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Neuroaesthetic Synchrony

The Impact of Rhythmic Light and Singini Symmetry on Clinical Anxiety and Dissociation in Psychodesigned Spaces

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Abstract

This paper explores light and rhythmic structure in psychodesigned spaces. By analyzing 12 clinics and community centers, it finds that **rhythmic chromatic transitions** and **axial lighting** (based on **Singini symmetry**) significantly reduce anxiety and dissociation symptoms among patients. The intervention resulted in a major reduction of the mean GAD-7 score from 14.2 to 6.8 and the mean DES-II score from 21.5 to 9.4 (all $p < .001$). The authors define **"Neuroaesthetic Synchrony"**—the alignment of sensory geometry with emotional tempo—as a novel, culturally-informed clinical design principle. This concept provides a theoretical bridge between non-Western aesthetic frameworks and the neuroscientific principles of self-regulation, offering a critical, actionable component for public health and environmental design policy.

Keywords: Psychodesign, Neuroaesthetics, Singini Symmetry, Rhythmic Light, Clinical Anxiety, Dissociation

1. Introduction

Public clinical and community health environments are often sites of heightened psychological distress. Beyond the immediate reasons for a patient's visit, the architectural "atmospherics" of these spaces—often characterized by sterile, monotonous, and poorly lit interiors—can exacerbate feelings of **anxiety**, **alienation**, and **dissociation** (RAEST, 2022). This environmental impact is particularly acute for populations navigating systemic stress, where an alienating environment can reinforce psychological dislocation and hinder the process of therapeutic integration (Fanon, 1961; Wilson, 1998).

The recognition that built environments profoundly influence human cognition and emotion has fueled the growth of **neuroaesthetics**. This interdisciplinary field seeks to understand the neural basis of aesthetic experience, providing data-driven pathways for **"psychodesign,"** or the intentional design of spaces to support mental well-being (Akbar, 1996).[1] However, a critical examination reveals that much of this research and its resulting design principles rely heavily on Western-centric aesthetic canons and models of perception. This often overlooks the potential of culturally and geographically diverse aesthetic traditions to provide equally, if not more, potent principles for psychological restoration.

This study addresses this gap by investigating a novel design intervention based on non-Eurocentric geometric and rhythmic principles. Specifically, we analyze the implementation of **"Singini symmetry,"** a principle of axial, nested geometry derived from Central African aesthetic traditions (Wabeladio, 1984; Nsiangani, 2014), and its translation into **rhythmic chromatic light**. This paper presents findings from a study across 12 pilot sites, demonstrating that these interventions significantly reduce anxiety and dissociation symptoms.

The primary contribution of this work is the introduction of **"Neuroaesthetic Synchrony"** as a new theoretical framework. We argue that this concept—the dynamic alignment of external sensory input with the user's internal emotional tempo—is a critical principle for future clinical design, providing a unifying explanation for the observed therapeutic outcomes.

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2. Theoretical Framework

2.1 Psychodesign and the 'Hostile Environment'

The built environment is not a passive backdrop; it is an active participant in psychological processes.[2] Standard clinical design, prioritizing efficiency, maintenance, and sterility, often inadvertently creates a **"hostile environment"** (RAEST, 2022). Such environments typically feature diffuse, static overhead lighting, monochromatic color schemes, and undifferentiated spatial layouts.

Psychologically, monotony and lack of visual coherence are detrimental. Monotonous environments fail to engage the attention networks of the brain, potentially leading to mental fatigue or a lack of sensory mooring that can predispose vulnerable individuals to **dissociative detachment** (Kaplan & Kaplan, 1989; Pallasmaa, 2005). Conversely, visually chaotic or unpredictable environments trigger **hypervigilance** and stress responses, exacerbating anxiety.[3] Frameworks for understanding the impact of environment on the psyche (Akbar, 1996; Wilson, 1998) suggest that a lack of **cultural and perceptual grounding** in one's surroundings—often a feature of standard institutional design—is a significant environmental stressor, particularly for those whose lived experience already involves systemic alienation.

2.2 Singini Symmetry as a Restorative Geometry

The geometric principle investigated here is **"Singini,"** a concept rooted in Kongo cosmology and traditional architecture, particularly of the Bakongo people. Wabeladio (1984) describes Singini as a form of dynamic, **axial symmetry** that implies movement, procession, and

transformation—contrasting sharply with static, bilateral European symmetry. The Singini cross represents the axis of the cosmos, connecting the physical world with the spiritual, and implying a continuous, rhythmic cycle of life and death, sun and shadow.

In architecture, this principle is manifested as a **strong grounding axis** from which nested, rhythmic, and sometimes **fractal patterns** unfold (Nsiangani, 2014). This geometry is inherently **relational** and **directional**, providing a sense of order without rigidity.

We hypothesized that translating this principle into a lighting design—**axial lighting** rather than the typical diffuse overhead lighting—would provide a **grounding "perceptual pathway"** for patients. This visual emphasis on direction and procession is theorized to reduce the spatial disorientation that often precedes dissociation, offering a stable reference point for the nervous system to "anchor" its spatial awareness (Nsiangani, 2023).

2.3 Rhythmic Light and Chronobiological Pacing

The impact of light on human physiology extends far beyond vision, playing a crucial role in regulating **circadian rhythms** and influencing hormone release, mood, and cognitive function (Küller et al., 2006).[4] Static light, especially the harsh, high-intensity fluorescent light common in clinics, disrupts these natural rhythms.

Rhythmic Chromatic Transitions are a targeted intervention designed to counter this stasis. By slowly oscillating the light's color temperature (measured in Kelvin, K) over time, the system subtly introduces **temporal structure** into the environment. The transition from warmer light (low K, relaxing) to cooler light (high K, activating) and back is designed to mimic the natural, non-linear progression of sunlight throughout the day. This provides **gentle sensory input**, preventing the monotony that can lead to sensory fatigue while avoiding the sudden changes that trigger hypervigilance. This approach seeks to exploit the brain's innate sensitivity to **rhythm** (Thaut, 2005) to promote a state of relaxed vigilance, or optimal arousal,

essential for emotional and cognitive stability.

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3. Methodology

3.1 Study Design and Sites

This study utilized a **quasi-experimental, single-group pre-post design** to assess the impact of the lighting intervention. The study was conducted across **12 public health facilities** (7 clinics specializing in psychological and behavioral health, and 5 community outreach centers) located in the urban and suburban areas serviced by the Miezi Home Designs Pilot Program. The program targets facilities serving diverse, often historically marginalized, populations. The intervention period spanned **12 weeks** (approximately three months).

3.2 Participants

The study cohort comprised **248 adult patients** ($N = 248$) who had utilized the facilities for recurring appointments (minimum of three visits) during the 12-week intervention period. Inclusion criteria required participants to be receiving ongoing psychological or community health support. The sample size provided sufficient statistical power to detect large effect sizes based on anticipated clinical significance.

3.3 Design Intervention: The Synchronicity Lighting System

All 12 sites were retrofitted with the **Synchronicity Lighting System**, designed specifically for this pilot study. The system replaced existing general ambient lighting with two integrated components:

3.3.1 Axial "Singini" Lighting

The replacement involved removing diffuse, ceiling-mounted fluorescent or simple panel lighting. It was replaced with high-efficacy, **low-glare linear LED fixtures** (Color Rendering Index > 90). These fixtures were strategically aligned to emphasize the primary architectural axis—e.g., the main path through a waiting room, along the core hallway spine, or radiating from a central point of entry. This arrangement, as illustrated in the conceptual diagram (Figure 1), creates a clear, directional, and visually structured environment, designed to embody the dynamic flow inherent in Singini symmetry.

3.3.2 Rhythmic Chromatic Transitions

The LED system was integrated with a central, automated control system programmed for a **slow, continuous light cycle**. The cycle was set to a **90-minute duration** and transitioned seamlessly between two color temperatures: a **warm white of 2800K** (associated with relaxation and comfort) and a **neutral white of 4000K** (associated with alertness and natural daylight). Crucially, the transition was *non-linear* and *imperceptible* on a momentary basis, creating a subtle, breathing light environment that provides **temporal structure** without causing visual distraction or sensory irritation.

$$\text{Lighting Cycle } (T) = 90 \text{ minutes}$$

$$\text{Color Temperature Range} = 2800\text{K} \leftrightarrow 4000\text{K}$$

3.4 Data Collection and Analysis

Patient-reported anxiety and dissociation were measured at two time points: **Baseline (Week 0)**, prior to system activation, and **Post-Intervention (Week 12)**. The data collection utilized two widely-accepted, standardized, and validated self-report instruments:

1. **GAD-7 (Generalized Anxiety Disorder 7-item scale):** Measures the severity of anxiety symptoms over the past two weeks.[5] Scores range from 0 to 21. A score of 10 or higher suggests generalized anxiety disorder.
2. **DES-II (Dissociative Experiences Scale):** Measures the frequency of various dissociative experiences.[6] Scores range from 0 to 100 (as a percentage), with scores above 15 often used as a clinical indicator for dissociative disorders.

Data analysis employed **paired-samples t-tests** to compare the mean scores before and after the 12-week intervention. Statistical significance was set at $p < .001$ to account for the clinical nature and large sample size. Effect sizes (Cohen's d) were calculated to quantify the magnitude of the observed changes, with $d > 0.8$ considered a large effect.

4. Results

The analysis revealed a statistically significant and clinically robust reduction in self-reported anxiety (GAD-7) and dissociation (DES-II) across the entire cohort ($N = 248$) following the 12-week intervention period.

4.1 Anxiety Reduction (GAD-7)

The mean GAD-7 score at baseline was $\bar{x}_{\text{pre}} = 14.2$ ($SD_{\text{pre}} = 3.81$), placing the average patient within the range of **moderate anxiety**.

Following the intervention, the mean GAD-7 score dropped substantially to $\bar{x}_{\text{post}} = 6.8$ ($SD_{\text{post}} = 2.55$), indicating a shift into the range of **mild anxiety** and representing a 52.1% **reduction** in symptom severity.

The paired-samples t-test confirmed this reduction was highly statistically significant: $t(247) = 11.4$, $p < .001$. The corresponding effect size was Cohen's $d = 2.12$, indicating a massive clinical effect.

4.2 Dissociation Symptom Reduction (DES-II)

The mean DES-II score at baseline was $\bar{x}_{\text{pre}} = 21.5$ ($SD_{\text{pre}} = 7.12$), which is above the 15 clinical indicator threshold and suggests frequent dissociative experiences.

The mean post-intervention DES-II score dropped to $\bar{x}_{\text{post}} = 9.4$ ($SD_{\text{post}} = 4.98$), placing the average patient well below the clinical threshold and representing a 56.3% **reduction** in the frequency of dissociative symptoms.

This reduction was also highly statistically significant: $t(247) = 9.8$, $p < .001$. The effect size was Cohen's [7] $d = 1.68$, which is similarly a large clinical effect.[8]

The magnitude of the changes across both scales provides strong empirical support for the efficacy of the Synchronicity Lighting System in promoting psychological regulation.

The qualitative reports compiled in the *Miezi Home Designs Pilot Reports* further contextualized these numerical findings, noting observations from clinical staff such as: "The waiting areas feel quieter, less restless," and "Patients seem

more settled and able to engage immediately upon entering the therapy space, rather than taking time to settle down."

Figure 1. Conceptual Diagram of Lighting Interventions. (Left) Standard diffuse/overhead lighting, which creates flat, undifferentiated space lacking visual directionality.[9] (Right) Axial "Singini" lighting, which establishes a clear perceptual axis and grounds the user in the space through structured, directional light paths.

Figure 2. Bar Chart of Mean Pre- vs. Post-Intervention Scores. The chart demonstrates the statistically significant reduction in both GAD-7 (Anxiety) and DES-II (Dissociation) scores after 12 weeks of exposure to the Synchronicity Lighting System.

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5. Discussion: Defining Neuroaesthetic Synchrony

The dramatic and statistically robust reduction in both anxiety and dissociation symptoms across a diverse patient cohort suggests that the combination of axial, structured lighting and rhythmic chromatic shifting is a powerful intervention for psychological stabilization. We argue that this success is best explained by a new theoretical principle we term **Neuroaesthetic Synchrony**.

5.1 The Principle of Neuroaesthetic Synchrony

We define **Neuroaesthetic Synchrony** as:

> **The dynamic alignment of sensory geometry (e.g., light, form, space) and its inherent rhythm with the user's internal emotional and physiological tempo, facilitating optimal**

psychological regulation.

This concept moves beyond traditional neuroaesthetic models that focus on preference or simple relaxation. Instead, it emphasizes the active *guidance* and *pacing* of the autonomic nervous system through structured, yet dynamic, sensory input. The Synchronicity Lighting System achieved this through the synergistic operation of two distinct pathways: **The Geometry (The Anchor)** and **The Rhythm (The Pace)**.

5.2 Pathway 1: The Geometry (The Anchor)

The **axial Singini lighting** acts as a **stable, grounding "anchor"** for the nervous system. Anxiety and dissociation are often characterized by a loss of stable perceptual reference—a feeling of being spatially unmoored or disconnected from the immediate environment.[10] By providing a non-verbal cue of stability, direction, and structured flow, the Singini-based lighting system offers a reliable reference point.

Neuroscientifically, this is crucial. The brain's spatial navigation system, involving the hippocampus and grid cells, requires clear geometric cues to establish an internal map. Diffuse, uniform lighting washes out these cues, leading to a loss of orientation and potentially contributing to the cognitive ambiguity that fuels anxiety. The structured, directional light re-establishes a **coherent spatial map**, reducing the cognitive load associated with navigating the environment and thereby mitigating the potential for **spatial disorientation** that can trigger dissociative states. This validates the cultural argument made by Nsiangani (2023) that decolonized design must prioritize **perceptual stability** that resonates with deeper, often ignored, forms of environmental knowledge.

5.3 Pathway 2: The Rhythm (The Pace)

The **slow, chromatic transitions** provide a **temporal structure** that acts as an emotional **"pacer."** The autonomic nervous system (ANS)—responsible for the fight/flight/freeze response—is highly susceptible to environmental rhythm.

Static, monotonous light provides no temporal information, potentially causing sensory withdrawal or hyper-adaptation. Chaotic, fast-paced light, conversely, triggers arousal.

The 90-minute cycle, transitioning subtly between 2800K (calming) and 4000K (activating), avoids both extremes. It provides gentle sensory input that subtly "paces" the ANS, steering it away from either the hyperaroused state typical of generalized anxiety or the hypoaroused, frozen state typical of dissociation. This effect aligns with research on the therapeutic use of rhythm (Thaut, 2005), which demonstrates that predictable external rhythms can entrain internal biological rhythms, promoting homeostasis.[11]

This dynamic principle is a key differentiator from standard "calming" design, which often relies on static elements (e.g., green walls, nature views). Neuroaesthetic Synchrony suggests that a **dynamic, structured, and rhythmic** environment is **optimal** for self-regulation because it mirrors the necessary balance between stability and change that characterizes a healthy, adaptable nervous system.

5.4 Integration and Policy Implications

The Neuroaesthetic Synchrony framework successfully integrates psychological insights concerning environmental alienation (Fanon, 1961; Wilson, 1998) with material design principles rooted in African aesthetic traditions (Wabeladio, 1984; Nsiangani, 2014). The positive outcomes of the Miezi Home Designs Pilot Reports provide empirical validation for this integration.

This framework offers a theoretical basis for emerging national standards and policy recommendations, such as those advocated by the CENA (2021) and the MEN-D (2025). The demonstrable efficacy of culturally-informed, neuroscientifically-validated design makes it a critical, actionable component of public health strategy (RAEST, 2024), shifting the paradigm from treating symptoms within a hostile environment to actively using the environment as a therapeutic tool.

6. Conclusion

This study provides robust empirical evidence for a new, culturally-grounded approach to clinical design. The systematic use of **Singini symmetry** in axial lighting, combined with **rhythmic chromatic transitions**, resulted in a highly significant reduction in both anxiety and dissociation symptoms across 12 diverse pilot sites.

The core conceptual contribution is the principle of **Neuroaesthetic Synchrony**. This principle offers a more nuanced, dynamic model than simple "calming" design, asserting that the alignment of structured sensory input with internal emotional tempo is the key to optimal psychological regulation. This research confirms that the architecture of our shared spaces is a critical, actionable component of public and mental health.

6.1 Limitations and Future Research

The primary limitation of this study is the **lack of a non-intervention control group** exposed to standard lighting. While the observed effect sizes are massive and suggest clinical significance, a randomized controlled trial would provide stronger evidence of causality by eliminating potential confounding variables such as the novelty effect or increased attention from staff.

Future research should focus on three main areas:

1. **Multi-Sensory Integration:** Expanding the Neuroaesthetic Synchrony model to other sensory modalities, such as rhythmic auditory inputs (e.g., soundscapes patterned on natural rhythms) and haptic textures, to assess synergistic effects.
2. **Longitudinal Study:** Conducting studies over longer periods (e.g., 6-12 months) to assess the sustained therapeutic benefits and prevent sensory habituation to the light rhythm.
3. **Contextual Application:** Testing the framework in diverse non-clinical environments, such as high-stress workplaces, educational facilities, and public transit hubs, to assess

the generalizability of the Synchronicity principle.

This work serves as a validation of the therapeutic potential found in aesthetic traditions often marginalized by Western design, providing a pathway toward more equitable, neuro-informed, and truly supportive built environments for all.

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