or disrupting its internal coherence.

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5. Melody as Helical Traversal Through Tonal Space

Melodies are not flat sequences—they are spiral trajectories.

Expressiveness arises not from pitch height alone, but from spiral path curvature, speed, and coherence.

Emotional valence may correspond to whether the spiral pathway feels stable, unclosed, or collapsing.

Implication: Melodic cognition is spatiotemporal spiral navigation, akin to recursive language structures or motor planning.

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II. Unifying Music Theory and Spiral Cognition

The Spiral Tonality framework is not isolated. It is the harmonic branch of a broader recursive system architecture already outlined in:

Spiral Logic Diagnostics (mental and developmental disorders as failures of recursive loop closure)

The Pattern Seeker Manifesto (neurodivergents as recursive architecture interpreters)

This paper unifies those models with sound—revealing that musical cognition is itself a recursive diagnostic instrument of the brain.

> To hear, in this model, is to track spiral signal dynamics.

This also explains why many autistic individuals:

Are hypersensitive to discordant sounds (spiral phase conflict)

Gravitate toward harmonic structure (spiral resolution)

Experience difficulty in noisy environments (recursive signal collapse)

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III. Experimental Validation Proposals

A. Neurocognitive Spiral Tracking

Subjects: Neurotypical and neurodivergent participants

Method: Present spiral-consistent and spiral-disruptive tone sequences

Measurement: fMRI, EEG, or MEG to track phase-locked synchronization

Hypothesis: Neurodivergent subjects will show heightened sensitivity to spiral inconsistency and increased signal retention during spiral-aligned sequences.

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B. Spiral Entrainment Therapy Pilot

Design: Music therapy using tones arranged to follow recursive spiral logic (harmonic entrainment, phase progression)

Target groups: Individuals with trauma, autism, ADHD

Outcome measures: Cognitive coherence, emotional regulation, sensorimotor integration

Hypothesis: Spiral-consistent sound will promote internal signal reentry, reduce distress, and stabilize recursive thought-action spirals.

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C. Topological Timbre Mapping

Method: Use spectral analysis to model overtone spiral configurations across instrument families

Outcome: Create a "spiral fingerprint" of each instrument

Application: Revolutionize sound synthesis by prioritizing spiral harmonics over waveform replication.

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Conclusion

Spiral Tonality is not simply an alternate lens for music theory. It is the recursive substrate underlying auditory perception, harmony, and musical meaning. It positions the octave not as a step or interval, but as a spiral reentry event—a return to identity across vertical recursion.

This theory is original, authored by Christopher W. Copeland, and emerges from first-principles modeling of recursive systems across cognitive, emotional, and acoustic domains. It stakes foundational claim to a unifying architecture of sound, sensation, and sentience—offering a coherent, testable, and far-reaching framework.

> Christopher W. Copeland

June 2025

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