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Título *Visual Narratives of Social Data: Color as an Emotional and Semiotic Mediator in the Understanding of Complex Data*

Autores (nombres y apellidos cada uno con sus metadatos)
Jeice Dayanna Hernández Contreras
Doctora en Arte: Investigación y Producción – Universitat Politècnica de València
Docente-investigadora – Universidad Santo Tomás
CVLAC:https://scienti.minciencias.gov.co/cvlac/visualizador/generarCurriculoCv.do?cod_rh=0000096336
Google Academic https://scholar.google.com/citations?user=hcMOTFcAAAAJ&hl=es
ORCID: https://orcid.org/0000-0002-1486-1333
Gruplac
https://scienti.minciencias.gov.co/gruplac/jsp/visualiza/visualizagr.jsp?nro=00000000015735

Resumen
Este estudio examina el papel del color como lenguaje perceptual y simbólico en la representación visual de fenómenos sociales complejos. Desde un enfoque mixto, crítico y transdisciplinar, se analizan los efectos cromáticos en la interpretación de datos sociales relacionados con la percepción ambiental en Chía (Cundinamarca, Colombia). Se desarrollaron tres visualizaciones del mismo conjunto de datos —monocromática, divergente y emocional— para evaluar su impacto en la claridad interpretativa, la recordación y la carga afectiva. Los resultados demuestran que el color no solo organiza la información, sino que configura la narrativa y la experiencia emocional del espectador, influyendo en la percepción de gravedad o empatía frente al fenómeno representado. Se concluye que el color opera como mediador semiótico y ético en la comunicación de datos humanos, y que su uso responsable permite equilibrar precisión analítica con resonancia social.

Palabras clave
visualización de datos, color, narrativas visuales, comunicación social, percepción.

Abstract
This research explores color as a perceptual and symbolic language in visual representations of complex social phenomena. Through a mixed, critical, and transdisciplinary approach, it analyzes the chromatic influence on interpreting environmental perception data in Chía (Cundinamarca, Colombia). Three visualizations—monochromatic, divergent, and emotional—were designed to assess interpretative clarity, recall, and affective response. Findings reveal that color not only structures information but also shapes narrative tone and emotional engagement, influencing how audiences perceive urgency and empathy. Thus, color emerges as a semiotic and ethical mediator in the communication of human data, balancing analytical accuracy and social resonance.

Keywords
data visualization, color, visual narratives, social communication, perception.

Introduction

Data visualization has evolved from a purely analytical practice into a narrative and interpretative field capable of translating complex social realities into visual stories. In this transformation, color plays a central role—not only as a design variable but as a perceptual and semiotic language that bridges quantitative precision and human experience. Within contemporary contexts marked by information saturation and emotional disconnection, color emerges as a mediating force that activates empathy, directs attention, and constructs meaning. Recent studies in visual communication and social design have shown that chromatic decisions can significantly influence how audiences interpret urgency, severity, and responsibility in social phenomena such as climate change, inequality, and displacement (Muñoz-Pico & León, 2024; Hernández & Oliveros, 2023). This growing recognition situates color as a key component in shaping collective perception and emotional engagement through data storytelling.

The present research focuses on examining how chromatic scales affect both the interpretative clarity and emotional response of audiences when engaging with social data. It adopts a mixed, critical, and transdisciplinary perspective to explore how the visual language of color contributes to humanizing data—turning abstract statistics into situated, culturally meaningful narratives. Using environmental perception in Chía (Cundinamarca, Colombia) as a case study, the study investigates how monochromatic, divergent, and emotional color schemes influence the viewer's cognitive and affective interpretation of environmental data. In doing so, it argues that color functions not merely as an aesthetic resource but as an ethical and communicative tool capable of shaping the way societies understand and respond to complex realities.

State of the Art

The field of *data storytelling* has progressively evolved from a technical exercise in information display to an interpretive practice where semiotics, emotion, and cognition converge. Segel and Heer (2010) and Kosara and Mackinlay (2013) emphasize that visualizations are no longer neutral carriers of information, but narrative instruments that actively shape the audience's interpretation. This shift has opened the way for the integration of affective and cultural dimensions into data design. Lupi (2017) and D'Ignazio and Klein (2020) advocate for the "humanization of data," proposing that design should move beyond efficiency to cultivate empathy and ethical awareness. Within this framework, color emerges as a critical narrative variable: it structures information, conveys hierarchy, and evokes emotional resonance.

Recent scholarship has strengthened this relationship between color, perception, and meaning. Cottam and Glinka (2023) note that color choices directly influence trust and credibility in data interpretation, while Gramazio, Schloss, and Laidlaw (2021) demonstrate that even domain experts are susceptible to misreading when chromatic codes lack conceptual grounding. From a semiotic standpoint, Kress and van Leeuwen (2002) view color as a "cultural grammar," capable of generating ideological and affective associations. Similarly, Hernández Contreras (2019) frames color as a transversal element that links symbolic and aesthetic dimensions in visual narratives. These perspectives establish a foundation for this research, which proposes a contextually grounded and ethically aware chromatic grammar. By integrating semiotic analysis, perception studies, and narrative visualization theory, this study seeks to examine how color

functions as both a communicative strategy and a cultural agent, setting the stage for the mixed-methods approach described below.

Objectives

General Objective:

To analyze the role of color as a semiotic and emotional mediator in the representation of complex social data.

Specific Objectives:

1. To explore how different chromatic scales influence the interpretation and emotional charge of data.
2. To evaluate the narrative effectiveness of color schemes in the communication of social phenomena.
3. To propose ethical and perceptual guidelines for the use of color in the visualization of human data.

Methodology

This study adopts a mixed, critical, and transdisciplinary methodology that combines quantitative precision with qualitative depth to explore how color influences the interpretation of social data. The approach integrates concepts and tools from design research, semiotics, and social sciences, allowing for a holistic understanding of how visual language shapes perception and emotional response. The mixed-methods design enables a dialogue between measurable variables—such as interpretative clarity—and experiential dimensions, such as empathy and narrative engagement. This articulation between data and emotion supports a broader vision of color as a semiotic and perceptual mediator rather than a merely decorative or technical element in visual design.

The research was conducted in four stages. The first phase involved contextual and perceptual data collection in the municipality of *Chía, Cundinamarca* (Colombia), chosen for its hybrid urban–rural dynamics and its relevance in discussions on environmental perception and urban sustainability. Through secondary data review and preliminary interviews, the study identified key emotional and cognitive associations with environmental change among local participants. In the second phase, these insights informed the creation of three distinct visualizations derived from the same dataset: a monochromatic version focused on analytical clarity, a divergent version emphasizing contrast and polarity, and an emotional version designed to evoke symbolic and affective readings of the phenomenon. These visualizations allowed the research to assess how different chromatic systems alter both comprehension and affective engagement with the data.

The third phase consisted of the application of an evaluation instrument based on a Likert-type survey complemented by open-ended questions. A total of 55 participants, aged 18–25—an age group documented as especially sensitive to environmental issues (Luna Pereira, Rueda Vera, & Avendaño Castro, 2021)—were asked to assess each visualization. The instrument measured interpretative clarity, narrative comprehension, recall, and emotional impact. The fourth phase corresponded to data integration through a *joint display* model (Johnson et al., 2019), which synthesized quantitative tendencies and qualitative insights in a unified analytical framework. This combination of perspectives made it possible to compare how participants reacted

cognitively and emotionally to each visual approach, providing empirical evidence for understanding the narrative and ethical potential of color in data visualization.

Results

The comparative analysis between the three visualizations revealed clear distinctions in how participants interpreted and emotionally engaged with the data. The monochromatic visualization was consistently rated highest in interpretative clarity and cognitive precision. Its minimal chromatic variation facilitated analytical comprehension, allowing users to focus on quantitative relationships without distraction. Conversely, the divergent visualization achieved moderate results in clarity but excelled in representing contrasts and patterns of opposition within the dataset. This approach proved effective in highlighting variability and difference, although its emotional engagement remained relatively neutral. The emotional visualization, however, generated the strongest affective response. Participants described it as "immersive," "expressive," and "closer to reality," emphasizing its ability to evoke empathy and a sense of urgency toward the environmental issue depicted.

Statistical analysis of the Likert-scale responses confirmed these tendencies: while the monochromatic design averaged higher scores in analytical comprehension, the emotional visualization dominated in memorability and perceived narrative impact. Qualitative feedback complemented these findings by showing that color saturation, temperature, and symbolic connotation directly influenced emotional resonance. Participants associated warm tonalities with alertness and concern, while cooler tones elicited calmness or detachment. This demonstrates that color schemes not only guide cognitive processing but also shape the moral and affective framing of information. Such insights align with Ware's (2021) findings on perceptual salience and Kennedy et al.'s (2016) discussions of data visualization ethics, reaffirming that chromatic design operates as both a technical and political act. The study thus establishes empirical evidence that color, when consciously designed, enhances interpretative depth and emotional connection in social data communication.

Conclusions

The findings of this study confirm that color in social data visualization operates as a semiotic, emotional, and ethical mediator, rather than as a merely aesthetic component. Its ability to code, contextualize, and emotionally activate information demonstrates that visual design decisions can transform statistical content into meaningful narratives that foster empathy and social awareness. The evidence obtained from participants reveals that chromatic systems not only guide perception but also construct interpretative hierarchies and affective responses. Consequently, visualizations of social phenomena demand a reflective and context-sensitive approach in which chromatic choices are grounded in ethical awareness, cultural sensitivity, and perceptual precision. Through this perspective, color becomes an active narrative agent that contributes to the humanization of data and the democratization of information.

Beyond its empirical contribution, this research opens new avenues for exploring color as a tool for social transformation through design. It highlights the need for interdisciplinary collaboration between designers, social scientists, and data communicators to establish a framework of

chromatic integrity (Silva & Sousa Santos, 2024) that ensures inclusivity, accessibility, and emotional coherence in visual communication. The study's methodological integration—combining perceptual testing, narrative analysis, and empirical validation—sets a foundation for future research on ethical and affective data design. In this sense, the project contributes to rethinking the role of design in the representation of complex realities: not merely as a mediator of information, but as a catalyst for critical reflection, empathy, and collective understanding.

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