

UC Berkeley

UC Berkeley Electronic Theses and Dissertations

Title

Seeing by Numbers: Color Systems and the Digitization of Perception

Permalink

<https://escholarship.org/uc/item/4f4852q8>

Author

Zeitlin Wu, Lida

Publication Date

2022

Peer reviewed|Thesis/dissertation

Seeing by Numbers: Color Systems and the Digitization of Perception

By

Lida Zeitlin Wu

A dissertation submitted in partial satisfaction of the
requirements for the degree of

Doctor of Philosophy

in

Film and Media

in the

Graduate Division

of the

University of California, Berkeley

Committee in Charge:

Professor Mary Ann Doane, Chair

Professor Jacob Gaboury

Professor Kristen Whissel

Professor Abigail De Kosnik

Summer 2022

© 2022 Lida Zeitlin Wu

All Rights Reserved

Abstract

Seeing by Numbers: Color Systems and the Digitization of Perception

by

Lida Zeitlin Wu

Doctor of Philosophy in Film and Media

University of California, Berkeley

Professor Mary Ann Doane, Chair

This dissertation reframes color as an experiential category that is consistently manipulated and calibrated through technological means, often to the benefit of corporate institutions and global structures of power. “Seeing by Numbers” is organized around what I call “the digitization of perception”: an epistemological mode that equates numbers and measurement with knowledge that emerged in the early twentieth century. I argue that color systems (diagrams or models that organize the color spectrum in visual and spatial terms) emblemize the tension between quantified norms and embodied experience that characterizes much of postindustrial culture. Analyzing examples ranging from nineteenth-century commercial paint charts to the postwar suburban home to Pantone’s Color of the Year and Adobe Photoshop, I reveal how modern color models, which were adapted for industry standards in fields ranging from agriculture to computer interfaces, continue to inform how we use and experience color today. In this way, the project charts a narrative of continuity rather than rupture when it comes to digital and algorithmic technology and contends that qualities commonly linked to digital color—such as numerical representation, modularity, and detachment from form—map onto a way of seeing that has been with us since long before computational technology.

In chapter one, my engagement with turn-of-the-century developments in synthetic dyes and the emerging fields of psychophysics and spectroscopy reveals that the color grid overtook the color wheel as the primary organizational mode beginning in the early twentieth century. Grid configurations such as the Standard Color Card of America taught citizens to see colors as discrete entities that were abstracted from objects, reshaping human perception and patterns of consumption in a rapidly industrializing world. The next chapter moves to the American postwar suburban home. Reading the writings of famed color consultant Faber Birren alongside mid-century color psychology and advertising theory, I contend that the so-called freedom of color choice within the home promoted by color consulting firms and paint companies actually cemented set identity categories, as gender and race became subject to standardization and classification under the guise of personality. I then turn to the period between the 1980s and early 2000s, when color standards initially designed for pigments were adapted for light-emitting digital screens. From social media accounts to installation works, users and artists alike understand digital color as modular and choppy rather than seamless, drawing inspiration from the material aspects of the computer supposedly obfuscated by the screen. The final chapter

consists of two central case studies—the Color Factory, an interactive pop-up Instagram exhibition, and Pantone’s Color of the Year—demonstrating how color today cannot be separated from the rise of an attention-based platform economy grounded in voluntary self-surveillance and the commodification of emotions. By capitalizing on the notion that color is nostalgic or “authentic,” both these examples promote color as an escape from the “always-on” mindset of a technologically saturated existence, despite the irony that they depend on this very framework to survive. Ultimately, by taking a critical stance on color systems and diagrams that purport to be objective, I draw attention to the ways in which changing representational strategies continue to play a key role in establishing ways of knowing and constructing both the self and the world around us.

Contents

Acknowledgments.....	ii
Introduction.....	1
<i>Chapter One. The Wheel and The Grid: Thresholds of Experience.....</i>	12
<i>Chapter Two. Our Chromatic Categories: Mood-Conditioning the Postwar Interior.....</i>	48
<i>Chapter Three. Impossible Geometries: From Color Space to Interface.....</i>	87
<i>Chapter Four. Escape into Color: The Rise of the Experience Economy.....</i>	116
Coda	157
Bibliography.....	165

Acknowledgments

Completing a dissertation is always a collaborative effort, but even more so when one is writing during a historically unprecedented period of precarity and uncertainty. The bulk of this project was completed during the first two years of the COVID-19 pandemic, which, as I sit down to write this in May 2022, shows no signs of subsiding. Trying to stay motivated and hopeful while isolating alone as a socially extroverted person was an immense challenge, and I could not have finished this dissertation without the support—both professional and personal—I have received over the past few years from people near and far, on Zoom and face-to-face.

First, I need to thank the department of Film & Media at UC Berkeley, including faculty, graduate students, and administrators alike, who have been my academic family for the past five years. I initially began my graduate career in Comparative Literature, and when I moved from the first to the top floor of Dwinelle Hall (and later, when a heated discussion of *Bojack Horseman* broke out at a department party), I knew I had finally found my people. My advisor, Mary Ann Doane, embodies in so many ways the kind of scholar I would like to be. I've had the privilege of TA-ing for her three times, and after each lecture, the world feels new and unfamiliar to me in the best way. As a mentor and reader, I appreciate her sharp eye and seemingly limitless knowledge of media theory and philosophy, as well as her deadpan (but hilarious!) sense of humor. Deepest thanks to Jacob Gaboury, who has been excited and optimistic about this project from the very beginning, despite it not always fitting tidily into any one discipline, and who has always been unthinkably generous with his time and energy.

Thank you to Kristen Whissel, who supported my interest in color going all the way back to my qualifying exams and made my archival research trip to the East Coast possible with her research funds. Kristen is also a rock for graduate students on the job market, and I appreciate her coaching me through this turbulent and uncertain process in a way that is both pragmatic and empathetic. I would also like to thank Gail De Kosnik for being gregarious, honest, and open and for giving me the confidence to write about pop culture in a rigorous way. Finally, I would be remiss not to mention Mark Sandberg, who, despite not being on my committee, is the kind of mentor all graduate students dream about. Mark has always treated me as an intellectual equal and colleague, and I don't think I could have gotten through the past few years without him.

I feel also extremely lucky to have gotten to know some outstanding scholars beyond Berkeley. As fellow color-obsessed people, they know what it's like to research a topic that is simultaneously ultra-niche and all-encompassing. When I first read Carolyn Kane's work, I had no idea she would become a mentor and even a friend, and I'm excited to continue collaborating with her on future projects. Michael Rossi took the time to read through the entire dissertation, which he peppered with fascinating historical tidbits and the occasional color-themed pun. I can always turn to him when I need the historian of science perspective.

The librarians and archivists of the world don't get enough credit (to which my Aunt Ari can attest). That this project became so archivally oriented is thanks to the vast resources at Smithsonian Libraries, the New York Public Library, and Yale University and the availability of their staff. Thank you especially to Jennifer Coleman Bracchi at Cooper Hewitt Research Library. The first time I met her, she was wearing a necklace made of colored pencils, and I knew right away that we were kindred. This project was partly funded by the Smithsonian's

Baird Resident Scholar program (which I completed remotely), and Jen spent hours poring through the archives while also sharing her own experiences curating an exhibition on color.

I received a dissertation grant from the UC Berkeley Graduate Division to participate in an interdisciplinary writing group in Summer 2020. Though I have yet to meet everyone in person, I have such a warm feeling when I remember daily check-ins with Katie Bondy, Elisa Russian, David Bratt, and Dominick Lawton. All talented scholars in their own right, their presence, despite being virtual, was integral to completing the chapter with which I struggled the most. Since then, Katie has also become a dear friend, one on whom I can depend on for deeply honest conversation whenever we find ourselves in the same city.

One of the defining characteristics of academic life is the blurring of the collegial and the personal, so the order of the next couple paragraphs is admittedly somewhat arbitrary. I want to acknowledge the brilliant minds of the graduate students I have met at Berkeley, many of whom have become lifelong friends. To Harry Burson and KC Forcier: I love the triumvirate of our occasionally related—but usually quite different—projects and ways of thinking through media objects (Harry, someday we’ll co-teach that “Sound and Color” class, psychophysical treatises and all). Lisa Jacobson, I can’t believe I found someone at Berkeley with whom I share early life experiences with so acutely; thank you also for being such a dazzling co-teacher and pedagogical mentor. Caleb Murray-Bozeman, I’m so glad we met: who else could I nerd out with about wine and media theory in the same conversation? Linda Zhang, Jianqing Chen, Yvonne Lin, Dolores McElroy, Renee Pastel, Emily West, and Chelsea Ward: thank you for sharing your intellect, humor, and friendship with me over the past few years. Marlena Gittleman, even though I’m no longer in Comp Lit, I’m so glad our friendship has sustained. To Lauren Miller—my friend who never shies away from color—it’s been such a pleasure to witness your career journey these few years and to be along for the ride. To Zach Hicks and Sunayani Bhattacharya (and now baby Atri), all I can say is *enacubo*. Here’s to future meals and travels, wherever life takes us.

Thank you to everyone who has made the Bay Area feel like home for the past seven years. To Shira Tannor and Lucy Snow for their unrelenting generosity (and seemingly endless supply of king salmon) and for always being there no matter what. Magdalena Cadena, your friendship was one of the best things to come out of the pandemic. To Jehan Hakimian: thanks for all the blind tastings, and for expanding my world more than you know. Crystal Chen, thanks for your much needed perspective and dry wit. Ezra Chomak, thank you so much for your unparalleled kindness and support in the midst of job market uncertainty. Not only did you make this year bearable, but you made it endlessly joyful and exciting. To all the wine shops I have loved: Bay Grape, minimo, and Oakland Yard, thank you for helping me cultivate relationships outside of academia and keeping me well-watered!

I owe my deepest thanks to those who feel like home wherever I go. I’m grateful for the extended Zeitlin family and Zeitgeist family group chat—I never know what to expect when a new message pops up. My grandmother Froma Zeitlin (a.k.a. FIZ) is especially a force to be reckoned with. Alia Goehr, I love that you balance exuberance and delight with biting critique and honesty. I know you have my back for life. Lilly Lerer and Steven Lucy, thank you for the community and connections you seem to create so effortlessly. Andrew Sandwick and Page Redding, I love knowing that we’ll share memories and inside jokes regardless of how much we change. And thanks to Mitya, my witch’s familiar, for unconditional feline affection and

companionship.

Finally, to my parents, Judith Zeitlin and Wu Hung: you are my fiercest advocates and interlocutors. You've given me a lot to live up to, but I think I'm up for the challenge. Thank you for letting me grow up surrounded by words, images, and ideas. I love you both more than I can say.

Introduction

Colors flood our spaces so fully that there isn't any. They allow us to discriminate among otherwise identical things (gold and green racing cars, football teams, jelly beans, red-brown- blond- and black-haired girls); however, our eye is always at the edge, establishing boundaries, making claims, so that colors principally enable us to discern shapes and define relations...

William Gass

I. Color™

Between 2020 and 2021, I, along with much of the rest of the world, found myself adjusting to a screen-based existence brought on by a global pandemic where nearly all communication and social interaction was now relegated to the virtual realm. My extended family, which spans multiple continents and time zones, created a WhatsApp group chat to share photos, articles, and general updates. Checking these notifications became part of my daily rhythm. Of all the miscellaneous content shared in this chat over this excruciating fifteen-month period, however, one conversation thread stands out in my mind. Having spent much of my adult existence reading and thinking about color, this particular exchange served to affirm and strengthen a belief I had long held but was struggling to articulate in my own writing: namely, that *there is no such thing as an unmediated experience of color*, and that *the segmentation of the visible spectrum into a seemingly infinite number of commodifiable and measurable swatches has fundamentally reshaped how we see and relate to color in everyday life*.

My uncle, an avid cyclist who lives in Amsterdam, posted a photo of himself dressed head-to-toe in a mint green spandex biking outfit and joked, “Bianchi is paying me for this” (Bianchi being the oldest known bicycle company, founded in Italy in 1855). What ensued was a lively exchange during which various family members attempted to describe this precise shade.¹ My mother wrote: “Bronze Patina Green.” “The trademark shade of green,” a cousin responded, referring to Bianchi’s signature color that the company calls “Celeste” (which translates approximately to “sky blue”) or alternately “Bianchi Blue.”² The partner of another cousin chimed in, “Ah, Bianchi Celeste Green versus Tiffany blue... both subtle but very trademarked,” attaching a GIF of Audrey Hepburn saying, “I’m just *crazy* about Tiffany’s!” Both companies’ images are intimately linked to their signature colors, which actually look quite similar [Figure 1]. “Celeste is Bianchi, Bianchi is Celeste, the two are indivisible,” reads a blurb on the company’s official website. A similar declaration of ownership over color can

¹ It seems also telling that this conversation took place on a digital interface, where—potential differences in color acuity and perception aside—none of us could be sure that our individual color displays were the same.

² The origin of Bianchi’s signature color is the source of much speculation. Some suggest that founder Eduardo Bianchi gifted a bike to the Italian queen and painted it to match her eyes; others believe it resulted from an abundance of leftover paint after World War II; still others suggest the color resembles the sky over Milan. See the Bianchi official website for a promotional account of this color titled “Celeste: The Color of Legends and Dreams.” <https://www.bianchi.com/celeste/>. Other articles on the origins of Bianchi Blue include Matt Phillips, “What’s the Story Behind Bianchi’s Signature Color? *Bicycling*, April 6, 2015. <https://www.bicycling.com/news/a20014309/bianchi-celeste/> and “A Bit of Cycling History...” *Athletic Camps*, January 16, 2018. Blog post. <https://www.athleticamps.com/blog-1/2018/1/16/a-bit-of-cycling-history>

be found on the Tiffany & Co website: “Tiffany Blue®: A Color So Famous, It’s Trademarked.”³

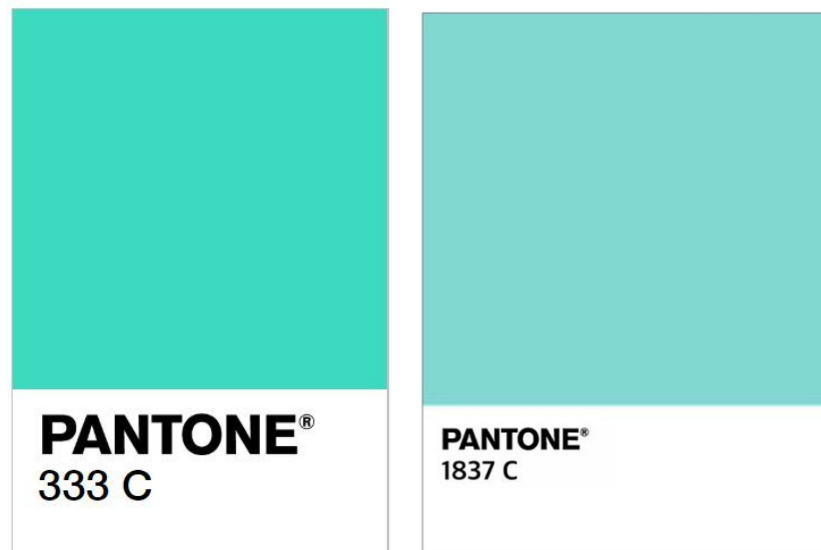


Figure 1. Official Pantone Matching System colors for Bianchi’s Celeste (**left**) and Tiffany Blue (**right**)

What exactly does it mean to trademark a color? Certainly, copyright law plays a role—Tiffany & Co registered Tiffany Blue as an official trademark in 1998—but this only tells us part of the story.⁴ I am interested in looking at these commercialized hues beyond critiques of commodification and the rise of corporate capitalism, though these frameworks provide crucial historical context. What has been largely obscured from discussions of industrial and postindustrial color is that these industry standards are inseparable from technologies of measurement and quantification. By working with color matching systems such as Pantone, which function as intermediaries, companies seek to reproduce their signature colors across both print and screen technologies (graphic designers and color consultants call this “color management”). These matching systems segment the color spectrum into thousands of numerically labeled swatches or chips: Coke Red is PMS (Pantone Matching System) 185, whereas Tiffany Blue is PMS 1837, a customized color not available for the general market.⁵

Furthermore, these technologies, which generate a seemingly infinite set of discrete units identifiable primarily by a unique string of numbers, respond to existing historical trends while also catalyzing changes in how color itself is perceived. While consumers are unlikely to memorize these precise numbers, patented colors become so distinctive and pervasive that they become instantly recognizable. “Think of the Coca Cola® brand,” an overview on color standards by design firm Neglia Design reads. “What color do you see? If you’re like most people, you see the color red. Not just any red. Coke red.”⁶ On an online message board dedicated to Baby Boomer nostalgia, a user reminisces about the impact Venus Paradise colored pencils had on her perception of color: “As adults, my sister and I would often describe colors to

³ “Our Story: Tiffany Blue.” *Tiffany & Co Newsroom*. <https://press.tiffany.com/our-story/tiffany-blue/>. The 2016 documentary *Crazy About Tiffany’s* (dir. Matthiew Miele) traces the origins of Tiffany Blue, including the company’s ongoing efforts to copyright the shade.

⁴ “Trademarks & Copyrights.” Tiffany & Co, <https://www.tiffany.com/policy/trademarks-copyrights/>

⁵ 1837 is the year Tiffany & Co was founded.

⁶ “What’s the Difference Between PMS, CMYK, RGB and HEX?” Neglia Design, <https://negliadesign.com/ask-a-designer/whats-the-difference-between-pms-cmyk-rgb-and-hex/>

each other in terms of the Venus Paradise numbering scheme. ‘It’s a kind of #7 blue.’”⁷ We thus see that patenting and standardizing color isn’t simply about “good marketing” or commodifying the maximum possible number of hues, but also the ways in which the numerical labeling systems used to classify color have the capacity to transform how we see color by targeting perception itself.

As late capitalist subjects, we’re surrounded by examples that point to an increasing tendency to see colors as standardized, numerical, and even patented, ranging from more serious artist’s installations and video works to more ephemeral pop cultural examples like memes [Figure 2]. In 2016, renowned sculptor and installation artist Anish Kapoor obtained exclusive rights to use Vantablack, a pigment dubbed “the blackest black” in existence due to its carbon nanotube structure, which absorbs up to 99.6 percent of incoming light.⁸ Kapoor’s monopoly over Vantablack was not well-received by other artists, particularly Stuart Semple, who, in an act of performative revenge, manufactured a powder he called “the pinkest pink.” This, alongside other powders and pigments designed by Semple, including Black 3.0, which absorbs almost as much light as Vantablack (99 rather than 99.6 percent) [Figure 3], are “available to everyone *except* Anish Kapoor (who won’t share his black!)” A separate disclaimer on Semple’s website reads: “Important: By backing this project you confirm that you are not Anish Kapoor, you are in no way affiliated to [sic] Anish Kapoor, you are not backing this on behalf of Anish Kapoor or an associate of Anish Kapoor. To the best of your knowledge, information and belief this material will not make its way into the hands of Anish Kapoor.”⁹ In the end, Kapoor did in fact get his hands on some of Semple’s pink, giving Semple the (powder-coated) middle finger in a photo posted on social media.

The Kapoor-Semple feud, while admittedly petty, foregrounds the discrete, modular, and above all numerically based qualities of individual colors, revealing them to be inseparable from global consumerism and branding as well as technologies of both mechanized standardization and digital customization.¹⁰ Thus, instead of seeing color as a continuous gradient, it seems more accurate to talk about not *color* in the singular, but *colors* in the plural. Celeste and Tiffany Blue may resemble each other to the untrained eye, hovering somewhere on the imperceptible border between blue and green, but it is ultimately numerical standards that set the score. The fact that both my first instinct, as well as my mother’s and cousin’s, was to describe Bianchi’s signature shade as green rather than blue already makes it clear how much speculation and linguistic maneuvering describing colors requires, especially when it comes to those that seem to sit on the cusp between distinct hues such as blue and green (and even the division between these colors is not guaranteed, there being two unrelated words for “dark blue” and “light blue” in Russian, *sinii* and *goluboi*). Alphanumeric labels do away with some of this discursive labor and attempt to eliminate the contingency that is often associated with something as notoriously unreliable and

⁷ Duff, “Venus Paradise: Paint-by-Number Coloring Sets,” May 9, 2009. *The Baby Boomer E-Museum*. <http://www.mikanet.com/museum/item.php?cat=27&index=172>

⁸ Manufactured by Surrey Nanosystems, Vantablack is primarily used for aerospace and military purposes. Engineers at MIT have since outstripped Surrey Nanosystems in manufacturing an even “blacker” black, also using carbon nanotubes, which captures at least 99.995 percent of light.

⁹ “The world’s Pinkest Pink- 50G Powdered Paint by Stuart Semple.” *Culture Hustle by Stewart Semple*, <https://www.culturehustleusa.com/collections/powders/products/pink-50g-powdered-paint-by-stuart-semble>.

¹⁰ There are also several precedents to this, where an individual artist attempts to patent a particular color, most notably Yves Klein’s International Klein Blue in the early 1960s.

ephemeral as color (I say “attempt” because as will become evident, these attempts to harness the visible spectrum are never wholly successful).

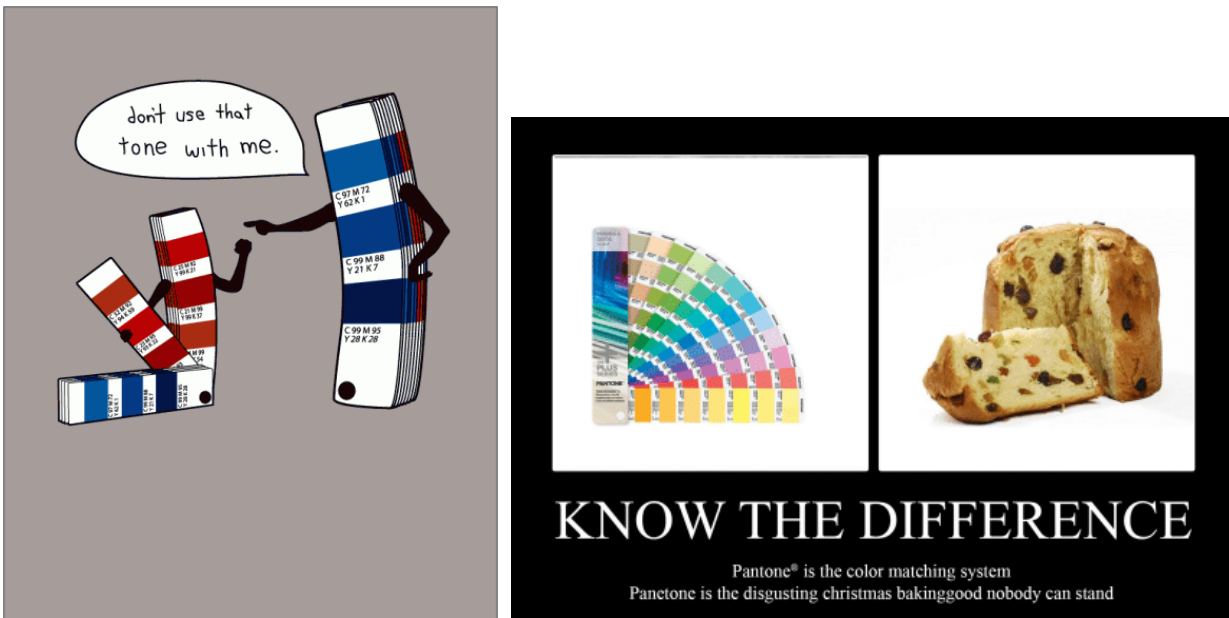


Figure 2. Memes and cartoons humorously demonstrate the ways in which number-based color matching systems, particularly the international corporation Pantone, have become stand-ins for color itself.



Figure 3. Promotional content for Black 3.0 from Stuart Semple's website. Courtesy of the artist.

Following Friedrich Kittler's assertion that “after 1880 we find ourselves in an empire of standards,” this dissertation reframes color as an experiential category that is consistently

manipulated and calibrated through processes of standardization and quantification.¹¹ By mapping several key moments from the late nineteenth century to the present, I argue that color has long served as a primary site for reevaluating the shifting relationship between screen and storage media and perception—both as an external process of making sense of the world and an inward-looking mode of self-knowledge. The first full-length study to treat color systems and models (such as the Ostwald, Munsell, and Pantone color systems) as aesthetic and technological objects in their own right, I trace how such systems, which have been adapted for industry standards in fields ranging from agriculture to computer interfaces, continue to inform how we relate to color today. The gradual absorption of these mathematical color systems into first-person experience gives way to what I call the *digitization of perception*: an epistemological mode where numbers and measurement come to be equated with both external and internal awareness. Ultimately, by taking a critical stance on color systems and diagrams that purport to be “objective,” I draw attention to the ways in which changing representational strategies continue to play a key role in establishing ways of knowing and constructing both the self and the world around us.

II. Color Systems: An Overview

Several paradoxes built into the very concept of color have plagued artists, scientists, and philosophers for millennia. An expansive, amorphous category, much like time or space, color has historically been a target of measurement, rationalization, and quantification. Yet color somehow always manages to escape the confines of systematic representation, giving way to a constant push-pull between disembodied empiricism and embodied sensory experience. Color is therefore ontologically problematic because while it is irreducible to form, it is also inseparable from it—an object we perceive to be a certain color absorbs all wavelengths of light *except* that particular color. Though color is to a certain degree measurable and belongs to the optical faculty of sight, it must be filtered through the subjective perception of an external observer, blurring the lines between perceiver and object perceived—thus always skirting the edge of representation.

Because color has such a slippery relationship to representation and objecthood, it makes sense that there have been ongoing efforts to create an interdisciplinary field of “color studies.” With several anthologies and conferences dedicated to the topic, these projects often showcase a collection of topical ideas rather than solidifying a unified methodology or approach. Often, edited volumes on color focus on a particular medium (film, photography, literature, fashion), thus conceiving of color as a quality or property of existing material technologies rather than a mediating force in and of itself,¹² and many monographs on film color relegate color to the

¹¹ Friedrich Kittler, “Theoretical Propositions.” In *Optical Media: Berlin Lectures 1999*, trans. Anthony Enns (Polity Press, 2010), 37.

¹² See, for example, Angela Dalle Vacche and Brian Price, eds. *Color: The Film Reader* (Routledge, 2006); Simon Brown, Sarah Street, and Liz Watkins, eds. *Color and the Moving Image: History, Aesthetics, Archive* (Routledge, 2013); Regina Lee Blaszczyk and Uwe Spiekermann, eds. *Bright Modernity: Color, Commerce, and Consumer Culture* (Palgrave Macmillan, 2017); Joshua Yumibe, Giovanna Fossati, Bregt Lameris, Sarah Street, Victoria Jackson, and Elif Rongen-Kaynakçi, eds. *The Colour Fantastic: Chromatic Worlds of Silent Cinema* (Amsterdam University Press, 2018); and Barbara Flueckiger, Eva Hielscher, and Nadine Wietlisbach, eds. *Color Mania: The Material of Color in Photography and Film* (Lars Müller Publishers, 2020). There is also an International Conference on “Colour in Film” that has been held annually since 2016.

narrative or symbolic realm or treat it as one aspect of industry history.¹³

In this dissertation, I am concerned less in foregrounding the materiality of color technologies or meaning-making through color (i.e. what individual colors signify in different cultural contexts), but rather in reframing color itself as a quality of lived experience—one that overlaps with, but is not subordinate to, specific technological apparatuses or media forms. Drawing on Carolyn L. Kane's claim that "color is and always has been a kind of technology," I argue that color serves a mediating function between self and environment, but one that is always filtered or manipulated through the prism of different ordering systems.¹⁴ Color technologies, with all their promises of realism and fidelity, are never able to capture the full spectrum of visible colors. In their respective attempts at standardization, film, television, and digital screen displays must overlook differences in color spectrum between individuals, as well as contingent environmental conditions such as lighting, pointing to the ways in which the experience of color is always mediated and constructed.

While there are no doubt key differences between filmic, televisual, and digital color technologies, they do have one thing in common: all rely on preset or calibrated color settings in order to guarantee consistency across multiple reels, monitors, and screens.¹⁵ These systems and diagrams, which range from color wheels to grids to three-dimensional "color spaces," are all attempts to organize and classify the color spectrum in visual and spatial terms. While these colorful and symmetrical representations are admittedly aesthetically pleasing—museum giftshops and online stores sell reproductions of them printed onto t-shirts and tote bags in a textbook Benjaminian gesture—their significance to the study of color and modern perception goes far beyond the decorative. The few full-length studies of color systems tend to be found in the hard sciences, the most cited text being chemist and textile engineer Rolf Kuehni's detailed survey *Color Space and Its Divisions: Color Order From Antiquity to the Present* (Wiley, 2003). These mathematical and quantitative color models, which have been largely omitted from artistic and cinematic studies of color, draw our attention to two seemingly contradictory yet interdependent modern phenomena: a widespread obsession with quantitative norms or standards on the one hand and the valorization of individual experience as a source of self-knowledge on the other.

Though color systems are largely considered to be "objective" (a concept that is itself historically and culturally contingent rather than eternal), the historical and ideological contexts in which they emerged, as well as the at times arbitrary decisions built into their structure, reveals this so-called "neutrality" to be a myth.¹⁶ Color emerges as a site for "rational thinking" alongside the emergence of modern psychophysics, the branch of perceptual science which measures the relationship between external stimuli and sensation. Mid-century psychophysical studies of color, which assumed the existence of a "standard observer," sought to maximize efficiency by building the perceptual limitations of this hypothetical observer (based on the assumption that the eye is less sensitive to certain wavelengths of color) into technologies such as

¹³ For largely narrative readings of film color, see Paul Coates, *Cinema and Colour: The Saturated Image* (Bloomsbury, 2010). Industry-focused monographs on color film include Scott Higgins's *Harnessing the Technicolor Rainbow: Color Design in the 1930s* (University of Texas Press, 2007) and Sarah Street, *Colour Films in Britain: The Negotiation of Innovation, 1900-55* (Palgrave Macmillan, 2010).

¹⁴ Carolyn L. Kane, *Chromatic Algorithms: Synthetic Color, Computer Art, and Aesthetics After Code* (The University of Chicago Press, 2014)

¹⁵ The exception to this may be hand-colored early films, though even then the goal of processes such as tinting and toning was to color several batches of film strips at once.

¹⁶ Lorraine Daston and Peter Galison, *Objectivity* (Zone Books, 2010)

color television.¹⁷ Over the course of the twentieth century, color vision was imbued with a distinctly *informatic* quality that was inseparable from the standardization, measurement, and commodification of perception under postindustrial capitalism.

III. The Digitization of Perception

In arguing that perception itself is socially and historically structured by distinct representational systems and dominant ideologies, I build on a line of thinking formulated by Foucault and pursued by scholars of modernity and visibility such as Jonathan Crary.¹⁸ As such, in direct opposition to the turn to posthumanism and new materialism, which foreground physical technologies and hardware over the human subject, I stress how color can be viewed as one of many categories of experience targeted by patented representational systems and commercial enterprise, which seek to normalize the perceptual modes they deem most “efficient” and profitable. As a way of making sense of the world, it also follows that color plays a key role in formations of selfhood by reducing the body and sensorium to a set of key operations. More holistically, modern color psychology cemented a connection between color, emotion and mood, as well as discourses surrounding personality and identity formation.

In tracing how this preoccupation with measuring and quantifying the human subject has distinctly modern origins, I present a narrative of continuity rather than rupture when it comes to digital technology, thus diverging from an approach outlined by several new media theorists over the past decade. These critics—responding in the 2010s to the screen-centered approach of “software studies”—argued that the computer interface’s resemblance to other screen-based media such as film and television conceals its ultimate ontological basis: numbers and protocols rather than images.¹⁹ While the structural logic of the digital computer screen undeniably

¹⁷ Jonathan Sterne calls this economization of perception “perceptual technics.” Sterne first introduces the concept of perceptual technics in *MP3: The Meaning of a Format* (Duke University Press, 2012), noting that frequencies that are inaudible to the human ear can be eliminated in order to conserve bandwidth, generating “perceptual capital.” In a piece cowritten with Dylan Mulvin, Sterne and Mulvin demonstrate the relevance of perceptual technics to color as well as sound by examining color television standards in the 1950s. See “The Low Acuity for Blue: Perceptual Technics and American Color Television,” *Journal of Visual Culture* 13, no. 2 (2014): 118-138. In *Bright Signals: A History of Color Television* (Duke University Press, 2018), Susan Murray explores the postwar American obsession with color theory, colorimetry, color design, and color psychology, noting that many color primers used by mainstream TV networks in the 1950s were based on proprietary color spaces such as the Ostwald Color System, which likewise sought to standardize color perception.

¹⁸ In particular, I draw on Foucault’s early work on epistemology and ordering systems as outlined in *The Order of Things: An Archaeology of the Human Sciences* (Random House, Inc., 1970), his later lectures on the self published in *Technologies of the Self: A Seminar With Michel Foucault*, eds. Luther H. Martin, Huck Gutman, and Patrick H. Hutton (University of Massachusetts Press, 1988), and Jonathan Crary’s discussion of optics and color in *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century* (The MIT Press, 1990).

¹⁹ Wendy Hui Kyung Chun, *Control and Freedom: Power and Paranoia in the Age of Fiber Optics* (The MIT Press, 2006) and “On Software, or the Persistence of Visual Knowledge,” *Grey Room* (Winter 2005): 26-51. Alexander Galloway later responded to this essay in a piece titled “Language Wants to Be Overlooked: On Software and Ideology,” *Journal of Visual Culture* 5 no. 3 (2006): 315-331. His books *Protocol: How Control Exists After Decentralization* (The MIT Press, 2004) and *The Interface Effect* (Polity Press, 2012) also make the claim that the computer is a unique and non-visual medium.

operates differently from televisual or projected images, I contend that the computer—and by extension, computer color—represents another stage in a much more gradual fusion of first-person experience and colorimetric systems that begins in the late nineteenth century. In this sense, I don't believe that the computer is an ultimately non-visual medium, one that obfuscates rather than reveals. Vision has not disappeared but rather transformed: it isn't that we no longer see, but rather that we see in mathematical terms. Pantone's 2019 Color of the Year may be called "Living Coral," but it is really 16-1546, and also exists in both print (CMYK) and screen (RGB) form, with unique serial numbers corresponding to both. Rather than seeing color as anchored to objects in the world, colors have become numbered, interchangeable swatches, a way of breaking up the spectrum *ad infinitum*.²⁰ "Digital" in this project therefore refers to a mode of presenting and receiving information or sensory input that is associated with discreteness and numerical representation, which I argue historically precedes the computer.

I thus offer a longer history of what we mean when we talk about the digital by redefining "digital color" as an emergent property that is itself pre-computational but continues to exist alongside computational and algorithmic technology. In four chapters, I map out what I view as distinct transitional moments from the early twentieth century to the present, during which color emerges as a primary site for reevaluating the relationship between technology, aesthetics, and perception in *digital* terms. Though they are chronological, the chapters are not meant to be a comprehensive history—rather, each isolates what I see as a pivotal turning point in this narrative of color systems and rationalized perception. Two primary strands of inquiry run through this dissertation: Chapters One and Three are more technical, drawing on science and technology studies and media theory in order to examine the rationalization and quantification of color in the form of systems and geometrical diagrams. By contrast, Chapters Two and Four are concerned with the institutionalization and reconfiguration of the self vis-à-vis these color systems, taking inspiration from cultural studies and theories of racial and sexual difference. In looking at the social and political ramifications of normalized color vision, I argue that standardized color has historically been promised as a way of achieving happiness and self-fulfillment and a lens through which to view one's identity.

Though my object of study is the experiential category that is color itself, I ground my analysis in material culture by engaging closely with popular artifacts that include trade magazines, paint chip samples, three-dimensional color models and texts written by color consultants and designers, blogs and message boards, and memes. I choose to look at vernacular, domestic, and often highly gendered objects such as paint pamphlets and magazine columns due to the crucial role they played in circulating information among relatively anonymous groups of people (thus dispensing with an innovation-centered narrative of technical "genius"), as well as establishing identity formations in relation to color. These ubiquitous objects can themselves be seen as storage media, relying on color matching technologies as well as color printing and photography. Moving fluidly between so-called "high" and "low" culture (an antiquated binary that means little to nothing at this point), I also bring in close readings of films, television shows, and visual artworks in order to map distinct historical moments during which color becomes a target of measurement and rationalization. I use these case studies as a means of investigating the types of practices of looking, feeling, and sensing color that are embedded within historically specific social frameworks. While I begin with a broader overview of what has come to be known

²⁰ I should also clarify that in using the terms "seeing" and "vision," I am not exclusively referring to the optical faculty of sight, but a broader epistemological process by which we translate our perceptions into knowledge and experience.

as “color theory” in the West and eventually move towards a more “global” understanding of color standards, the dissertation primarily focuses on the United States, where the proliferation of color models is deeply embroiled in the growth of global corporations, scientific management, and the normalization of surveillance.²¹

I begin my analysis in the late nineteenth century on the cusp of a new paradigm of mass-produced color. Chapter One, “The Wheel and the Grid: Thresholds of Perception,” looks at the two primary models used to represent color in art and science—the color wheel and the color grid—mapping these systems onto distinct ways of knowing and understanding the visible world. Whereas the color wheel merges adjacent tints to create a sense of boundlessness or immeasurability, the color grid emphasizes multiplicity, modularity, and discreteness over continuity. Taking a long historical view beginning with the emergence of the first circular color diagrams in the eighteenth century drawn by figures such as Newton, Moses Harris, and Goethe, I trace how the grid overtakes the wheel as the predominate mode of systematizing color beginning in the late nineteenth century. The newfound ability to synthesize dyes from coal tar—known as aniline—made it possible to detach color from object, as synthetic colors such as mauve had no direct tie to the physical world. The shift from artisanal to synthetic pigments, alongside the growth of industrialism and technologies of mechanical reproduction, saw the mass-produced color swatch or color card emerge as a new organizational form, a way of exerting control over patterns of consumption. At the same time, developments in optics, spectroscopy, and psychophysics reconfigured color as a numerical variable and a stimulus that could be quantified and measured. It was at this time that mathematical color models, particularly the Munsell and Ostwald color systems, each of which provide a unique set of alphanumeric notations for different colors, emerged on the scene; these two models in particular would be adapted by governing bodies seeking to standardize color such as the National Bureau of Standards and the Optical Society of America, thus establishing a normalized perception of color that remains remarkably unchanged today.

If Chapter One focuses on experts in industry and the creators of color systems themselves, Chapter Two, “Our Chromatic Categories: Mood Conditioning the Postwar Interior,” jumps ahead to the 1940s when these standardized models of color had become part of everyday life. Following the postwar economic boom, particularly in the United States, technologies ranging from film, television, and lighting to household items such as furniture and food became more vibrant and chromatically varied, lending this period the retroactive moniker “The Color Revolution” due to its color-driven consumer aesthetic.²² This aesthetic was most pronounced within the single family home, as home-dwellers learned to regulate the atmospheric intensities of their surroundings through a highly controlled use of color and light. Bolstered by the growing field of behavioral psychology, changing advertising philosophies, and the mid-century design principles of “functional color” and “mood conditioning,” selecting the colors and lighting schemes for one’s home now took on both a biological and moral imperative. On the one hand, it was now widely accepted that color had the ability to soothe, stress, or alter human behavior, and

²¹ In recent years, two notable monographs have focused on color science in relation to modern perception: Michael Rossi’s *The Republic of Color: Science, Perception, and the Making of Modern America* (The University of Chicago Press, 2019) and Nicholas Gaskill’s *Chromographia: American Literature and the Modernization of Color* (University of Minnesota Press, 2018), which looks at the impact of early twentieth century systems of color measurement on literary form.

²² Regina Lee Blaszczyk, *The Color Revolution* (The MIT Press, 2012)

on the other, color became a way of signaling uniqueness and “personality.” As the site of the banal and the everyday, it was thus in the domestic interior that color vision itself, as well as identity, could be standardized most potently by being paradoxically framed through a rhetoric of individualism. I focus on the writings of Faber Birren, arguably the most famous color consultant in history, who published prolifically in popular magazines as well as in specialized scientific journals. Birren’s writings demonstrate the ways in which the so-called “freedom” of color choice promoted by color consulting firms and paint companies actually cemented set identity categories. The average consumer was assumed to be a white middle-class woman, and the slippery relationship between the abstract color swatch, skin color, and color preference meant that in addition to gender, race also became subject to standardization and classification in the name of social and technological “progress.”

What I have outlined thus far long precedes the emergence of digital technology. The first two chapters can thus be seen as presenting a *longue durée* that sets the preconditions for a way of seeing digitally, the implications of which become fully clear in the second half of the dissertation when “actual” digital technology enters the picture. Chapter Three, “Impossible Geometries: From Color Space to Interface,” marks a turning point where the digital-as-epistemology and the digital-as-hardware or apparatus finally begin to merge—a convergence that was not a foregone conclusion, but instead stems from the adaptation and reconfiguration of pre-computational color standards initially designed for pigments to light-emitting screens. Digging deeper into the messy landscape of standards, mismatched color systems, and flawed displays in order to explain the explosion of multiple competing articulations of computer color in our current moment, I demonstrate how no existing screen exists—nor will ever exist—that can capture the full spectrum of visible colors. I focus on two digitally specific spatialized models of color: *color space* (an idealized geometrical model that seeks to encompass all visible colors) and *color depth* (the number of bits per pixel needed to render color on electronic screens). Together, color space and color depth draw our attention to the inherent paradox of standardized color: the goal of reproducing the totality of color perception while simultaneously constraining it by drawing literal edges and boundaries. Referencing a wide variety of examples, including social media platforms, message boards, popular television shows, and contemporary installation and video artworks, I argue that color’s ubiquity on electronic screens has led to an increasing attentiveness to color’s status as modular, discrete, and choppy rather than seamless. In this sense, the material aspects of the computer supposedly obfuscated by the screen, such as its numerical code and frame buffer bit structure, have played a key role in creating a new vernacular surrounding digital color.

The final chapter, “Escape into Color: The Rise of the Experience Economy,” moves to social media, concentrating on the self-management of networked color on platforms such as Instagram, whose adjustable filters allow users to customize and share their experience of color on an unprecedentedly large scale. Consisting of two central case studies, the chapter contends that color today cannot be separated from the rise of an attention-based platform economy where the commodification of emotions—particularly happiness—has rendered experiences, likes, and reposts more valuable than singular objects or artworks. These case studies—the Color Factory, an interactive pop-up “Instagram exhibition” themed around color that first debuted in 2017 in San Francisco, and Pantone’s Color of the Year—are both temporary or recurring trends that depend on a pervasive online presence. Whereas the Color Factory at first glance seems to foster unmediated physical intimacy through activities that emphasize human connection, built-in, cameras that photograph participants actually serve to normalize new modes of voyeurism and consensual self-monitoring. Pantone’s Color of the Year presents a

Euro-American progress narrative of self-improvement and individualism as a global one by presenting color as a universal language. Both these examples play into the growing industry of “self-care” or “wellness,” encouraging visitors or users to surround themselves with digitally reproduced colors in order to achieve self-awareness and fulfillment. By capitalizing on the myth that color is nostalgic or “authentic,” they promote color as an escape from the “always-on” mindset of a technologically saturated existence. The irony, of course, is that digitally reproduced colors and their subsequent circulation on social media depend on this very framework to survive.

Color therefore emerges as one major aspect of perception that can be—and has been—instrumentalized to certain ends, often to the benefit of large-scale institutions and structures of power. It is part of a distinctly modern compulsion to try and classify, harness, and commodify perception itself, a goal that forever remains just out of reach. Because color is paradoxically both uniquely conducive and resistant to systemization, I don’t attempt to provide an ontology of color. Instead, I am more interested in its discursive function: how the classification of color speaks to historical anxieties about the relationship between technology, knowledge, perception, and personhood. I thus offer the digitization of perception as a way into examining the thorny ramifications of standardized color systems and their envelopment of lived experience. Color is a technology and a medium, a capacious and politically charged facet of perception that is so much more than wavelengths of light.

Chapter One

The Wheel and The Grid: Thresholds of Experience

Snap to Grid

In 2008, the Museum of Modern Art curated an exhibition titled *Color Chart: Reinventing Color, 1950-Today*. The exhibition showcased the work of postwar artists who took up the commercial color chart—a matrix-like formation consisting of rows and columns of color swatches on a neutral background—as a central metaphor or problematic in their work, particularly American Abstract Expressionists and Pop artists such as Frank Stella, who famously said that paint was best “straight out of the can.” Stella’s *Miniature Benjamin Moore Series (Island No. 10; Palmito Ranch, Sabine Pass; Hampton Roads; New Madrid; Delaware Crossing)* (1962) [Figure 1], featured in the show, is a three-by-two grid configuration of six square canvases. Inspecting the series’ matrix-like arrangement, the viewer feels there should be an underlying logic to what is clearly a system—but how to decipher it? The colors of each canvas—a dark, forest green; a warm, sunny yellow; black; royal blue; and two reds (one a fiery orange, the other slightly cooler in tone and tending towards violet)—are not grouped in any arrangement that would be recognized as “harmonious.” The colors are not equally saturated or warm, nor are they pairs of complementaries. Instead, what unites them is their use of what MoMA curator Ann Temkin calls “color as readymade.” In this case, all the paints used in Stella’s *Benjamin Moore Series* (1961-1963) are pre-mixed alkyd wall paints produced by Benjamin Moore, the American corporate paint manufacturing giant. By mimicking the commercial color chart, Stella “openly declares the status of paint as a factory made commodity.”¹ The implications of “color as ready-made” are vast: color itself comes to stand in for a medium or artistic tool, and yet, we also cannot say that color and paint are equivalent. The colors of Stella’s paintings and the commercial color chart have been pre-mixed and selected for the user. Industrial color, like Duchamp’s urinal, only needs to be cheekily re-presented and relocated to the gallery space to be turned from an everyday object into an aesthetic one. Color seems to transcend materiality when we treat it as an abstract value.

This tension between artisanal and mass-produced synthetic color is often presented as an aesthetic or taste-based judgment. Roland Barthes, writing in the 1950s about the then-relatively new material of plastic, which he called “ubiquity made visible,” showed contempt for the acrylic paints used to color it. Plastic “seems capable of conveying only the most chemical-looking [colors],” he wrote. “Of yellow, red and green, it keeps only the aggressive quality, and uses them as mere names, being able to display only concepts of color.”² Similarly, in *Chroma*, a hybrid memoir and philosophy of color, avant-garde British filmmaker Derek Jarman disparaged paints produced by U.K. company Dulux, a portmanteau for “durable” and “luxury”:

To understand the passion for gemlike colour, look at the illuminated manuscripts [of the

¹ Ann Temkin, “Color Shift.” In *Color Chart: Reinventing Color, 1950-Today*, ed. Ann Temkin (The Museum of Modern Art, 2008), 16.

² Roland Barthes, “Plastic.” In *Mythologies: The Complete Edition, in a New Translation*, trans. Richard Howard and Annette Lavers (Hill and Wang, 2013), 194.

Middle Ages]—the passing centuries rubbed the color off old walls, but in the manuscripts hidden from the light that creates and destroys, you can see color bright as the day it was laid down by the illuminator. In the chalky world of Dulux and the color chart, you remember color was once bright and precious. There is not a drop of vermilion or ultramarine, congealing today in these rusty cans. If the Scarlet Whore of Babylon was painted with these house paints you would not notice her, but in a Book of Hours she would flame like the sunset.³

Both Barthes and Jarman romanticize artisanal paint, which they deem more “authentic” than its mass-produced counterpart, which functions as a kind of simulacrum of color. And yet, particularly in the postwar United States, the commercial color chart and the world of so-called “high art” collided. Though the color chart in its original form was intended as a tool or instrument rather than the end-product in itself, as the *Color Chart* show demonstrates, it was transformed into an aesthetic object by artists who took both commercial paint and the color chart as their subject matter.

In pointing to the inscrutability of the color chart, the artists in the exhibition create their own color systems, often to obsessive and at times comedic ends. This is made clearest by works such as Ellsworth Kelly’s *Spectrum Colors Arranged By Chance* (1951) [Figure 2] and *Sanary* (1952) [Figure 3], in which color patterns are generated by assigning individual colors random numbers that would dictate their placement algorithmically, freeing the work from any personal intervention or artistic “touch.” Whereas *Sanary* uses the medium of oil paint to subvert distinctions between synthetic and artisanal color, *Spectrum Colors* consists of hundreds of squares of colored paper akin to the color swatches or chips one might find in a home decorating catalogue. Similarly, Andy Warhol’s *Do it Yourself* series (1962), which consists of five works, plays with the idea of the “paint by numbers” kits that were so popular in the postwar period. Warhol based paintings such as *Do it Yourself (Flowers)* [Figure 4] and *Do it Yourself (Landscape)* [Figure 5] on the pre-sketched drawings sold by company Venus Paradise to accompany their colored pencils.⁴ Using Liquitex, a quick-drying acrylic paint, straight out of the tube, the *Do it Yourself* paintings have a deliberately unfinished quality: an aggressively opaque deep blue sky and a fiery red barn offset, cartoon-like, the negative space of trees and foliage. Beneath the colored layer, we are led to believe, are instructional numbers: anyone can be *trained* to draw or paint when provided with a set of guidelines. Here, numerical representation precedes color itself.⁵

Such a move—turning an everyday found object into a gallery piece—is hardly novel, but it has important ramifications for understanding the slippery relationship color has to systemization. There is something about the color chart and the grid more generally that suggests order, consistency, and rationality. At the same time, however, the color chart also invokes modularity, randomness, and chance. It is these tensions, both contained within the form of the color chart, that are part and parcel of color’s very existence. In an essay accompanying the *Color*

³ Derek Jarman, *Chroma: A Book of Color* (The Overlook Press, 1995), 49.

⁴ Ann Temkin, ed. *Color Chart: Reinventing Color, 1950-Today*, 68.

⁵ As bioengineer Donald Ingber reminisces about the surprisingly enlightening process of coloring by numbers: “At first glance, the Venus Paradise Coloring Set seemed to demand constraint, with all creativity stifled by rigid instructions that dictated what pencil would be applied to what exact spot on paper, but in fact, the set was more like a Rorschach test, a projective screen onto which each user could see and do something different.” Donald Ingber, “What We Sort: Venus Paradise Coloring Set.” In *Falling for Science: Objects in Mind*, ed. Sherry Turkle (The MIT Press, 2011), 258.

Chart exhibition catalogue, Briony Fer observes that one of the central paradoxes of color is how it often turns against itself. As she describes, the commercial color chart, initially intended as a way of organizing, coding, and controlling colors in a commercially viable and manageable way, meets its demise when artists turn it into a space of aesthetic potential.⁶ Fer's analysis of the color chart is similar to Rosalind Krauss's identification of the grid as a quintessentially modern form that embraces the qualities of Greenbergian modernist painting: flatness, abstraction, and an emphasis on synthetic materials. In Krauss's analysis, the grid is as much an ideological device as it is a formal one, declaring art's autonomy from the world around it. In this sense, the grid of modernist painting distinguishes itself from Renaissance perspectival mapping systems, which provide coordinates in space. By contrast, the modernist grid's only reference point is the surface of the painting itself: "[Its] mythic power is that it makes us able to think we are dealing with materialism (or sometimes science, or logic) while at the same time it provides us with a release into belief (or illusion, or fiction)."⁷

Though the works in the *Color Chart* show are in certain respects the opposite of what Krauss describes—after all, in classic postmodern fashion, they blur distinctions between art and non-art, avant-garde and kitsch—both the grid and the color chart, despite stemming from a desire for standardization, produce ways of thinking and creating that need themselves not be rational. As Fer writes:

Counting and coloring—from painting by numbers to counting the numbers of squares in a color chart—intertwine at some basic level that is not about the math. There is no mathematical relationship between numbers and colors (unlike between numbers and musical notes in harmonics, for example), only an elaborate and vast sea of numbers that have been invented to create a fictional system.⁸

Though Fer is right to draw our attention to the failures or inadequacies of these systems to represent or encompass the full spectrum or experience of color vision, we also cannot dismiss that there *is* in fact a mathematical or quantitative way of measuring color, and that is by wavelength. Though the full electromagnetic spectrum includes more wavelengths than are visible to the human eye, as early as the thirteenth century, the science of optics sought to divide and measure this spectrum by separating colors through a prism. Today, these "spectral colors" are often presented in nanometers (nm) when used to describe wavelength and terahertz (THz) to denote the amount of electromagnetic radiation. Yet, despite the fact that such a correlation between color and wavelength or electromagnetic radiation can be represented numerically, to divide and represent the spectrum in a way legible to non-specialists, it was necessary to label colors numerically: in English, colors with the shortest wavelength—between 380 and 450 nanometers—are called "violet," whereas those with the longest wavelength are called "red."⁹

⁶ Briony Fer, "Color Manual." In *Color Chart: Reinventing Color, 1950-Today*, ed. Ann Temkin (The Museum of Modern Art, 2008), 28-29.

⁷ Rosalind Krauss, "Grids." *October*, vol. 9 (Summer 1979), 52.

⁸ Briony Fer, "Color Manual," 33-34.

⁹ While this dissertation is written in English and focuses on primarily English language materials, I acknowledge that there is always a slippage between color and language that differs across cultures. For example, in Russian, there are two distinct words for "blue" that are not etymologically related: *goluboi* (light blue) and *sinnii* (dark blue). The division of what English speakers see as one continuum (blue) into two discrete segments indicates the ways in which language inevitably informs perception and vice-versa. It is thus crucial to consider the high degree of subjectivity and cultural specificity in any system of color

Thus, the problem of color and counting is not just about randomness or chance, but what novel types of perceptual engagement these systems invite. Color systems, as with any system of representation, are a way of seeing and categorizing the world, and in doing so, making it visible and comprehensible.



Figure 1. Frank Stella, *Miniature Benjamin Moore Series* (*Island No. 10; Palmito Ranch, Sabine Pass; Hampton Roads; New Madrid; Delaware Crossing*) (1962). Alkyd on canvas (Benjamin Moore flat wall paint).



Figure 2. Ellsworth Kelly, *Spectrum Colors Arranged By Chance II* (1951). Cut-and-pasted color-coated paper and pencil on four sheets of paper.

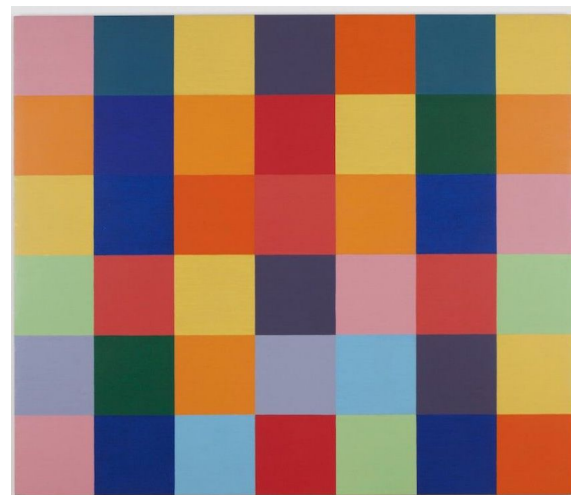


Figure 3. Ellsworth Kelly, *Sanary* (1952). Oil on wood.

labeling or organization, whether verbal or numerical.



Figure 4. Andy Warhol, *Do It Yourself (Flowers)* (1962). Acrylic, pencil and Letraset on linen.



Figure 5. Andy Warhol, *Do It Yourself (Landscape)* (1962). Acrylic, pencil and Letraset on linen.

This chapter backtracks chronologically from the *Color Chart* exhibition to trace the emergence of color grids before they were self-consciously taken up as artistic subject matter. While the amount that has been written about the science and philosophy of color is vast, here I reframe key debates in the history of color theory in terms of how various thinkers and systems attempted to reorganize and reshape perception itself. Taking a long historical view beginning with the emergence of the first circular color diagrams in the seventeenth century, I examine the two primary visual systems used to represent the color spectrum: the color wheel or circle and the color grid or chart. Though rationalized color systems have also taken the form of several other Euclidean shapes such as cones, pyramids, and hexagons, the circle and grid have remained the most dominant modes of ordering color. Whereas the color wheel merges adjacent tints to create a sense of boundlessness or immeasurability, color grids emphasize multiplicity and discreteness over continuity. In their emphasis on edges, thresholds, and breaking points, color grids and charts attempt to label and identifying as many intermediate colors or categories as possible, an obsession with labeling that is deeply entwined with the industrialization of pigments and mechanical reproducibility. Drawing on developments in optics, the synthetic dye industry, and modern psychophysics, I map out the role that abstract color models played in shaping perceptual norms between the seventeenth and twentieth centuries and how this representational shift plays into contemporary conceptualizations of the digital.

It's important to note that I am not arguing for a complete rupture between grids and circles, but a shift to what I call a *grid-like logic* that begins in the late nineteenth and early twentieth centuries—and this logic, somewhat counterintuitively, may or may not coincide with a visibly grid-like system. The growing dominance of this grid-like logic simultaneously reflects and provokes an epistemological shift that I call the *digitization of perception*, where colors increasingly

come to be seen first and foremost as automatically generated alphanumerical values. In this sense, the digital is an act that is done *to* something else, a new way of generating meaning through an abstract representational system. The digital—or rather, digitization—is not a default condition but a process of discretization, “the making-discrete of the hitherto fluid, the hitherto whole, the hitherto integral.”¹⁰ The color grid *anticipates its technical reproducibility*: digital ways of seeing do not only precede computational or algorithmic technology, but set the stage for their emergence.

A Prehistory of Digital Color

Appropriating commercial color charts in a painterly context addresses not only a fundamental shift in the availability of certain materials, but also shifting ways of seeing color and the world at large numerically. Specifically, digital *colors*, in their necessary plurality, demonstrate a shift from seeing the color spectrum as continuous to infinitely indivisible into discrete swatches. The digital, as I argue, predates the emergence of what we tend to think of as “digital” technology (that is, computers that use binary code). “Digital color” did not emerge in the 1980s as the technological narrative commonly goes, but a hundred years earlier with modern psychophysics, which attempted to regulate perception by quantifying the body, and in doing so, rendering color as an abstract sensation that could then be labeled alphanumerically and organized systematically.

Specifically, the early twentieth century and after shows an epistemological shift towards a “digital, computational, and informatic worldview” in which we come to equate knowledge or truth with what is measurable or quantifiable.¹¹ This shift towards “digital seeing” has moved fluidly across media, with color grids eventually acting as the foundation for printing and computational interfaces. The grid, as German media theorist Bernard Siegert argues, is a cultural technique (*kulturtechnik*)—a set of cultural practices that demonstrate how intellectual shifts stem from a changing set of relations between humans and technology. “Cultural techniques,” Siegert defines, “are conceived as operative chains that precede the media concepts they generate.”¹² Though Siegert’s grid is slightly different than the one I look at in this chapter (he primarily focuses on the cartographic grid as a way of “ruling space”), I likewise contend that grid-like, digital color precedes the emergence of computational or algorithmic media.

Matrices first entered computational practice in the 1840s, later providing the foundation for electronic CRT screens and eventually digital pixel grids. Since the 1970s, electronic matrix screens have turned the grid into a “universal imaging technique” that provides the foundation for both virtual and physical spaces today.¹³ Though the pixel grid of the computer screen is not always visible, it provides the underlying structure for representing and scaling objects—including colors—on screen. For example, the color picker tool in Photoshop [Figure 6], which allows the user to adjust the numerical values of any given pixel to change its color, appears as a gradient—

¹⁰ Alexander Galloway, *Laruelle: Against the Digital* (The University of Minnesota Press, 2014), 52.

¹¹ Meredith Hoy, *From Point to Pixel: A Genealogy of Digital Aesthetics* (Dartmouth College Press, 2017), 13.

¹² Bernard Siegert, *Cultural Techniques: Grids, Filters, Doors, and Other Articulations of the Real*, trans. Geoffrey Winthrop-Young (Fordham University Press, 2015), ii.

¹³ Jonathan Crary, *Suspensions of Perception: Attention, Spectacle, and Modern Culture* (Cambridge, MA: The MIT Press, 1999), 102 and 213.

indivisible and fluid. Yet, the underlying logic is always the grid: we can click at any interval on the gradient and determine a precise numerical value. Similarly, the “snap to grid” function uses an invisible grid to automatically line files or images up with precise horizontal and vertical lines. A digital image is thus in a sense already a matrix where rows and columns of pixels and numerical values correspond to individual sets of color values. Though the increase in color resolution and display renders smoother images and obscures pixelation, occasionally the modularity and grid-like structure of computer color becomes visible to the user, a phenomenon known as “color banding.” Most computer screens today use 32-bit color, which can display over 16 million colors, as opposed to the 8-bit color of the early 1990s, which could only display 256 distinct colors, resulting in a “choppier” image with abrupt transitions between hues.

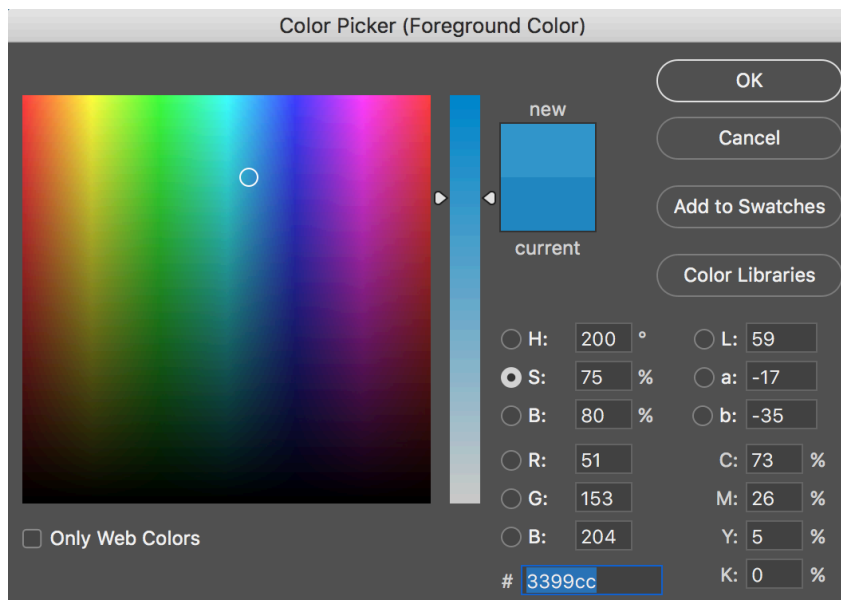


Figure 6. The color picker tool in Adobe Photoshop. While the image on the left shows a color gradient, the breakdown of the precise position of the cursor into numerical variables actually demonstrates a grid-like logic.

The identification of grids, matrices, and even color charts specifically as somehow intrinsically “digital” became a common trope beginning in the early 2000s, of which the *Color Chart* exhibition is one clear example. The catalogue delineates a clear narrative from the commercial color chart to color editing software and identifies the exhibition’s current moment (2008) as the “age of digital color,” in which “every home and office computer offers a convenient world of ready-made color to its user.”¹⁴ While the exhibition organizers acknowledge a distinction between the materiality of paint and color swatches and screen color, they observe that digital color has “inherited the same language and the same possibility for infinite reproduction,” where “the grid remains the key format.” Fer issues a provocation: “Rather than being new technologies marking a revolutionary change... perhaps digital technologies are themselves still registering and internalizing, in a delayed reaction, the aftereffects of color chart color.”¹⁵

While the *Color Chart* catalogue’s invocations of “digital color” remain surface level—the

¹⁴ Temkin, “Color Chart,” 17.

¹⁵ Fer, 37.

curators observe a superficial resemblance between the commercial paint chart and the arrangement of pixels on electronic screens without dwelling on their specific material and technological histories—what I find useful here is the notion that what we think of as “digital color” may not be a complete rupture from previous ways of representing color, but instead a numerically-inflected way of seeing and knowing the world that predates computer interfaces. But is there anything specific about the color chart—or grids more broadly—that would suggest something uniquely “digital?” In 2001, Lev Manovich identified what he called “principles of new media,” several of which can be applied to the color chart: *modularity* (swatches can be rearranged without compromising the chart’s integrity), *variability* (the chart exists in multiple, potentially infinite versions), and *numerical representation* (each color swatch has its own alphanumerical descriptor).¹⁶ Though Manovich opts to use the term “new media” instead of “digital media,” his discussion of analog to digital conversion, which involves turning continuous data into discrete data, demonstrates the ways the creation of a digital artifact involves breaking down a continuum into smaller numbered units.

Along these lines, several artists and critics have identified the color wheel or spectrum as analog and its counterpart, the color grid, as digital. Contemporary artist Liz Deichenen writes: “Analog color is continuous, like the spectrum. Digital color is discontinuous, and involves separations determined by the pixels.”¹⁷ In *Chromophobia* (2000), David Batchelor terms the 1950s onward as “the period of the digitalization of color in art.” Citing many of the artists featured in the *Color Chart* show (though eight years before the exhibition opened) such as Warhol, Gerhard Richter, and Robert Rauschenberg, Batchelor draws a direct analogy between color systems and the analog/ digital opposition: “Digital color is individuated; it comes in discrete units; there is no mergence or modulation; there are only boundaries, steps and edges. Analogical color is color; digital color is colors.”¹⁸ Most recently, in the past two years, media theorists have elaborated on Batchelor’s discussion of analog and digital color, which focused primarily on painting (despite the fact that these terms evoke electronic media). Carolyn Kane emphasizes that digital color always involves “[dividing] color along a continuum, grid, matrix, chart, or index. Digital colors retain distinctions between inside and outside: where one color begins and when it ends, and what color is and what it is not.”¹⁹ For Kane, like for Batchelor, the color wheel is the starting point—a continuous spectrum that is then divided into discrete, standardized units. Though she gestures towards it, Kane largely emphasizes the color chart as a material artifact rather than a way of organizing the world—that is, a system that both shapes and informs the malleability of perception in relation to technology.

This tendency to focus on objects as material artifacts rather than as distinct ways of perceiving or knowing is echoed in Timon Beyes’ entry for *The Oxford Handbook of Media, Technology, and Organization Studies*, which is titled simply “Colour Chart.” Beyes calls the color chart “a profane organizational device, or perhaps a behind-the-scenes organizational player... that epitomizes the strange fate of color as organizational force.”²⁰ Reiterating the now familiar paradigm of a shift from analog color wheel to digital color grid, he identifies the chart as a

¹⁶ Lev Manovich, “Principles of New Media.” In *The Language of New Media* (The MIT Press, 2001): 27-48.

¹⁷ Liz Deichenen, quoted in *Color Chart: Reinventing Color, 1950–Today*, 213.

¹⁸ David Batchelor, *Chromophobia* (Reaktion Books, 2000), 105.

¹⁹ Carolyn L. Kane, *High-Tech Trash: Glitch, Noise, and Aesthetic Failure* (Berkeley: The University of California Press, 2019), 114.

²⁰ Timon Beyes, “Colour Chart.” In *The Oxford Handbook of Media, Technology, and Organization Studies*, ed. Timon Beyes, Robin Holt, and Claus Pias (Oxford University Press, 2020), 125.

“radical [break] from the color wheel” by “individualizing and autonomizing specific colors.”²¹ But somewhat bizarrely, Beyes sees this break from analog to digital color as a move towards greater flexibility and freedom “from the dictates of color theory,” a “[loosening of] former rules and codifications of chromatic representation.”²² For some, the grid’s apparent variability and interchangeability of the grid make it more “democratic” than the predetermined order of the circle.²³ But we would do well to put “democratic” in scare quotes: the color chart is hardly a matter-of-fact “listing of what is commercially available”—in stark contrast to this understanding of the color grid as somehow liberating, the discretization and quantification of the spectrum is a denial of contingency and fluidity that emerges alongside the commodification and standardization of color.²⁴

The Spectrum and the Circle

In Autumn 1966, Robert L. Feller, head conservationist and curator at the National Gallery of Art, published the somewhat hyperbolically titled article “Rediscovery of the Wheel” in the journal *Color Engineering*. Feller was responding to the appearance of a facsimile of British naturalist and engraver’s Moses Harris’s *The Natural System of Colours*, believed to date to 1766. Color consultant and writer Faber Birren had created and published the facsimile in 1963, noting in an accompanying forward that the drawing “represent[ed] the first known presentation of a color circle in full hue,” as well as “one of the first attempts ever made to organize colors into a comprehensive system which included not only prismatic (pure) colors but modified (muted) colors as well.”²⁵ Prior to this, Harris’s color circle had been nearly unknown due to the scarcity of existing copies, of which only two or three remain.²⁶ Intriguingly, in the *Color Engineering* piece, Feller places more emphasis on the “rediscovery” of the image than the content or appearance of the image itself, proclaiming: “The world of color has recently had the pleasure of rediscovering the first color wheel. This device, based on red, yellow, and blue with complementary colors on opposite sides, is so familiar that, just as with the wheel in engineering, we have largely forgotten that it was once invented.” He then goes on to add that chemist Wilhelm Ostwald, who is known for his 1917 *Color Primer*, remarked “as late as 1934... that the discoverer of the color wheel was not then known.”²⁷ Though we should be suspicious of deterministic narratives about the serendipitous “discovery” or “invention” of technologies or systems as a product of individual “genius” or innovation, Feller’s comparison between the color wheel and the mechanical wheel is nevertheless telling. It speaks to the post-industrial subject’s difficulty of imagining a time *before* color wheels, before the spectrum could be “tamed” or harnessed in an ostensibly rational

²¹ Ibid, 129.

²² Beyes, 130.

²³ Perry Kulper, “The Calculus of Paint.” *The Journal of Architecture* 14, vol. 3 (2009), 378.

²⁴ Ibid.

²⁵ Faber Birren, “Forward.” *The Natural System of Colours by Moses Harris: a facsimile edition of what is perhaps the rarest book in the literature of color, with historical notes and commentary by Faber Birren* (New York: privately printed, 1963)

²⁶ The known remaining copies of the first edition of *The Natural System of Colours* are held at the Royal Academy in London and at in the Faber Birren Papers (Robert B. Haas Family Arts Library, Yale University).

²⁷ Robert R. Feller, “Rediscovery of the Wheel.” Originally published in *Color Engineering* (November-December 1966). Faber Birren Papers, Robert B. Haas Family Arts Library, Yale University.

manner, as well as the color wheel as something systematic and useful—itself a technology.²⁸

As the “Rediscovery of the Wheel” piece makes so clear, that the color spectrum can be presented in a seamless circular form seems to us today intuitive or even obvious. However, wheels did not become a convention of representing color until the late seventeenth and early eighteenth centuries with Newton’s color experiments that were eventually published in *Opticks*. Their status as cultural and aesthetic artifacts ultimately supersedes their scientific validity: the color spectrum is not a loop, but jumps back from the shortest wavelength (violet) back to red. By contrast, the wheel is an “artificial device” that organizes the visible spectrum into a visually appealing symmetrical shape conducive to mixing paint shades.²⁹

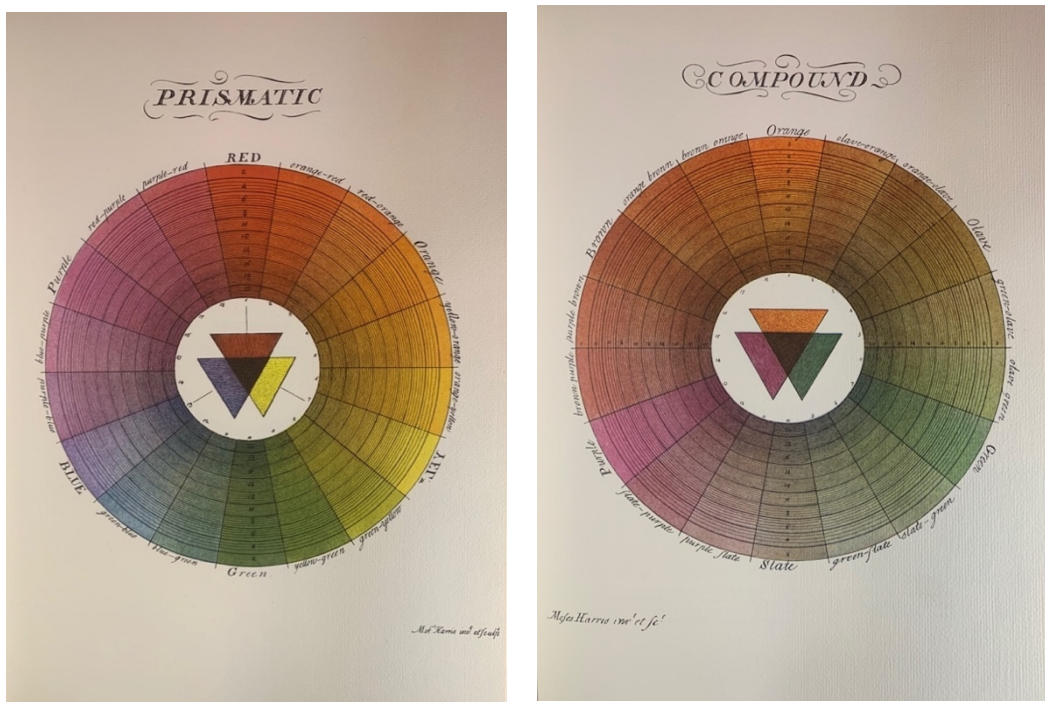


Figure 7. Moses Harris, “Prismatic” and “Compound” wheels from *The Natural System of Colours* by Moses Harris: a facsimile edition of what is perhaps the rarest book in the literature of color, with historical notes and commentary by Faber Birren (New York: privately printed, 1963). Held by Cooper Hewitt Research Library, Smithsonian Museums.

An entomologist by training, Harris’s circular drawing likely accompanied his *Exposition of English Insects* (1766) as a set of guidelines for artists to faithfully reproduce colors as found in nature and thus serves a primarily taxonomic function—all characteristics of what Foucault has

²⁸ Harris himself did not describe his diagram as a wheel, but rather a circle, and neither did Newton, whose color circle from *Opticks* (1704) actually precedes Harris’s system. The first known use of “color wheel” in English did not appear until 1909; therefore, the use of the term to describe seventeenth- and eighteenth-century circular color diagrams speaks to a distinctly twentieth-century outlook. “Wheel” evokes invention, industry, and kinetics, whereas “circle” primarily denotes form or geometry. It is particularly telling that the first use of “wheel” to describe circular color configurations emerged around the same time as psychophysical devices such as color tops and Maxwell discs, which physically spin to produce a kind of “optical color mixing.” Despite this semantic discrepancy, I will use “wheel” and “circle” interchangeably for simplicity’s sake, keeping in mind each term’s respective historical context.

²⁹ Philip Ball, *Bright Earth: Art and the Invention of Color* (The University of Chicago Press, 2001), 39.

identified as the Classical Age’s “exhaustive ordering of the world.”³⁰ The emergence of the field of natural history during this period comes from a newfound impulse to name what is seen, a translation of physical objects as they are perceived and understood—flora, fauna, and in this case, colors—into language.³¹ Color in particular, as I’ve already stressed, has a uniquely slippery relationship to language and representation, one that eighteenth-century naturalists attempted to classify according to taxonomical nomenclature. The color wheel is a verbal linguistic tool as much as it is a visual one, where the problem of how many segments into which to divide the spectrum is also a question of how to see, group, and name things, or the “nomination of the visible.”³² It points to a desire for organization more than it does to any fundamental truth about color itself.³³

Taxonomic systems in the eighteenth century equated nature with order: they viewed color as deeply entrenched with substances anchored in the natural world. Unlike measurement, which depends on consistent ratios of equality and inequality, order merely demands that a grouping of elements encompass a greater totality.³⁴ In the brief treatise accompanying his color wheel, Harris discloses that he has taken “nature for his guide and assistant,” determining the order of colors in his “Prismatic” wheel according to their reflection through a prism—“that order which nature seems to demand”—and that this “continual succession” of colors indicates that “they should be placed in a circular form.”³⁵ Though Harris’s prismatic color wheel [Figure 7] actually corresponds to the three primaries of red, yellow, and blue, his use of the word “prismatic” is a clear reference to Newton’s circular diagram [Figure 8], which describes the splitting of the visible spectrum when refracted a prism and the colors that result (this process is also known as light-based or *additive color mixing*). Newton divided his diagram into seven segments arranged proportionately by wavelength: not simply an abstract representation, his circle was designed as a pragmatic tool predict the color composition of a given mixture of light rays.³⁶

Historians of science frequently cite Newton’s color wheel, with its precisely measured angles and crisp lines, as an example of Enlightenment-era empiricism, particularly when contrasted with Goethe’s color wheel from his *Über Farbenlehre* (1810) [Figure 9], published just over a century later. Harris’s inclusion of two variations of the same diagram maps onto two models of color mixing: one light-based, the other pigment-based. Though both wheels, particularly the “Compound” wheel (which describes secondary color mixing) [Figure 7] ultimately indicate Harris’s preference for the medium of painting and pigment-based *subtractive color mixing*, his inclusion of the Prismatic wheel indicates an ongoing dialogue with Newton’s light-based color model.

A commonly held notion at the heart of what we know today as “color theory” is that Newton and Goethe’s views are incompatible—that is, whereas Newton demonstrated the spectral nature of color, where color exists in light rather than physical bodies or within the eye, Goethe developed a more phenomenological philosophy of color that has more thoroughly permeated the arts.³⁷ For example, Jonathan Crary contrasts the ways in which Newton and

³⁰ Michel Foucault, *The Order of Things: An Archaeology of the Human Sciences* (Random House, Inc., 1970), 72.

³¹ *Ibid.*, 135.

³² *Ibid.*, 132.

³³ Ann Temkin, “Color Chart,” 17.

³⁴ Michel Foucault, *The Order of Things*, 53.

³⁵ Moses Harris, *The natural system of colours by Moses Harris*, 2.

³⁶ Dennis L. Sepper, *Goethe Contra Newton: Polemics and the Project for a New Science of Color* (Cambridge University Press, 1988), 1.

³⁷ *Ibid.*, 10.

Goethe used the camera obscura in their respective color experiments, noting that whereas Newton viewed the camera obscura as a transparent window onto the world, Goethe was more interested in “physiological colors” that belonged to the eye itself and were therefore phenomenally distinct from the technical apparatus (as seen in his key example of after-images or optical “halos”). For Crary, Newton’s observational experiments that treated color as separate from the body are a historical product of Enlightenment-era rationality’s disembodied “knowing” subject, whereas Goethe’s assertion that the human body could itself produce colors creates an autonomous, embodied observer possessing subjective vision.³⁸

Though there are key distinctions between Newton and Goethe’s respective understandings of color, I see this binary as somewhat overstated. Despite this tendency to position the two as polar opposites—one a rationalist and the other a Romantic or proto-phenomenologist—the two find common ground in choosing to fuse the two ends of the color spectrum together, where the color wheel emphasizes color’s ephemeral status as light or shadow and acknowledge the infinite number of intermediate colors imperceptible to the human eye.³⁹

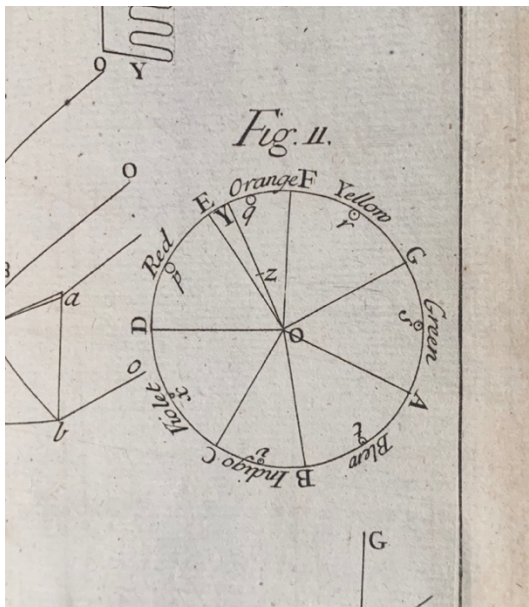


Figure 9. Newton’s color wheel. Fold-out plate from *Opticks, or, A Treatise of the Reflections, Refractions, Inflections and Colours of Light*. 2nd ed. Smithsonian Libraries.

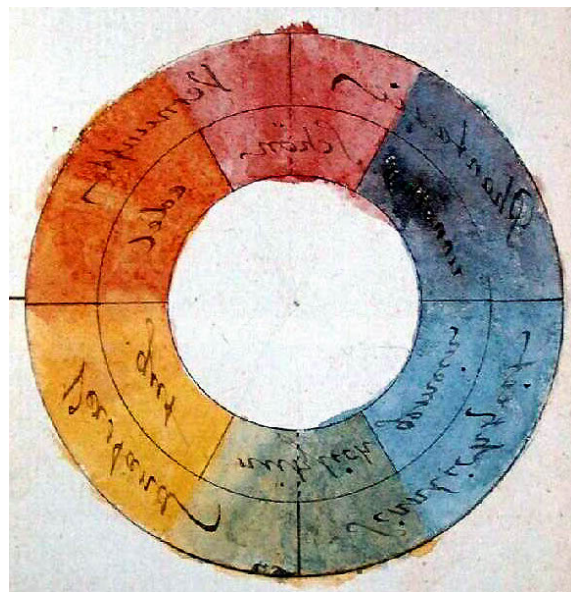


Figure 10. Goethe’s color wheel from *Zür Farbenlehre* (1810). Watercolor and ink on paper.

Whereas Newton developed an understanding of color harmony based on musical analogy, Goethe established a harmony based on complementary colors and the polarity of light and darkness. The painted watercolors of Goethe’s color circle begin to smear and blur: colors bleed into one another and outside the lines, illustrating the German writer’s claim that color, light, and

³⁸ Jonathan Crary, *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century* (The MIT Press, 1990), 40.

³⁹ That color prior to the twentieth century was seen as ephemeral—and that this ephemerality should be harnessed in a circular configuration—cannot be more clearly expressed than in the cyanometer, an instrument designed to measure the blueness of the sky dating to 1789.

shade, rather than form, constitute “the visible world.”⁴⁰ Furthermore, each color on Goethe’s wheel corresponds to a specific human attribute, where red is *schön* (beautiful), orange is *edel* (noble), yellow is *gut* (good), green is *nützlich* (useful), blue is *gemein* (common), and violet is, somewhat bizarrely, *unnöthig* (unnecessary). Each outer segment of the circle maps onto a particular area of mental or spiritual life: red/orange for *Vernunft* (reason), yellow/green for *Verstand* (intellect), green/blue for *Sinnlichkeit* (sensuality), and purple/red for *Phantasie* (imagination) to close the circle, thus establishing a symbolic or moral understanding of color.

Even Newton’s color circle, so often cited as the result of “objective” empirical experiments, the color wheel, which can be divided into an infinite number of sub-groupings that need not depend on any mathematical calculation, contains a certain amount of subjectivity or arbitrariness. Though he took care to segment his wheel into discrete variables, he acknowledged in *Opticks* that it was “hard to determine [the] proportion” of blue and violet, “for the Circle made by the violet was too dark to be seen.” Newton continued: “To carry on the computation, let us therefore suppose that the Differences of the Diameters of the Circles [...] are in proportion as the differences in a Monochord which found the Tones in an Eight, That is, as the numbers 1/9, 1/16, 1/10, 1/9, 1/1/16, 1/15, 1/9.”⁴¹ Newton’s decision to divide the spectrum into seven was ultimately based on a desire to draw an analogy between color and musical notation, where the “harmony” of the overlapping colored rays that combine to create white light corresponds to musical harmony—in this case, the musical intervals in the Dorian mode. In introducing “genuine ambiguity” into his division of the spectrum, Newton’s color wheel makes manifest the at times arbitrary choices he had to make in where to demarcate these segments.⁴² Similarly, Harris acknowledges that while he could have further divided his circle, that too many divisions “render it [not] more useful but rather tend to create confusion between the teints [sic]... and would be one step toward reducing it to its primitive chaos, from which the author has taken so much pains to extricate it.”⁴³ Circular color diagrams must therefore strike a balance between no divisions at all—the “primitive chaos” that is color outside representation—and too many of them.

Color wheels are thus a study in edges and the ambiguous relationships that arise when these edges overlap—they can never be wholly rational or empirical. Like the lemniscate (∞), ouroboros, and Möbius strip, the color wheel has no beginning or end: it is a “continuum, a seamless spectrum, an undivided whole, a merging of one color into another.”⁴⁴ Such looping configurations do not just denote infinity but also indeterminacy: in mathematical equations the lemniscate represents a *potential infinity*, referring to a set of numbers that get closer and closer to infinity, but never reach it. Whereas the ouroboros, the mythological image of a snake eating its own tail, “is the symbol of the riddle that we can never solve,”⁴⁵ the unsolvable riddle is the differentiation of the spectrum whose number of gradations are both invisible to the human eye and impossible to describe sufficiently in words.⁴⁶

⁴⁰ Johann Wolfgang von Goethe, *Theory of Colors*, trans. Charles L. Eastlake (Dover Publications, 2006)

⁴¹ Sir Isaac Newton, *Opticks: Or, a Treatise of the Reflections, Refractions, and Inflexions of Light* (Printed for Sam. Smith, and Benj. Walford, London, 1704), 93. Digitized by Smithsonian Libraries.
<https://doi.org/10.5479/sil.302475.39088000644674>

⁴² Seppers, 35.

⁴³ Harris, 6.

⁴⁴ David Batchelor, *Chromophobia*, 94.

⁴⁵ Wendy Doniger O’Flaherty, *Dreams, Illusion, and Other Realities* (The University of Chicago Press, 1984)

⁴⁶ It is perhaps worth noting that “spectrum” comes from the Latin for “appearance,” as well as the verb *specto* (“to see” or “to watch”) and was also used to refer to the phenomena seen through the *camera obscura*.

The development of spectroscopy, the branch of science that provides precise measurements of the electromagnetic spectrum, further exposed the imprecision of the color wheel and ultimately accelerated its obsolescence.⁴⁷ Unlike the color wheels discussed so far, even those based on prismatic measurements such as Newton's, spectrum analysis in the nineteenth century provided a more meticulous method for measuring electromagnetic frequencies—and here we see *measurement* slowly superseding *order* as the primary organizational mode in the sciences. Though French chemist Michel Eugène Chevreul is primarily known for his research on color in the realms of the textile and dye industries, he also dabbled in optics and spectroscopy.⁴⁸ Spectroscopy, as Chevreul saw it, would provide him with a set of standardized colors for his color wheel; by projecting refracted light onto a screen, he thought, he could then map and standardize colors by holding up a piece of wool next to the screen.⁴⁹ Initially conceived as a three-dimensional hemisphere but ultimately presented as a two-dimensional circle, prior to his experiments with spectroscopy, Chevreul had created a color model that included 14,400 colors classified by hue (*nuance*) and tone (*tone*). Beyond his initial color wheel, Chevreul also published ten tonal variants called “chromatic circles” (*cercles chromatiques*) [Figure 10], which involved creating multiple color scales by mixing each section with black, emphasizing the seemingly infinite gradations that could be achieved through painterly color mixing (he called these intermediate tones “broken colors”).⁵⁰

Yet, there are also aspects of Chevreul's wheel that indicate a more mathematical approach to color: the perimeter of the circle, in tiny letters, labels each hue. Though the primary and secondary colors are first labeled by name (green, red, and so on), intermediary tints are simply marked numerically. Even colors such as “green,” once known as *émeraude*, have numerical equivalents indicating their ratio of chroma (or “pure” color) to black, such as *2 vert 11 ton*.⁵¹ Chevreul's color wheel thus reveals an underlying a grid-like logic in his creation of a “system” of multiple color wheels, his desire to measure color more precisely through quantification, a shift from artisanal to mass-produced paints, where paints that were pre-mixed

The rainbow, the most “concrete” visualization of the visible spectrum, is also the most ephemeral, as it is not an object that can be physically approached, but can only be seen from a given angle opposite the light source.

⁴⁷ Physicist and historian of science Klaus Hentschel notes that “an unidentified spectrum... shares much with *terra incognita*: both have to be mapped for orientation purposes, as well as in order to truly ‘know’ them. In both cases it is not clear from the outset how to overcome their inherent amorphousness, which allows several nonequivalent ways of ‘mapping’ them.” See Klaus Hentschel, *Mapping the Spectrum: Techniques of Visual Representation in Research and Teaching* (Oxford University Press, 2002), 10.

⁴⁸ Chevreul, who lived a then-unthinkable one hundred and two years, is best known for describing the phenomenon of “simultaneous contrast,” in which a given shade seems to change appearance depending on the colors next to it. He first became aware of this phenomenon when he noticed that textiles would appear differently depending on the juxtaposition of different colors of yarn or thread. For example, if we look at two red squares—one on a gray background and the other on a green background—the red appears less vibrant against the grey than the green (this illusion is due to the fact that colors appear lighter when juxtaposed with a dark background, and vice-versa). Simultaneous contrast, an example of a *contrast effect*, locates color within the embodied perception of an external observer and was later confirmed by psychophysical studies in the late nineteenth century.

⁴⁹ Theresa Levitt, *The Shadow of Enlightenment: Optical and Political Transparency in France, 1789-1848* (Oxford University Press, 2009), 66.

⁵⁰ Laura Ann Kalba, *Color in the Age of Impressionism: Commerce, Technology, and Art* (The Pennsylvania State University Press, 2017), 21.

⁵¹ *Ibid.*

could be marketed as discrete colors, and it was their serial numbers, rather than their names, that mattered above all.



Figure 10. Three consecutive steps of Chevreur's ten chromatic circles. Michel Eugène Chevreur, *Des couleurs et de leurs applications aux arts industriels à l'aide des cercles chromatiques* (1864). Engraved by René-Henri Digeon. Aquatint with yellow, blue, red, and black ink on paper. Cooper Hewitt Research Library, Smithsonian Museums.

Chevreur's color system and corresponding principles of perception can thus be seen as on the cusp of a new paradigm of modern, industrial color. Ultimately, comparing textile or pigment-based colors with optical or light-based ones revealed the incompatibility between these two color systems, particularly when it came to the difficulty of naming or quantifying intermediate tones. As with Newton, the transitions from one band of color to the next on the spectrum become more and more difficult for the human eye to discern as they approach violet. Chevreur's drawing *Couleurs d'un Spectre Solaire* (1864) [Figure 11] includes color names that correspond to division of the spectrum, beginning with violet-red on the left and ending with the full absorption of rays into black on the right. However, as the diagram moves towards blue-violet, the color names become murkier and less precise: "blue-violet" encompasses three increments, the last with a question mark. The diagram concludes with "violet??" (two question marks), followed by the markings "I" and "II," with Chevreur seemingly unable to provide verbal equivalents at this point.

Color wheels, which emphasize the chromatic fluidity derived from artisanal color mixing, are thus a distinctly pre-industrial form that by the late eighteenth century had become a deeply ingrained and intuitive way of representing color as well as part of most painters' toolkits.⁵² An aesthetic form masquerading as a scientific one, this facade occasionally crumbles in examples such as Schiffermüller's ornamental engraving from his *Versuch eines Farbensystems* (1772) [Figure 12], which juxtaposes a color wheel with Rococo-style architecture and even includes a decorative rainbow in the upper left-hand corner.⁵³ Though it may have originated as a primarily pragmatic attempt to rationalize and segment the visible spectrum, by the mid-nineteenth century it had become an aesthetic convention, standing in not for quantification or measurability, but their opposites: ephemerality, the unreliability of perception, and painterly experimentation.

⁵² John Gage, *Color in Turner: Poetry and Truth* (New York, NY: Frederick A. Praeger, Inc., 1969), 13.

⁵³ Schiffermüller himself acknowledged that his use of the color wheel form was primarily for decorative purposes. See John Gage, *Color and Meaning*, 6.

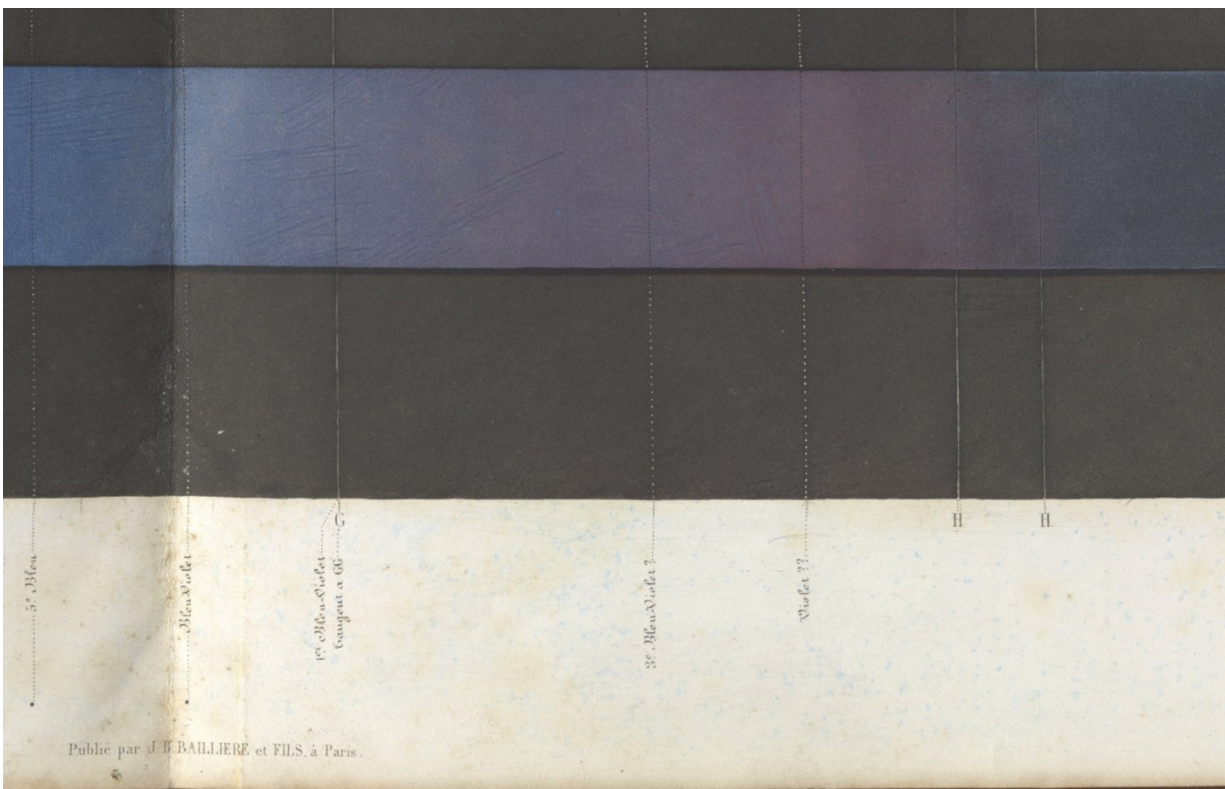
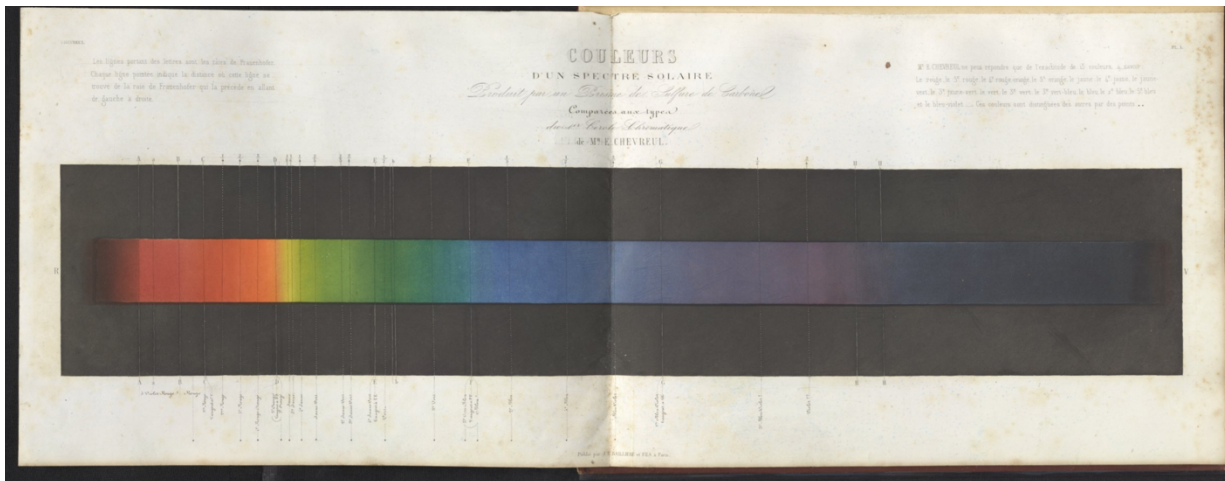


Figure 11. Upper: Michel Eugène Chevreul, *Couleurs d'un Spectre Solaire* (Paris: J.B. Baillière et Fils, 1864). Lower: detail indicating the difficulties of labeling wavelengths towards the end of the spectrum, with two question marks next to “Violet.” Cooper Hewitt Research Library, Smithsonian Museums.

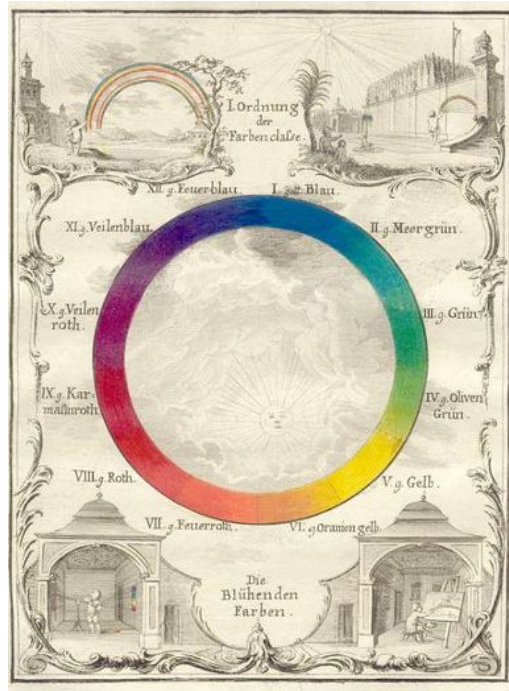


Figure 12. Engraved plate from Ignaz Schiffermüller's *Versuch eines Farbensystems* (1772)

British painter J.M.W. Turner, to take a key example, was skeptical that any system could sufficiently account for color's tendency towards contingency and variation, particularly when it came to environmental factors such as light, shade, and reflection, which played tricks on the eye (and art historian John Gage has gone so far as to describe Turner's "lifelong distrust of color systems").⁵⁴ Turner's *Light and Colour (Goethe's Theory)—The Morning After the Deluge—Moses Writing the Book of Genesis*, part of a pair that includes *Shade and Darkness—the Evening of the Deluge* (1843) treats the color wheel as a compositional advice, but ultimately, this form is revealed to inadequately address or encapsulate the politics of vision and perception of the late nineteenth century.⁵⁵ This pair of paintings, which I will call "the Deluge paintings" going forward, were both exhibited at the Royal Academy of London in 1843 and build on Goethe's emphasis on color harmony through polarity—in this case, the opposition between light/ shadow and blue/ yellow (which Goethe described as complementary colors with opposite symbolic meanings, blue being passive and yellow being active). Yet, the Deluge paintings also show a clear break with *Zür Farbenlehre* and an incredulity towards color systems more generally, revealing a "struggle with

⁵⁴ Gage, *Color in Turner*, 54. In a text titled "A Note on Reflexes and English Landscape" (circa 1810), Turner described reflections (which he called "reflexes") as antithetical to any system. "Among the mutable and infinite contrasts of light and shade," he wrote, "none is so difficult either to define or [to make] deductible [*sic.*] to common vision as reflexes. They enter into every effect in nature, oppose even themselves in theory, and evade every attempt to reduce them to anything like rule or practicality. What seems one day to be equally governed by one cause is destroyed the next by a different atmosphere." J.M.W. Turner, "A Note on Reflexes and English Landscape." Reproduced in Gage, 213.

⁵⁵ Turner was acquainted with Charles Eastlake, the English translator of *Zür Farbenlehre* (which was translated as *Theory of Colors* in 1840), and owned a heavily annotated copy of the translation, as well as Newton's *Opticks* and texts such as David Brewster's *A Treatise on the Kaleidoscope* (1819).

visuality” that goes beyond Goethe’s theory.⁵⁶



Figure 13. J.M.W. Turner, *Shade and Darkness—The Evening of the Deluge* (1843). Oil on canvas.



Figure 14. J.M.W. Turner, *Light and Colour (Goethe's Theory)—The Morning After the Deluge—Moses Writing the Book of Genesis* (1843). Oil on canvas.

Shade and Darkness [Figure 13] is comprised of muddy browns and grayish-whites, the underpainting peeks out from beneath in a vivid cerulean—the sky behind the torrential downpour—and there is a distinctly yellowish tint to the fog and clouds curtaining the horizon. *Light and Color* [Figure 14], on the other hand, shimmers so brightly with saturated colors—rich oranges and yellows and a glimpse of violet-blue—as to be almost opalescent. On the one hand, the two images seem to be direct opposites—shadow and blue form the backdrop of one, light and yellow the other—but on the other, both present color as “floating” and “ephemeral” and thus constantly dissolving and recombining from disparate elements. Contrary to its title’s implied resolution—“the morning *after* the deluge”—the painting does not provide conceptual or visual clarity, showing the disorienting powers of color. The color wheel appears in almost three-dimensional form, as an iridescent bubble in which the visible spectrum swells and threatens to burst. Instead of dividing the spectrum, the color circle becomes a compositional strategy, a window or lens that serves as the frame or viewpoint onto the scene portrayed. The circular frame also mimics the shape of the iris, becoming “a radial fusion of eye and sun” and revealing perception itself to be the focus of the painting.⁵⁷

Turner’s adoption of the color wheel as an aesthetic or formal technique showcases his views on vision, which might at best be described as conceptually agnostic, and respond directly to the supposed “neutrality” of visual systems. Much has been written on Turner as a transitional figure between pre-industry and modernity who neither fully dismissed nor embraced representational systems that present themselves as ideologically neutral—in particular, linear

⁵⁶ Nicholas Mirzoeff, “On Visuality.” *journal of visual culture* 5 no. 1 (2006), 161.

⁵⁷ Crary, *Techniques of the Observer*, 143.

perspective. Contemporary artist and theorist Hito Steyerl has argued that Turner's paintings, in blurring or obscuring the horizon line or vanishing point, dispense with "resolution" and a "clear view to any past or future." The horizons of the Deluge paintings are obscured from view, but their existence is also not fully denied.⁵⁸ One-point linear perspective, as Erwin Panofsky famously demonstrated, paradoxically presents the point of view of a static, monocular subject just as it declares absolute objectivity and neutrality: a window onto the world as it is.⁵⁹ Perspectival images, Steyerl asserts (drawing on Panofsky), have been used to cement dominant ideologies, particularly western expansion and colonialism, in normalizing a supposedly universal worldview that "helped set standards for marking people as other, thus legitimizing their conquest or the domination over them."⁶⁰

Steyerl cites *The Slave Ship*, exhibited just three years before the Deluge paintings, which Turner painted for an anti-slavery conference. This painting, based on a real-life atrocity in which a captain had all of the sick and dying bondspeople on his boat thrown overboard (since insurance only covered those drowned or lost at sea), once again obscures and tilts the horizon line, rendering the viewer's position unstable: "at the sight of colonialism and slavery, linear perspective... is abandoned and starts tumbling and tilting, taking with it the idea of space and time as systematic constructions."⁶¹ Turner's mistrust of the supposed neutrality or ideological uniformity of representational systems extended beyond perspective into color theory: in the Deluge paintings, the color wheel is subsumed into the formal structure of the canvas just as it becomes trivialized as an aesthetic convention that blurs rather than clarifies perception. By the late nineteenth century, around the time Turner was grappling with these issues, a different organizational color diagram was quickly gaining ground across the arts and sciences, one that claimed to be even more mathematically rigorous and objective: the color grid.

Synthetic Rainbows and Reproducible Swatches

Alongside color wheels, color charts played a key role in categorizing color prior to industrialization; Foucault even calls the seventeenth and eighteenth centuries "the age of the catalogue" whose primary tool is the table.⁶² Yet these taxonomic charts present a very different logic than the postwar commercial color charts referenced in the MoMA show, which treat colors as a mathematical array of abstract values. Despite their "grid-like" appearance, with rows, columns, and individually labeled color swatches, these diagrams have more in common with the logic of the unknowable color circle. The color grids of the seventeenth through mid-nineteenth centuries were primarily intended for the natural sciences or for mixing artist's paints: as early as 1692, a Dutch artist known only as "A. Boogert" created an 800-page set of guidelines for creating different hues from watercolors. This particular text, which was recently scanned and made available online, has recently come into the public eye on several popular media websites that call it a "Pre-Pantone Guide to Colors."⁶³ Unlike Pantone, however, a company founded in

⁵⁸ Hito Steyerl, "In Free Fall: A Thought Experiment on Vertical Perspective." *e-flux*, no. 24 (April 2011)

⁵⁹ Erwin Panofsky, *Perspective as Symbolic Form*, trans. Christopher S. Wood (Zone Books, 1997)

⁶⁰ Steyerl, "In Free Fall"

⁶¹ Ibid.

⁶² Foucault, *The Order of Things*, 75 and 131.

⁶³ See Gina Marinelli, "Before Pantone Color Chips, There Was This 300-Year-Old Book." *Refinery 29*, May 22, 2015. <https://www.refinery29.com/en-us/original-pantone-color-book>; "A Pre-Pantone Guide

the 1950s that bases itself on standardization and reproducibility on a massive scale (and as I discuss in later chapters, one that would play an increasingly hegemonic role in discourses surrounding industrialized color), the mystique surrounding Boogert's color guide [Figure 15] stems from the fact that there is only one copy in existence—precisely replicating these hand-painted colors would not have been possible at this time.



Figure 15. A. Boogert, a two-page selection from *Traité des couleurs servant à la peinture à l'eau* (1692). This hand-painted, hand-written manuscript is characterized by its materiality and singularity. The Bibliothèque Méjanes, Aix-en-Provence, France. Scanned digitally and accessible online. By contrast, the Pantone Matching System (first introduced in 1963) prides itself on its accessibility and reproducibility.

Prior to color photography, diagrams in the sciences relied on colored drawings and paintings to render objects more “naturalistically.” Color in these charts serves a mimetic function, grounding it in rather than abstracting it from pre-existing forms.⁶⁴ Patrick Syme’s

to Colors: Dutch Book From 1692 Documents Every Color Under the Sun.” *Open Culture*, July 9, 2014. <http://www.openculture.com/2014/07/dutch-book-from-1692-documents-every-color-under-the-sun.html>; Ashley Hamer, “This 800-Page Book of Colors Predates Pantone By 271 Years.” *Curiosity*, January 13, 2017. <https://curiosity.com/topics/this-800-page-book-of-colors-predates-pantone-by-271-years-curiosity/>; and Sarah Cascone, “Handpainted Color Guide from 1692 is Pre-Modern Pantone.” *Artnet*, May 6, 2014. <https://news.artnet.com/art-world/handpainted-color-guide-from-1692-is-pre-modern-pantone-14121>

⁶⁴ Bettina Bock von Wülfigen, “The Periodic Tableau: Form and Colors in the first 100 Years.” In

commentary to *Werner's Nomenclature of Colors* (1821), which Darwin is said to have consulted, makes it clear that taxonomic tables are merely approximations of the infinite colors found in nature: “Those who have paid any attention to colors, must be aware that it is very difficult to give colors for every object that appears in nature; the tints are so various, and the shades so gradual, they would extend to many thousands.”⁶⁵ Whereas the colors found in nature are “real,” color tables are merely approximations.

In *Werner's Nomenclature* [Figure 16], though colors are presented in grids, each grid corresponds to a set of hues on the spectrum—whites, blues, greens, and so on—and further classified by “animal,” “vegetable,” and “mineral,” which describes where in the natural world such a color might be found.⁶⁶ Like Boogert's book of watercolors, Syme's commentary is didactic, instructing the reader how to mix these colors from organic compounds: Duck Green is “composed of emerald green, with a little indigo blue, much gamboge yellow, and a very little carmine red.”⁶⁷ Whereas color swatches originated as samples of distinct materials—“the capturing of a window of pigment where the grain of the ingredients could be identified by artists”—the shift from artisanal paint to the chemical synthesis of colors with no direct analogue in nature resulted in the disappearance of any “grain” or material trace.⁶⁸

The growth of the synthetic dye industry accelerated the wheel's obsolescence by introducing the color chart as its primary form of representation. The chemical revolution of the eighteenth century involved transforming color into a property that could be measured and standardized, creating a demand for chromatic novelty and commercial paints.⁶⁹ As an outcome of the Industrial Revolution and the rise of mechanical reproducibility, the late nineteenth century also saw a profound shift in the way color was experienced, categorized, and consumed, and the once accepted idea that color could be separated from the body or individual perception fell under scrutiny.⁷⁰ This shift in color perception at first seems to be paradoxical: if color in the nineteenth century was accepted as ultimately irrational, immeasurable, and grounded in subjective experience, how can we explain the sweeping growth of standardized color systems that assume the existence of a “standard observer?” To unpack this apparent contradiction between standards and norms on the one hand and an emphasis on embodiment on the other, we need to turn to two primary shifts: 1) the rise of mass-produced industrial color and 2) modern psychophysics, which treats color as an “abstract intellectual property”—as in “the idea of blueness, whiteness, redness, and so on”—that can be separated from specific objects or

Lykknes, Annette and van Tiggelen, Brigitte, eds. *The Periodic system as an icon in chemistry and a typology of science. Special Issue in Centaurus, International Journal of the History of Science and its Cultural Aspects* (2019): 379-404.

⁶⁵ Patrick Syme, *Werner's Nomenclature of Colors: Adapted to Zoology, Botany, Chemistry, Mineralogy, Anatomy, and the Arts* (London: The Trustees of the Natural History Museum, 2018), 13.

⁶⁶ Other examples of eighteenth-century color taxonomies include Viennese lepidopterist Ignaz Schiffermüller's table of different shades of blue to aid with identifying butterfly specimens from *Versuch eines Farbensystems* (1772) and Robert Ridgeway's *Nomenclature of Colors For Naturalists and Compendium of Useful Knowledge for Ornithologists* (1886).

⁶⁷ Syme, *Werner's Nomenclature of Colors*, 37.

⁶⁸ Natasha Eaton, *Color, Art and Empire: Visual Culture and the Nomadism of Representation* (London: I.B. Tauris & Co, Ltd, 2013), 139.

⁶⁹ Kalba, 22.

⁷⁰ For more detailed accounts on modernity's restructuring of perception, see Stephen Kern, *The Culture of Time and Space, 1880-1918* (Harvard University Press, 1983) and Mary Ann Doane, *The Emergence of Cinematic Time: Modernity, Contingency, the Archive* (Harvard University Press, 2002)

images, despite being grounded in individual physiology.⁷¹ With both of these ruptures, color emerges as a site for “rational thinking” through counting, labeling, and the attempted regulation and standardization of perception.

GREYS.					
N ^o	Names.	Colours.	ANIMAL.	VEGETABLE.	MINERAL.
9	Ash Grey.		Breast of long tailed Ben Titmouse.	Fresh Wood ashes	Flint.
10	Smoke Grey.		Breast of the Robin round the Red.		Flint.
11	French Grey.		Breast of Red Wag tail.		
12	Pearl Grey.		Backs of Black headed and Kittiwake Gulls.	Back of Petals of Purple Hepatica.	Porcelain Jasper.
13	Yellowish Grey.		Vent coverts of White Rump.	Stems of the Barberry.	Common Galenology.
14	Bluish Grey.		Back, and tail Coverts Wood Pigeon.		Limestone
15	Greenish Grey.		Quill feathers of the Robin.	Bark of Ash Tree.	Clay Slate. Barke.
16	Blackish Grey.		Back of Nut hatch.	Old Stems of Hawthorn.	Flint.

YELLOWS.					
N ^o	Names	Colours	ANIMAL.	VEGETABLE.	MINERAL.
69	Gallstone Yellow.		Gallstones.	Marigold Apple.	
70	Honey Yellow.		Lower Parts of Neck of Bird of Paradise.		Fluor Spar.
71	Straw Yellow.		Polar Bear.	Out Stran.	Scherite. Calamine.
72	Wine Yellow.		Body of Silk Moth.	White Currants.	Saxen Topaz.
73	Senna Yellow.		Vent Parts of Tail of Bird of Paradise.	Stamina of Honey-suckle.	Pale Brazilian Topaz.
74	Ashre Yellow.		Vent Coverts of Red Start.		Porcelain Jasper.
75	Cream Yellow.		Breast of Teal Drake.		Porcelain Jasper.

Figure 16. Two pages from Patrick Syme, *Werner's Nomenclature of Colors: Adapted to Zoology, Botany, Chemistry, Mineralogy, Anatomy, and the Arts* (London: The Trustees of the Natural History Museum, 2018). There is a clear connection between the names of colors and objects found in the natural world.

As Michael Taussig writes: “It was the search for dazzling, standardized colors that in the mid nineteenth century led to the new science of organic chemistry from which emerged a world of commodities beyond even the dreams of Faust, just as it was those same dazzling, standardized colors that gave the final spit and polish to what Karl Marx saw as the spirit-like character of the commodity.”⁷² Dyes and paints hand-mixed from natural pigments rather than synthesized from coal tar had clear referents in the external world (red cochineal came from beetles of the same name, lapis from lapis lazuli, zinc white from zinc oxide, and so on); by contrast, the advent of the synthetic dye industry allowed made it possible to sever the bond between color and the referential world. Whereas the colors named by naturalists were approximate at best, these dyes were patented and could thus be mass-produced and sold as commodities. While it is important to note, as Carolyn Kane has at length, that so-called “synthetic and sacred colors are not *mutually exclusive*”—humans have been fabricating synthetic pigments since antiquity—the preoccupation with so-called “authenticity” is a distinctly modern one.⁷³ If we recall Barthes’ and Jarman’s mournful tones as they reminisce about the disappearance of the “true” or “real” colors of preindustrial times, it’s difficult not to view this

⁷¹ Laura Ann Kalba, *Color in the Age of Impressionism*, 3.

⁷² Michael Taussig, *What Color is the Sacred?* (The University of Chicago Press, 2009), 5.

⁷³ Carolyn L. Kane, *Chromatic Algorithms: Synthetic Color, Computer Art and Aesthetics After Code* (The University of Chicago Press, 2014), 44.

perceived shift from sacred to synthetic color as a loss of aura or originality. In her remarkable exploration of the German chemical industry from the eighteenth century to the Third Reich, Esther Leslie describes genuineness as “that which cannot be reproduced. Genuineness gains in value in a world of endless reproduction and synthetics, precisely because it exists no more. It is all the more loudly asserted for that.”⁷⁴

In the nineteenth century, for the first time, color could be transformed into a stable property that could be measured and standardized on a mass scale, to be used in dyes, pigments, and textiles.⁷⁵ From Henry Perkins’ accidental “discovery” of mauve (also known as mauveine) in 1859 to the synthesis of alizarin, a chemical substitute for the deep red pigment known as madder, by German chemists Carl Graebe and Carl Liberman in 1868, to synthetic indigo’s introduction to the mass market in 1890, the growth of the modern chemical industry resulted from the newfound ability to create a rainbow of colors out of black coal tar. Far from a clinical process devoid of emotion or wonder, aniline dyes appeared an almost alchemical miracle. These manufactured colors were not initially perceived as an echo of the physical world, but a way of bringing it into being; they declared “a war on physical reality, outbidding nature’s own productions.”⁷⁶ Aniline made it possible to detach color from object; as Nicholas Gaskill writes: “To put it starkly, after aniline the referent of ‘color’ changed: whereas it once referred to a sensory property of natural objects, by the end of the nineteenth century it invoked the artificial means of manipulating and exaggerating chromatic quality as an abstract entity with its own rules, even its own language.”⁷⁷

Commercial synthetic dyes, which created widespread demand for chromatic novelty and commercial paints, were the colors of modernity: they colored magic lantern slides, theater lights, posters and, textiles, and were used to tint, tone, and stencil early films, most famously Georges Méliès’ phantasmagorical productions such as *La Voyage Dans La Lune* (1902).⁷⁸ Situated at the nexus of photography, film, and fashion, synthetic dyes were ideal for coloring the animal fibers and gelatin comprising photographic and film emulsions, and as a result, the color samples used by companies such as Pathé, Agfa, and Kodak resembled those used in fashion and design.⁷⁹ While chemical colors transformed the media landscape, however, they also attempted to replicate existing pigments that had previously been acquired through colonial trade at a cheaper cost, resulting in the production of “substitutes, analogues, imitations, and duplicates.”⁸⁰ By the 1860s, aniline dyes were already in the process of being replaced by acid-based dyes that attempted to replace artisanal colors such as cochineal red through rebranding and renaming. Often, these synthetic replacements would keep the same names of the pigments they attempted to mimic, even though there was no longer an immediate link to be drawn between color and material. This notion of artisanal material as vestigial can be seen in most industrial paint

⁷⁴ Esther Leslie, *Synthetic Worlds: Nature, Art, and the Chemical Industry* (London: Reaction Books, 2005), 190.

⁷⁵ Kane, *Chromatic Algorithms*, 46.

⁷⁶ Esther Leslie, *Synthetic Worlds: Nature, Art, and the Chemical Industry*, 9.

⁷⁷ Nicholas Gaskill, *Chromographia: American Literature and the Modernization of Color* (Minneapolis: The University of Minnesota Press, 2018), 20.

⁷⁸ See Joshua Yumibe and Sarah Street, *Chromatic Modernity: Color, Cinema and Media of the 1920s* (New York: Columbia University Press, 2019)

⁷⁹ Olivia Kristina Stutz, “Such (Dye-)Stuff as Dreams Are Made On: Material Interactions between the Photography, Film, and Fashion Industries.” In *Color Mania: The Materiality of Color in Photography and Film*, eds. Barbara Flueckiger, Eva Hielscher, and Nadine Wietlisbach (Fotomuseum Winterthur: Lars Müller Publishers, 2020), 122.

⁸⁰ Esther Leslie, *Synthetic Worlds*, 7.

manuals; as late as 1950, the Container Corporation of America provided a dictionary of color names for their Color Harmony Manual, clarifying that while “certain of the color names used refer to precious and semi-precious stones and other natural objects... there is sometimes a difference between the actual color of an object, such as a precious stone or ivory, and the color which the mass markets associate with its name.”⁸¹

The growing market for synthetic dyes was thus inseparable from the technologies that brought them into being: namely, those of mechanical duplication, reproduction, and standardization. It is for these reasons that the color chart was the ideal form for circulating color standards—as a form “based on numbers and codes,” its grid format was designed to “make specific hues reproducible.”⁸² By representing individual colors as alphanumeric variables, the commercial color chart attempted to eliminate the ambiguity of the color wheel; great pains were taken to label as many distinct shades as possible. There were of course clear economic motivations for this discretization of color: after all, the more pre-mixed colors could be identified, the more could be sold. But the rise of the color chart and numerical color was about more than commodification—that is, the mass production of colors as sellable goods. What was being sold was not just paints or textiles, but an increasingly pervasive understanding of not *color*, but *colors* in the plural, as a seemingly infinite number of interchangeable entities that one could choose from (Barnett Newman, an outlier among postwar artists, chose not to use acrylics or vinyl, drawing a distinction between “the *color* [he made] out of colors” and synthetic *colors*, which were “anything anybody [could] buy and squeeze... out of tubes.”)⁸³

The number of distinct commercial dye colors grew exponentially between the 1870s and the first years of World War I, by fifteen to twenty each year.⁸⁴ But how to manage this limitless array of colors, the proliferation of which could easily turn into “chromatic chaos?”⁸⁵ A system was needed to record, manage, and categorize these colors—and as it turned out, the “sample color card,” a grid of paint chips or fabric swatches arranged by likeness, would assist in both standardizing and organizing colors and serve as a fashion forecasting tool, predicting which color palettes would be most popular each season. In the early twentieth century, these color tools often served to standardize color on a national level, as seen in the Standard Color Card of America [Figure 17], which included a color name and identification number for each hue.⁸⁶ Commercial charts served as a manual or visual resource for consumers and designers, to be physically handled as everyday tactile objects. By the mid twentieth century onward, however, there was no longer a single national color standard, but a set of competing companies, each with their proprietary set of color samples. The most well-known of these standards were created by

⁸¹ Helen D. Taylor, Lucille Knoche, and Walter C. Granville, eds. *Descriptive Color Names Dictionary: A Supplement to the Third Edition of the Color Harmony Manual* (Chicago, IL: Container Corporation of America, 1950). Cooper Hewitt Research Library, Smithsonian Museums.

⁸² Beyer, 131.

⁸³ Barnett Newman, quoted in *Color Chart*, 19. Emphasis mine.

⁸⁴ Kalba, 29.

⁸⁵ Regina Lee Blaszczyk, “Color Forecasting in the U.S. and Great Britain.” In *The Fashion Forecasters: A Hidden History of Color and Trend Predictions*, eds. Regina Lee Blaszczyk and Ben Wubs (London, UK: Bloombury Visual Arts, 2018), 39.

⁸⁶ *Ibid*, 48. Beginning in 1915, the Standard Color Card of America was widely circulated as a color forecasting tool. Because there was an embargo on German chemicals, which had previously been the country’s primary source of paints and dyes, there was a decidedly nationalistic impulse behind the creation of an “all-American” color standard.

print and paint companies such as Pantone, Sherwin-Williams, and Benjamin Moore.⁸⁷ The latter two specialized in pre-mixed industrial paints for both industrial and home use (see Chapter Two), with each company providing its own system of numbering and serializing colors [Figure 18].



Figure 17. Sample Book, Standard Color Card of America, Ninth Edition; USA; label: board covers, printed cardboard pages, silk samples. Textiles Department, Cooper Hewitt, Smithsonian Design Museum

By the 1950s, the color chart was a recognizable image in popular culture, and consumers were invited to interact with grid-like color in a range of ways, ranging from Sherwin-Williams’s Kem Colormeter Mixing Machine (1959), an in-store chip-dispenser, to the paint-by-numbers kits mentioned earlier. Sold by companies such as Palmer Paint, these kits included multiple brushes and up to ninety premixed paints whose numbers corresponded to the negative space on the surface to be colored, with the tagline “Every man a Rembrandt!”⁸⁸ Some of these kits were sold as “mystery paintings,” with the images subject matter only being revealed once all the colors were applied.⁸⁹ As with Warhol’s *Do it Yourself* paintings, which evoke the feeling of a “number painting” in progress, these kits encouraged consumers to view colors as numerical values first and foremost, rather than originating from the objects to which they “belonged.”

⁸⁷ Sherwin-Williams and Benjamin Moore remain two of the largest paint manufacturers in the U.S. today. Though both companies were founded in the late nineteenth century (Sherwin-Williams in 1866 and Benjamin Moore in 1888), their influence steadily grew through the World Wars. The U.S. government was Sherwin-Williams’ biggest customer during World War II: color was in high demand, from camouflage paint for tanks and supplies, blackout paint, and coatings for grades, bullets, and bombs. Many *camoufleurs*, or visual artists who were put to use in developing military camouflage, became commercial colorists, applying techniques of visual deception to product design, particularly within the automobile industry. See Regina Lee Blaszczyk, *The Color Revolution* (The MIT Press, 2012).

⁸⁸ William L. Bird, Jr., ed. *Paint by Numbers: The How-to Craze that Swept the Nation* (Princeton Architectural Press, 2001). Exhibition catalogue.

⁸⁹ Karal Ann Marling, *As Seen on TV: The Visual Culture of Everyday Life in the 1950s* (Harvard University Press, 1994), 60.



Figure 18: Sherwin-Williams and Benjamin Moore charts throughout the decades. Upper: Sherwin-Williams, “Standard Colors Adopted by Airplane Manufacturers” (1920). This color chart also includes metallics and suggestions for color mixing with the pigments provided. Lower: Benjamin Moore, color fan deck (1987). The colors are aggregated by likeness and numbered accordingly. Both from Birren Collection of Books on Color, Robert Haas Family Arts Library, Yale University.

Just as the color wheel eventually became a predominantly aesthetic device, the color chart also found its way as a visual trope into popular films such as *Funny Face* (Stanley Donen, 1957), in which color swatches function as both infrastructure and theme. (In a perhaps unintentionally self-reflexive move, *Funny Face* was shot in Eastmancolor, a one-strip color film process that was widely used and much more standardizable than Technicolor, since it didn’t require special camera equipment). The film includes several scenes in the headquarters of fictional fashion magazine *Quality*; the lobby’s pristine white walls and floors serve as a backdrop to the seven colored doors on its back wall. In colors ranging from pale yellow to deep blue to bright orange, the doors’ matte finish and rectangular shape against the white background resemble a life-sized color chart [Figure 19]. The easy interchangeability of color swatches is played with in musical numbers such as “Think Pink” [Figure 20], in which a crew repaints the doors the same color pink that is being promoted as a new fashion trend while singing and dancing. But instead of becoming an aesthetic relic, the color grid represented a way of seeing that was becoming more and more normalized, characterized by the abstraction of color from object and the association of colors with alphanumeric labels. This epistemic shift revealed the color wheel’s status as fundamentally incompatible with postindustrial understandings of vision that favored grid-like, mathematical representations—both as an aesthetic and as a mode of perception.



Figure 19. Colored doors in *Funny Face* (Stanley Donen, 1957) resemble the color swatches of a commercial paint chart.



Figure 20. During the musical number “Think Pink,” workmen paint the doors the same color pink that is being promoted as a new fashion trend.

Psychophysical Color and the Abstract Body

Coinciding with the emergence of synthetic color and mass-produced paints was the establishment of modern psychophysics, which measures the relationship between physical stimuli and psychological phenomena. This shift from color as a descriptor or characteristic of objects found in nature to color as understood in terms of alphanumeric code is what historian Michael Rossi (borrowing from physicist Ogden Rood’s text of the same name) calls *modern*

chromatics, “a science based on the measurement and codification of sensations of color” that begins at the turn of the century.⁹⁰ On a basic level, psychophysics measures the relationship between an external stimulus and the resulting sensation or perception experienced by an observer. An early form of experimental psychology, psychophysics sought to understand the human body as a feedback mechanism by which various sensations such as sound, touch, and light could be predicted and explained. Thus, in order to abstract the body from the world, sensation itself had to be scrutinized, rendered measurable and quantifiable, and turned into data.⁹¹ By presenting a science where color was assumed to be “unscientific” or irrational, psychophysical researchers claimed to be a select few who were able to expertly mediate between perception and reality. Psychophysics thus played a key role in rationalizing color in numerical terms while simultaneously emphasizing its resistance to systemization. As Carolyn Kane lucidly puts it,

In the nineteenth century, scientists like Gustav Theodor Fechner, Ernst Heinrich Weber, Hermann von Helmholtz, Johannes Müller, James Clerk Maxwell, and Thomas Young pioneered the scientific study of optics and perception. They saw value in Goethe’s “embodied” color and likewise located visual truth in the corporeal body. But no sooner was this body identified as the source of visual knowledge than it was also removed and abstracted from the world. In pursuit of an “ideal subject” of vision, perceptual processes were isolated and idealized into objects for rational observation and calculation.⁹²

It was during this time, starting in Germany and culminating in the United States, that Goethe’s writings on color, which had been largely lampooned outside of artistic circles for their dismissal of Newton’s prismatic color theory, resurfaced with newfound interest. Because Newton did not draw clear distinctions between the physics of color (in terms of wavelength and radiation) and its connected psychological sensations, his framework could not be seen as a fully fleshed out theory of color science and perception.⁹³ Although Helmholtz ultimately rejected Goethe’s theory as the work of a poet rather than a scientist,⁹⁴ Fechner’s proposition on which all of psychophysics was based, that sensation could be understood “not primarily in terms of physical *causes* but in terms of the *responses* of nerves to specific sorts of stimuli” was directly influenced by Goethe.⁹⁵ Unlike Goethe’s approach, however, sensation no longer belonged to a subject, but could be isolated as a free-floating entity.⁹⁶ Fechner and other researchers saw

⁹⁰ Michael Rossi, *The Republic of Color: Science, Perception, and the Making of Modern America* (The University of Chicago Press, 2019), 18.

⁹¹ Friedrich Kittler, *Discourse Networks 1800/1900*, trans. Michael Metteer and Chris Cullens (Stanford University Press 1990), 229.

⁹² Kane, *Chromatic Algorithms*, 34.

⁹³ Sepper, x.

⁹⁴ Alexandra Hui has described the difficulty of separating aesthetics from science in early psychophysical experiments in her book *The Psychophysical Ear: Musical Experiments, Experimental Sounds, 1840-1910* (The MIT Press, 2012). For a more detailed account of Helmholtz’s relationship to Goethe’s ideas, see Jeffrey Barnouw, “Goethe and Helmholtz: Science and Sensation.” In *Goethe and the Sciences: A Reappraisal*, eds. Frederick Amrine, Francis J. Zucker, and Harvy Wheeler (Dordrecht, Holland: D. Reidel Publishing Company, 1987): 24-82.

⁹⁵ Michael Rossi, *The Republic of Color*, 38.

⁹⁶ Jonathan Crary, *Suspensions of Perception: Attention, Spectacle, and Modern Culture* (Cambridge, MA: The MIT Press, 1999), 27.

physiological sensation in mathematical or quantitative terms: although sensation itself could not be measured, stimuli could be.⁹⁷ As such, psychophysics was particularly interested in determining thresholds of perception (also called *limens*), or the precise point of intensity at which a subject can detect a change in external stimulus. Within this framework, then, color has no symbolic meaning or association with a given object: it is just another sensation derived from a stimulus.⁹⁸

The perceived failure of language to encompass the millions of stimuli visible to the average eye as the sensation of color becomes even more apparent with representations of color from the early twentieth century onward, which use numbers and letters rather than descriptive names that tie colors to specific objects.⁹⁹ This reliance on alphanumeric representation explains the abundance of grid-like color models that emerged as a result of psychophysical research. I say “grid-like” rather than “grids” because many of these models were conceived in three-dimensional terms and took on forms such as pyramids, spheres, and cubes, which, despite exhibiting a geometrical variety, all exemplify what I have called the digitization of color perception. This grid-like, alphanumeric logic, which stems from an insatiable desire for systemization, renders color infinitely plural, divisible, and able to be rearranged at random. In a foreword to Ostwald’s *Color Primer*, color consultant Faber Birren describes color systems as superior to the ultimate disorganization of nature. “In visual sensation,” Birren writes, “are thousands of hues, tints, shades, and tones which are seen everywhere in natural and manmade objects and environments. Although a certain amount of order will be found to exist in a rainbow or sunset, for the most part nature uses color in a lavish and indifferent way. How is one to take all that is seen by the eye, organize it, sort it out, and arrange it in a sensible and tidy

⁹⁷ Central to psychophysical understandings of color were two rival theories: the Trichromatic Theory (also known as the Young-Helmholtz trichromatic theory, or simply trichromatism) and Ewald Hering’s Opponent-Process Theory. While both theories turned to the retina itself as a site of color production in response to the recent discovery of rods and cones in the eye, each provided a different explanation for color vision. The Trichromatic Theory, as outlined in Helmholtz’s *Physiological Optics* (1860), identified the retina having three types of color receptors in the eye—red, blue, and green—which, combined with light-based stimuli, produce the colors we see. However, this theory did not account for the fact that staring at a given color for an extended period will result in an after-image of its complementary shade, nor did it explain the production of colors such as yellow and white. If all colors were combinations of red, blue, and green, why was yellow not experienced as “greenish-red” or “reddish-green?” Eighteen years later, enter Hering’s Opponent Process Theory, which conceived of the complex relations between the retina, optic nerve, and the brain as a feedback mechanism and perception as a biodynamic system. Highly influenced by Goethe’s “physiological colors,” or optical phenomena such as after-images and floating halos that could not be explained without reference to the human body, Hering argued that cone receptors in the eye are divided into pairs (blue/yellow, red/green, and black/white). Only half of each pair of cone receptors can be perceived at the same time, hence why the concept of “reddish-green” is an impossibility. Much like the Newton-versus-Goethe debate that preceded this, Hering and Helmholtz’s theories were not entirely oppositional, but instead highlighted different aspects of a much larger system of color perception. Whereas trichromatism frames color vision in terms of photoreceptors within the eye, the opponent process theory explains how neural processes result in specific color phenomena. Though the validity of each theory was hotly debated from the late-nineteenth to early-twentieth centuries, subsequent research in color science and its sister discipline, colorimetry, can largely be seen as responses to these two understandings of color perception.

⁹⁸ Rossi, 10.

⁹⁹ Gage, *Color and Culture*, 23.

manner?”¹⁰⁰ This understanding of nature as chaotic and imperfect is the polar opposite of the eighteenth-century taxonomies cited earlier, in which color systems are at best mimetic approximations of natural beauty. The colorist’s task is to re-organize and represent color in a “sensible and tidy manner,” suggesting that color systems have a sanitary, almost infrastructural quality to them. Rather than referencing the natural world, as we saw with eighteenth-century taxonomic tables, colors become constants and variables within a mappable virtual space.

One of the many difficulties of classifying color is the variety—and at times incompatibility—of linguistic terms used to systemize it, such as *hue*, *value*, *chroma*, *tint*, *wavelength*, and *purity*; such terms are known as “color constants.” Different color spaces use a variety of color constants, which serve as the mathematical axes of the space, and while some of these are synonymous, others are not. Likewise, two color theorists may use the same term but use it to describe two different phenomena. Here I try my best to define and describe the terms on a case-by-case basis, keeping this slippage in mind. This resistance to verbal description is a large part of the reason why color systems often opt for numerical labeling.

Mimicking the cartographic formula of latitudinal and longitudinal lines, color models, like maps, become geographical coordinates that can be specified by a set of symbols such as numbers or letters. Philipp Otto Runge’s *Farbenkugel*, or *Color Sphere* (1810) [Figure 21], can be seen as an early attempt to represent a greater totality of color combinations in spherical form. Using a globe metaphor, the primary colors of red, yellow, and blue are closest to the equator, white and black form the poles, and intermediate mixtures connect these points on all axes. Colors thus become coordinates that can be mapped at uniformly equal distances between points. English architect William Benson published a cubic color system in 1868 [Figure 22], which, like Runge’s sphere, involves depicting colors as coordinates that, when linked together through lines, formed an idealized geometrical solid. Whereas Runge, a painter and friend of Goethe’s, only depicts subtractive color mixing (in which there is a reduction in light when colors are mixed, as in with pigments) in his solid, Benson’s cube is based on red, green, and blue additive primaries (where these colors when mixed, combine to create white light). The cube consists of three types of axes: primary, secondary, and tertiary, which map onto primary, secondary, and tertiary color mixing. Once again, intermediate colors find precise coordinates in mathematical space.

One color model that has sustained in different forms since its inception—it provided the basis for the 1931 CIE chromaticity diagram (Chapter Three provides a more detailed account of its history and function), which is still used to calibrate color televisions and other light-emitting screens—is James Clerk Maxwell’s color triangle [Figure 22]. Maxwell superimposed vertical and horizontal lines over the diagram to create a grid-like system of color notation where all possible combinations can be represented through a set of coordinates. As in additive color mixing, each corner of the equilateral triangle corresponds to red, green, and blue primaries, which, when combined equally, combine to form white, which is located at its center. Using the equation $C = aR + bG + cB$, where C is the resulting color, R , G , B , are the primaries and a , b , and c represent the amount of each primary, the diagram allows the observer to differentiate between *hue* (spectral color, defined by wavelength), *tint* (amount of saturation), and *shade* (degree of illumination). One constraint of Maxwell’s triangle, however, is that it only accounts for one uniform level of color brightness—it does not consider how the color of an object appears

¹⁰⁰ Faber Birren, “Foreword.” In Wilhelm Ostwald, *The Color Primer: A Basic Treatise on the Color System of Wilhelm Ostwald*, Edited and with a Foreword and Evaluation by Faber Birren (Van Nostrand Reinhold Company, 1969), 9.

differently under different lighting—and as we will see, almost all color models possess some kind of built-in limitation in their attempts to standardize perception.

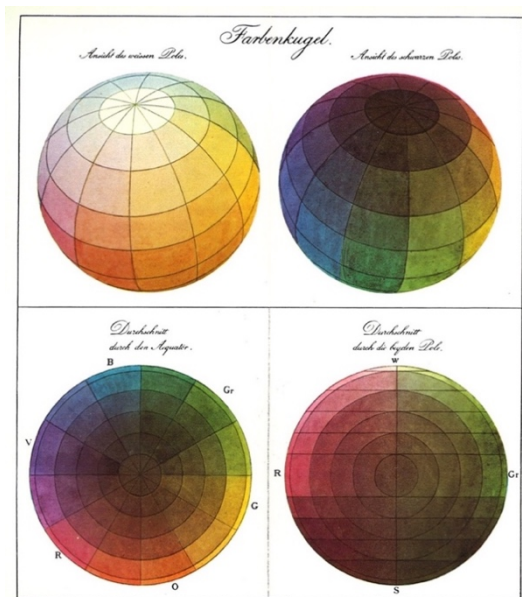


Figure 20. Philipp Otto Runge, *Farbenkugel* (1810)

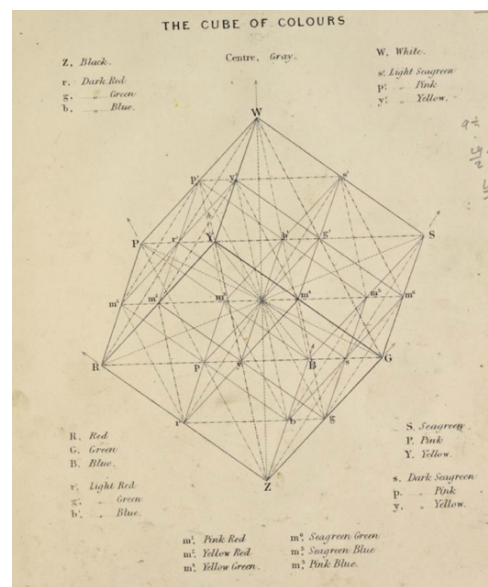


Figure 21. William Benson, “The Cube of Colours.” In *Principles of the science of colour: consisely stated to aid and promote their useful application in the decorative arts* (London: Chapman & Hall, 1876). Getty Research Institute.

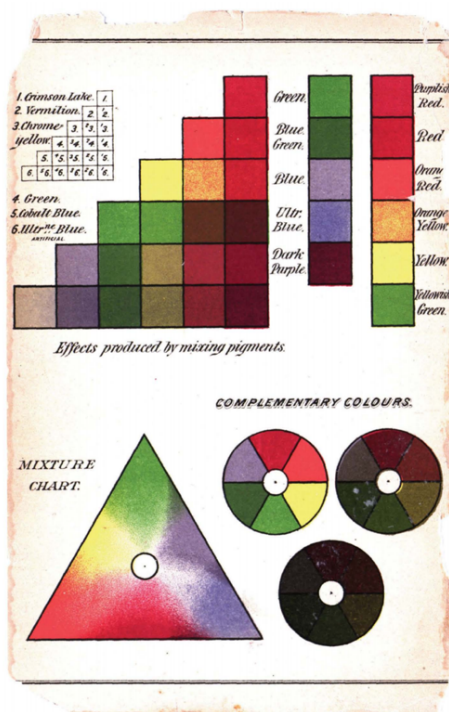


Figure 22. Colored plate from Rood's *Modern Chromatics, with Applications to Art and Industry* (New York: D. Appleton and Company, 1879)

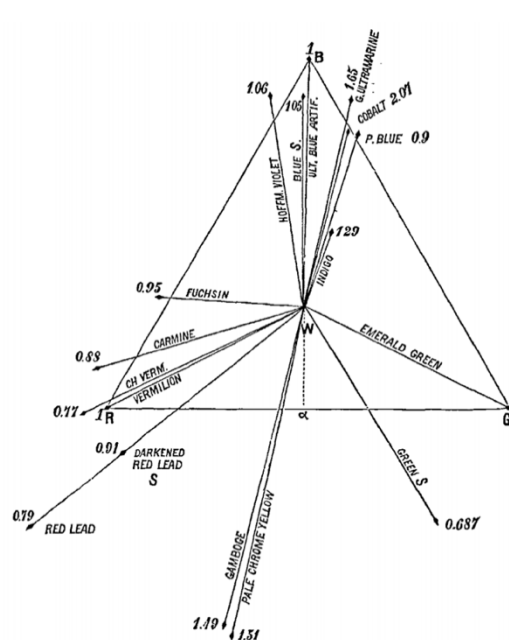


Figure 23. Ogden Rood's rendering of Maxwell's color triangle.

The beginning of the twentieth century into World War I also witnessed a shift towards a nationally determined system of standards across industry and technology, such as the National Bureau of Standards, the founding of the Optical Society of America 1916 and, three years later, their Committee on Colorimetry, as well as the Color Association of the United States, and in France, the CIE (Commission Internationale d'Éclairage, or International Committee on Illumination).¹⁰¹ We can also see that color had begun to be conceptualized in terms of a set of rules or norms from the increasing usage of the word “grammar” to describe color theory and its corresponding systems.¹⁰² Two color systems were particularly influential in establishing this methodical, rule-driven understanding of color and in turn, were absorbed into a wide-scale push towards technological standards, many of which remain in place today. These systems are the Munsell Color System, created by American art educator and painter Albert Henry Munsell, and the Ostwald Color System, designed by Latvian-born German chemist Wilhelm Ostwald. These systems played arguably the most significant role in normalizing numerical color over the course of the twentieth century: more than any other color systems, they were integrated into and adapted by multiple government organizations and corporations, such as the Container Corporation of America, the above-mentioned National Bureau of Standards, and the United States Department of Agriculture.

The institutional application and promotion of Munsell and Ostwald's systems thus means that these color systems, more than others, are intertwined with large power structures and the circulation of information. The Munsell and Ostwald systems largely functioned as color matching systems used to calibrate and standardize individual swatches were later built into the infrastructure of national television standards and color calibration on computer screens. While there are several key differences between the two, both serve a similar purpose, pushing institutional and artistic norms to think about and label color in discrete, quantifiable terms. Likewise, both color spaces have built-in “flaws” that deny contingent or environmental conditions that might affect the way a given color is perceived, and in this denial of contingency, the Munsell and Ostwald systems integrate these limitations into perception itself, establishing a “standard” or “normal” way of seeing.

Munsell and Ostwald were contemporaries, one living in Massachusetts, the other in Leipzig, meeting once in 1905 to exchange ideas on ordering color.¹⁰³ Both were influenced by Ogden Rood's *Modern Chromatics* (1879), which, following Rood's psychophysical experiments using rotating disks, produced what he called a “scientific color circle.”¹⁰⁴ Rood's color circle is a perfect exemplar of a circle based on a grid-like logic in which every point on the circle depends on the color constants of luminosity (lightness or darkness), wavelength and purity (saturation), and it is telling that Rood also cited Maxwell triangles and color charts as ways of representing color. In Rood's system, a three-dimensional cone [Figure 22], the underlying logic of each formulation is more important than the appearance of shapes themselves. Indeed, Rood distinguished his own color diagrams from “the color-charts which thus far have been published,” which, in their imprecise division of the color spectrum, cannot be seen “as a true step toward a philosophical classification of colors.”¹⁰⁵

¹⁰¹ Rossi, 21.

¹⁰² Gage, *Color and Culture*, 243.

¹⁰³ Kuehni, 85.

¹⁰⁴ Michael Rossi offers a detailed account of *Modern Chromatics* and Rood's contributions to color science. See the chapter “Modern Chromatics: Ogden Rood and the Wrong-Workings of the Eye” in *The Republic of Color*, 23-54.

¹⁰⁵ Ogden Rood, *Modern Chromatics, With Applications to Art and Industry* (New York: D. Appleton and Company,

Following in Rood's footsteps, both Ostwald and Munsell sought to match colors to a set of standards by classifying and numbering each color according to three variables. Ostwald adapted Rood's terms using the color constants of *dominant wavelength*, *purity*, and *luminance*, where Munsell opted for *hue* (dominant wavelength), *chroma* (saturation, analogous to Rood's usage of "purity"), and *value* (lightness or darkness, or what Rood calls "value"). While both systems ultimately emphasize the three same primary variables, the geometrical forms they take on (Ostwald's double cone solid versus Munsell's asymmetrical "tree") and the characteristics of color they emphasize (for Ostwald, that proportional amounts of black and white determine color harmony; for Munsell, pigment mixing specifications) are distinct. Ultimately, however, both also stressed the need for a set of standards with which to describe and represent color, to the point that standardization took on a kind of moral imperative. "Color anarchy is replaced by systematic color description," Munsell proclaimed in 1905, describing his three-variable color system.¹⁰⁶ Munsell compares his *Atlas of Color* to a globe, noting: "If this chart were bent around the equator of the color sphere forming a cylindrical envelope, it would imitate a Mercator chart of the globe, each hue taking the place of a meridian and each value level representing a parallel of latitude, while the chroma numerals would respond to altitudes."¹⁰⁷ The Mercator projection, which was largely accepted as the standard representation of the Earth at the time of Munsell's writing, actually distorts the relative size of continents by making Europe and North America appear much larger than Africa and Asia, a geographically inaccurate representation that reflects its original purpose: navigation along colonial trade routes and imperial expansion.

Whether Munsell was aware of this ideologically inflected distortion or not, the analogy is apt for a system that purports to be universal despite its subjective viewpoint. The *Atlas of Pigment Color* was created with the aid of photometers, spectroscopes, and Maxwell discs (a circle divided into segments of color that when rotated, results in a kind of "optical mixing") to establish "a norm, or average, of color discrimination," as well as to eliminate "mental fog and a personal bias."¹⁰⁸ Yet color samples were always based in subjective comparisons and could fade over time. This tension between empiricism and individual perception is exemplified in Munsell's definition of color: "Objectively, that quality of a thing or appearance which is perceived by the eye alone, independently from the form of the thing; subjectively, a sensation peculiar to the organ of vision, and arising from the optic nerve."¹⁰⁹ Munsell's "Color Tree" is an asymmetrical configuration that can still be purchased as a three-dimensional table-top model [Figure 24] where each axis corresponds to one of his three color constants: value on the vertical axis or "trunk," chroma on the horizontal axis, and groupings of color by hue branching out as "leaves" above the base. Unlike the Ostwald color solid, which contains a finite number of colors, the Munsell Tree can be added onto, expanding outward indefinitely. This open-endedness meant that ultimately the Munsell system was more desirable for color manufacturers who used consult color chips as a matching tool. A manufacturer could thus respond to a client's order by "seeing"

1879), 222-223.

¹⁰⁶ A.H. Munsell, *A Color Notation: An Illustrated System Defining All Colors and Their Relations by Measured Scales of Hue, Value and Chroma Made in Solid Paint for the Accompanying Color Atlas* (Boston, MA: Geo H. Ellis Co., 1905), 67. Cooper Hewitt Research Libraries, Smithsonian Museums.

¹⁰⁷ A.H. Munsell, "Chart 8: Index for Color Notation." In *Atlas of The Color Munsell Color System* (Malden, MA: Wadsworth, Howland & Co., 1915), 9.

¹⁰⁸ A.H. Munsell, "Preface to the Third Edition." In *A Color Notation: An Illustrated System Defining All Colors and Their Relations by Measured Scales of Hue, Value and Chroma Made in Solid Paint for the Accompanying Color Atlas*, 4.

¹⁰⁹ A.H. Munsell, *A Color Notation*, 108.

color as Munsell notation alone: hues are notated by letter (e.g., R for red, BG for blue-green) and chroma and value by their position on the tree. The manufacturer need only see “5R 7/2” to know that this is a color in the red group with a value of 7 and a chroma of 2 and then locate this particular swatch on their personal Munsell chart.¹¹⁰



Figure 24. Assembly instructions for a contemporary rendition of the Munsell Color Tree. Cooper Hewitt Research Library, Smithsonian Museums.

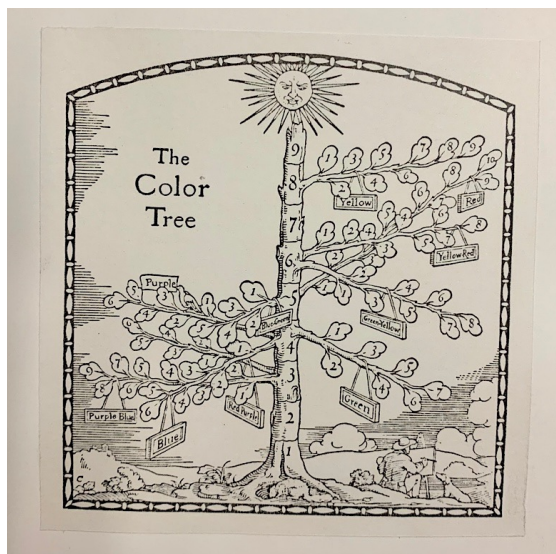


Figure 25. Facsimile of Thomas Maitland Cleland's rendition of Munsell's Color Tree, originally published in *A Grammar of Color* (Mittineague, MA: The Strathmore Paper Company, 1921). Faber Birren Papers, Robert Haas Family Arts Library, Yale University.

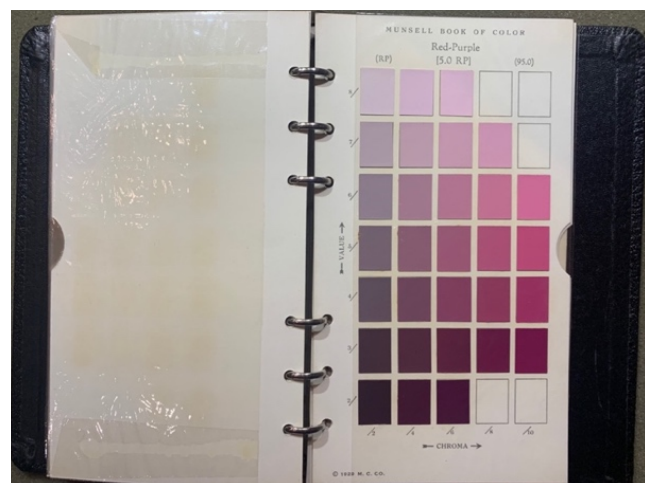


Figure 26. Munsell color chips are always designed against a white background. *Munsell Book of Color: A Revision and Extension of 'The Atlas of the Munsell Color System' by A.H. Munsell, Abridged Edition* (Baltimore: Munsell Color Company, Inc., 1929). Cooper Hewitt Research Library, Smithsonian Museums.

¹¹⁰ Dorothy Nickerson, “History of the Munsell Color System and its Scientific Application.” *Journal of the Optical Society of America* 30 (December 1940): 575-586.

A metaphor for knowledge, the tree has long been used to chart and represent relationships between things. The Munsell Color Tree would thus seem to present itself as a kind of genealogy of color. One rendition of the Color Tree [Figure 24], drawn by illustrator Thomas Maitland Cleland to accompany *A Grammar of Color* (published posthumously in 1921 after Munsell's death in 1918), resembles a Dürer etching: a slender trunk nearly touches an anthropomorphized sun, and its branches are each labeled with a distinct color: purple, purple blue, blue, red purple, and blue-green make up the left set of branches, with yellow, red, yellow-red, green-yellow, and green on the right. The tree stands on a bucolic landscape; in the lower right-hand corner, a sunhat-clad painter is seated, painting *plein air*, his dog at his side. Yet, despite the drawing's anachronistic, folksy appearance, one key feature betrays its modern context: the meticulously numbered leaves and segments of the tree trunk, which turn the tree into a set of discrete and abstract units. Also telling is the fact that the drawing itself is not in color: alphanumerical representation allows the viewer to *know* and understand color without seeing it.

Thus, though at first the organic metaphor of the tree would seem to be antithetical to Munsell's emphasis on standards and numbers, he sought to synthesize human experience by treating the individual as a set of predictable responses to external stimuli, where the pedagogical end goal was not the creation of material objects but instead the re-structuring of visual perception and sensory experience. By representing colors as numbers and symbols, Munsell believed he could "[do] away with the foolish misleading names... prevalent" in many color order systems, moving towards and increasingly abstract understanding of color. A professor of drawing and painting, he intended his system "as an aid to the training of color perception and the quickening of an instinct for color;" it thus marks a shift towards color perception as something one can be trained to acquire.¹¹¹

Ostwald, like Munsell, designed a color system "meant to serve as a three-dimensional diagram of the way in which color sensations find order and relationship in human experience."¹¹² Despite presenting itself as "objective" or standardized, however, this model depended largely on taste-based and aesthetic judgments. Whereas Munsell treated black, white, and gray as neutrals, for Ostwald, they functioned as primaries and the primary determinants of color harmony. As Ostwald described in his *Farbenfibel*, or *Color Primer* (1917), color combinations that were the most "harmonious" involved pairing colors that were equal in "purity" or saturation. Harmony was thus synonymous with order; colors should thus "be selected from the standard series so that they will have equal intervals."¹¹³ Most important in the Ostwald Color System is the ratio or distance between colors, rather than the significance of individual colors: color is wholly relational and by definition plural, existing in multiple permutations. The shape, a double cone that resembles a spinning top and is known as the Ostwald Color Solid [Figure 27], consists of 24 hues at the "equator" and 8 value steps ranging from white at the "north pole" to black at the bottom or "south pole." Thus, all intermediate colors are a mixture of hue, black and white ($C + B + W = 1$). Ostwald's aim was to "[obtain] a display of the entire color world,"

¹¹¹ A.H. Munsell, "Introduction to the Munsell Color System." In A.H. Munsell and Thomas Maitland Cleland, *A Grammar of Color: Arrangements of Strathmore Colors in a Variety of Printed Combinations According to the Munsell Color System* (the Strathmore Paper Company, 1921), 7. Cooper Hewitt Research Library, Smithsonian Museums.

¹¹² Wilhelm Ostwald, *The Color Primer: A Basic Treatise on the Color System of Wilhelm Ostwald Edited and with a Foreword and Evaluation by Faber Birren* (Van Nostrand Reinhold Company, 1969), 15.

¹¹³ Ibid, 65.

accounting for all possible variations by making them plottable on a grid”—but short of this goal, his color solid only contains 672 discrete colors, and unlike the Munsell tree, colors cannot be added to the diagram.¹¹⁴

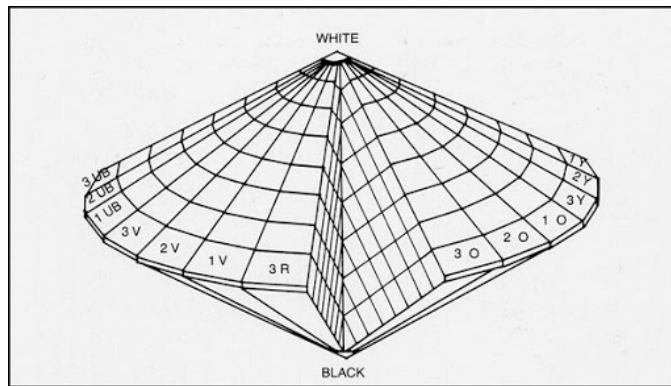
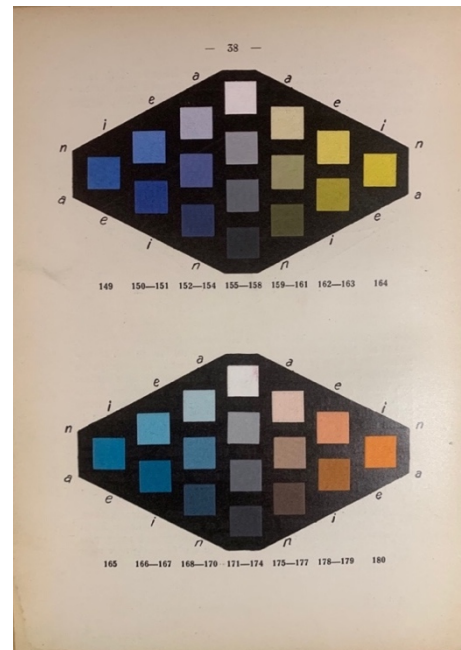


Figure 27. Ostwald's color solid and two cross sections (1917). Cooper Hewitt Research Library, Smithsonian Museums.



Ultimately, both Munsell and Ostwald's systems are “flawed”—they don't represent the full gamut of colors but rather a series of compromises. Because both systems are based on the study of color as subjective sensation, independent of external environmental conditions, neither addresses the way in which lighting, reflection, or shadow alters the way a color is perceived (this phenomenon is known as *metamerism*).¹¹⁵ For example, Munsell color chips [Figure 26] are designed against an achromatic background of the same value, despite the fact that the surrounding of a given color greatly affects the way we perceive it. Yet these two systems would continue to be adapted and reformed throughout the remainder of the twentieth century alongside the emergence of electronics and storage media. In the 1960s, Faber Birren noted that “most of us see the world of color as Ostwald organized it,” particularly when it came to consumer goods and style trends.¹¹⁶ But who is this “us” Birren speaks of? In this chapter, I have primarily focused on the creators of color systems which assist in normalizing an increasingly grid-like, mathematical understanding of color. But color systems were never merely about the organization of color; rather, they “encoded, supported, and reflected different ideas about what human beings were like and how they should relate to one another.”¹¹⁷ How were these color systems and psychophysical principles integrated into everyday life? What groups of people were targeted and excluded from color standardization, and to what ends? In what follows, I turn to the domestic sphere and the growth of a color-driven “consumer aesthetic” in the postwar period. Numerical color is no longer in the hands of a select few experts, but woven into the very fabric of everyday lived experience.

¹¹⁴ Ibid, 58.

¹¹⁵ Dorothy Nickerson and Milton E. Bond, “Color-Order Systems, Munsell and Ostwald.” *The Journal of the Optical Society of America* 32 (December 1942), 709.

¹¹⁶ Faber Birren, “An Evaluation.” In Wilhelm Ostwald, *The Color Primer*, 73.

¹¹⁷ Rossi, 20.

Chapter Two

Our Chromatic Categories: Mood-Conditioning the Postwar Interior

In the ruins of the war, colour was reinstated. The pastels of the 1950s, each wall a different shade, pale shades of Mondrian's bright and scintillating Broadway Boogie Woogie. 1960. In the white heat of Harold Wilson's technological revolution we reinstated white. Out came the white lino paint, and white emulsion covered the browns and greens of our Victorian past and those Fifties pastels. Our rooms were empty, pure and dazzling, though difficult to keep that way as feet soon scuffed the white off the floorboards... In this white we lived coloured lives. It was a brief moment. By 1967 the jumbled psychedelic rainbow flooded the room.

Derek Jarman

For America has gone from a state of color-consciousness to almost complete color-mindedness, expecting to see the spectrum in virtually everything within sight.

Faber Birren

Domestic Dreams

The house is two stories high with a gabled roof. A classic colonial farmhouse, its slate gray shingles offset its cool white wooden exterior and subdued blue-green window shutters and trimmings. The exterior color scheme previews the rest of the house's palette: walking through the spacious entryway, you note that the hallway walls are light green and the woodwork a darker shade of the same tone. In the living room, a centrally located green marble fireplace anchors the space, the walls surrounding it a vivid teal, a color that is echoed throughout the rest of the house. This is color as motif, schema, and mood, where every surface, nook, and cranny has been painted with almost surgical precision to engineer an atmosphere of tranquility, abundance, and comfort. This is, in the eyes of postwar American consumer culture, a "dream house."

This particular structure is in Portland, Oregon, but it is also in Chattanooga, Tennessee, Ottawa Hills, Ohio, and seventy-two other locations in the United States (the original set is in Malibu). Designed by RKO Radio Pictures and David O. Selznick to promote their 1948 comedy *Mr. Blandings Builds His Dreamhouse* (directed by H.C. Potter) and featuring General Electric's latest appliances, the houses were replicas of the film's eponymous "dreamhouse," a fixer-upper in rural Connecticut that New Yorkers Jim Blandings (Cary Grant) and his wife Muriel (Myrna Loy) revamp from top to bottom as they make the transition from urban to country living. The seventy-five Dream House replicas were open for public tours and eventually sold by raffle; an article published in *The Oregonian* described the Portland version as proof "that modern technical designing and traditional furnishings can live together harmoniously."¹

¹ Grace Holm, "Public to Inspect Blandings Dream House With Ceremonial Booked for 2 P.M. Saturday." *The Oregonian*, November 6, 1948. Accessed online at <https://vintageportland.files.wordpress.com/2012/01/blandings-house-feature-1948.jpg>. Several of the

The Dream House replicas are a self-reflexive realization of the mass-produced housing developments of the postwar period, which often came with built-in fixtures and painted (rather than wallpapered) walls, blurring the boundaries between Hollywood set and inhabited space. Much of the excitement surrounding the open houses also had to do with the fact that the replicas came with what was then viewed as cutting-edge technology: electric blankets on every bed, a dishwasher, a garbage disposal, a washer-dryer, and—the cause of the most furor—an automated garage door. A General Electric ad featured in *Life* magazine [Figure 1] attempted to dazzle consumers into designing their own customized “General Electric Dream Kitchen,” which came with floor plans and a color photograph of the final product.² Decades before the digital “smart home,” the growing electronic culture of the postwar period reimagined the home as a sentient organism, as well as a blank canvas—quite literally—onto which homeowners could project their desires for both technological novelty and domestic stability.

There is one catch to these Dream House replicas, however: the original film is in black-and-white.³ The model homes are therefore not just duplicates, but a kind of remediation between the achromatic images onscreen and a three-dimensional, inhabitable space in color that the viewer can quite literally step into. *Mr. Blandings* was produced in the 1940s when expensive and cumbersome three-strip Technicolor was reserved primarily for films with fantastical or musical elements, but just before the widespread conversion to cheaper and more accessible one-strip processes such as Eastmancolor and Agfacolor.⁴ Still, shooting in black-and-white did not deter RKO from emphasizing the central role of color in the narrative. *Mr. Blandings*’ central comedic aspect derives from the various mishaps and miscommunications that ensue during the moving process as the Blandings discover that renovating a home is more work than they thought. One of these miscommunications involves color—specifically, Muriel’s various attempts to describe to their decorator and his workman the color schemas she envisions for the house’s various rooms [Figure 2]. Holding up paint swatches and color samples, her monologue, punctuated with the decorator’s affirmative “yeses” and nods, is worth reproducing in its entirety:

Now, let’s talk about the painting. I had some samples. Ah, here we are. Now, first, the living room. I want it to be a soft green. Not as blue-green as a robin’s egg. But not as yellow-green as daffodil buds. Now, the only sample I could get is a little too yellow. But don’t let whoever does it get it too blue. It should be a sort of grayish yellow-green. Now the dining room. I’d like yellow. Not just yellow. A very gay yellow. Something bright and sunshiny. I tell you, if you’ll send one of your workmen to the grocer for a pound of their best butter and match that exactly, you can’t go wrong.

This is the paper we’ll use in the hall. It’s flowered. But I don’t want the ceiling to match any colors of the flowers. There are some little dots in the background. And it’s these dots

various replicas have since been repainted over the years, but they were initially uniform in color.

² “General Electric has made your Dream House come true!” *Life* 24 no. 26 (June 28, 1948): 78.

³ A colorized version came out in 1989 at the height of the colorization craze, but, as with the vast majority of colorized classical Hollywood films, was a flop.

⁴ Scott Higgins provides a detailed industry history of three-strip Technicolor in *Harnessing the Technicolor Rainbow: Color Design in the 1930s* (Austin: University of Texas Press, 2008). For a more wide-ranging history of cinematic color, see Richard Misek, *Chromatic Cinema: A History of Screen Color* (Wiley-Blackwell, 2010).

The painstakingly descriptive language in this monologue serves both the function of attempting to compensate for the absence of color onscreen while simultaneously drawing our attention to the gap between color names and perceived hues. Though filmed in black-and-white, Muriel's vivid wording invites the viewer to imagine the house's color schema (despite the fact that the workmen ultimately reduce her effort to "red, green, blue, yellow, white"). Though she compares her desired colors to organic objects—apples, butter, sunshine—these analogies ultimately fail her as she is forced to express these imagined shades in the negative: "*not* as blue-green as a robin's egg, but *not* as yellow as daffodil buds"; "*not* a cold, antiseptic hospital white... but still, *not* to suggest any other color but white." This Goldilocks-like language—not too warm, but not too cold, not too yellow, but not too green—exposes the insufficiency of verbal description in lieu of numerical or measurable standards. Muriel doesn't pull out an apple and ask the designer to match his paint shades to that; such a task would be impossible, as the apple she envisions—"between a healthy Winesap and an unripened Jonathan"—exists only in her imagination. Instead, the objects she consults—a spool of thread, wallpaper samples, paint swatches—detach color from referent as it becomes increasingly abstract.

Figure 1. “General Electric has made your Dream House come true!” *Life* 24 no. 26, June 28, 1948.



Figure 2. Muriel Blandings (Myrna Loy) holds up samples as she describes her desired color scheme to the designer and his workman. Still from *Mr. Blandings Builds His Dream House* (H.C. Potter, 1948).

On the one hand, this scene pokes fun at the seemingly infinite proliferation of color names during the postwar period and their clear commercial motivations: after all, the more colors are named, the more they can be commodified. The humor here is clearly gendered, with Muriel playing the controlling housewife whose detailed requests the male laborers ultimately brush aside. The scene thus plays into commonly held beliefs at this time that women were more emotional, detail-oriented, and attuned to the nuances of color than men.⁵ Yet the joke may also be at the workmen's expense: the painter, clad in grubby overalls, clearly does not possess the same aesthetic sensibilities or income bracket as the Blandings, a white, upwardly mobile nuclear family who are very much the embodiment of the postwar domestic ideal. Satire is a powerful tool that allows us to situate the film historically, as viewers at the time would need to be sufficiently familiar with these tropes to get the joke. We can thus locate the film in relation to key shifts in the conceptualization of standardized color in the postwar period, particularly as it played into identity formation along racial, class-based, and gendered lines.

The production studio of *Mr. Blandings* was also picking up on, as well as cashing in on, the beginning of a national phenomenon—namely, the intersection of the postwar economic boom and the growth of the suburbs, which presented the single-family home as the foundation for new color palettes and electronic appliances. Color cannot be separated from growing electronic consumer culture during this period, which saw the rise of “mood-conditioning” and functional color, two analogous design principles that sought to engineer the ambience of a given space through a highly controlled system of colored walls and light fixtures. Functional and environmental color, theories that—responding to the contemporaneous rise in behavioral science—reconsidered the human as an organism responding to an external environment, sought to match paint and lighting to the given function of a space in order to produce desired psychological and physiological effects. Muriel's invocation of an “antiseptic hospital white” makes a contrast between warm and cool colors and their presumed psychological impact, as well

⁵ Regina Lee Blaszczyk, *The Color Revolution* (Cambridge, MA: The MIT Press, 2012), 139.

as the distinction between public and private space.

The notion of color or light as stimulus, as discussed previously, has roots in nineteenth-century psychophysics. But it was not until the 1940s that this psychophysical language entered the vernacular: though the 1920s and 1930s set the stage for an increasingly mathematical and systematic understanding of color, it was only after the postwar boom that this surge in mass-produced color began to permeate everyday life and lived spaces. Faber Birren, perhaps the most well-known color consultant in modern history, reflected in the mid-1950s on the decade's developments in color in an article titled "25 Years of Color Trends in America":

House & Garden magazine inaugurates a color styling service (1946) which loosens up the inertia of the past and points the way to new freedom and expression in interior styling. Technicolor movies go all out. Major magazines vastly increase their expenditures for color in text pages, and advertisers follow suit. Paint makers give birth to multicolor systems giving choices up into the thousands. There is a general spree, and the pot of color at the end of the rainbow boils over.⁶

Between the 1940s and 1960s in the United States there emerged an exponentially growing set of color terms and possible combinations of colors, which were made possible by the shift to synthetic dyes and pigments in the nineteenth century, slowed down during the Depression, and resumed at full speed after the war. In Hollywood, as mentioned above, three-strip Technicolor was being replaced with the more budget-friendly, standardized Eastmancolor. After Technicolor's decline, Eastman Kodak acquired a monopoly on color film as well as photography, and also provided test slides for television networks during the "Color Wars" in the late 1940s and early 1950s, during which RCA and CBS vied for ownership of the U.S. color TV standard. In an urban gallery context, the saturated palette and banal subject matter of Pop Art appropriated the colors and imagery of product packaging and print advertising, particularly those associated with the domestic sphere, where interiors, appliances, cars, clothing, and even food were becoming more chromatically varied, vibrant, and eye-catching—one could even serve Trix, the nation's first multi-colored breakfast cereal, released in 1954, in plastic or ceramic dishware in shades such as Chartreuse, Rose, Cobalt Blue, and Forest Green. The 1950s are the pinnacle of what Regina Lee Blaszczyk calls "The Color Revolution" due to the rise in mass-produced synthetic pigments, growing research in colorimetry, and increasing demand for professional colorists that accelerated during the first half of the 20th century.⁷ In other words, during this period, standardized color became fairly inescapable, both on and off screen.

Whereas the measurement and standardization of color had previously been in the hands of a few self-proclaimed experts, these experts now attempted to simplify daunting psychological principles for the masses, encouraging ordinary people to integrate functional color into their everyday lives. The expansion of several color-focused design corporations, such as Pantone, Color Dynamics, and Color Conditioning emerged on the scene, resulted in jobs for "color forecasters," "color engineers," and "color stylists" such as Birren, who were hired by both homeowners and corporations to systematically engineer the ambience of a given space. The ultimate goal in choosing colors for the home was not merely aesthetic, but biological, as matching paint and lighting to a room's particular function was thought to produce desired

⁶ Faber Birren, "25 Years of Color Trends in America" (New York: Birren, n.d.). The Faber Birren Papers, Haas Family Library, Yale University.

⁷ Regina Lee Blaszczyk, *The Color Revolution* (Cambridge, MA: The MIT Press, 2012)

psychological and behavioral effects.

Though color consultants spent the bulk of their time designing color schemes for institutional and municipal workspaces such as hospitals, office buildings, and shopping areas, the rhetoric surrounding these spaces stood in stark contrast to that of domestic spaces. Whereas public or corporate color schemes could not by definition be tailored to individual tastes, the nuclear family home would be a reprieve from purely *functional color*, “a system or method of color application in which definite objectives are set up and in which results are determined by measurement. In other words, beauty is made subservient to utility, and pleasure becomes a by-product of purpose.”⁸ At the same time, however, the supposedly anti-aesthetic qualities of functional color possessed their own aesthetic: “With single colors, ugliness seems to exist where they are difficult to classify, where they lie on borderlines and fail to exemplify clarity.”⁹ Proponents of functional color, in part drawing on the legacy of modernist architects such as Le Corbusier, found beauty and harmony in regularity and predictability.¹⁰ Color was a mathematical variable to be harnessed and controlled, the color grid once again displacing the circle.

In what follows, I reframe this national obsession with chromatic variety in relation to changing understandings of technologically mediated perception under capitalist ideologies of efficiency and planned obsolescence. The chapter’s title, “Our Chromatic Categories,” is a nod to Sianne Ngai’s 2012 book *Our Aesthetic Categories: Cute, Zany, Interesting*, which describes three “vernacular” or “minor” affects—the cute, the zany, and the interesting—and their relevance to late capitalism and the creation of a consumer aesthetic that can be traced to the postwar period.¹¹ Provoked by Ngai’s discussion of the restructuring of aesthetic experience in a media-saturated environment characterized by “artful” design and packaging, I dissect a historical moment during which color, divided into serialized paint swatches, becomes grid-like, modular, and severed from form. These few decades witnessed a shift from individualistic proprietary capitalism to an increasingly bureaucratic corporate economy based on neoliberal ideals, as well as the creation of a new type of modern subject: the individual consumer. Though this consumer could select from a range of customized or “individualized” choices, these options were limited by predetermined standards: in the case of color, a finite number of numbered swatches that

⁸ Faber Birren, *New Horizons in Color* (New York: Reinhold Publishing Corporation, 1955), 2-3.

⁹ Faber Birren, *Creative Color* (New York: Reinhold Publishing Corporation, 1961), 40.

¹⁰ Developing a system that combined painting and architecture known as polychromy, Le Corbusier and other proponents of Purism such as Amadée Ozenfant treated color itself as a building material capable of structuring an individual’s living environment. Polychromy relies on the juxtaposition of two-dimensional planes and three-dimensional space, where the architect selects on the color of each wall based on the amount of light it absorbs or refracts. In this way, color itself becomes inseparable from form in its ability to create space—a notion that derives from the systematic study of sensation. Though these theories of functionalism have adapted to suit different sociopolitical and geographical contexts—from Purism’s austere palette to the candy-colored toasters and dish-ware of the postwar U.S., from the socialist inclinations of the European avant-garde to American corporate capitalism—what remains consistent is the notion that color itself is architectural, infrastructural, and supposedly capable of enacting social change. For more detailed discussions of Purism and polychromy, see Mark Wigley, *White Walls, Designer Dresses: The Fashioning of Modern Architecture* (Cambridge, MA: The MIT Press, 1990), Jan De Heer, *The Architectonic Colour: Polychromy in the Purist Art of Le Corbusier* (Rotterdam: 010 Publishers, 2009), and William W. Braham, “Solidity of the Mask: Color Contrasts in Modern Architecture.” *RES: Anthropology and Aesthetics* 39 (Spring, 2001): 192-214.

¹¹ Sianne Ngai, *Our Aesthetic Categories: Cute, Zany, Interesting* (Harvard University Press, 2012)

provided the illusion of agency and variability. As the site of the banal and the everyday, it was in the home that vision itself could be standardized most potently by being paradoxically framed through an individualistic rhetoric of personality and identity.

My primary objects of study are the writings of American colorist Faber Birren, who pioneered the concepts of functional color and color conditioning, as well as material artifacts such as interior design magazines, paint chip samples, and print advertisements. These objects can themselves also be seen as media objects or storage technologies, relying on color matching technologies such as spectroanalysis and color printing and photography and may be viewed as what Wendy Chun calls *habitual media*, “media [that] matter most when they seem not to matter at all, that is, when they have moved from the new to the habitual.”¹² By analyzing a variety of popular material objects connected to industrialized color within the home, I argue that it was in the domestic interior, as opposed to public spaces such as hospitals or offices, where the cultivation and subsequent commodification of personality became synonymous with both technological and political progress. According to the growing field of color psychology, “favorite colors” could determine what kind of person you were, as personality itself became subject to standardization and classification. Still, homeowners were encouraged to follow the basic principles of functional color (e.g. certain color combinations were considered more “harmonious” than others), albeit more loosely, in order to make their living environments utterly their own. Ultimately, however, the rise in customized interiors was wholly dependent on mass standardization, as consumers were given the “choice” to choose from a predetermined set of color samples. The ubiquity of materials such as plastic, PVC, linoleum and laminates, as well as the availability of commercial-grade paints in an ever-growing number of colors led to a consumer culture characterized by a Fordist logic of mass production and standardization on the one hand and an increase in do-it-yourself culture defined by customized color palettes on the other. Thus, though color consultants emphasized that the domestic space was a space to assert individual aesthetic preferences, I contend that the situation was actually in the reverse: people adapted to their environments and, by extension, to increasingly regulated understandings of selfhood.

Ambient Color and the Controlled Environment

In the mid-century interior, *feeling* colors was more important than seeing them, as atmospheric color and lighting took on a nearly subliminal quality (and recall that the word “subliminal” comes from *limen*, the perceptual threshold that so fascinated psychophysical researchers). The home was not just a place for eating or sleeping, but a “controlled environment,” as color consultants and behavioral scientists called it. Through a deliberate and controlled use of colored paints and lighting, color consultants and designers attempted to engineer ambience and mood systematically. Color systems and charts were key tools in this process: they sampled, discretized, standardized, and measured the visible spectrum, transforming the world into an infinitely divisible arrangement of modular or interchangeable parts. Even when taking individual preferences for style or specific colors into account, consumers had to follow a quantitative rubric; choosing what color sofa to buy or whether to paint your kitchen Eggshell or Taupe was thus far from a passive endeavor. In Baudrillard’s critique of postindustrial color, he claims that

¹² Wendy Hui Kyung Chun, *Updating to Remain the Same: Habitual New Media* (The MIT Press, 2016), 1.

We are no longer dealing with colors *per se* but with abstract values. The combination, matching and contrast of tones are the real issues when it comes to the relationship between color and atmosphere. Blue can go with green—all colors are capable of combination—but only certain blues with certain greens; furthermore, it is not so much a question of blue and green as one of *hot and cold*. At the same time, color is no longer a way of emphasizing each object by setting it off from the décor; colors are now contrasting ranges of shades, their value has less and less to do with their sensory qualities, they are often dissociated from their form, and it is their tonal differences that give a room its “rhythm.”¹³

Color thus becomes a matter of control, with the mid-century home dweller acting as an interior designer, “neither an owner nor a mere user, [but] an active engineer of atmosphere.”¹⁴

Color consultants in the postwar period were primarily interested in how a variety of shades interacted with light, shadow, and the physical constraints of a given space. Colors were nothing more than abstract, numerical entities that could be switched out interchangeably; there were “bright red armchairs, sky-blue settees, black tables, multicolored kitchens, living-rooms in two or three different tones, contrasting inside walls, blue or pink façades (not to mention mauve and black underwear).”¹⁵ Individual colors had no psychological or symbolic meaning, but an array of shades together possessed a discernible psychic charge. Together, “pure hues, tints, shades, tones, adjacent, complements, etc.” were less important to color consultants than an “over-all and pervading beauty that finds its secret in the general character of the field or background.”¹⁶ This “general character” was always a matter of balance, where relationality, and measurability were more important than any specific hue. Consumers could finesse the mood or ambience of a given space with the aid of a rubric or manual and a few cans of paint, turning their homes into life-size, immersive versions of the color-by-numbers kits that were so popular in the 1950s. Like color-by-numbers kits, which involved painting over instructional numbers in a predetermined order, functional color likewise posited a direct correlation between colors, numbers, and accessibility. Anyone could be *trained* to paint or decorate their home harmoniously when provided with a set of guidelines or a formula. In the postwar interior, numerical representation and systematization were ultimately more important than color itself.

While it might be tempting to view this chromatic explosion as indicative of new possibilities for creative self-expression when it came to color, especially within the home, this rhetoric of consumer choice ultimately served to naturalize and regiment existing social hierarchies and normative modes of vision. As the site of the banal and the everyday, it was in the home that vision itself could be standardized most potently by being paradoxically framed through an individualistic rhetoric of personality and identity—and that it was through the controlling and categorizing logic of the color grid that this standardization was made possible. The proliferation of different colors available for each product as reflected in the form of the grid is a clear illustration of what sociologist Lawrence Busch calls “standardized differentiation,” or when standards are implemented primarily to establish degrees of separation between fixed categories (in this case, the separation between discrete, nameable colors). Standardized differentiation, as opposed to the assembly line logic of mass standardization, has clear links to neoliberal

¹³ Jean Baudrillard, *The System of Objects*, trans. James Benedict (Verso, 1996), 35.

¹⁴ *Ibid.*, 25.

¹⁵ *Ibid.*, 31.

¹⁶ *Ibid.*

understandings of selfhood, in which privatized markets emphasizing individual choice began to overtake collective models of consumption after the Second World War.¹⁷ Ultimately, the rise in customizable color was wholly dependent on this model, as consumers were given the “choice” to choose from a grid of color samples that were already predetermined.

The assumption that ambient color and light could be subsumed under a room’s practical function emerged from the growing field of color psychology, which, building on the psychophysical experiments of the late nineteenth century, viewed color as an entity that could not be separated from the limitations of human vision. The American color consultant and writer Faber Birren (1900-1988) [Figure 3], arguably one of the most color-crazed figures of the twentieth century, played a key role in popularizing colorimetry and psychophysics to make color theory and psychology accessible and appealing to what he saw as the average American consumer.¹⁸ Birren believed that only by first removing color from any specific physical context could he establish a standard or system for color that could be implemented across industries.



Figure 3. Color consultant Faber Birren in his office. *American Color Trends* (1956). Box #1. Faber Birren Papers, Rare Manuscripts and Archives Division, The New York Public Library.

¹⁷ Lawrence Busch, *Standards: Recipes for Reality* (Cambridge, MA: The MIT Press, 2011), 186.

¹⁸ A lifelong collector of paint pamphlets and color charts, Birren published hundreds of articles and several books on color theory, as well as editing and republishing canonical texts on color such as those by Chevreul, Ostwald, Munsell, and Rood. Raised on the north side of Chicago, Birren’s interest in color arose in 1919 when he studied color theory at the University of Chicago’s School of Education with painter Walter Sargent. Birren began to study color intensively while working in publishing and doing freelance advertising writing and book cover design. He published his first articles on color in the 1920s, after which his first book, *Color in Vision*, was published in 1928, followed by *Color Dimensions* and *The Printers’ Art of Color* in 1934. American government institutions found Birren’s attempt to provide a standardized color model particularly pressing during wartime, as there was a widespread demand in functional color for military purposes. In the 1940s, Birren worked with the U.S. Navy to counteract visibility problems on submarines, as well as developing a color code for safety on a national level. After the war, he shifted his focus from color perception in the visual arts to the growing field of color psychology and its implementation in workplaces such as offices, factories, and hospitals, as well as within the domestic sphere, publishing articles in journals such as *Psychological Review*, *The American Printer*, *Advertising and Selling*, *Graphic Arts Monthly*, *Packaging Digest*, and *Architectural Forum*, as well as the books *Color Psychology and Color Therapy* (1950), *Your Color and Your Self* (1952), and *Selling Color to People* (1956). He established American Color Trends, a research agency that studied national color preferences and worked with chemical manufacturer Du Pont to develop a Color Conditioning program that would increase productivity and lower the risk of accidents in their facilities.

Citing Ostwald, who he called “the greatest scientist ever to devote a large portion of time and energy to color harmony,” as his prime influence, Birren wondered if there would ever be a color standard so universally adapted that one day, “objects will be defined in color as easily as they are now measured and weighed.”¹⁹ But he also acknowledged the difficulty of creating such a widespread standard, citing six key characteristics that such a color system would have to possess:

1. It must be based on truth
2. It must exploit the world of color in a well-related and evident way
3. It must allow for complete flexibility—notations for all tones in continuous rather than alternate sequence
4. It must provide an equation that is not merely a symbol or a tag but an actual formula that will give the exact composition of the tone
5. It must be universally applicable to measurements of all surface colors and clear enough to be interpreted and understood by all persons
6. It must be simple and economical enough to permit widespread acceptance and use.

“This is a big order to fill,” he concluded, somewhat tongue-in-cheek.²⁰

Though Birren never claimed to have created a universal color standard, this wasn’t for lack of trying. Borrowing heavily from Ostwald’s *Principles of Harmony*, which maps colors within a three-dimensional space defined by three variables—white content (W), black content (B), or hue/color content (C)—he designed what he called the Birren Color Equation, thus adhering to the fourth characteristic of his ideal color system (“It must provide an equation that is not merely a symbol or a tag but an actual formula that will give the exact composition of the tone”). For Ostwald, as I noted previously, color harmony depends first and foremost on order and relationality and the assumption that colors have fixed or standardized properties. Birren believed that Ostwald’s system was uniquely suited to design and consumer goods, since the eye registers color not in terms of lightness or darkness, but in terms of “blackness,” “whiteness, and “grayness,” where every color combination contains a proportion of these categories—hence the popularity of palettes such as pastels, “muted colors,” and “fall colors” that are grouped together in terms of their gray content. According to Birren, when it came to consumer goods, the average person was able to “sense” these proportions of black, white, and gray, and it was by grouping colors that had the same gray content that one could create the most “harmonious” palettes and color schemes.²¹

The Birren Color Equation [Figure 4] is thus more or less the same as the Ostwald system, but the two differ in their notation. Ostwald used an upper-case letter or number to

¹⁹ Faber Birren, *Color Dimensions: Creating New Principles of Color Harmony and a Practical Equation in Color Definition* (Chicago: The Crimson Press, 1934), 35 and 54.

²⁰ Ibid, 54.

²¹ Faber Birren, “Application of the Ostwald Color System to the Design of Consumer Goods.” *Journal of the Optical Society of America* 34, no. 7 (July 1944), 398.

denote hue, followed by lower-case letters to show white and black content—that is to say, red is 8pa and light pink is 8ea, these colors differing in their respective amounts of white content. Because one primary critique of Ostwaldian notation was its counterintuitiveness (who sees “8pa” and automatically pictures red?), Birren opted for a more legible numerical system, where pure hue is 0-0, pure white is 100-0, and pure black is 0-100. With these three numbered pairs comprising the corners of the triangular solid, individual hues can be then mapped proportionally on this axis depending on their distance from the edges. Birren claimed that any straight line drawn within the grid lines of the triangle would result in “natural color harmony.”

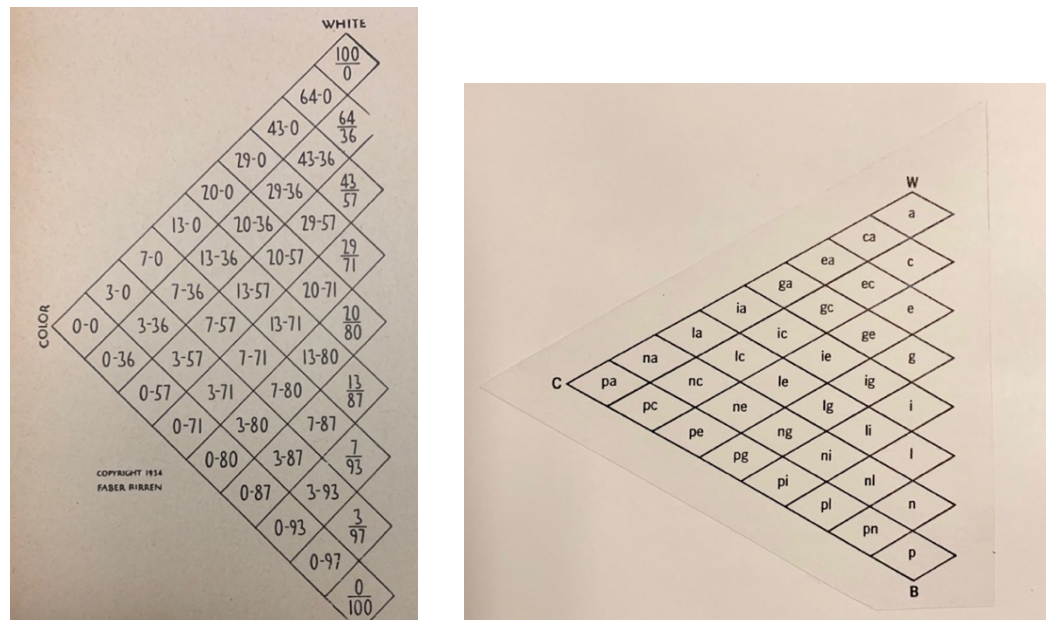


Figure 4. Left: Birren Color Equation. Box #1. Faber Birren Papers, Archives and Manuscripts Division, New York Public Library **Right:** Ostwald Color System. Box #7, Folder 8. Faber Birren Papers, Robert B. Haas Family Arts Library, Yale University

One of the main limitations of the Ostwald color solid is that it ultimately contains a finite number of colors (unlike the Munsell Tree, which can expand outward infinitely). These logistics did not concern Birren, however, who primarily used his Equation as an artistic guide rather than a precise colorimetric tool.²² Ever the public intellectual, Birren claimed that his Color Equation was the most “democratic” color system due to its accessibility: one didn’t have to purchase an expensive atlas or color charts, but only required thirteen cardboard disks of “pure hues,” a white disk, a black disk, and a device to spin the disks to create optical mixtures—and all these materials could be purchased by mail-order for the low price of five dollars, complete with instructional booklets [Figure 5]. A 1948 review by Richardson Wright, an editor at *House and Garden* magazine, reads: “After using the more cumbersome and expensive color charts, it is sheer joy to have so complete and handy a guide... It slips into the pocket—and will

²² Color scientist Dorothy Nickerson, a contemporary of Birren’s, noted that the Munsell system was better suited for uses that demanded precise colorimetric values, whereas the Ostwald color system was popular among designers due to its emphasis on color harmony. See Milton E. Bond and Dorothy Nickerson, “Color-Order Systems, Munsell and Ostwald.” *Journal of the Optical Society of America* 32 (December 1942): 709-719.

slip into many a garden and house as well.”²³ Wright’s review points to the portability of Birren’s color guide, reiterating the message that *anyone* can apply the principles of functional color to their surroundings as long as they learn the formula, again cementing the notion that qualities such as accessibility and creative experimentation were unique to the home. At the same time, the guide’s five-dollar price tag (which in 1948 would have been roughly sixty dollars in 2022), confirms its target market as solidly middle class, where the promise of having the world of color at one’s fingertips was by no means achievable for all.²⁴

Similarly, Birren’s Gloray Prism, “A Device That Should Belong to Everyone Interested in Color,” capitalized on the home’s associations with play and self-expression. Essentially a simplified spectroscope, the Gloray Prism [Figure 6], when placed on the windowsill in direct sunlight, projected the full color spectrum on the opposite wall. “Hold it before your eyes and all the world will be decked in rainbows,” the advertising blurb gushes. “Set it up as an elementary spectroscope and see it reveal the elements in a Neon sign, in common table salt, in colored objects. Gaze at a series of black and white charts and see them blaze forth with color—plain lines that change to rainbows, designs that grow iridescent, colorless flowers that suddenly blaze with hue.”²⁵ The Gloray Prism presents color as something playful and whimsical, capable of producing a sense of wonder to adults. Such devices underscored that individuals could assert their own aesthetic preferences in order to cultivate wellbeing and happiness. This emphasis on uniqueness and creativity in the postwar discourse on color was especially pronounced in the domestic sphere, where these qualities were framed as a foil to new corporatized modes of vision in the workplace. But crucially, though domestic color palettes may have appeared more aesthetically varied and whimsical than those of municipal and commercial spaces, toy-like mechanisms such as the Gloray Prism were part and parcel of the same normalizing logic, where color and lighting were always a means to an end—towards greater efficiency, productivity, and profitability.

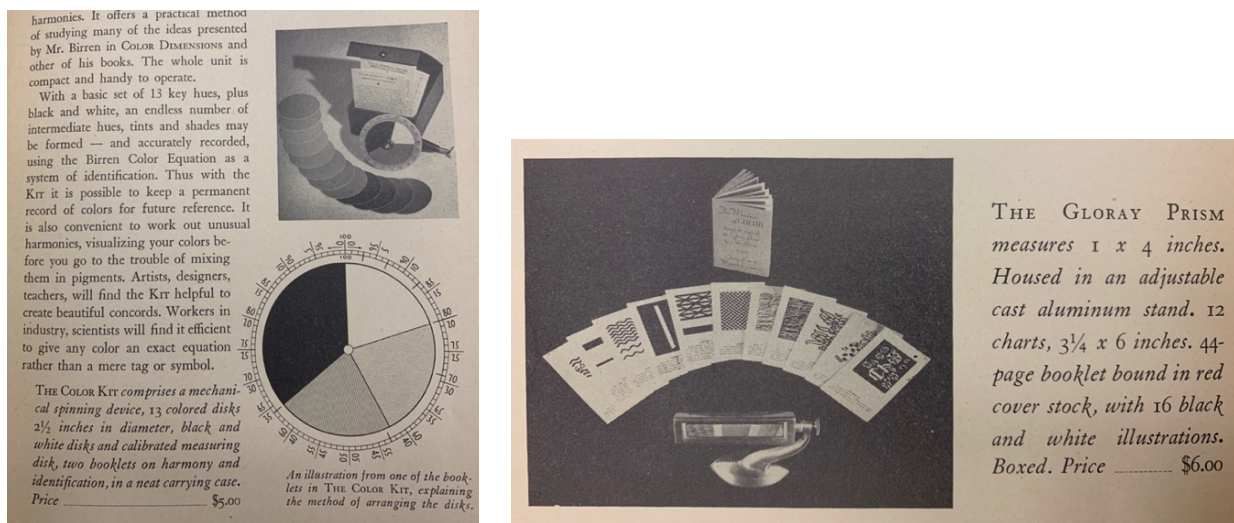


Figure 5 (left). “The Color Kit” and **Figure 6 (right).** “The Gloray Prism.” From “A Catalogue of Books on Color by Faber Birren” (Westport, CT: The Crimson Press, 1942). Box #1. Faber Birren Papers, Manuscripts and Archives Division, The New York Public Library.

²³ “A Catalogue of Books on Color by Faber Birren” (Westport, CT: The Crimson Press, 1942). Box #1. Faber Birren Papers, Manuscripts and Archives Division, The New York Public Library.

²⁴ I want to thank Michael Rossi for catching this crucial historical detail, which I managed to overlook.

²⁵ “A Catalogue of Books on Color by Faber Birren.”

Though conglomerates such as Du Pont and General Electric had almost all started as smaller family-run businesses, between the early and mid-twentieth century, a fundamental shift was taking place from an individualistic “proprietary” capitalism to the now familiar corporate capitalist model consisting of large bureaucratic structures. It was in part through color science that this new corporate model was made “sensible”—that is, as Michael Rossi puts it, “ordered in such a way that sensing beings could join the emergent political structures of a self-consciously modernizing American state.”²⁶ “Here are but a few of literally hundreds of items consumer style or functionally designed in color,” Birren tabulates in his color forecasting agency *American Color Trends*:

Consumer goods: automobiles; blankets, bedspreads and towel; candles; desks; cribs and infants’ furniture; carpets and rugs; electric razors; furniture; glassware and chinaware; greeting cards; housewares; household appliances; pens; plastics; radio and television cabinets; textiles; vacuum cleaners; Venetian blinds; vinyl film; wallpaper. Building materials: composition flooring; finished wallboard; hardware; kitchen cabinets; laminated plastics; plumbing fixtures; power tools and machinery; roofing and siding; tile and terra cotta. Functional products: communication equipment; instruments and controls; office furniture; printing papers and inks; school furniture; typewriters and calculating machines. Miscellaneous: automobile service stations; office, factory, school and hospital interiors; packaging evaluation; transportation equipment; ship interiors; store interiors.²⁷

As this exhaustive laundry list indicates, it appears that nearly every facet of postindustrial society, however mundane seeming, can be subsumed under the rubric of functional color. *American Color Trends* emphasizes that functional color, when applied to work environments, will achieve “better seeing,” prioritizing “efficient visibility, comfort and public appeal... over beauty or fashion.”²⁸ It was not only individuals or families who hired color consultants (think back to Muriel Blandings); more commonly, professional colorists made a living, much like advertising agencies, by advising national companies on how to implement the principles of functional color to maximize efficiency and increase profit.

For companies seeking to accelerate their growth and prioritize efficiency, color was a worthy investment: like lighting, to which it was intimately related, color had the potential to disrupt work and overstimulate the nervous system. Glare, problems of visibility, and eyestrain and other forms of ocular fatigue were all potential dangers that could interfere with the intended function of a given space: learning in schools, healing in hospitals, completing tasks in offices, increasing sales in shops, and so on. Modern vision itself was a type of work, subject to Taylorization through time-saving techniques, and it was architectural spaces that served as testing grounds for this kind of perceptual training.²⁹ By measuring brightness and saturation levels and implementing color and lighting schemes for different locations, government institutions and privately owned enterprises hoped to increase productivity and efficiency while

²⁶ Michael Rossi, *The Republic of Color: Science, Perception, and the Making of Modern America* (The University of Chicago Press, 2019), 5.

²⁷ *American Color Trends* (New York: Faber Birren & Company, 1956). Box #7, Folder 1. The Faber Birren Papers, Haas Family Library, Yale University.

²⁸ *Ibid.*

²⁹ *Ibid.*, 151.

decreasing the risk of accidents in power plants and factories, distraction in schools, and stress and fatigue in hospitals. Companies such as General Electric developed “light conditioning” campaigns—directly related to color conditioning—in which they advocated for brighter and better-lit work places to ensure greater productivity on the part of workers.³⁰ Vita-Lite, a fluorescent lighting manufacturer, claimed that their full spectrum fluorescent light would “[increase] work accuracy, [provide] ideal color rendition, and [...] reduce absenteeism.”³¹ Together, a highly standardized and controlled use of color and electric light played a key role in conserving “visual labor,” with the worker’s body functioning as an energy-expending machine.³²

Even the mentally ill or disabled, who had largely been seen as exempt from the labor demands of capitalist society could be trained under this rubric of efficiency. Not only were the principles of functional color subsumed into the infrastructure of clinical facilities to create a more “emotionally pleasing environment,” but relieving glare and providing a variety of colors would also “[improve] work capacity among handicapped persons who can do useful work and earn wages.”³³ The first rendition of the Diagnostic and Statistical Manual of Mental Disorders (DSM), which was released in 1952, provided a taxonomy of mental disorders. It attempted to standardize symptoms and unify them under a common rubric, which despite emphasizing the process of self-monitoring as a type of autonomy, actually “[created] a largely standardized regulatory regime of the self.”³⁴ As such, it’s not surprising that the standardized principles of functional color, combined with color’s presumed ability to impact mental health, would emerge as a kind of treatment. Patients diagnosed as manic should be “sedated” with blue and green tones and dim lighting, whereas those who were deemed “melancholic” should be exposed to bright lights warm in hue.³⁵ The use of color as both clinical treatment and to bolster productivity further increased the gap between “normal” and “abnormal,” making it possible to not only standardize colors, but also identity categories and diagnoses. As we will see, the domestic sphere was by no means exempt from this rationalized outlook, but by acting as a place of reprieve from homogenized bureaucratic spaces, it made more socially acceptable the perceived split between public and private understandings of selfhood and personality.

Relatedly, in the 1940s and 1950s the color theories pioneered by Munsell and Ostwald were adapted by corporations as part of a larger “color conditioning” campaign that would minimize undesirable factors such as eyestrain and glare and maximize both physiological and psychological comfort. Following the principles of functional color, “color conditioning,” emphasizes the use of environmental color and lighting as a training ground.³⁶ Jarring color combinations should be avoided, allowing for “variety and contrast within reason” in order to conserve visual labor.³⁷ In 1942, the Container Corporation acquired the Ostwald color system,

³⁰ Sandy Isenstadt, *Electric Light: An Architectural History* (The MIT Press, 2018), 151.

³¹ Advertisement for Vita-Lite Full Spectrum Daylight Bulbs. n.d. (c. 1960s). Faber Birren Papers, Robert B. Haas Family Library, Yale University. Box #1, Folder, 17.

³² Sandy Isenstadt, *Electric Light*, 140.

³³ Faber Birren, “To Calm the Mind.” In *Color and Human Response: Aspects of Light and Color Bearing on the Reactions of Living Things and the Welfare of Human Beings* (John Wiley and Sons, 1978): 97-110.

³⁴ Lawrence Busch, *Standards: Recipes For Reality*, 148.

³⁵ Faber Birren, *New Horizons in Color*, 128.

³⁶ See Faber Birren, “Color Conditioning: Aid to Getting Work Done.” *Dun’s Review* (January 1949): 17-20. Box #7, Folder 1. Faber Birren Papers, Robert B. Haas Family Arts Library, Yale University.

³⁷ Faber Birren, “Choosing the Right Color.” *Machine Design* (August 6, 1959: 100-106). Box #7, Folder 1. The Faber Birren Papers, Robert B. Haas Family Arts Library, Yale University.

renaming it the Container Corporation Color Harmony Manual [Figure 7].³⁸ A little over a decade later in 1957, Du Pont developed their Classified Color Selector, a quantitative sampling of colors based on the Munsell concepts of hue, value, and chroma; the company intended the standard primarily for communication between color stylists and paint manufacturers.³⁹

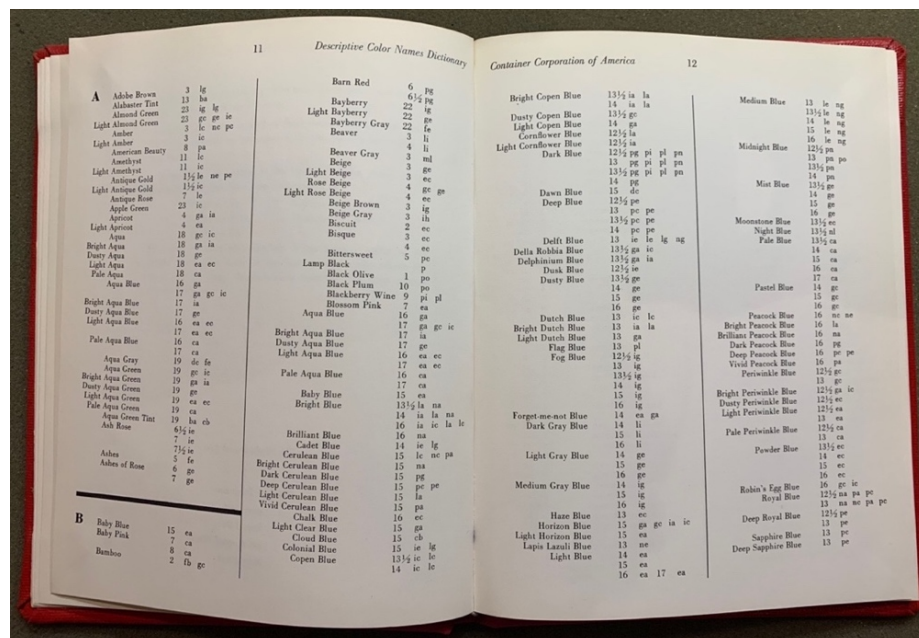


Figure 7. The Container Corporation of America lists colors are listed in alphabetical order with accompanying Ostwald notation. Helen D. Taylor, Lucille Knoche, and Walter C. Granville, eds. *Descriptive Color Names Dictionary: a Supplement to the Third Edition of the Color Harmony Manual* (Container Corporation of America, 1950). Cooper Hewitt Research Library, Smithsonian Museums.

The Ostwald and Munsell systems were particularly conducive to standardized color, with fairly straightforward forms of notation that could be communicated across industries. Both NBC and RCA, then the two major American television networks, consulted these systems when competing to create a viable standard for color TV. NBC used a colorimeter to compare colors on screen to hand-held Munsell color scales, later using the Munsell color system to create color-sample chips that would calibrate their broadcasts.⁴⁰ Broadcast networks also employed color experts who would verse them in the principles of color harmony. In addition to using Munsell scales, NBC also used the Container Corporation's *Color Harmony Manual*, adapting the Ostwaldian understanding of black-and-white content as a determinant of harmony.⁴¹ In order to conserve bandwidth, the televisual image, which consisted of red, green, and blue phosphors mimicking the perceptual structure of human color vision, incorporated the assumed limitations of an imagined "standard observer" into its design, establishing a single "normal" way of seeing.⁴²

For example, in the 1950s, the National Television System Committee (NTSC) put select observers in a laboratory setting through a series of color tests which revealed that the average

³⁸ See Helen D. Taylor, Lucille Knoche, and Walter C. Granville, eds. *Descriptive Color Names Dictionary: a Supplement to the Third Edition of the Color Harmony Manual* (Container Corporation of America, 1950). Cooper Hewitt Research Library, Smithsonian Museums.

³⁹ E.I. du Pont de Nemours & Co., "Du Pont Classified Color Selector" (1957). Cooper Hewitt Research Library, Smithsonian Museums.

⁴⁰ Susan Murray, *Bright Signals: A History of Color Television* (Duke University Press, 2018), 68 and 103.

⁴¹ Ibid, 49.

⁴² Jonathan Sterne and Dylan Mulvin, "The Low Acuity For Blue: Perceptual Technics and American Color Television." *journal of visual culture* 13, vol. 2 (2014): 118-138.

human eye is less sensitive to blue than other wavelengths. Because a central goal of broadcast television was to conserve bandwidth in order to maximize efficiency, the NTSC concluded that they could reduce the amount of blue transmitted in the televisual image based on the limitations of an imagined viewing subject.⁴³ This restrictive understanding of “standard” human vision, which assumes a viewer who is not color-blind, but also does not possess unusual visual acuity, has helped further engrain the ultimately deceptive notion that color technologies faithfully imitate how all people see and are therefore “objective.” Thus, unlike film, color television relied much more heavily on corporate color standards in order to broadcast the *same* set of images onto multiple screens. The combination of this “corporate adoption of [color] harmony” and these built-in perceptual constraints meant that color television, as Susan Murray notes, was “positioned as the ideal form of modern American consumer vision.”⁴⁴

Electricity as Infrastructure

But it was not only idealism and progress narratives that informed these color conditioning campaigns. Just as electromagnetic waves had the capacity to communicate across vast distances or to broadcast live images simultaneously into thousands of living rooms, the same waves were also feared for their potentially dangerous impact on the nervous system, to expose the human body to invisible substances the nature of whose effects were not yet fully known. We need look no further than to that evangelist of postwar electronic culture, Marshall McLuhan, who heralded the 1960s as the “Electric Age.” Yet while McLuhan outlined a utopian narrative of electricity’s capacity to transcend time and space, recreating the world as a “global village,” he also believed that electronic media, which he saw as extensions of the physical body, could have a numbing or narcotic effect, cutting off the senses rather than enhancing them.⁴⁵

Whereas artificial lighting had once been emblematic of the wonders of modern technology, by the 1920s and 1930s it had gone from dazzling spectacle to a part of everyday experience so taken for granted as to appear immaterial or even invisible.⁴⁶ Not only does

⁴³ Sterne and Mulvin, “The Low Acuity for Blue”

⁴⁴ Murray, 103 and 6.

⁴⁵ Marshall McLuhan, *Understanding Media: The Extensions of Man*, ed. Terrance Gordon (Ginkgo Press, 2005).

⁴⁶ The widespread implementation of earlier forms of electricity such as gas lamps, arc lamps, and the incandescent lightbulb in the nineteenth century fundamentally reconfigured everyday experience, as scholars such as Wolfgang Schivelbusch have claimed. Public responses to urban electric lighting at the time often described it as “turning night into day,” and the presence or absence of artificial lighting structured the temporal rhythms of both waking and non-waking life. See Wolfgang Schivelbusch, *Disenchanted Night: The Industrialization of Light in the Nineteenth Century*, trans. Angela Davies (University of California Press, 1988). Other texts that discuss the impact of electricity on modern experience include Peter C. Baldwin, *In the Watches of the Night: Life in the Nocturnal City, 1820-1930* (The University of Chicago Press, 2012), and of course. Walter Benjamin’s *The Arcades Project*, in which he describes the arcades of 1920s Paris (one of the earliest sights of gas lighting) as where “the Milky Way appears as an avenue illuminated at night by gaslamps.” Walter Benjamin, *The Arcades Project*, trans. Howard Eiland and Kevin McLaughlin (Cambridge, MA: The Belknap Press, 1999), 64. For writings on this topic beyond the nineteenth century, David E. Nye and Sandy Isenstadt dissect the progress narrative of electricity, and Jonathan Crary examines the implications of today’s “always on” mentality, where there are no longer any clear divisions between night and day in terms of illumination. See David E. Nye, *Electrifying America*

electricity shape our environments, but it is part of us; as Friedrich Kittler, following in McLuhan's footsteps, notes, electronic media forms "the uncomplicated, and hence imperceptible, rhythm of our evenings and of an antenna called the body."⁴⁷ As color is ultimately inseparable from light rays, both light and color were often treated as similar entities. Both largely perceived as immaterial, they paradoxically acted as infrastructure, enforcing the boundaries of spaces and their associated living conditions.



Figure 8. *Electronics: a New Science for a New World* (trade catalogue). General Electric Company (Schenectady, New York, 1942). Cooper Hewitt Research Library, Smithsonian Museums.

The most notable shift from the late nineteenth to mid-twentieth century, however, was a growing concern about not just the presence or absence of light, but about its *quality*, which included color. Such concerns and anxieties stemmed from concurrent discoveries in the realms of electromagnetic radiation, vision science, and the increasing presence of broadcast media in the home. A 1942 General Electric trade catalogue titled "Electronics: a New Science for a New World," depicts, through imaginative colored illustrations, the mythos of the electron, situating it within an epic history of human control over the elements—Icarus's winged feet, Benjamin Franklin's kite, and an infant gazing up at a starry sky, surrounded by objects such as crystal formations that can only be seen under a microscope [Figure 8]. Making manifest the direct link between light and color, the catalogue provides another example of enhanced and more precise vision in the form of the spectrophotometer [Figure 9], "the most reliable method of analyzing color ever devised." "The human eye can detect some ten thousand tints of reds, blues, greens, browns, yellows," reads the caption to an illustration of the spectrophotometer—a device made of steel but here designed on a multicolored background to signal its purpose to the reader. "But this amazing tool of the Electronic Age defines two million shades!"⁴⁸

As a color matching tool, the spectrophotometer could transcend the bounds of human vision, splitting the spectrum into a seemingly infinite number of colors. Yet the catalogue also emphasizes that despite the technologically enhanced eye of the spectrophotometer, these devices

(Cambridge, MA: The MIT Press, 1990), Sandy Isenstadt, *Electric Light: An Architectural History* (Cambridge, MA: The MIT Press, 2018), and Jonathan Crary, *24/7: Late Capitalism and the Ends of Sleep* (Verso, 2013).

⁴⁷ Friedrich Kittler, *Gramophone, Film, Typewriter*, trans. Geoffrey Winthrop-Young and Michael Wutz (Stanford University Press, 1999), 122.

⁴⁸ General Electric, *Electronics: a New Science for a New World* (Schenectady, New York, 1942). Trade Catalogue. Cooper Hewitt Research Library, Smithsonian Museums.

are but tools in harnessing a primordial desire for light and color that precedes the emergence of this technology. This double-sided rhetoric, between technological progress and qualities that were considered intrinsically “human,” meant that despite the growing number of instruments that could be used to measure color—such as lasers, colorimeters, spectrophotometers, and techniques of color reproduction in print, photography, film, and television—popular literature at the time claimed that beneath all this, humans possessed an innate intuition and feeling for color, one that could not possibly be engineered.⁴⁹

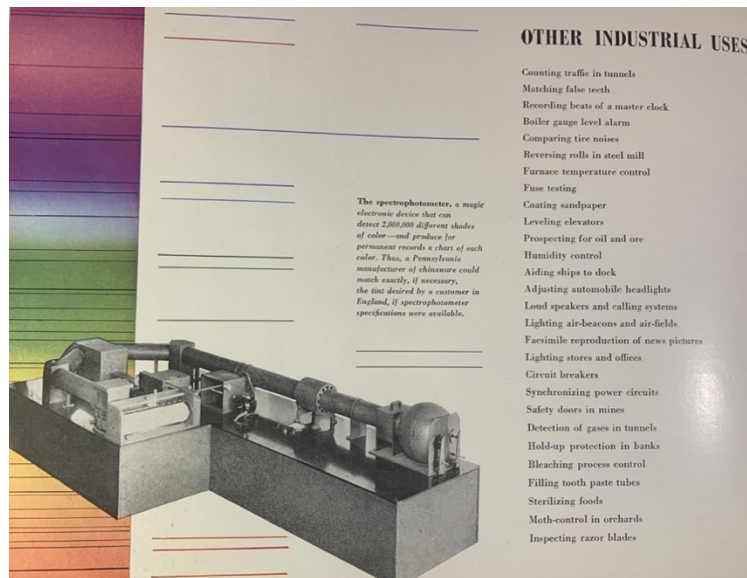


Figure 9. The spectrophotometer, “a magic electronic device.” *Electronics: a New Science for a New World* (trade catalogue). General Electric Company (Schenectady, New York, 1942). Cooper Hewitt Research Library, Smithsonian Museums.

The appearance of each electric or electronic appliance—deep-freezers and refrigerators, color televisions, air conditioners—pushed the American market increasingly towards what has been described as the “controlled environment.” In her work on television and the home, Lynn Spigel examines the postwar domestic space as a site of cultural production in which everyday life can be seen as “a series of technologically controlled scenes.”⁵⁰ As Spigel notes, the new electronic culture of the postwar period, combined with the machine-like streamlined aesthetic of mid-century modern architecture and design, presented a utopian narrative of a futuristic and efficient living space, a “consumer oriented technological sublime.”⁵¹ Functionalism was always about more than merely mechanical or technological efficiency—it used the *ideas* of efficiency and speed as markers of social progress and a heightened aesthetic sensibility. Yet, the desire for a controlled, highly sanitized living space furnished with all the latest gadgets and fashionable

⁴⁹ See Faber Birren, “Color and Human Response”

⁵⁰ Lynn Spigel, *Welcome to the Dreamhouse: Popular Media and Postwar Suburbs* (Duke University Press, 2001), 1.

⁵¹ Ibid, 383. Streamlining, which involves simplifying an object’s form, often by encasing it in a protective shell or “skin,” derives from aerodynamics, where contouring increases a jet’s capacity for speed and agility. By the 1930s, streamlining, despite its aerodynamic origins, was often applied to objects such as household appliances and furniture, thus becoming a stylistic nod to movement and dynamism even when the objects themselves were stationary. See Donald J. Bush, *The Streamlined Decade* (New York: George Braziller, 1975).

colors also stemmed from early anxieties about human intervention in the natural environment and fears of being *exposed* to invisible substances. Though anxieties surrounding the dangers of microwaves, aerosol sprays, airplane exhausts, lasers, atomic tests, sitting too close to the television, and research on the negative impact of sensory deprivation peaked slightly later in the late 1960s and early 1970s, already in the immediate postwar period an obsession was emerging with manipulating one's environments as a way of guaranteeing mental and physical well-being—particularly through light and color.⁵²

No medium better encapsulated this tension between the utopian promises of electronics and their simultaneous physiological dangers than the emerging technology of television. As a technology that found its primary place within the home, the television, not unlike the car, was a conduit between the household and the world outside.⁵³ Not only did television reshape the rhythms of daily life, but it brought flickering images into the home, and with them, the promise of immersion into worlds beyond. Color television in particular capitalized on this heightened sense of immersion: as with film, color technologies strove for verisimilitude while simultaneously linking color's novelty to fantasy and spectacle. At the same time, television brought with it anxieties not associated with film—anxieties having to do with adjustments that could be made in the privacy of one's home, such as altering one's distance from the screen or calibrating its color.⁵⁴ Furthermore, the glare of the television screen collapsed distinctions between “exposure and protectedness, agency and passivity, sleep and waking, and publicness and privacy”: it raised concerns that the light emitted by this ubiquitous medium was something to which one could be *exposed*.⁵⁵

Beyond vision, certain colors and wavelengths of light (many invisible to the naked eye, such as ultraviolet) were also thought to either amplify or neutralize physiological responses. Clinical studies measured blinking rates, pupil dilation and contraction, and muscular contractions, drawing conclusions such as that strobing or pulsating lights could induce seizures in epileptics or otherwise trigger nausea or headaches. Take, for instance, this passage from Birren's bluntly titled *Selling Color to People* (1956). In this book, Birren suggests that companies can increase revenue based on their color choices, suggesting that butcher counters in grocery stores would benefit from blue counters, which makes meat look redder and more appealing, and that pink light could be used over meats and green light over vegetables and produce. He deems particular colors as inappropriate for certain settings, even capable of cutting off the senses entirely:

Yellow-green in an aeroplane has been known to aggravate nausea. Large areas of intense ultramarine blue may make the eye so nearsighted that the head feels dizzy. Brilliant red under strong illumination may cause a distressing restlessness, and its green afterimage may give all things in sight a sickening aspect. Reflections from lemon yellow walls may

⁵² See Faber Birren, *Light, Color and Environment: A discussion of the Biological and Psychological Effects of Color, with Historical Data and Detailed Recommendations for the Use of Color in the Environment* (New York: Van Nostrand Reinhold Company, 1969). In this text, Birren notes that “Virtually all human effort these days is leading toward the controlled environment” (4). He envisions a future in which “man will go forth into nature by land, sea or air, gaze through the clear plastic shell of his conveyance and say to his children, ‘This may be hard to believe, but your ancestors used to live out there!’” (6).

⁵³ Raymond Williams calls this phenomenon by which cars and the medium of television allowed the family unit to “travel” without relinquishing its privacy “mobile privatization.” See *Television: Technology and Cultural Form* (London: Routledge, 1975)

⁵⁴ Murray, 92.

⁵⁵ Jonathan Crary, *24/7: Late Capitalism and the Ends of Sleep* (Verso, 2013), 79.

produce a psychological form of a jaundice that may make a person sick to his stomach. An overabundance of white may so constrict the pupil of the eye that sharp pains across the forehead are felt.⁵⁶

Here, light and color are not merely aesthetic or decorative, but biological; the worker or consumer is an organism, a cog in a machine where biology and technology are fused. The growing counterculture around psychedelic drugs further entrenched the notion that colors could be felt and experienced internally. Novelist Aldous Huxley had published *The Doors of Perception*, a first-person account of his experiences taking mescaline, in 1954, and behavioral scientists expressed concern that overstimulating the senses with light and color could have the same effect as an acid trip, producing “psychedelic effects” without taking any drugs at all.⁵⁷

In contradistinction to General Electric’s Light Conditioning campaign for workspaces, around the same time the company also began to manufacture a line of “decorator” bulbs specifically for the home—most famously their Glamour Pink bulb. Coated in colored ceramic, these “Coloramic” bulbs came in a variety of shades, including Dawn Pink, Sky Blue, Sun Gold, and Spring Green.⁵⁸ Rival companies such as Sylvania Electric also began to market colored bulbs, releasing their “Softlight” incandescent bulb in 1955. The Softlight bulb came in yellow and orange hues and was said to cast a soft glow, making objects appear warmer in color and thus creating a more “comforting” mood.⁵⁹ Not only did such products emphasize the role of consumer choice and customizability, but they also played a large role in educating homeowners in basic principles of color theory. In purchasing a Softlight bulb, one could experience relational color firsthand, noticing that a given color will appear different depending on ambient lighting conditions. In this sense, while the home did not appear to be subject to the same kind of controlled vision as public spaces, it actually acted as a training ground by which consumers were taught to apply the principles of color conditioning and functional color to their surroundings. Design firms hoped that consumers would become more “color-conscious” by hiring consultants to help them select the colors and lighting in their home, thus allowing them to develop an increased sensitivity to external stimuli.

Here we see a shift from the fin-de-siècle color synesthesia outlined by figures such as Rimbaud, Nabokov, Scriabin, and Kandinsky, who viewed the blurring of the various senses with color as a purely aesthetic form of transcendence, to the more cognitively informed understanding of colored hallucinations as biologically triggered, controlled experiments.⁶⁰ At the same time, the late 1950s and 1960s saw the beginnings of New Age-informed treatments such as chromotherapy and a growing popular discourse in alternative medicine and the healing power of color.⁶¹ This interest in chromotherapy had been in part set in motion by the esoteric

⁵⁶ Faber Birren, *Selling Color to People* (New York: University Books, 1956), 135.

⁵⁷ Carolyn Kane provides an illuminating (pun intended) account of the relationship between mainstream color consumption and 1960s counterculture, taking fluorescent colors and acid tests as her primary examples. See the section in *Chromatic Algorithms* titled “Industrial Color: Synthetics through Day-Glo Psychedelics,” 42-57.

⁵⁸ Petty, 159.

⁵⁹ Ibid, 157.

⁶⁰ On modernist synesthesia, see Kevin T. Dann, *Bright Colors Falsely Seen: Synaesthesia and the Search for Transcendental Knowledge* (New Haven: Yale University Press, 1998) and Polina Dimova, *At the Crossroads of the Senses: The Synaesthetic Metaphor Across the Arts in European Modernism* (Forthcoming). I also discuss the twenty-first-century ramifications of color-based synesthesia, or chromosthesia, in Chapter Four.

⁶¹ Edwin D. Babbitt’s writings in the 1870s can be seen as an early example of chromotherapy, and while

philosophies of theosophy and anthroposophy, which posited that there was a direct correlation to be drawn between specific mental states and the color spectrum, and had for decades made popular in the United States the notion that colors possessed spiritual or transcendent properties.⁶² How to account for this tension between this holistic or mystical outlook and the psychophysical understanding of color as an abstract, quantifiable entity?

In an essay on color therapy, Michael Rossi argues that in the twenty-first century, we remain surrounded by this dual understanding of color—chromotherapy is still offered as a holistic treatment for anxiety, despite a lack of scientific research to back it up. Ultimately, Rossi paints these two conceptions of color as mutually exclusive: “the meaning of green as a synoptic analogy for nature on the whole... could not exist with the new meaning of green—not as a color of nature, but as a measurable and largely non-referential electrochemical response to a particular stimulus.”⁶³ I would argue, however, that popular conceptions of color healing and personality thrived and capitalized on precisely this contradiction, and they did so in part to propagate a narrative of human “authenticity” at the heart of technological progress. What better example of this tension between holistic color and biological color than that color-changing accessory, the mood ring? The mood ring, which was created in 1975, has a thermochromic substance in its center (usually liquid crystal), which changes colors based on surrounding temperature. Though intended to reveal the wearer’s emotional state, the mood ring is based on the principles of biofeedback: by looking at the ring and seeing that one’s mood is, for example, “passionate,” the wearer is actually given the chance to control or moderate their own behavior, and by extension, group their feelings into pre-set categories.

The ultimate goal of color conditioning was thus the manipulation and standardization of sense perception and vision by treating colors as discrete variables within a larger system. The perceived link between color and lighting within the home or workplace and mental or physiological wellbeing is distinctly historical: we reenact the legacy of functional color and color conditioning every time we select an LED bulb instead of a fluorescent one, believing that the former’s warm, yellow glow will create a gentler ambience than the harsh glare of the latter. The growing electronic culture of the postwar period, combined with the emerging concept of “personality,” meant that it was within the domestic space above all where a culture of technological progress merged with ideologies of self-expression in relation to color.

What’s Your Color?

Though specific color palettes cycle through alternating phases of popularity—from 1950s pastels to 1960s Day-Glo to 1970s Avocado Green, jumping all the way back to pastels again with Pantone’s 2016 Colors of the Year “Rose Quartz” and “Serenity”—what remains consistent is the now-ingrained assumption that color can soothe us, produce feelings of anxiety,

they have largely been debunked as pseudoscientific, Babbitt himself was responding to then emerging technologies of the X-ray and fluorescent lightbulb with inventions such as the *thermolume*, a chamber whose colored glass walls and light filters would cast heated rays onto the person sitting inside. See Edwin D. Babbitt, *Principles of Light and Color: the Classic Study of the Healing Power of Color*, ed. Faber Birren (New York: University Books, 1967)

⁶² Stephen Eskilson, “Color and Consumption.” *Design Issues* 18, no. 2 (Spring 2002), 21.

⁶³ Michael Rossi, “Green is Refreshing: Techniques, Technologies, and Epistemologies of Nineteenth-Century Color Therapies.” In *Science in Color: Visualizing Achromatic Knowledge*, ed. Bettina Bock von Wülffingen (Berlin: Walter De Gruyter, 2019), 131.

and even alter human behavior. Today, interior design websites such as Apartment Therapy, which frequently publishes color-oriented articles, frame the home as a place where we can assert our individual personalities and identities, a space of creative potential. A quick search for “color” on Apartment Therapy’s website reveals thousands of headlines, including the following: “The One Color That Might Actually Make You Calmer, According to Science”; “This is Your Power Color, According to Your Astrological Sign”; “Could this Bedroom Trend Actually Help You Get a Better Night of Sleep?”; and “Here’s What Your Childhood Bedroom Color Says About You.”⁶⁴ The irony of invoking both science and astrology shouldn’t be lost on us, firmly situating this pop color psychology in that blurry zone between scientific “proof” backed up by empirical research and holistic beliefs often dismissed as pseudo-science. Platforms such as Apartment Therapy largely erase the historical and political origins of this way of thinking about color as a remedy for physical and psychological discomfort or as an answer key to gleaning insight about one’s individual personality.

As I have already argued, in the postwar period the industrial design principles of functional color and color conditioning, combined with the emerging field of color psychology, presented the domestic space as largely exempt from the top-down regulations of corporate or municipal spaces. By contrast, how you decorated your home and what colors you chose were not only up to you, but these choices also spoke volumes about who you were as a person. Yet even this emphasis on do-it-yourself (DIY) culture and customization was only made possible by the mass standardization of available colors and materials. Additionally, the norm established by psychophysics of a “standard” observer meant that it was not only paint colors that could be standardized, but human perception itself. The establishment of normalized understandings of both vision and personality also codified and made visible certain categories to the exclusion of others. As I discuss below, this process of categorization becomes itself a way of “doing” race and gender according to numerical color. The postwar home was thus not a blank canvas for creativity and personality as much as it was a space where normalized identity categories could be reinforced under the guise of domestic bliss.

What had been called “character” during the nineteenth century was based on the notion that personal identity was a kind of “call to duty” embedded within a broader framework of social morality. By contrast, personality, which came to replace character, was a largely secular and individualistic construct tied to specifically American ideologies of democracy.⁶⁵ In the early years of World War II, behavioral psychologists and sociologists promoted the idea of a “democratic personality,” which would allow individuals to cultivate their own personality development while simultaneously boosting collective morale and patriotism.⁶⁶ In contrast to

⁶⁴ Caroline Biggs, “The One Color that Might Actually Make You Calmer, According to Science.” *Apartment Therapy*, February 14, 2020. <https://www.apartmenttherapy.com/baker-miller-pink-effects-36716406>, Samantha Leal, “This is Your Power Color, According to Your Astrological Sign.” *Apartment Therapy*, July 31, 2019. <https://www.apartmenttherapy.com/this-is-your-color-power-according-to-your-astrological-sign-36629958>, Kelsey Mulvey, “Here’s What Your Childhood Bedroom Color Says About You.” *Apartment Therapy*, July 16, 2019. <https://www.apartmenttherapy.com/heres-what-the-color-of-your-childhood-bedroom-says-about-you-36624167>, and Danielle Blundell, “Could this Bedroom Trend Actually Help You Get a Better Night of Sleep?” *Apartment Therapy*, February 19, 2019. <https://www.apartmenttherapy.com/dark-bedroom-sleep-benefit-266759>

⁶⁵ Margaret Maile Petty, “Glamour Pink: The Marketing of Residential Electric Lighting in the Age of Color, 1920s-1960s.” In *Bright Modernity: Color, Commerce and Consumer Culture*, ed. Regina Blaszczyk and Uwe Spiekermann (Palgrave Macmillan, 2017), 150.

⁶⁶ Fred Turner, *The Democratic Surround: Multimedia and American Liberalism from World War II to the Psychedelic*

what they saw as the top-down homogenization of identity under both fascism and communism, mass media (radio, television, newspapers, etc.) would “train the perceptual apparatuses of American citizens” to favor a particularly “democratic mode of seeing.”⁶⁷ Both the concepts of character and personality contained built-in contradictions from the get-go: with character, one was expected to cultivate skills of self-control or self-mastery while simultaneously adhering to civic laws and moral ideals. The inherent paradox of personality, on the other hand, was a need to discover and express one’s own uniqueness, to make oneself distinct from the crowd—but at the same time to also present oneself as appealing, magnetic, and charismatic to society.⁶⁸

In the case of color, one’s “true self” was thought to be revealed by one’s favorite color, which Birren described as “the shade which, whenever you think of it, makes you feel beautifully happy, content, protected, inside.”⁶⁹ Targeting perception gave citizens a sense of agency and choice; though personality was supposedly malleable, it was only malleable within certain classifiable parameters. Of course, the irony here is that self-help literature and advertising encouraged individuals to be unique, to shun the advice of others, while encouraging them to do exactly that by providing a set of guidelines or standards to follow.⁷⁰ Much like Birren’s compromise of “variety and contrast within reason” for functional color, this illusion of choice meant that people adapted to their surrounding environments, rather than the other way around.

Self-assessments or personality quizzes, which involve answering a series of questions to gain insight about oneself, especially emblemized this kind of standardized individualism, where the ideal outcome was for the test-taker to “see, in a rationalized fashion, the outside world.”⁷¹ These quizzes, which were extremely in the postwar period, were meant to be introspective processes for the individual taking them, ultimately taking the form of a kind of self-monitoring. The first personality assessments emerged in the in the 1910s to identify soldiers who were more prone to nervous breakdowns, followed by the Rorschach test in 1921 and the Myers-Briggs test in 1962. With the Myers-Briggs test, which was based on Jungian psychoanalysis, self-assessments and personality tests became an established convention in the workplace, designating specific tasks to individuals who fit particular “archetypes.”⁷² Emerging alongside developmental psychology and its application to commercial industries, personality was seen as something that could be cultivated, an “adaptable psychological outlook” that determined your success in attracting a husband (since writings on personality were nearly always geared towards women) or achieving success in the workplace.⁷³ It was the home in particular, however—the middle-class

Sixties (The University of Chicago Press, 2013), 44-45.

⁶⁷ Ibid, 63.

⁶⁸ Warren I. Susman, “‘Personality’ and the Making of Twentieth Century Culture.” In *Culture as History: The Transformation of American Society in the Twentieth Century* (New York: Pantheon Books, 1984), 180.

See also Raymond Williams, “Personality.” In *Keywords: A Vocabulary of Culture and Society* (New York: Oxford University Press, 1983), 232-235.

⁶⁹ Faber Birren, “Meet Your Color Mate.” *Woman* 47, no. 1219 (London: October 15, 1960): 9-11. Faber Birren Papers, Robert B. Haas Family Library, Yale University.

⁷⁰ Warren I. Susman, “‘Personality’ and the Making of Twentieth Century Culture,” 277-278.

⁷¹ Elspeth H. Brown, *The Corporate Eye: Photography and the Rationalization of American Commercial Culture, 1884-192* (Baltimore: The Johns Hopkins University Press, 2005), 50.

⁷² The Myers-Briggs test remains the most widely taken psychological questionnaire today. See Merve Emre, *The Personality Brokers: The Strange History of Myers-Briggs and the Birth of Personality Testing* (Doubleday, 2018). Sociologist Eva Illouz also cites Myers-Briggs as an example of bringing psychological archetypes into the corporate workplace in *Cold Intimacies: The Making of Emotional Capitalism* (Polity Press, 2007).

⁷³ Margaret Maile Petty, “Glamour Pink: The Marketing of Residential Electric Lighting in the Age of

housewife's stomping ground—where the science of personality and consumer culture merged, resulting in the “[application of] a spatialized concept of personality to the domestic environment.”⁷⁴

Around the same time he was writing about color conditioning, Birren also coined the term “psychodecor,” an interior design schema that would take personal preference and individual sensation into account while also adhering to measurable criteria.⁷⁵ Unlike hospitals, offices, or factories—settings in which decorating according to personality was unnecessary and even inappropriate—the domestic space could not be subsumed under too rigid a standard. In order to preserve and normalize the notion that humans possessed an intuitive sense for color, color consultants never gave top-down advice in the home, but instead wanted homeowners to obtain a greater awareness of what colors best fit *them*. “A color expert is perhaps the last person who should tell a woman how to decorate her home,” Birren wrote. “Nonetheless, a scientific viewpoint is possible... if only to remind architects and decorators that reason and purpose may support a quest for beauty. There are functions to be served in the choice of color.”⁷⁶

The combination of these aesthetic and social factors meant that most idealistically, color was capable of enacting social change, making people into more perceptive individuals. More sinister was the notion that having a “color sense” (“a distinctive faculty for feeling colors”) could be used to “[mark] a perceiver as ‘primitive’ or ‘civilized.’”⁷⁷ As Nicholas Gaskill traces, the phrase “color sense,” which comes from philology and ethnography, appears primarily in the late 19th and early 20th centuries. A central tenet of American Progressivism involved integrating abstract color standards into the everyday experience of individuals, especially children, with the goal of molding them into better, more “civilized” citizens. This notion of “civilized” color perception was intensely racialized, stemming from dominant beliefs that color sensitivity differed hierarchically by race and ethnicity; at the same time, children were thought to have “primitive” impulses in their unruly desire for bright colors that had to be tightly controlled if they were to become productive members of (white) American society.⁷⁸ This is where color systems using numerical notation created by educators such as Munsell, Milton Bradley, and Louis Prang came in. They “encouraged children to approach the visible world as an assortment of decomposable colors able to be reconstructed and mass-produced on demand,” revealing the ways in which modern color standards were inseparable from the socially and technologically deterministic re-engineering of perception itself in quantitative terms.⁷⁹

But while Gaskill claims that the fact that the phrase “color sense” was not widely used after the 1920s indicates a decline of the concept, I would argue that this notion of a civilized color sense had been so absorbed into the surrounding discourse by the 1950s, to name it was no longer necessary. The commitment to a “systematic training” of perception was fully integrated into both technological infrastructure (as we saw with color television) and the by-then popularized fields of color theory and psychology. However, whereas Progressive-era color educators were highly critical of consumerism, which they saw as a cause of moral degeneracy, their sense-training regimens were ironically perfectly suited to a neoliberal corporate context in

Color, 1920s-1960s,” 150.

⁷⁴ Ibid, 152.

⁷⁵ Faber Birren, *New Horizons in Color* (New York: Reinhold Publishing Corporation, 1955

⁷⁶ Ibid, 138.

⁷⁷ Gaskill, 7

⁷⁸ Ibid, 124.

⁷⁹ Ibid, 129.

which color standards, consumer capitalism, and identity formation were inextricably linked. Viewed through this lens, the “standard observer” of color television can be viewed as an adaptation of the idealized color-conscious modern subject to a highly mediated mass culture.⁸⁰ As I discuss below, the test cards and stock images used to calibrate optical media to favor paler “flesh tones” likewise stemmed from turn-of-the-century attempts to classify and catalogue racial, ethnic, and sexual difference with the aid of standardized color swatches, demonstrating how the construction of race via skin color is historically embedded within the very material substrate of color technologies themselves. Mid-century views on color were largely rooted in nineteenth-century eugenics and early ethnography, where color became a way of classifying and cataloguing racial, ethnic, and sexual differences between people—not just in terms of skin color but also in terms of color preferences and perception.

While in the postwar United States this cultivation of color perception was often framed in terms of a kind of democratization of taste, those who had a greater propensity for “feeling” color often belonged to fixed identity categories. The average consumer was perceived as a white, middle-class woman (or at least, naturalized as such in idealized images of domesticity in print and screen media), where women were seen as more color sensitive both due to their lower rates of color blindness and largely unfounded cultural beliefs that viewed them as more attuned to sensory pleasure and emotion.⁸¹ These notions about the innateness of color sensitivity in women, combined with the notion that the home was the “woman’s domain,” meant that color campaigns were almost entirely targeted towards female consumers. Between the 1930s and 1960s, Benjamin Moore’s color mascot, “Betty Moore” (almost certainly based on Betty Crocker), was an imaginary color consultant who provided decorating advice in magazines, as well as over the radio. In 1952, in conjunction with the release of their *Paint and Style Guide*, Sherwin Williams designed a nook to be built into stores where the catalogue was sold. These nooks were specifically meant for women to browse through the catalogue and be inspired by the color swatches within.⁸²

Class politics also played a key role in popularizing theories of color harmony and functionality: so-called “high-brow” culture was defined by a complete aestheticization of everyday life, where color design principles (by way of mass media and advertising) were “turning the ugly American into a design-conscious aesthete.”⁸³ Finally, the average consumer was assumed to be white not simply because of white hegemony in America but more specifically, because of color’s slippery relationship to both skin color and racialized color perception (two separate but intricately related topics which I will touch on below). As Diane Harris notes in *Little White Houses: How the Postwar Home Constructed Race in America*, coordinated color palettes in the mid-century interior conveyed qualities like “hygiene, novelty, sophistication, and individual distinction,” all of which were central to constructing an idealized image of middle-class

⁸⁰ Rossi, 252.

⁸¹ Dominique Grisard notes that this discourse around color and gender “[devalued] women’s collective consumption as irrational but [elevated] the choice of the masculine individual as rational and authentic.” See “‘Real Men Wear Pink’: A Gender History of Color.” In *Bright Modernity: Color, Commerce and Consumer Culture*, ed. Regina Blaszczyk and Uwe Spiekermann (Palgrave Macmillan, 2017), 90.

⁸² Kathleen McDermott and Davis Dyer. *America’s Paint Company: A History of Sherwin-Williams* (Cambridge, MA: the Winthrop Group, Inc., 1991), 67.

⁸³ Lynn Spigel, *TV By Design: Modern Art and the Rise of Network Television* (The University of Chicago Press, 2008), 155 and 67.

whiteness.⁸⁴ This racially charged rhetoric was also inseparable from discussions of technological and social progress: if color had the potential to impact mood and disrupt productivity, it had to be used responsibly, regulated, and controlled—and there was no better way to do this than through numerical representation and abstraction, which carried with them the guise of objectivity and ideological neutrality.

To examine how this correlation of color and personal identity was cemented, I turn to several popular examples of color advertising from the two decades following the postwar economic boom. These include questionnaires on the inside of paint pamphlets and columns in women's magazines, both of which seek to train consumers in the principles of color harmony and provide insight about their personalities or identities. In their ubiquity and tactility, these seemingly banal or mundane objects are themselves storage technologies that catalogue everyday lived experience. With these examples, the color chart once again functions as a way of discretizing color, here emphasizing the plurality and variability of identity categories. Yet these identities and color preferences must necessarily map onto the types available: the color grid categorizes through exclusion, interpellating those who participate in its structural logic.⁸⁵ Much like the news anchor of live TV, these materials are often characterized by “shifters,” or words such as “we,” “you,” “I,” “here,” and “now” that directly address the viewer or reader, making them feel like they embody the same space and time as the speaker.⁸⁶ “If you say, ‘Give me any shade as long as it’s red,’ see this page for your character analysis,” reads a 1946 article in *Today’s Woman* titled “Choose your Color.” “Few people choose blue-green. Are you one of them? Page 65 tells you about yourself.”⁸⁷ Like broadcast television, this particular mode of address insists upon the medium’s spontaneity and immediacy, equating liveness with indisputable truth.⁸⁸

Though the popular examples I discuss primarily rely on hand-drawn illustrations rather than photographs as their primary mode of visual representation, the widespread introduction of color photography, particularly in the realm of advertising, made it imperative that colors be consistently reproduced on a mass scale, as the abundance of colorful commodities and standardized paint colors increased the demand for colorful images in both print and screen media. In lifestyle magazines, colorful images more convincingly made idealized domestic scenes appear attainable, provided one purchased the objects the images advertised. Though these print advertisements primarily circulated through serial publications such as newspapers and magazines due to the ongoing difficulty of calibrating and standardizing color television during this period, they possess a similar sense of presentness or urgency through the “voice” of their slogans. Though it does not possess the same potency of the live broadcast televisual image, print advertising and color forecasting too thrive on their obsolescence: the consumer must act now, order now, in order to acquire the color that captures their “unique” personality.

⁸⁴ Diane Harris, *Little White Houses: How the Postwar Home Constructed Race in America* (Minneapolis: University of Minnesota Press, 2013), 96.

⁸⁵ Bernard Siegert, *Cultural Techniques: Grids, Filters, Doors, and Other Articulations of the Real*, trans. Geoffrey Winthrop-Young (Fordham University Press, 2015), 98.

⁸⁶ Mary Ann Doane, “Information, Crisis, Catastrophe.” In *New Media, Old Media: A History and Theory Reader*, ed. Wendy Hui Kyong Chun and Thomas Keenan (Routledge, 2006), 258.

⁸⁷ Faber Birren, “Choose Your Color.” *Today’s Woman* 13 no. 76 (February 1946), 33. Faber Birren Papers, Robert B. Haas Family Arts Library, Yale University.

⁸⁸ Jane Feuer, “The Concept of Live Television: Ontology as Ideology.” In *Regarding Television: Critical Approaches—an Anthology* (American Film Institute, 1983): 12-22.

Standards of Selfhood

In the first season of the AMC historical drama *Mad Men* (2007-2014), which is known for its nearly fetishistic attention to period detail in its depiction of New York advertising agencies in the 1960s, the firm Sterling-Cooper is asked to come up with a new campaign for fictional cosmetics company Belle Jolie (S1E6 “Babylon,” 2007). According to one executive, “They make more colors of lipstick than Howard Johnson has ice cream flavors, but sales are in the crapper.” They then proceed to name several of these colors—“Passion Flower Peach, Boudoir Red, Ethel Rosenberg Pink”—and, finding themselves at a loss, enlist the female office workers to pick their favorite shades as an informal study. While the ad men voyeuristically watch the women through a one-way mirror, the camera, embodying their gazes, pans left to right on what looks like an assembly line of cardigan-clad brunettes as they blot their lips in sequence and toss their tissues, in slow motion, into the trash can. Cut to close-up: a blanket of white peppered with magenta and crimson blots [Figure 10]. Secretary Peggy Olson impresses her superiors when she calls the trash can a “basket of kisses” and dismisses the experiment, saying: “I don’t think anyone wants to be one of a hundred colors in a box.” Peggy is then invited to work on the campaign’s updated tagline: “From a basket of kisses, she picks one. It makes her unique, marks her kiss, and she marks her man. Belle Jolie: Mark Your Man” (S1E8, “The Hobo Code”).

Though *Mad Men* is of course a fictionalized version of the 1960s filtered through a contemporary lens, several mid-century ad campaigns did in fact use a similar strategy by stressing the fact that color signaled uniqueness, choice, and therefore female consumer power—even if this choice was ultimately “one of [many] colors in a box.” This correlation between color and uniqueness was not simply an advertising strategy, however, as *Mad Men* might suggest, but was in fact an increasingly ingrained way of thinking about selfhood in relation to one’s surrounding environment and the physical objects it contained. Color functioned as a gateway through which a woman’s psychology or personality could be revealed “deep down” not just in cosmetics, but more prevalently in home decoration and paint colors. Ironically, however, the concept of personality was ultimately described as one of surface and externality rather than depth: “the outward expression and *perception* of personal attributes, rather than the attributes themselves.”⁸⁹ “Marking” or claiming her male object of desire through a lipstick kiss—as the targeted female consumer is encouraged to do—it goes without saying, is a highly gendered act. While on the one hand this diffusion of a woman’s unique or personalized color onto “her” man suggests agency or ownership, the “marker” in this scenario is necessarily female and the “markee” male, reinforcing the gender binary. The “Mark Your Man” campaign (set in 1960) suggests that the primary purpose of such personalized shades is to reaffirm the institutions of coupledness and matrimony. Simultaneously, it also offers a wink and a nod to contemporary viewers on the other side of history, gesturing towards the sexual revolution on the horizon that would challenge these very norms.

⁸⁹ Elspeth H. Brown, *The Corporate Eye: Photography and the Rationalization of American Commercial Culture, 1884-1929*, 61.

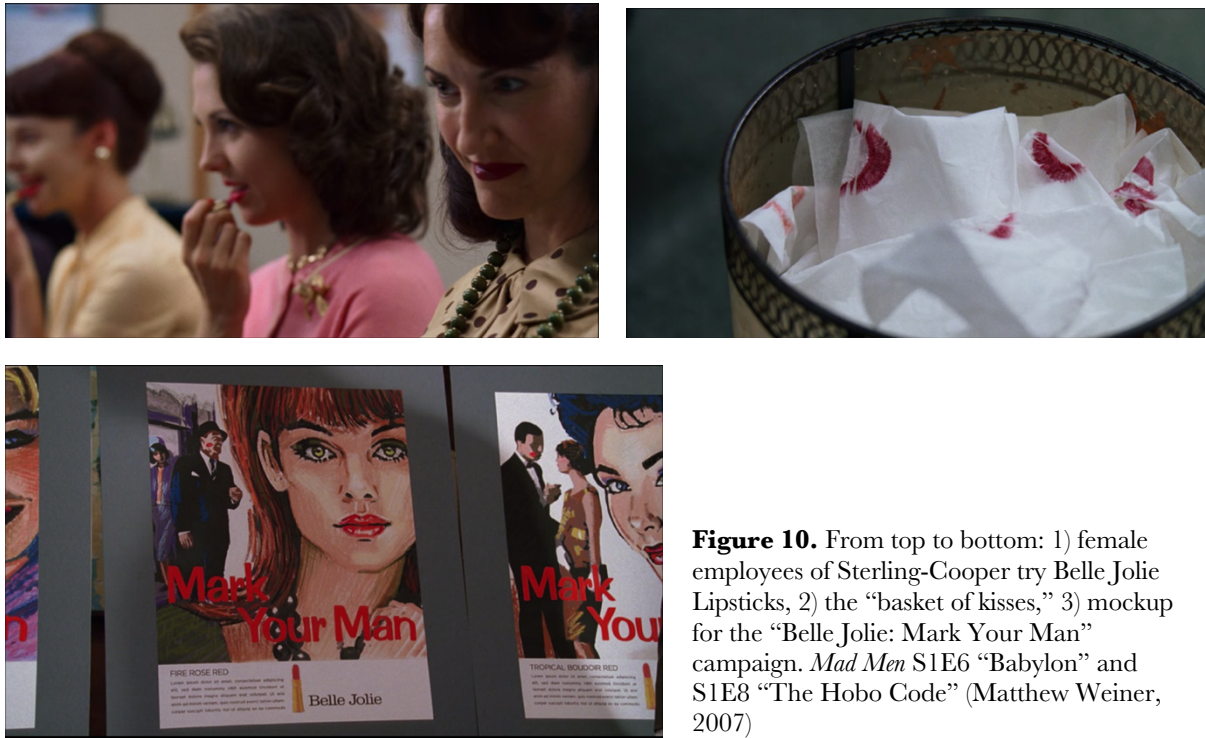


Figure 10. From top to bottom: 1) female employees of Sterling-Cooper try Belle Jolie Lipsticks, 2) the “basket of kisses,” 3) mockup for the “Belle Jolie: Mark Your Man” campaign. *Mad Men* S1E6 “Babylon” and S1E8 “The Hobo Code” (Matthew Weiner, 2007)

Colored illustrations played a crucial role in promoting this ideology of identity creation. Though magazines did for a short time in the early twentieth century include black-and-white photographic images, which could be reasonably rendered through halftone screen printing, the following decades saw a shift to hand-drawn or painted illustrations. This shift was part of a broader change in advertising philosophies: from “reason-why copy,” which assumed that consumers made purchases based on rational decision making, to the idea—influenced by behavioral psychology—that consumers irrationally chose products by associating them with positive emotions. These two advertising strategies also reflected two different kinds of consumers, from the idealized “rational man” to the irrational “emotional woman” (along these lines, it should be noted that Birren always uses male pronouns to describe the perceiver of color more broadly, but female pronouns to describe the consumer or home dweller). Whereas photography was assumed to have a documentary purpose, illustrations, by contrast, were thought to activate subconscious desires through abstraction.⁹⁰

That there was a lag in the shift from the use of drawn or painted images to photographs in magazines was due not only to the technological limitations and complications of consistent color reproduction, but also because of the connotations of hand-drawn versus photographic media. Analog photography, and to a lesser extent, film, in the twentieth century were largely discussed in terms of realism or indexicality—that is, the notion that as an imprint of light, the photographic image was “the object itself” and possessed a specific kind of truth value.⁹¹ Photography also possessed a particular type of temporality defined by its ability to capture the past, a “that-has-been,” as Roland Barthes calls it. Yet color has always had a particularly fraught

⁹⁰ Ibid, 166-167.

⁹¹ André Bazin, “The Ontology of the Photographic Image.” In *What is Cinema? Vol. 1*, trans Hugh Gray (University of California Press, 1967), 14.

relationship to indexicality: the first color photographs were hand-colored, with color acting as a surface layer floating above the recorded image beneath. Long after color photography had superseded black-and-white in virtually all spheres of representation, Barthes saw color as ultimately untruthful or superficial, “a coating applied *later on* to the original truth of the black-and-white photograph.”⁹² Processes such as Kodachrome, which involved immersing black-and-white film in a series of colored dyes *after* the photo was taken, could not be considered fully “indexical” if one adhered to the notion that the photograph’s indexical quality comes from the imprint of light. At the same time, however, the color photograph’s potency derived from its dual promise of fantasy and realism, and colors that appeared “off” would destroy this power completely. Color photography struggled to avoid being accused of “a realism that seemed too automatic or a chromatic intensity that seemed too coarse.”⁹³

It thus makes sense that even after color photographic processes were widely available, magazines continued to rely on illustrations rather than photographs in their attempt to appeal to emotions and the ideas established by popular color psychology. A fold-out pamphlet for Colorizer paints from 1960 called “Color and Your Personality” comes with a set of personality traits that correspond to both color likes and dislikes. The pamphlet, which claims to be supported by recent clinical and psychological findings, attest that color preferences “may reveal a great deal about the kind of person you are down deep at heart.”⁹⁴ The pamphlet’s cover unfolds into three sections: the middle section—the first thing a consumer would see—contains a color wheel with no divisions [Figure 11], the seamless gradient suggesting an infinite spectrum of difference.

Another pamphlet, this time for the Paint Merchandising Council (1956), reiterates this theme: this time the color gradient spans all four quadrants, slowly moving from red to green, the edges between hues imperceptible. This cover of this particular pamphlet renders even more clearly this usage of color gradation to indicate fluidity in relation to personality: etched in white ink on a black background is a sketchy illustration of a fortune-teller, clad in a jeweled turban and star-patterned robes [Figure 12]. This orientalist stereotype raises his hands around an orange globe suggesting a crystal ball: within the globe, block letters read “*Which color do you like best?*” The combination of color gradients, which I have written elsewhere embody unknowability and fluidity, with the image of the fortune teller, suggest a correlation between color and personality that is organic bordering on mystical. There is also an added layer here in which it is the “primitive” fortuneteller who embodies Otherness who is more in touch with the mysterious or undefinable, and therefore magical or incomprehensible aspects of color—by contrast, the pamphlet claims that its findings have been “fact-checked against the findings of modern scientists and psychologists.”⁹⁵

⁹² Roland Barthes, *Camera Lucida: Reflections on Photography*, trans. Richard Howard (New York: Hill and Wang, 1981), 71.

⁹³ Claire Lehmann, “Color Goes Electric.” *Triple Canopy*, May 31, 2016. Online. <https://www.canopycanopycanopy.com/contents/color-goes-electric>

⁹⁴ Faber Birren, “Color and Your Personality.” Colorizer Paint, 1960. Box #7, Folder 1. Faber Birren Papers, Robert B. Haas Family Arts Library, Yale University.

⁹⁵ Faber Birren, “Character Analysis Through Color.” Paint Merchandising Council, 1956. Box #7, Folder 1. Faber Birren Papers, Robert B. Haas Family Arts Library, Yale University.

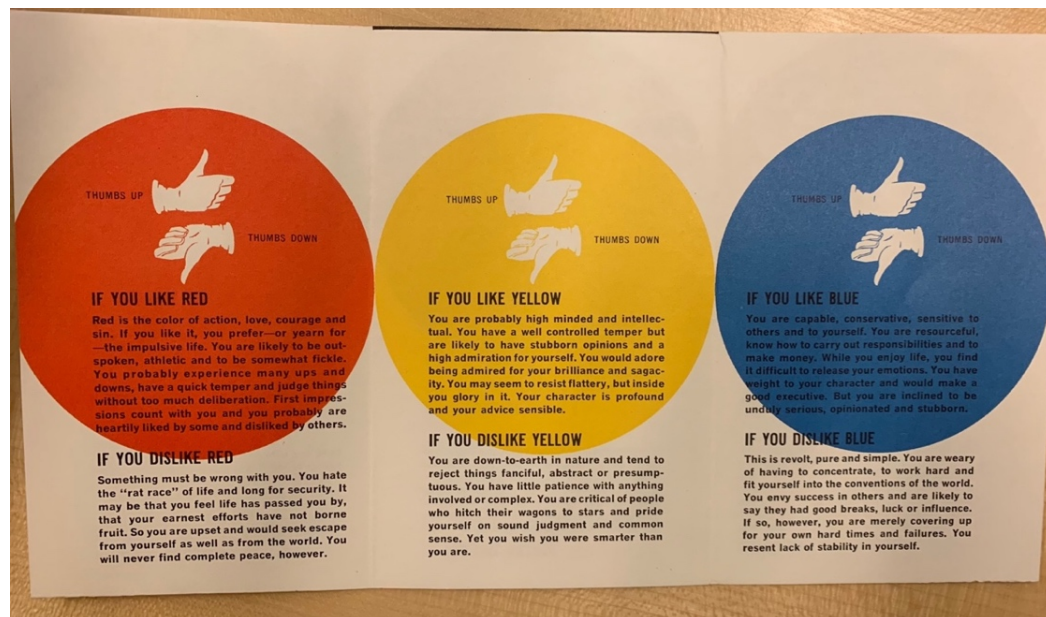


Figure 11. “Color and Your Personality.” Colorizer Paint, 1960. Box #7, Folder 1. Faber Birren Papers, Robert B. Haas Family Arts Library, Yale University.

Recalling the distinction I drew in Chapter One between a “grid-like logic” and a physical grid, in which an actual color grid does not need to be present in order for the process of quantification and discretization to take place, we find that the gradients and color wheels here are smoke and mirrors. The Paint Merchandising Council’s gradient primarily functions as a decorative backdrop to set categories. Each quadrant provides insight about a particular color and what it reveals about one’s personality: red, pink, orange, and green are the only available options. Though the pamphlet advertises the availability of 13,222 distinct paint colors, there are only four “color personalities” listed. These basic categories, which do not include, for example,

“reddish-orange” or “yellowish-green,” cannot by definition capture the nuances of the background behind them, and ironically, pink and orange are actually located on the yellow quadrant.



Figure 12. “Character Analysis Through Color.” Paint Merchandising Council, 1956. Box #7, Folder. 1. Faber Birren Papers, Robert B. Haas Family Arts Library, Yale University.

Birren acknowledges this very dilemma in a 1951 feature for *Better Home and Gardens*:

You might well ask: How about coral and brown and peach and chartreuse and purple—not to mention dozens of subtler shades? The truth of the matter is that: (1) It would take an entire issue of this magazine to show the *exact* tints and shades that correspond with various

personality types, and (2) I couldn't tell you whether you were a ginger-peachy personality or a special rosy beige. About the best I can do is tell you that according to the law of averages, you'd probably get more satisfaction from some shade of green, for example, then you would from the red family—which includes everything from orange to brown.⁹⁶

Birren's language here feels defensive, anxiety-ridden, even, exposing the discursive challenges of systematizing and describing color. Once again, standards and norms emerge as the primary mode of preventing the linguistic and philosophical slippages that emerge alongside "subtler shades." The phrase "law of averages" is key: the decision to group "subtler" colors together is more than a question of efficiency. Instead, it creates standards and averages things out, demanding that consumers select options that may not be their "true" favorite colors. There is thus no clear correlation between the gradient and these color categories, which, in their emphasis on edges and boundaries, belong to the logic of the grid, which controls, captures, and categorizes. "Red is the color of action, of sacrifice and sin, love and courage," the leftmost quadrant reads. "To prefer it is to reveal a yearning for the impulsive life." By contrast, pink "is frequently liked by persons who have lived a sheltered and protected existence" and who "probably lack the nerve (of red) to do anything really bad."⁹⁷

Though these descriptions vaguely build on widely culturally accepted symbolic associations (red evokes anger, pink gendered passivity), the symbolism rings hollow, as the division between these two colors is largely arbitrary—pink, though largely considered a distinct color, is merely red with the addition of white. The separation of these as unrelated entities makes them mutually exclusive: one cannot prefer both pink and red any more than one can have both an active and a passive personality at the same time. The Colorizer pamphlet goes a step further in establishing this binary logic, indexing both color likes and dislikes, accompanied with thumbs-up and thumbs-down illustrations—one cannot feel lukewarm or neutral about a color or change one's preferences over time.⁹⁸ You must either like or dislike yellow: if you like it, "you are probably high minded and intellectual," whereas if you dislike it, "you have little patience with anything involved or complex."⁹⁹

Like the individual swatches of the color chart, the usage of color to define and predict individual traits reveals the chart's status as a "technology of organizing the social."¹⁰⁰ The color chart catalogues and indexes individual elements by assigning them fixed locations, and in emphasizing edges and boundaries, it inevitably makes visible certain categories while making others invisible by exclusion. One such identity category was that of the homemaker, the key target demographic of houseware and paint companies. Not simply housewives, but future housewives and brides-to-be were also imbricated in this schema (career women are conspicuously absent). The *Better Home and Gardens* article cited above includes a personality quiz for couples to take, with the assumption that their relationship compatibility will be reflected by shared color preferences. These color preferences can then be used to decorate the home they

⁹⁶ Faber Birren, "What is *Your* Favorite Color?" *Better Home and Gardens* 29 no. 14 (October 1951), 57. Box #7, Folder 1. Faber Birren Papers, Robert B. Haas Family Arts Library, Yale University.

⁹⁷ Faber Birren, "Character Analysis Through Color."

⁹⁸ The rendering of the thumbs up and thumbs down, alongside the "like" and dislike" binary, reminds us of the algorithmic logic of social media platforms that force users to catalogue their preferences in binary terms.

⁹⁹ Faber Birren, "Color and Your Personality."

¹⁰⁰ Timon Beyes, "Colour Chart." In *The Oxford Handbook of Media, Technology, and Organization Studies*, ed. Timon Beyes, Robin Holt, and Claus Pias (Oxford University Press, 2020), 126.

share together—and if there are clashes, compromise is possible: “If you and she differ, how about different colors for different rooms?”¹⁰¹

A similar personality quiz in *Woman* goes as far as providing examples of “color-compatible couples,” whose color preferences are not identical, but rather complement each other [Figure 13]. These gendered color preferences vaguely map onto complementary color pairings, such as red with blue or green, orange and yellow with purple: cool or low wavelength colors with warm, high wavelength ones. This binary between hot and cool also maps onto the popularly held division of colors in the 1950s into “active” and “passive” categories, where colors such as red, orange and yellow are active, green, while blue, purple, white and black are passive.¹⁰² Importantly, these assigned emotional values exist entirely independently of any specific viewer or observer: what we see “codified and packaged is not just... the visual perception of color but the emotional response [it] supposedly inspired.”¹⁰³ Color then becomes a kind of distilled, abstracted identity that can be used to design a harmonious living space.

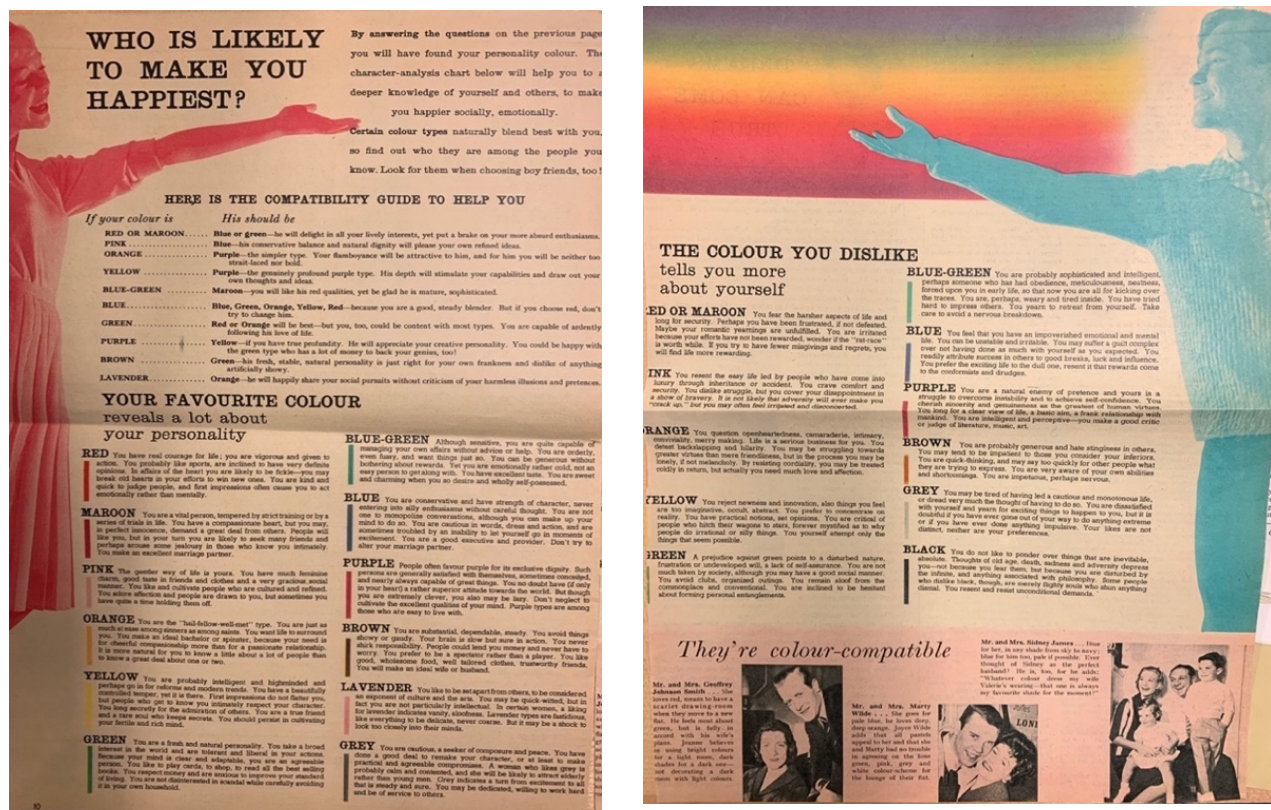


Figure 13. “Meet Your Color Mate.” *Woman* 47 no. 1219 (October 15, 1960). Box #7, Folder 1. Faber Birren Papers, Robert B. Haas Family Arts Library, Yale University.

¹⁰¹ Faber Birren, “What is Your Favorite Color?” *Better Home and Gardens*, 57.

¹⁰² Murray, 108.

¹⁰³ Ibid, 107.

One so-called “color-compatible” couple listed in the article, the Wildes, have created a color scheme for their home based on their respective favorite colors: “She goes for pale blue, he loves deep, deep orange. Joyce Wilde adds that all pastels appeal to her and that she and Marty had no trouble in agreeing on the lime green, pink, grey and white color-scheme for the lounge of their flat.” Another couple, the Jameses, provides an alternate model of adaptability: “For her, in any shade from sky to navy; blue for him too, pale if possible. Ever thought of Sidney as the perfect husband? He is, too, for he adds: ‘Whatever color dress my wife Valerie’s wearing—that one is always my favorite shade for the moment!’”¹⁰⁴ What we see here is not simply innate color preferences but also the possibility of self-molding: after completing the quiz, the test-taker is instructed: “Turn to the charts on the next page for an analysis of your character, and discover which color personality would make you the best partner.” The character analysis tagline, “If your color is... His should be...”, implies that personality is malleable, but only by self-monitoring and adapting to fit pre-established categories.

With any form of standardization, counting and quantifying cannot be separated from the things and people being turned into numbers, no matter how abstract or objective seeming the final product.¹⁰⁵ In order to make living beings legible within such a mathematical system, however, certain groups inevitably become “outliers” by being marked as either unclassifiable or nonstandard.¹⁰⁶ There is a distinctly material way in which media of quantification and distinction index a politics of segregation that is explicitly racialized in the mid twentieth century. This politics of segregation was especially insidious when it comes to color technologies, whose infrastructure played a key role in naturalizing the historical relationship between so-called “abstract color” and skin color as an index of race. There has recently been a wealth of publications on the once relatively obscure reference images known as “Shirley Cards” or “China Girls”—test cards of anonymous, conventionally attractive white women (despite the Asiatic connotations of the name) used to calibrate color photography, television, and film to favor “ideal” skin tones.¹⁰⁷ These reference images were juxtaposed with “color control patches”—grids that sampled the colors contained in the image—in order to fine-tune the desired level of exposure and color balance. These critics (who touch peripherally on color but do not make it a central focus) point to the ways in which systems of mediation are not only a product of historical conditions informed by racial and gendered hierarchies but continue to produce and reinforce these very norms by design. While I likewise want to insist on the entrenched relationship between race and media infrastructure, rather than focusing on Shirley Cards or any one material artifact or technology, I treat color *itself* as a form of mediation, shaped by a historical context in which grid-like color transformed identity categories into discrete, numerical data with the pretenses of objectivity and scientificity.

That the discretization of race via color emerged alongside the industrial color chart as an organizational mode was not merely accidental, but owed much to the formation of the

¹⁰⁴ Faber Birren, “Meet Your Color Mate.” *Woman* 47 no. 1219. October 15, 1960. Box #7, Folder 1. Faber Birren Papers, Robert B. Haas Family Arts Library, Yale University.

¹⁰⁵ Busch, 143.

¹⁰⁶ Geoffrey C. Bowker and Susan Leigh Star, *Sorting Things Out: Classification and Its Consequences* (Cambridge, MA: The MIT Press, 1999), 38.

¹⁰⁷ See Lorna Roth, “Looking at Shirley, the Ultimate Norm: Colour Balance, Image Technologies, and Cognitive Equity.” *Canadian Journal of Communication* 34, vol. 1 (2009): 111-136; Genevieve Yue, *Girl Head: Feminism and Materiality* (New York: Fordham University Press); Mary Ann Doane, *Bigger Than Life: The Close-up and Scale in the Cinema* (Durham: Duke University Press, 2021); and Dylan Mulvin, *Proxies: The Cultural Work of Standing in* (Cambridge, MA: The MIT Press, 2022).

disciplines of physical anthropology, ethnography, and eugenics at the turn of the century. These disciplines attempted to tie race to phenotypical color not just in terms of skin, but also hair and eye color, using numerically ranked color swatches as matching tools to calibrate and measure skin tone. Both racial classifications and color systems operated by the principles of visual contrast, relationality, and rationalization, making the color grid the ideal format for the naturalization of racial hierarchies (even though it became quickly clear that terms like “Black,” “White,” “Red,” and “Yellow” didn’t literally describe the color of peoples’ skin). Color tables such as physician and anthropologist Paul Broca’s *Table Chromatique* (1879) [Figure 14] were quite literally held up to living subjects in an attempt at racial standardization. Later, devices such as spectrophotometers would prove an even more “scientific” way of measuring “middle” colors more precisely, leaving no skin tone left unlabeled.¹⁰⁸ All of these models—it probably goes without saying—took for granted that whiteness was the default “neutral” rather than a constructed category, with qualities such as “civilizedness” and intelligence decreasing the further away subjects veered from this ideal. By extension, central to the American eugenics movement was the idea that race was a “colorimetric quality” that could be measured quantitatively.¹⁰⁹ Prominent eugenicist Charles Davenport even expressed a desire to design his own color grid using readily available commercial paints, pointing to the alarming ways in which the industrial color chart is deeply entrenched in institutionalized violence and anxieties around racial “purity.”¹¹⁰

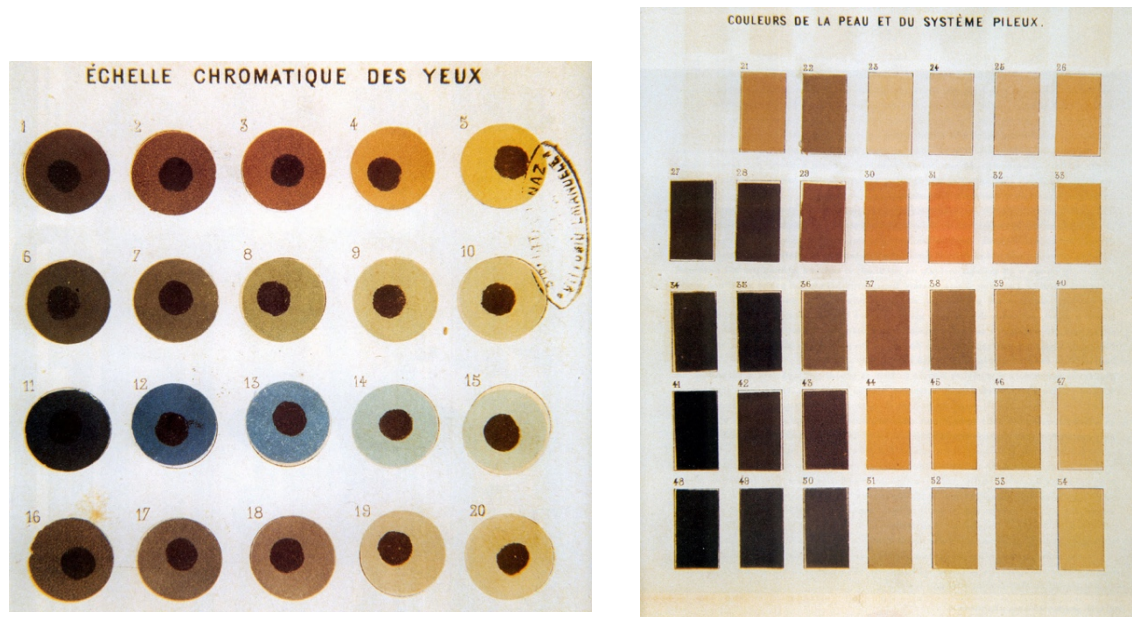


Figure 14. Charts measuring eye and hair color from Paul Broca’s *Table Chromatique* (1879)

In this sense, the discretization of color via race is a process that feigns neutrality while keeping whole groups of people on the outside. Once it became clear that physical color attributes could never fully function as an index of race, cataloguing color preferences emerged as another way of differentiating race—as we saw with the training of the “color sense.” What

¹⁰⁸ Michael Kevak, *Becoming Yellow: A Short History of Racial Thinking* (Princeton: Princeton University Press, 2011), 85.

¹⁰⁹ Rossi, 229.

¹¹⁰ Ibid, 232.

made the postwar period distinct, however, was that color typologies were linked to consumer choice, individualism, and even pleasure. Particularly within the discourse of color psychology and personality testing, there was a clear perceived correlation between skin tone and color preference (even though this correlation was ultimately arbitrary). No longer in the hands of specialists, taking quizzes to determine one's color "personality" or learning how to dress in a way that flattered one's complexion and hair color made codifying oneself via color a type of voluntary labor.

Notably, whereas the "standard" subject—a white, middle-class woman— could choose from a plethora of favorite colors, racial and ethnic groups not included within this framework were lumped into types with homogeneous color preferences. As something more intangible than phenotypical skin color, the link between personal color preference and race/ethnicity was easier to insist upon—and, by extension, more difficult to disprove. Drawing on what he claimed were "proven" psychological studies, Birren wrote: "Warmth and coolness in color choice may also reveal racial types. Persons of Latin descent—Spanish, Italian, French, Balkan—may prefer warm colors, as will the majority of people having brunette complexions. Persons of Nordic descent, the English, Scandinavian, the typical American, will prefer cool colors, for cool colors seem to be emotionally pleasing to those with blonde complexions."¹¹¹ Note that "Latin" as a group includes not just Spanish, but Italian, French, and Balkan—a seemingly random collection of European demographics that becomes one umbrella category. With mass immigration from Europe to the U.S. following World War II, rapidly changing demographics shifted discussions of race in terms of Black and White towards the plurality of ethnicity.¹¹² And yet, we can see from Birren's language that certain European groups had not yet assimilated and were seen as "white-adjacent." In this reading, only white Americans of a certain means had the luxury of being "individuals," an individualism that could be expressed through color in both fashion and interior design.¹¹³ The establishment of those of Scandinavian descent as the de facto group, it hardly needs to be said, is part of a much longer and troubling history of an aspiration towards racial purity that treats pallor and whiteness as neutral.

The "objective" or immersive qualities of photography, combined with the subjectivity and emotional emphasis of illustration, further cemented the triangulated relationship between so-called abstract color, skin color, and color preference as a determinant of race. We need look no further for evidence of this synthesis of race and color preference via photography than a feature Birren published in *American Magazine* (1948) featuring a color photograph of Ava Gardner clad in a coral red dress with matching shawl [Figure 15]. The choice of Gardner, a Hollywood celebrity whose image was primarily mediated through the screen, is not coincidental, since, as I previously noted, color film and photography media were historically calibrated to highlight pale skin tones or "flesh tones," which were established as the norm. Unlike drawn images, these technologies, with their connotations of realism and "objectivity," helped cement and neutralize whiteness as the norm by targeting perception itself.¹¹⁴

Gardner, who is said to have "the average American girl's complexion," then serves as a starting point for the division of women into types, such as "pink and white skin with the bluish

¹¹¹ Faber Birren, "Find Yourself in Whose-Hue." *Bride & Home LXV* (Summer 1959): 70-75. Faber Birren Papers, Robert B. Haas Family Arts Library. Yale University.

¹¹² Diane Harris, *Little White Houses*, 17.

¹¹³ Ibid, 128-129.

¹¹⁴ See Richard Dyer, *White: Essays on Race and Culture* (New York: Routledge, 1997)

cast,” which includes “the pastel girl, the Irish colleen type, and the strawberry blonde.”¹¹⁵ In this case, categorizing women by skin tone went beyond color preferences and into the realm of color matching in cosmetics and fashion: just as lipstick shades could be numbered and differentiated, so could the faces with which one could match them. Most striking (and in fact, quite sinister) here is Birren’s clinical language: “I’m stubborn enough to believe that the colors women wear are just another phase of engineering,” he writes. “When an engineer thinks (professionally) of a woman’s complexion, he doesn’t think of ‘peach-blow,’ or ‘moon-glow,’ or ‘pomegranate Canada gold-dust.’ A color engineer is more concerned with surface capillaries, venous blood, and pigmentation.”¹¹⁶ Two aspects of this quote are worth noting: first, the substitution of poetic language with the perceived “objectivity” of scientific jargon builds on what I have already identified as the legacy of ethnography, anthropology, and eugenics, all of which involved “engineering” and quantitatively measuring human subjects, reducing them to objects of study rather than living beings in the process. Second, by encouraging female consumers to reflect on which colors suit their hair and eye color and complexion the best, Birren frames in terms of empowerment and choice what is really a process of disciplining the eye to recognize color distinctions in racialized terms.



Figure 15. “What’s Your Color?” American Magazine 146, no. 3 (September 1948). Box #7, Folder 1. Faber Birren Papers, Robert B. Haas Family Arts Library, Yale University.

We thus see that the slippery relationship between the abstract color swatch, skin color,

¹¹⁵ Faber Birren, “What’s Your Color?” *American Magazine* 146, no. 3 (September 1948). Box #7, Folder 1. Faber Birren Papers, Robert B. Haas Family Arts Library, Yale University.

¹¹⁶ Ibid.

and color preference meant that in addition to gender and class, race also became subject to normalization. Returning to *Mr. Blandings Builds His Dreamhouse*, we see an idealized depiction of an archetypal mid-century nuclear family: a working father, a stay-at-home mother, two children, and their African-American maid Gussie (played by Louise Beavers, an actress known for primarily portraying enslaved women and servants of the “Mammy” stereotype). Even the last name “Blandings” connotes averageness or banality, evoking the image of a retroactively established image of a cookie-cutter (middle-class, white, heteronormative) 1950s American suburban lifestyle—one that has become synonymous with its cinematic representations.

The color swatch, with its guise of ideological neutrality, has followed us from the beginnings of standardized, reproducible color in print to electronic and digital screens. But the gap between these systems—between print-based and light-based color—would prove difficult to bridge. If we revisit the “Find Yourself in Whose-Hue” feature for *Bride & Home Magazine*, we see a photo spread of various interiors that are meant to match different color palettes and corresponding personality types. The blue room, said to match the “elegant” personality of the “blue girl,” has floral curtains, blue upholstered chairs, and a matching carpet. With copper accents and even a blue rotary phone and blue books, the photograph’s colors appear exaggerated and garish. Devoid of people, the staged rooms resemble stock images, a type of photograph that, as Claire Lehmann notes, “point to the slippage between technological and mathematical precision and the pull of preference; they function as both tool and metonym for the entire visual project of extracting a consistent, and consistently pleasing, representation of the physical world.”¹¹⁷ Other color schemes in the photo spread include red, yellow, and green, and the magazine provides a set of color swatches to complement each room, alongside the caption “Color... as ordered” [Figure 16].



Figure 16. “Find Yourself in Whose Hue.” *Better Home & Gardens* LXV (Summer 1959). Box #7, Folder 1. Faber Birren Papers, Robert B. Haas Family Arts Library, Yale University.

¹¹⁷ Claire Lehmann, “Color Goes Electric.”

With these swatches, the image itself starts to break down, as this would appear to be a kind of pre-computational color sampling. We are reminded of the various processes of conversion that made possible the printing of this photograph, in which paint colors and furniture were selected, then photographed. The colors of the photograph than had to be adapted for print. Finally, the magazine makes it clear that one can purchase the color schema and furniture of these various rooms (“to buy your yellow room setting, see page...”). The consumer thus orders the objects in the photo, bringing this process full circle.¹¹⁸

The room for error between each step of mediation is vast, and it is here that we begin to see just how difficult—and in fact, impossible—the complete standardization or quantification of color perception would prove to be. As evidenced by Ngai’s so-called “minor” aesthetic categories with which I began this chapter, it is precisely the most seemingly banal design choices made within the home that most acutely embody the inseparability of taste-making and consumerism. Just as Ngai focuses on the cute, the zany and the interesting for their unique relevance to the transformation of aesthetic experience under postindustrial capitalism, I argue that the “chromatic categories” of the postwar period rendered numerical and mass-produced color inseparable from changing understandings of taste, selfhood, and personality. Specifically, the commercialized color swatch played a key role in mediating tensions between the perceived scientificity or objectivity of abstraction and questions of individual choice and agency. Together, the dual design principles of mood-conditioning and functional color cemented the domestic sphere as a space where customized color and lighting schemes could produce desired emotional or behavioral effects. Yet, while the rise of do-it-yourself culture and popular discourses on personality might suggest a newfound freedom of self-expression, consumers were incentivized to mold themselves to fit set identity categories. As the primary site onto which middle class American homeowners projected their desires for stability and individuality, the single-family home in the postwar period embodies the inherent—and often dangerous—contradictions between narratives of technological progress and innovation and the never-ending quest for human “authenticity.”

¹¹⁸ Faber Birren, “Find Yourself in Whose Hue.” *Better Home & Gardens* LXV (Summer 1959). Box #7, Folder 1. Faber Birren Papers, Robert B. Haas Family Arts Library, Yale University.

Chapter Three

Impossible Geometries: From Color Space to Interface

Blue and Black or White and Gold?

In February 2015, a Tumblr user posted a seemingly innocuous image of a two-toned bodycon dress with lace detail accompanied by the following caption: “Guys please help me, is this dress white and gold, or blue and black? Me and my friends [sic] can’t agree and we are freaking the fuck out. I CAN’T HANDLE THIS.” Within 48 hours, the post had over 400,000 notes, and at its peak, was getting 14,000 views a second. Over on Twitter, users created the hashtags #blackandblue, #whiteandgold, and #dressgate to defend what they believed was the “true” color of the dress.¹ That same week, more than 1.8 million people participated in a poll conducted by the pop culture website BuzzFeed which revealed that 72 percent believed the dress was white and gold, while the other 28 percent claimed it was blue and black. The image, which came to be referred to as simply “The Dress,” was the first documented incident of color ambiguity gone viral on such a large scale—many articles described it as having “broken the Internet.”

Though many dismissed The Dress as yet another example of the banality of meme culture and the monetary drive behind clickbait, I would argue that it caused such an uproar precisely because it violated what many understood to be “real,” unquestionable, or calculable. The post produced a crisis of faith for those who had previously believed in the absolute consistency of photographic images across multiple screens and digital technology’s supposed ability to homogenize perception. That the dress itself actually turned out to be black and blue was ultimately anticlimactic, since it neither fully accounted for the perceptual anomaly of the image nor explained the fraught relationship between color and so-called “objective” perception. Despite the Internet’s treatment of The Dress as a chromatic anomaly, the image reveals that the perceived accuracy or objectivity of color is ultimately a myth, even—or as we will see, especially—when it comes to computer monitors.

As it turned out, the color ambiguity of The Dress stemmed from the ways different people perceive ambient lighting conditions. Those who understood the image to be lit by natural lighting during the daytime saw it as white and gold, whereas those who perceived the dress as illuminated by incandescent department store lighting saw it as blue and black. Such a discrepancy across individuals also depends on whether one’s eye has a preexisting bias to discount shorter or longer wavelengths on the color spectrum.² One crucial but overlooked reason for the inconsistent responses to The Dress had to do with the color balance and backlighting of individual computer monitors. For the optical illusion to work, The Dress could only have been a digital photo shot with a cell phone camera and displayed on an electronic screen. The photograph was overexposed, which threw off the light levels and color balance within the image, and because the photo was cropped in such a way so as not to provide any environmental context, it was impossible to tell what time of day it had been taken.

Ultimately, it was converting the image into RGB values in Photoshop that revealed The

¹ Olessia Vankevich, “The Dress: More Than Just a Meme.” *Medium*, February 2, 2017. <https://medium.com/rta902/the-dress-more-than-just-a-meme-6773578304d4>

² Rosa Lafer-Sousa, Katherine L. Hermann, and Bevil R. Conway. “Striking Individual Differences in Color Perception Revealed by ‘The Dress’ Photograph.” *Current Biology* 25, no. 13 (May 2015).

Dress’s “true” color [Figure 1], since uploading the image into Photoshop allows the user to adjust its color values on a sliding scale to make it appear white and gold *or* blue and black. However, this didn’t account for the fact that different computer monitors often have different color outputs, and factors such as backlighting, screen angle, the user’s physical distance from the monitor, and the color calibration of individual screens mostly flew under the radar.

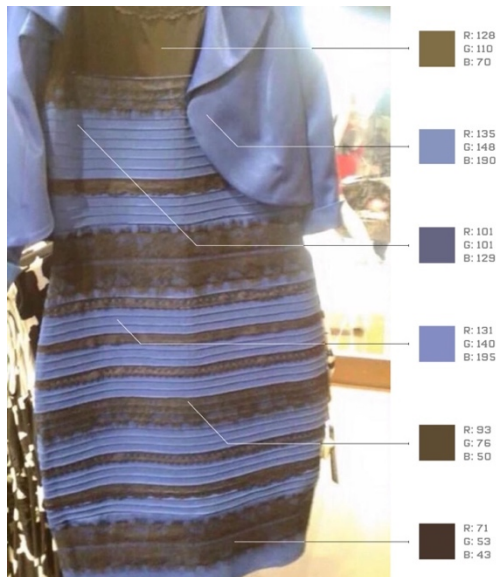


Figure 1. Color values of The Dress when uploaded into Photoshop.



Figure 2. A split-screen montage from the sitcom *Broad City* (S3E1 “Two Chainz,” 2016) features its protagonists Abbi and Ilana wearing the two “rival” versions of The Dress.

On the one hand, the ability to adjust individual pixels in Photoshop—a platform often described as the “industry standard” for photo-editing and graphic design—demonstrates how color has become increasingly standardized with the rise of “user-friendly” software. On the other hand, as The Dress meme demonstrates, customizable settings and variations *within* these supposedly standardized technologies, as well as differences in individual cognition, reveal the impossibility of fully automating color or human perception. What The Dress disrupted—if only temporarily—was the pervasive rhetoric that equates digital images with efficiency and exactitude. This discourse not only presumes that computer color faithfully reproduces human color vision, but also that these colors are easily translated between different technologies and formats.

It hardly needs to be said that presenting this process of translation as intuitive and easy is crucial for software companies like Adobe and color forecasting agencies like Pantone whose brand images are based on this notion of easy-to-use color. Tools such as the Color Picker and Eyedropper in Photoshop allow users to obtain a precise numerical color value by clicking on the desired part of the image. The Color Picker involves clicking on the foreground or background layer, the color value of which can then be sampled and adjusted for brightness, saturation, and other qualities. A menu pops up that displays the color’s numerical values in terms of various output formats (RGB, CMYK,³ and so on), making it possible to predict what the result will look

³ Printers today still use the CMYK subtractive process that dates to 1906, which processes four ink plates in different colors: cyan (or turquoise), magenta, yellow, and black (black becomes “key,” or the “K” in CMYK due to the fact that the black ink plate was used as the “key” plate that kept the other colored

like. The Eyedropper operates by a similar logic, sampling pixel values with a single click so that the color selected can become a new foreground or background color. Both tools are designed with painterly intuition in mind: even though the mathematical values of each color are visible, they give the user the illusion that moving between color systems is fluid and effortless.

The reality, however, is that moving between color systems designed for different technologies or purposes, known to graphic designers as “color management,” is a complex and messy endeavor that involves calibrating visual data from one source (e.g., an uploaded digital photograph) to fit an industry standard and then adapting this new data to the desired output device (e.g., a printer). Anyone who has tried to print in color knows that the printed image will differ from the on-screen version, a disparity that results from the incompatibility of CMYK (subtractive/pigment-based) and RGB (additive/light-based) color systems. Computer color is always multiple, adapting to different file formats and sizes, types of screens, and outputs. There are also many other complicating factors preventing the complete homogenization of digital color, such as differences in display and resolution between individual monitors highlighted by *The Dress*. Far from an intuitive process, color management is a “technological juggernaut”—a process of complex mediation and labor.⁴

Beginning with the earliest iterations of computer color in the 1970s and early 1980s, various color standards initially designed for pigments were adapted and reconfigured for light-emitting screens. Paint companies such as Benjamin Moore, Pantone, and Sherwin-Williams, which had peaked in popularity during the 1950s and 1960s, were forced to drastically rethink their business models as they tried hurriedly to adapt to the increasingly computer-focused world of color. Benjamin Moore’s Computer Color Matching System, released in 1982, could digitally match the color of a fabric or paint sample to a precise shade, giving customers a broader range of colors to choose from, rather than being constrained by a set of pre-existing color chips. Though their Color Matching System was created in 1963 specifically for color printing, Pantone likewise enthusiastically welcomed the shift to computer color. As early as 1974, the company created a Color Data System for computerized inkjet printing [Figure 3] and established an Electronic Color Systems Division in 1984.⁵ In the 1990s, Pantone amped up their commitment to digital color, hosting talks such as “The Future of Color in Computer Graphics” and creating an electronic “toolkit” that calibrated colors for Macintosh-compatible desktop systems.⁶ During

plates aligned). These four colors are the minimum colors needed to produce a wide array of shades through layering: cyan and yellow form green, magenta and cyan form purple, and so on. CMYK, like many of the color systems cited so far, approximates the color spectrum, which can be segmented an infinite number of ways through a finite number of variables.

⁴ Haji Nik Daravath and Uttam Kokil, “Effect of pre-defined color Rendering Intents (CRI) on the Hue attributes in a Color Managed Workflow (CMW).” *The Journal of Technology Studies* 40 no.1/2 (Spring/Fall 2014), 14.

⁵ A press release announcing Richard Herbert’s appointment as Vice President of Pantone’s Electronic Color Systems Division notes: “[Herbert] has been working since 1976 with color as it pertains to color order systems, spectrophotometric data and its translations into various color spaces such as RGB, CMYK and CIE.” Herbert was promoted to president of the whole corporation in 2001.

Pantone, “For Immediate Release: Richard Herbert Appointed Vice President of Electronic Color Systems Division for Pantone, Inc.” Press Release, 1984. Cooper Hewitt Research Library, Smithsonian Museums.

⁶ In 1990, Pantone stated in a press release that “In the last few years, the design field has been significantly affected by the computer. Much of the traditional method of creating visuals, drawings and finished art has been taken over by PCs and laser printers.” “Pantone is Color Communication.”

this time, they also added both RGB and HTML codes to all color values, and have since developed several digital apps such as Pantone Color Manager and Pantone Studio. Pre-computational color systems are therefore not obsolete but were instead subsumed (albeit with great difficulty) into electronic and digital media.



Figure 3. This 1987 Pantone Catalogue features a computerized scale for weighing inks, a Color Viewing Light, and Color Data System, which “incorporates the technology of a microcomputer, spectrophotometer and sophisticated software.” Box #3, Folder 34. Faber Birren Papers, Robert B. Haas Family Arts Library, Yale University.

This chapter examines the ways in which the material aspects of the computer supposedly obfuscated by the screen, such as its numerical code and frame buffer bit structure, have played a key role in creating a new vernacular surrounding digital color—what I call “seeing by numbers.” This shift in perception, whereby colors are ultimately understood as numerical, cannot be separated from the messy landscape of standards, mismatched color systems, and flawed displays that constitute today’s landscape of computer color. I focus on two prevalent spatial models of conceptualizing color on digital screens: *color depth*, or the number of bits per pixel used to render specific colors, and *color space*, a mathematical model that attempts to contain all perceivable colors within an idealized geometrical solid. By adapting to the limitations of specific technologies, together color depth and color space represent an impossible goal: to encompass the totality of color perception while at the same time demarcating its edges and borders. As such, these spatialized models of digital color are particularly emblematic of an ongoing tension between embodied experience and quantitative norms that characterizes much of postindustrial culture and technology.

Thus, rather than a purely obfuscating conception of digital color as “seamless,” color’s ubiquity on electronic screens has led to an increasingly attentiveness to color’s status as modular and discrete, whereby users are highly conscious of the choppiness and messiness of computer color. This worldview or outlook, which can be glimpsed within the increasingly blurry categories

(Pantone: Moonachie, New Jersey, 1990). Press release. Cooper Hewitt Research Library, Smithsonian Museums. On November 7th of the same year, Cooper Hewitt hosted a symposium, sponsored by Pantone, called “The Dynamics of Color.” Clement Mok, former creative director of Apple, led a computer demo titled “The Future of Color in Computer Graphics.” *The Dynamics of Color*, November 7, 1990. Cooper-Hewitt Museum, New York City. Printed schedule. Cooper Hewitt Research Library.

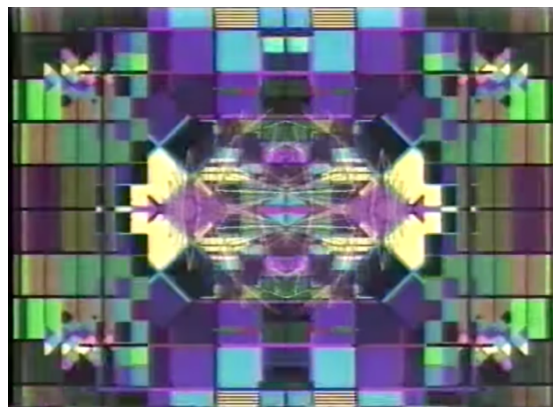
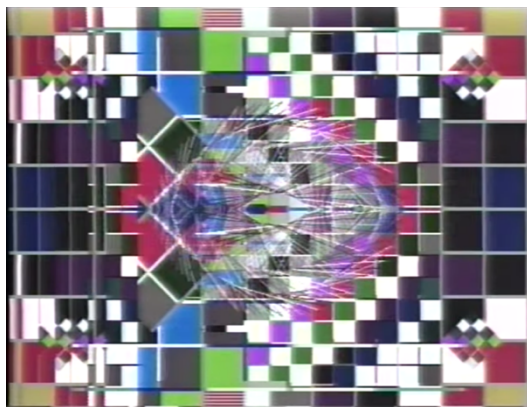
of so-called “high” and “low” culture (social media platforms, message boards, and popular television shows on the one hand, contemporary art installations and experimental films on the other), speaks to a broader, post-computational tendency to think of color as quantitative, reproducible, and above all, *plural*. Such a vernacular or discourse indicates an awareness of color’s highly mediated and constructed nature, whereby numbers, rather than being concealed, become part of a pervasive worldview.

(Super)Painting with Light

Rainbow starburst shapes erupt against a black background in time to the opening bars of “Jupiter” from Gustav Holt’s *The Planets Suite*.⁷ The color palette is overwhelmingly bright, luminous, and high contrast, recalling fluorescents and Day-Glo pigments. The screen flickers repeatedly and fades to black, only to be replaced by concentric squares that swipe and scan across in all directions. These squares, like the starbursts that preceded them, contain color gradients, but the transition between hues is anything but seamless: instead, we can clearly see stripes between intermediate shades, drawing our attention to the individual pixels of the monitor.



The chromatic frenzy continues with every sequence: a particularly psychedelic moment features a symmetrical, kaleidoscopic image with a shape resembling a peacock’s feather in its center.



⁷ Thanks to Andrew Sandwick for initially helping me identify the soundtrack.

Squares of color pulsate and blink rhythmically like tiny lights on a switchboard, splitting the screen into modular units. The animation begins and ends with a shape resembling a Rubix cube: an invisible hand fills in individual-colored blocks until the solid is complete, the image bringing itself into being.



Figure 4. Stills from *Vidbits* (Alvy Ray Smith and Richard Shoup, 1974; Xerox Corporation, Palo Alto Research Center). Accessed online via the Computer History Museum.

This mesmerizing fifteen-minute video is Alvy Ray Smith’s *Vidbits*, created in 1974 with SuperPaint, one of the earliest interactive digital paint systems that could render color graphics in real-time.⁸ At first glance, the animation recalls the twentieth-century abstract “visual music” of Oskar Fischinger, Mary Ellen Bute, and Len Lye, which attempted to capture a synesthetic relationship between color and sound.⁹ But whereas visual music usually involved painting or projecting directly onto film stock, *Vidbits* functions as a kind of tutorial or how-to manual for SuperPaint, which was created by Richard Shoup between 1972 and 1973 at Xerox Corporation at Palo Alto Research Center (also known as Xerox PARC).¹⁰ Showcasing multiple colors and tools such as the “cycle brush” feature (this is likely how Smith created the starburst-shaped color gradients), the animation displays SuperPaint’s affordances as well as its limitations. A frame buffer—a two-dimension grid that stores color information as numerical pixel values or “bits”—made it possible for the first time to display a much wider range of colors on screen.¹¹ But as an 8-bit system, SuperPaint could only display 256 distinct colors at a time and lacked the “airbrush” feature of newer 24-bit paint systems such as Paint3 that could smooth away the “choppy” boundaries between colors.¹² Ultimately, *Vidbits* emphasizes the modularity and manipulability of individual pixels made possible by digital paint systems.

Smith’s primary contribution to SuperPaint was the HSV (Hue, Saturation, and Value) algorithm, which created a more “intuitive” color-mixing experience than RGB, the default color

⁸ Though there were digital paint programs predating SuperPaint in the late 60s and early 70s, these relied largely on achromatic vector graphics rather than pixel displays with a wide array of available colors. See Jacob Gaboury, “The Random-Access Image: Memory and the History of the Computer Screen.” *Grey Room* 70 (Winter 2018): 24-53.

In 1975, *Vidbits* was exhibited at MoMA and featured on the WNET television show *VTR*.

⁹ See Joshua Yumibe and Sarah Street’s *Chromatic Modernity: Color, Cinema, and Media of the 1920s* (Columbia University Press, 2019) for an extensive analysis of “color music” and film.

¹⁰ Xerox PARC ended up pulling the plug on its color imaging research, and Smith and Shoup took their endeavors elsewhere—the former co-founding Pixar Studios and the latter Aurora Systems.

¹¹ Jacob Gaboury, “The Random-Access Image: Memory and the History of the Computer Screen.” *Grey Room* 70 (Winter 2018), 35.

¹² Alvy Ray Smith, “Digital Paint Systems: An Anecdotal and Historical Overview.” *IEEE Annals of the History of Computing* (April-June 2001), 20.

model for light-emitting screens. HSV deliberately references and borrows from pre-computational (and indeed, pre-electronic) color systems such as Munsell (recall that the Munsell System classified color by hue, chroma, and value, with chroma being more or less synonymous with saturation).¹³ By contrast, in an RGB additive color system, as seen in broadcast video and television, each point of color is a combination of different proportions of red, green, and blue light, with maximum amounts of each combining to create pure white. But in a system like SuperPaint, which was designed to emulate the experience of painting or drawing with paint and ink, it felt much more spontaneous for someone with an artistic background like Smith to adjust the on-screen image in a way that evoked subtractive color systems designed for pigment, in which there is a reduction in light when colors are mixed.¹⁴

SuperPaint thus involved a “canvas” featuring a sequentially numbered “palette” at the bottom of the screen from which one could choose colors, but an HSB slider at the top that allowed for mixing in real-time [Figure 5]. Ultimately, what made SuperPaint so unprecedented was its liveness—that is, using a stylus on tablet while seeing pixels change color on a TV monitor before one’s eyes (functions included Paint, Shrink 2X, Expand 2X, Move, Copy, Store and Load, Text, Video In, Make Brush, DrawLines, Gridding, Area Fill, and color table animation).¹⁵ By making screen graphics an essential part of the computer, SuperPaint thus marked the beginning of an ongoing disconnect between interface and code. Whereas programmers had previously only seen colors as numbers during the programming process, SuperPaint, like today’s computers, concealed digital color’s numerical status by allowing users to engage with color visually on screen—even though the numbers corresponding to each color “had no continuous or indexical connection to the actual output color.”¹⁶

Though we have come to take this kind of tactile interactivity for granted, Smith claimed that prior to the growth of personal computing in the 1980s, he had trouble explaining “that it really does work [in SuperPaint] to move your hand ‘down here’ on a mouse or tablet while watching the result ‘up there’ on a video display.”¹⁷ By creating a direct relationship between the (concealed) digital frame buffer with a television display, SuperPaint countered the notion that the computer was a “non visual number-crunching apparatus,” thus introducing colored interfaces as a key feature of the contemporary technological landscape.¹⁸ This fusion was made possible with an encoder that would convert digital RGB color values to analog NTSC ones (the color TV standard established by the National Television Standards committee). This conversion then gave

¹³ HSV was later renamed HSB (replacing “value” with “brightness”) at Adobe Systems in 2001.

¹⁴ As Smith reminisced in 2001: “... RGB color space controls are the natural ones for computer graphics and video, but I had trouble mixing, say, pink or brown with them. I asked Dick for the algorithm that converts RGB to and from the more intuitive hue-based world that I knew from painting: Mix a color by choosing a base with the desired hue; add white or black paint to lighten or darken it. So pink and brown are just red lightened with white and darkened with black, respectively. Surprised when Dick told me that no such algorithm existed, I sat down and invented one overnight—the first simple hue-based color mixing system for computers, the HSV algorithm—and coded it into Dick’s paint program.” Alvy Ray Smith, “Digital Paint Systems: An Anecdotal and Historical Overview,” 12.

¹⁵ Richard Shoup, “SuperPaint: An Early Frame Buffer Graphics System.” *IEEE Annals of the History of Computing* (April-June 2001), 34-35.

¹⁶ Carolyn L. Kane, *Chromatic Algorithms: Synthetic Color, Computer Art, and Aesthetics After Code* (The University of Chicago Press, 2014), 116.

¹⁷ Alvy Ray Smith, “Digital Paint Systems: An Anecdotal and Historical Overview,” 34-45.

¹⁸ Kane, *Chromatic Algorithms*, 162.

SuperPaint uses the option to either broadcast their work live or record it on a videotape.

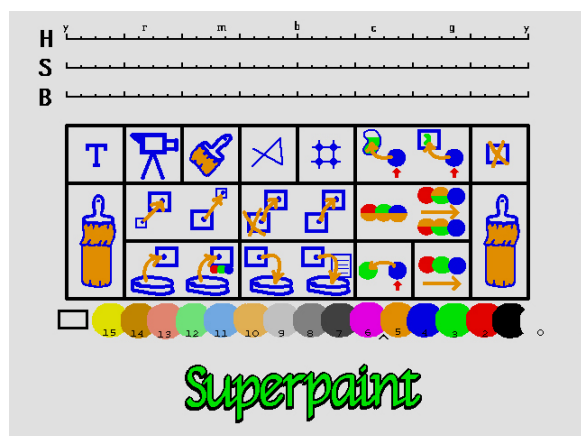


Figure 5. SuperPaint menu, circa 1972. Copyright Richard Shoup

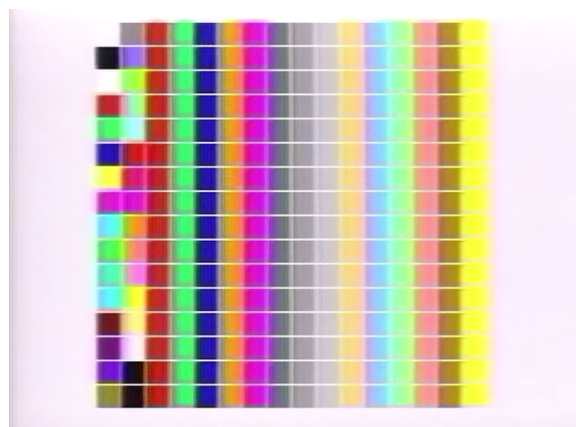


Figure 6. Alvy Ray Smith, a full array of SuperPaint's 256 possible colors. Still from "Early Digital Paint Systems Demonstration— Narration by Alvy Ray Smith" (2015). The Computer History Museum.

The title *Vidbits* is of course a portmanteau of “video” and “bits” (which is itself a portmanteau of “binary digit”), emphasizing SuperPaint’s fusion of digital bit color with the medium of video. While these technologies are no longer seen as distinct since photography, film, and television are all now largely shot digitally, it’s important to note that both television and video (unlike film) were intended for live broadcast and transmission rather than storage and recording. In this sense, interactive computing, which requires storing information in the form of bits, is inherently at odds with analog television and video. Bridging this divide was one of the key accomplishments of SuperPaint.

To those used to engaging with 24-bit color or “true color” (which can display 16 million colors), SuperPaint’s world of 8-bit color, with its mere 256 distinct colors and low resolution, feels like a sketch or cartoon rather than a 3D rendering—what Hito Steyerl calls a “poor image.”¹⁹ 8-bit color is flat and opaque, whereas true color also allows users to manipulate the opacity or transparency of each pixel. Today 8-bit color is cloaked with a good bit of nostalgia, associated with 1980s arcade and video games whose graphics appear to today’s users as “primitive.” *Scott Pilgrim Versus the World* (Edgar Wright, 2010), a film that pays homage to retro video games, opens with an “8-bit” version of the Universal logo [Figure 7]. Compared to the logo that was actually in use at this time [Figure 8], this version appears blurry: the edges of the globe are jagged, not smooth and the colors feel matte and flat (though the gradient on the globe is arguably more sculptural than would have been possible with actual 8-bit color). By contrast, the actual 2010 Universal globe has dimensionality and sheen: the globe emits a faint halo of light, and the rough texture of the Earth’s land masses contrasts with the smooth blue gradient of its oceans. The irony is that to be released in theaters, at least 24-bit color would have been required to meet the display requirements of such a large screen. This means that the choppiness and perceived pixelation of the *Scott Pilgrim* intro credits is a simulation, a nod to early computer graphics but in much higher resolution. 8-bit color has thus become a nostalgic aesthetic, where viewers and artists alike are hyper-aware of the modular nature of the computer screen.

¹⁹ Hito Steyerl, “In Defense of the Poor Image.” In *The Wretched of The Screen* (Sternberg Press/ e-flux journal, 2012): 31-45.



Figure 7. “8-bit” Universal logo from *Scott Pilgrim vs. the World* (Edgar Wright, 2010)



Figure 8. Official Universal logo from 2010

To take another example of this “8-bit aesthetic,” conceptual artist Angela Bulloch’s *Standard Universal: 256* (2001) takes the 256 possible colors of early 8-bit Macintosh Operating Systems as a point of departure. Part of Bulloch’s ongoing “Pixel Box” series, the installation consists of a series of glass-fronted boxes, each with a light-emitting screen. Illuminated from within by an RGB color system, the colors of each cube are programmed to modulate between a set number of shades. In the case of this particular work, there are only 256 available colors, but other pieces display up to 16 million in accordance with 24-bit color. The colors of the boxes are fixed permutations tied directly to the form of the grid, clearly demarcating the modularity and discreteness of numerical color.

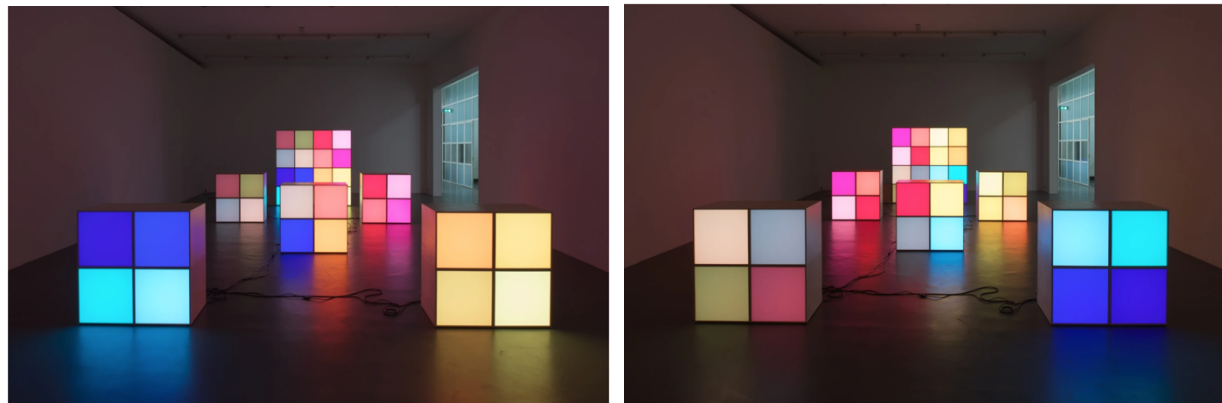


Figure 9. Angela Bulloch, *Gang of Four* (2004). 4 DMX boxes, 1 black box module, photographic print on transparent plastic, diffusion foil, 2 sheets of glass, frame. Esther Schipper Gallery

By taking the micro-unit of the pixel and giving it materiality and plasticity, Bulloch’s installations such as *Gang of Four* (2004) [Figure 9] recall the simple geometric forms of Minimalist art, but with a distinctly post-computational aesthetic. The viewer must position their body in relation to these “blown-up” pixels, to think about color sculpturally and architectonically, but in a way that is distinct from the work of artists who treat color as formless and fluid, such as James Turrell, Olafur Eliasson, or Dan Flavin. For Turrell and Eliasson’s work, color, light, and atmosphere are one and the same: ephemeral, without edges, infinite.²⁰ Whereas the colors of Flavin’s neon

²⁰ As Crary describes of Eliasson’s work, “he makes it impossible for a spectator to objectify the chromatic events as a property of a delimited surface or screen to which we have a contemplative relation.” Jonathan Crary, “Your Colour Memory: Illuminations of the Unforeseen.” In *Olafur Eliasson: Minding the*

installations appear to emanate from an unknown source, Bulloch showcases hardware, such as electrical cables and control panels, that is usually concealed.

Color depth (bits per pixel)	Number of possible colors	Type of monitor	Years in widespread commercial use
1	2	Monochrome display	1970s
2	4	Color Graphics Adapter (original PCs; displays with maximum 640 x 200 resolution)	1981-1984
4	16	Enhanced Graphics Adapter (displays with maximum 640 x 350 resolution)	1984-1987
8	256	Video Graphics Array (displays with maximum 640 x 480 resolution)	1987-1990
16 (“high color”)	65,536	Extended Graphics Array (displays with maximum 1024 x 768 resolution)	1990-the present
24 (“true color”)	16,777,216	Most cell phone and computer displays today	Early 1990s- the present
32	16,777,216 + transparency	Some smartphones; computer displays for professional purposes (design, visual effects, etc.)	Present day
48	281,474,976,710,656	Professional editing programs (e.g., Photoshop), large format digital scanners	Present day

Table 1. A history of color depth

This spatial or multidimensional understanding of digital color is made even clearer by the fact that the number of bits per pixel is referred to as *color depth*. As Table 1 indicates, color depth depends greatly on the type of monitor used and the resolution of images it can display. While Xerox PARC was developing 24-bit color (today’s default color depth for most devices) as early as 1977, such displays would not be in widespread commercial use for another few decades. The gradual increase in color depth and resolution over the past several decades might seem to suggest that computer graphics are moving closer and closer towards a mimetic or “real”

World, ed. Olafur Eliasson and Gitte Ørskou (ARoS Aarhus Kunstmuseum, 2004): 209.

replication of color perception. Such an interpretation recalls André Bazin's description in 1946 of what he called "total cinema" or "a total and complete representation of reality... the reconstruction of a perfect illusion of the outside world in sound, color, and relief."²¹ In this reading, new technologies such as sound and color, film can only ever asymptotically approach reality—moving towards it but never reaching it—forever retaining its status as imitation or representation.

But whereas Bazin's argument about film comes from an aesthetic project grounded in realism and indexicality, color systems, particularly electronic and digital ones, can never be fully mimetic due to their aims at complete standardization.²² Because color systems have historically attempted to organize, classify, and encompass all colors seen by a "standard observer," they deny any space for contingency or variation. As Kittler (whose disavowal of the human is the antithesis of Bazinian aesthetics) boldly asserts, "art and media are fundamentally about the deception of sensory organs."²³ It is precisely because of this sensory deception that technologies such as photography, film, and television have been discussed as replicating human vision and perception, even though they have actually been "developed strategically to override the senses."²⁴ All of these media exploit our eyes' ability to fill in the gaps between discrete units, such as the twenty-four frames per second in film that create the impression of seamless movement or the "optical mixing" that occurs when a viewer looks at red, green, and blue phosphor dots on a television screen. In film, the speed of twenty-four frames is too fast for human eyes to keep up with, making the illusion of movement more convincing, because the viewer does not notice the flickering of the shutter. Whereas the alternating frames and flickering light of the filmic apparatus can be traced to psychophysical experiments involving blinking and the persistence of vision, the additive structure of televisual images was based on the way the retina processes color.²⁵ R, G, and B, which are known as "tristimulus values," are based on nineteenth-century trichromatic theories of vision, which identified the retina having three types of color receptors in the eye (today we know these as cones)—red, blue, and green—which, combined with light-based stimuli, created the visible spectrum.

²¹ André Bazin, "The Myth of Total Cinema." In *What is Cinema? Vol. 1* (The University of California Press, 1967), 235.

²² The questions of realism and indexicality in relation to digital cinema have been hotly debated, but these discussions are part of a distinctly different lineage than the one laid out by Sterne. See Stephen Prince, "True Lies: Perceptual Realism, Digital Images, and Film Theory." *Film Quarterly* vol. 49, no. 3 (Spring 1996): 27-37; *differences* vol. 1 "Indexicality: Trace and Sign," edited by Mary Ann Doane (May 2007); and Francesco Casetti, "Sutured Reality: Film, From the Photographic to Digital." *October* no. 138 (Fall 2011): 95-106.

²³ Friedrich Kittler, "Theoretical Presuppositions." In *Optical Media: Berlin Lectures 1999*, trans. Anthony Enns (Polity Press, 2010), 38.

²⁴ *Ibid.*, 36.

²⁵ Mary Ann Doane examines the historical context of this fascination with the persistence of vision in relation to 19th-century optical toys such as the phenakistoscope. See "The Afterimage, the Index, and the Present" in *The Emergence of Cinematic Time: Modernity, Contingency, the Archive* (Harvard University Press, 2002): 69-107.



Figure 10. This 1861 image of a tartan ribbon by physicist James Clerk Maxwell is often cited as the first attempt at color photography. Responding to debates surrounding trichromatic vision and color perception, Maxwell overlaid red, green, and blue transparencies of the same image (taken with three different colored filters), creating a color composite. Photo credit: Timeline of Historical Film Colors.

At this point I'd like to step back and look more closely at the spatial characteristics of digital color I mentioned above with Angela Bulloch's work. While the embodied first-person experience of the physical gallery space might seem at odds with the detached standard observer of rationalized color systems, the two intersect in intriguing and complex ways in the realm of computer graphics. Here the title of Bulloch's pixel box series, "Standard Universal," takes on new meaning. Digital standardization and discretization must reckon with the continuity and boundlessness of the visual field, transforming the sensory experience of color into a set of mathematical variables to be normalized by technological media.²⁶

Color Space and Sensory Deception

In an evocative passage from 1942, artist Milton E. Bond and color scientist Dorothy Nickerson²⁷ describe an imaginary first-person spatial "encounter" with the Munsell Color System:

For a dramatic visualization of the color solid concept the teacher may present it as a sort of World's Fair building in the form of a cylinder. Its central core entered in utter blackness is an elevator shaft in the sub-basement. If you ride in the elevator you proceed from this blackness by degrees to utter whiteness at the top. At each floor level the elevator takes on the appearance of a lighter gray. On each floor corridors radiate from this central elevator toward the outside of the building. As you leave the elevator at, say

²⁶ Ricardo Cedeño Montaña, "Encoding Color: Between Perception and Signal." In *Science in Color: Visualizing Achromatic Knowledge*, ed. Betting Bock von Wülfingen (De Gruyter, 2019), 103.

²⁷ Painter Milton E. Bond (1891-1970) was initially trained as a chemist at the Rochester Institute of Technology but maintained a strong interest in color and the arts. He worked at the Munsell Company between 1922 and 1925 as a color specialist, creating a system to describe colors scientifically based on their position on the Munsell color solid. Dorothy Nickerson (1900-1985) worked for the Munsell Color Foundation from 1921-1926 as a laboratory assistant, then went to work for the U.S. Department of Agriculture. She is credited with creating the Munsell Soil Color Chart, which uses the Munsell system to classify the colors of different soils. Nickerson played a key role in the Munsell renovations conducted through the Optical Society of America and has published multiple articles on the subject.

the fifth floor, you notice that all the colors are of value 5, neither very light nor very dark. Perhaps you start down the red corridor. Near the elevator shaft all the red colors appear dull. As you proceed away from this central area the impression of redness increases until at the end of the corridor it is vivid! You could observe like effects in the green, blue, or purple corridors, or on other floors.²⁸

Recall from Chapter One that the Munsell Color System classifies color by *hue* (dominant wavelength), *value* (brightness), and *chroma* (saturation), and that it can be rendered three-dimensionally as either a color “tree” or a cylinder. In these spatial models, value makes up the “trunk” of the tree or vertical axis of the cylinder, with hue and chroma making up the “branches” or horizontal axes [Figures 11 and 12].

What is interesting about the above description is that an elevator, as opposed to a tree or a cylinder, involves a human subject. This subject, as indicated by the second-person address, is mobile, exploring Munsell’s color solid from within. The passage continues:

If you stand in the central shaft and turn about, as on a pivot, you may scan each hue in the circle about you, red, yellow, green, blue, purple, just as you might scan the horizon. It may be easy for students to remember the invariable arrangement in the color solid if they remember that H stands for hue, and also horizon. Dull hues form a near horizon as on a dull day, vivid hues a far horizon as on a clear day. The lower floors are dark in color, the upper light; therefore they might remember that V stands for value, also for vertical. Near the central shaft all is dull and gray; farther out all becomes more intense and vivid. The symbol C stands for chroma, also for centrifugal, radiating horizontally away from the neutral pole.²⁹

Here the color solid becomes an environment with its own geographical coordinates, where *hue* becomes *horizon*, *value* *vertical* and *chroma* *centrifugal*. Even though these associations are purely mnemonic, they indicate a spatialization of Munsell color that has been scaled to the human body. Though Bond and Nickerson make it clear, as indicated by the mention of students and teachers, that they conceived of this architectural metaphor primarily for pedagogical purposes, I find it striking that this metaphor is presented through the lens of first-person embodied experience (made even clearer with the second-person address). After all, the Munsell Color System is an abstraction of human vision involving color chips against an achromatic or “neutral” background, thus failing to account for the way the human eye adapts to varying levels of brightness or darkness. Yet, the words “horizon,” “dull day,” and “clear day” all indicate the evanescent nature of environmental color. Outside of Nickerson and Bond’s World’s Fair building analogy, however, such environmental conditions had to be eradicated from the system in its initial conception as a compromise where standards and norms always came first.

²⁸ Milton E. Bond and Dorothy Nickerson, “Color-Order Systems, Munsell and Ostwald.” *Journal of the Optical Society of America* 32 (December 1942), 716.

²⁹ *Ibid.*

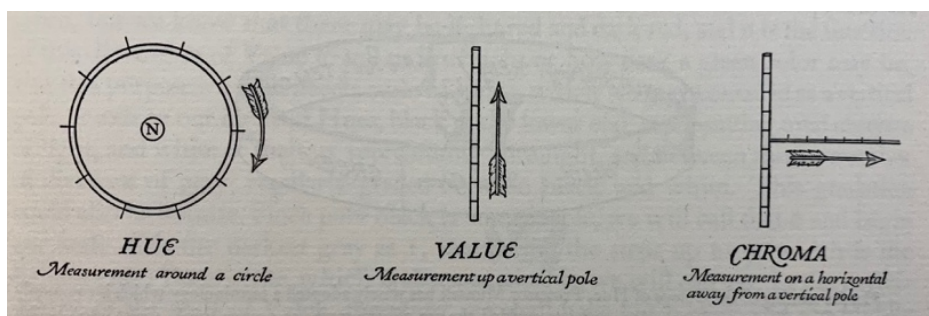


Figure 11. Hue, Value, and Chroma. A.H. Munsell, *A Grammar of Color: Arrangements of Strathmore. Papers in a Variety of Printed Color Combinations according to the Munsell Color System* (The Strathmore Paper Company, 1921). Cooper Hewitt Research Library, Smithsonian Museums.

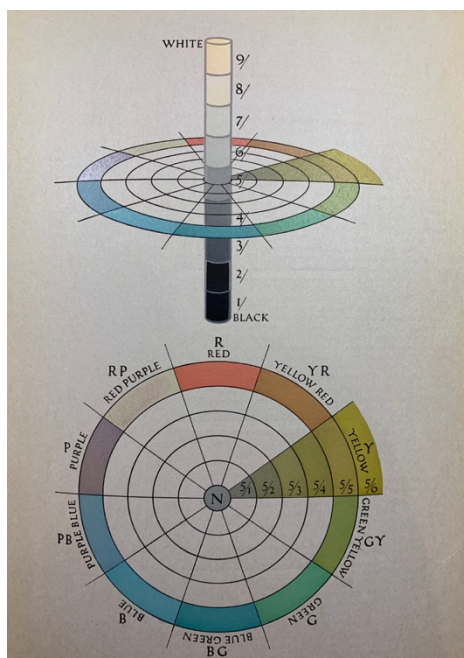


Figure 12. Aerial and side view of the Munsell color cylinder. A.H. Munsell, *Arrangements of Strathmore Papers in a Variety of Printed Color Combinations according to the Munsell Color System* (The Strathmore Paper Company, 1921). Cooper Hewitt Research Library, Smithsonian Museums.

The history of the Munsell Color System’s development makes manifest this tension between embodiment and abstraction. Ironically, painter and art educator Albert Henry Munsell himself had very little to do with today’s applications of the system that bears his name—that is, the regulation and calibration of color for commercial or governmental purposes. When he developed his color nomenclature in the early twentieth century, Munsell was primarily concerned with educational reform within the arts (though he did cultivate some ties to government and industry, education was his central concern). Believing that there was an ethical imperative to cultivate a “color sense” in children, he favored what he called “middle hues,” or colors containing an equal ratio of black and white, over the vivid, highly saturated colors that he saw as characteristic of consumer culture. By learning to intuit what color combinations were the most “harmonious,” he believed children would develop into upstanding adults—a kind of

training in aesthetic judgment through color.³⁰

With the establishment of the Munsell Color Company shortly before his death in 1918, however, the system began to be implemented on a wider industrial level, and shortly after, the company shifted from producing paper and school supplies to providing standardized measures for the sciences. In the 1940s, the Optical Society of America and the International Commission on Illumination made several changes to the system in conjunction with developments in spectrophotometry and colorimetry. Eastman Kodak, which by the 1950s held a monopoly on both photographic processes and film stock, helped establish the standard for color television through a series of test slides that relied on Munsell color swatches. These swatches acted as “control patches,” compressing the range of colors to maintain intermediate tones while limiting the brightest highlights and darkest shadow (or “dynamic range”).³¹ Because of the intimate link between color and standardized commodities, it was essential that colors in both printed and projected images match the colors of the product advertised in an attempt to bridge this gap between reproduced colors and reality. Ultimately, the Munsell system went from a largely artistic and pedagogical project—albeit one based in standardization and rationalization—to a technical and commercial one. As Nicholas Gaskill observes of Munsell, “Ironically, the man who set out to stymie the rise of consumer culture generated the very tools that fueled its acceleration.”³²

This shift from the experimental classroom to the standards and measurements of large-scale bureaucratic institutions also maps onto the transformation of the Munsell Color System into a set of notations that could be used to calibrate three-dimensional *color space*. The difference between a color system and a color space is not only semantic. Color systems merely seek to broadly classify and organize color; by contrast, though color spaces may be seen as a type of color system, the difference is that each color can be mapped onto a precise mathematical value, which can then be used to generate a wide range of colors for specific technologies. Rolf Kuehni and Andreas Schwartz, in their comprehensive survey *Color Ordered*, define color space as follows: “a conjectural geometric space in which all possible human color experiences are arranged in some kind of rational order, forming a color solid.”³³ To take a similar but slightly different definition, Pantone states on their website that “a color space represents the specific organization of available colors within a given system or color model used to render a digital image.”³⁴

Ultimately, color spaces aim to encompass all colors seen by an “average observer” within a three-dimensional space in order to standardize perception.³⁵ Though color spaces were initially to render analog color, as seen in the earliest standards for color television in the 1950s, they are indispensable for computer graphics and photo-editing programs such as Photoshop and InDesign, as well as visual effects in film. Color spaces are first and foremost about rendering

³⁰ Nicholas Gaskill, *Chromographia: American Literature and the Modernization of Color* (University of Minnesota Press, 2018), 126.

³¹ Such a compressed range was due to the fact that photographic images nearly always contain a narrower range of available colors than the objects depicted. Claire Lehmann, “Color Goes Electric.” *Triple Canopy*, May 31, 2016. Online. <https://www.canopycanopycanopy.com/contents/color-goes-electric>

³² Nicholas Gaskill, *Chromographia*, 128.

³³ Rolf G. Kuehni and Andreas Schwartz, *Color Ordered: A Survey of Color Systems from Antiquity to the Present* (Oxford University Press, 2008), 10.

³⁴ “What are Your Color Spaces? Understanding the Differences Between RGB, CMYK, CMYKOGV, and Spot Colors.” *Pantone*. [pantone.com/color-intelligence/articles/technical/what-are-your-color-spaces](https://www.pantone.com/color-intelligence/articles/technical/what-are-your-color-spaces)

³⁵ See Jonathan Sterne, *MP3: The Meaning of a Format* (Duke University Press, 2012)

color uniformly and reliably on electronic displays by describing the capabilities and limitations of a given device.³⁶ They also function as intermediaries, making it possible to move between different media and formats through numerical conversion (for example, printing an on-screen image or matching the color of a physical object to the same shade in Photoshop both rely on color spaces). To sum up, in their attempt to standardize reproducible color, color spaces are a simulation or idealization of perception, where no existing color space is capable of rendering the full spectrum of visible color—hence why they are “conjectural.” As such, today’s digital color spaces, such as Photoshop’s Adobe RGB, are part of an ongoing mission to give the *impression* of replicating the totality of human vision through a fixed and limited range of color and light values, even though this is an impossible task.



Figure 13. Catalogue of the Munsell system of color notation and the company’s major products (Macbeth, a division of Kollmorgen Corporation, April 1981). Faber Birren Papers, Robert B. Haas Family Library, Yale University.

When the Optical Society of America renoted the Munsell Color System in 1943, they standardized the previously murky concepts of hue, value, and chroma, making it possible to match and specify nearly any given color to a specific notation across industries.³⁷ A 1981

³⁶ Broadly speaking, there are two kinds of color spaces: *device-dependent spaces* and *device-independent spaces*. Device-dependent spaces are created for specific technical processes, such as the HSL space created for SuperPaint. Device-independent spaces such as CIE, on the other hand, express color in absolute terms with the aim of representing all colors that are visible to a “standard colorimetric observer” under idealized lighting conditions. Device-independent spaces are used as reference points for device-dependent spaces.

³⁷ The official ISCC-NBS Color-Name Charts list a variety of applications for the Munsell renotations. These include: “descriptions of drugs and chemicals; qualitative chemical analysis; dermatology; descriptions of mica, building materials, soils, and rocks; statistical studies of trends in industrial color usage; and planning lines of merchandise intended to have coordinated colors.” “ISCC-BNBS Color-

catalogue from the Munsell company [Figure 13] lists a range of objects for sale, such as a 3D model of Munsell Color Tree, a ColorChecker Color Rendition Chart (“a unique ‘test pattern’ scientifically designed to help photographers and cameramen compare the color reproduction of films, lighting conditions, cameras and lenses”), and a Student Spectrophotometer (“an instrument for teaching the basic principles of colorimetric absorption analysis. Features simultaneous display of the spectrum and its measurement at any selected wavelength from 400-700 nm”).³⁸ Slowly but surely, pre-existing color systems designed for pigment were being adapted for technologies that demanded the precise measurement of light. Indeed, the mathematically renoted Munsell color system forms the basis for most contemporary computerized color matching systems.³⁹

Several technological developments in the 1930s and 1940s made this transformation possible. The first was the invention of a commercial spectrometer (invented at MIT and manufactured by General Electric); this meant that Munsell color chips and swatches could be matched by wavelength and light intensity much more easily. 1931 saw the formation of the Inter-society Color Council (ISCC), an organization that holds an annual meeting to discuss the regulation of color across the arts and sciences.⁴⁰ The same year, the International Commission on Illumination, an international organization dedicated to standardizing light, illumination, and color, formulated their own patented color space. The color space, known as CIE (an acronym of its French name, “Commission internationale de l’éclairage”), was the first to establish a quantitative link between color as wavelength and colors as they are perceived in human vision. The combination of these factors meant that Munsell colors could be 1) measured spectrophotometrically, 2) converted into CIE data, and then 3) represented graphically as a series of mathematical curves on what is called the CIE chromaticity diagram [Figure 14].⁴¹ Though color television and digital screens were far on the horizon, the CIE color space would provide the foundation for these technologies—in fact, all digital color spaces today are based on the original 1931 diagram.⁴²

Chromaticity is the so-called “objective” quality of an object that separates color value from luminance, or brightness. Whereas color is a highly elusive, hard to pin down sensation dependent on both an object’s physical properties and the way the eye classifies visual information, chromaticity can be measured precisely by establishing three “primaries” such as

Name Charts Illustrated with Centroid Colors” (c. 1964). Cooper Hewitt Research Library.

³⁸ Catalogue of the Munsell system of color notation and the company’s major products (Macbeth, a division of Kollmorgen Corporation, April 1981). Box 3, Folder 34. Faber Birren Papers, Robert B. Haas Family Arts Library, Yale University.

³⁹ Edward D. Landa and Mark D. Fairchild, “Charting Color from the Eye of the Beholder: A century ago, artist Albert Henry Munsell quantified colors based on how they appear to people; specializations of his system are still in wide scientific use.” *American Scientist* 93 (September-October 2005), 442.

⁴⁰ See Ellen C. Carter and Cynthia Sturke, “Color in Science, Art and Industry: The Inter-Society Color Council 75th Anniversary.” *Inter-Society Color Council*, May 2006. Online.

<https://iscc.org/resources/Documents/ColorInScienceArtAndIndustry.pdf>

⁴¹ In 1943, ISCC, in collaboration with the U.S. National Bureau of Standards, officially renoted the Munsell Color System according to standardized CIE illumination levels. Dorothy Nickerson, “History of the Munsell Color Foundation 1942-1974 (Reprinted from ISCC Newsletter, No. 234, 197)” In *Munsell Color System, Company, and Foundation: Color Research and Application* 1 (1976), 8.

⁴² Ricardo Cedeño Montaña, “Encoding Color: Between Perception and Signal,” 106.

An updated color space known as CIELAB was created in 1976. Based on the 1931 CIE color space, CIELAB is most commonly used in Photoshop’s “Lab mode,” as well as PDF and TIFF photo formats.

red, green, and blue. By normalizing these primaries, color spaces can describe a light source mathematically without having to deal with the various environmental conditions that impact color appearance, such as background contrast, brightness, and other spectral effects. This highly abstract classification can be hard to wrap one's mind around: after all, is color without brightness still really color? Color spaces only include colors at a single set level of brightness; this means that the CIE diagram, which uses standard light sources, does not capture how the human eye actually processes color. Whereas the photoreceptors known as rods and cones automatically adjust to differently lit environments technologies that rely on color spaces, such as television, must separate color from brightness to ensure uniformity across multiple screens.⁴³ Rods function better in low lighting, whereas cones are largely responsible for perceiving color—we know that a red object is red even when the light dims, because our rods adapt to the dark and infer from context.

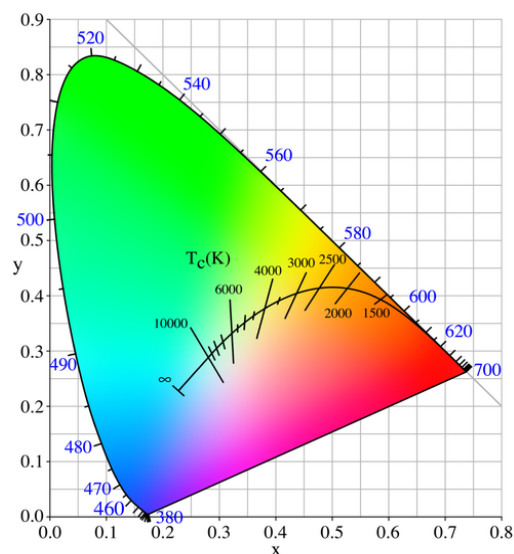


Figure 14. Color rendering of the 1931 CIE chromaticity diagram. Wikimedia Commons.

The human eye is therefore constantly adapting, adjusting its focus and translating light waves into visual sensations that the brain then processes as color. In contradistinction, cameras—particularly digital cameras that depend on color spaces—are *absolute measurement devices* that must be calibrated according to standard color and lighting schemes. If we think back to *The Dress*, where the digital photograph eliminated the context necessary to know the object's color, we are reminded that the eye is not a “passive camera.” Instead, it begins to “transform and reorganize the optical information that comes to it from the world... from the moment its receptors absorb light.”⁴⁴ Its reliance on standardized light sources and assuming the existence of a standard observer means that the CIE color space is a heavily streamlined and normalized approximation of human color vision. This restrictive understanding of “standard” human vision, which assumes a viewer who is not color-blind, but also does not possess unusual visual

⁴³ Kittler, “Optical Media.” In *Optical Media: Berlin Lectures 1999*, trans. Anthony Enns (Polity Press, 2010), 204.

⁴⁴ C.L. Hardin, *Color for Philosophers: Unweaving the Rainbow, Expanded Edition* (Hackett Publishing Company, 1988), 10.

acuity, has helped further engrain the ultimately deceptive notion that color technologies faithfully imitate how all people see.⁴⁵

The encroachment of CIE marked a key shift for spatial and mathematical conceptions of color. The CIE model visualizes color space as a series of curves on a graph—an upside-down horseshoe of sorts—where each point within the curved boundary has precise mathematical coordinates. The 1931 diagram has an X, a Y, and a Z axis, where these three variables mark the boundaries of color space.⁴⁶ Here, X, Y, and Z are not “real” colors, but standardized mathematical coordinates that set the limitations for how many colors can be included within this idealized color space—with the goal of encompassing as many perceivable colors as possible. By measuring the distance between the center of the color space and each axis, one can determine qualities such as saturation, hue, and so on (colors with higher saturation are at the edges of the diagram, whereas those lower in saturation are closer to the center). Though it is possible to plug in “real” color values, such as RGB, for XYZ, a decision still must be made about how to measure red, green, and blue. The original 1931 X, Y and Z values were based on three different standardized light sources, measured proportionally by temperature, whereas the values of R, G, and B are usually based on commercially available phosphors. The proportional relationship of these three values is more important than the values themselves, so that all colors can be mapped as some combination of X, Y, and Z, or R, G, and B within the color space.

While this may all seem overly technical, understanding the construction of the CIE chromaticity diagram is crucial, as it continues to function as the standard color space for screen color, often as an intermediary between two color spaces designed for different devices. For example, if a colorist working at a Pixar today wants to ensure that the colors of a film appear uniform across different devices (TV screens, computer monitors, projectors, and so on), they need to determine what is known as the *gamut* of each screen—that is, the range of perceivable colors a given device can reproduce. By embedding the gamuts of two different devices (which are rendered as triangles) within the “absolute space” of the CIE diagram, the colorist can then determine which precise color values these devices can both display [Figure 15]. The bigger the gamut, the closer the device can get to displaying the single-wavelength “pure colors” of red, green, and blue that constitute the edges of CIE color space.

Again, while it might be tempting to assume a gradual progression towards some kind of “perfect” screen that can display the pure spectral colors of red, blue, and green, color space remains an idealized, theoretical model. By contrast, physical materials such as inks, pigments, and the phosphors of most standard monitors are unable to reproduce these exact wavelengths. Thus, color spaces shift and adapt to the material structures and limitations of various technologies, where the output dictates the colors that must be used. Ultimately, the need to standardize these constants means color spaces will always be simulations, producing only a

⁴⁵ Here I am only discussing trichromatic color perception in so-called “average” humans (which is of course a problematic category). There are animals, such as most species of birds, that have four cones in their eyes and therefore can perceive far more color combinations, such as those deriving from ultraviolet. In theory, one could create a color space with an entirely different “standard observer”: color-blind humans, birds, and so on. Such a color space would look entirely different from the 1931 CIE diagram and have their own sets of color coordinates. One such experiment is a camera designed by photography and birdwatcher Nathan Chronister that attempts to replicates tetrachromatic “bird vision”:

<http://www.uvbirds.com/>

⁴⁶ The diagram itself is two-dimensional, but it’s important to remember that it is a 2D rendering of a 3D color space. Thus, Z is not included on the CIE chromaticity diagram, but it can be calculated mathematically.

subset of visible colors: there is no existing device that can reproduce the entire visible spectrum, even as gamuts increase in size [Figure 16]. Given that such color spaces provide the foundation for electronic and digital color, this means that *there is no such thing as a “true” or “accurate” color image*, as much as the image may convince the viewer that it does in fact represent what they see.

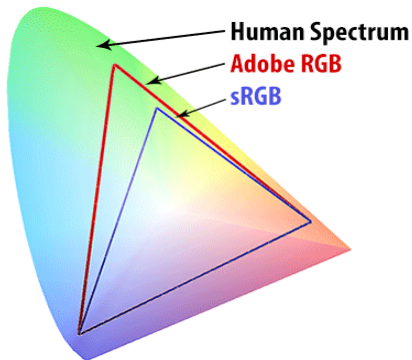


Figure 15. Adobe RGB has a larger color gamut than sRGB; it comes closer to approximating the full visible spectrum



Figure 16. A comparison between a device with a smaller gamut (left) and one with a larger gamut (right).



Figure 17. Tauba Auerbach, *RGB Colorspace Atlas* (2011). Three books, 8 x 8 x 8 inches each. Digital offset print on paper, case bound book, airbrushed cloth cover and page edges Binding co-designed by Daniel E. Kelm and Tauba Auerbach. The books were bound by Daniel E. Kelm assisted by Leah Hughes at the Wide Awake Garage. Image courtesy of the artist.

Still, despite the fact that the dissonance between the unchanging constants of abstract color space and the material limitations of various technologies is largely concealed, in the past decade, the mathematical nature of digital color has begun to enter popular and artistic discourse. Multidisciplinary artist Tauba Auerbach, who frequently turns to the implicitly “old” technology of the physical book to explore the relationship between human perception and abstract mathematical models, is one such example. Like Angela Bulloch, Auerbach uses computer color as an aesthetic paradigm, giving it materiality and physical substance. *RGB Colorspace Atlas* (2011) [Figure 17] is a series of bound books that measure 8 x 8 x 8 inches when opened; when folded, they transform into colorful cubes that reference the geometric structure of RGB color space.⁴⁷ Each book is digitally printed and airbrushed by hand to resemble a color

⁴⁷ *RGB Colorspace Atlas* was included in a solo show titled *Tetrachromat* (Bergen Kunsthall, November 11-December 22, 2011, Bergen, Norway). The term refers to organisms such as birds that have four cones in their eyes and can thus perceive colors invisible to humans, reflecting Auerbach’s continuing interest in color vision and perception.

gradient. Flipping through the pages, however, becomes a way of “slicing” through color space, the individual page serving a purpose similar to a pixel: barely perceptible discrete units that create the impression of a whole.

As I’ve already discussed, there is no existing technology can render the entire visible spectrum. Using the medium of print means that these so-called “RGB” cubes would have been created through conversion to CMYK, thus meaning that these objects are materially removed from the technology to which they refer. Yet, what is important here is not mathematical exactitude itself, but the way mathematical exactitude serves as an artistic or philosophical point of departure. Meredith Hoy reads such art objects, which have a distinctly “post-computational” or “informatic” aesthetic, as emblematic of an epistemological shift where “the ‘digital’ becomes a sensed and experiential, as well as a technological, category.”⁴⁸ The term “atlas” in *RGB Colorspace Atlas* invokes a compendium of knowledge, reflecting how knowledge in the post-computational era is often equated with quantification.⁴⁹ Auerbach, while well-versed in graphic design and printing, is not a programmer; her artists’ books are a way of thinking through what it means to “see by numbers” in a broader conceptual sense. “Seeing by numbers” as I conceptualize it does not refer to an absolute knowledge of exact numerical values, but rather to a shifting understanding of the discrete, modular, and rationalized nature of color made possible by standardized color systems—even though these systems fail to account for the contingent nature of perception itself.

Seeing by Numbers

In the past few years, I have encountered numerous blog posts, websites, social media accounts, and artworks that reflect a series of conversations or dialogues happening around this notion of seeing color by numbers. They indicate the emergence of a perceiving collective—a widespread discourse not attributable to any individual subject, but made possible by specific historical and technological conditions. Color sampling in particular encapsulates this tendency because it foregrounds the modular and discrete structure of the digital image. As it turns out, color, as with bits and color depth, becomes a way of manifesting this underlying structure, particularly as popular “color capture” apps such as Adobe Capture, Cone, and Color Grab make it possible to extract and sample the colors of a given image.

In June 2015, a user with the handle “Cygnus” wrote a post on their personal blog titled “Venus Paradise: Cyber Edition.”⁵⁰ In the post, Cygnus describes a nostalgic fascination with the color-by-numbers kits first released by Venus Paradise in the 1950s—the same kits that Warhol riffed on in his *Do it Yourself* paintings. Having received a few of the kits as Christmas gifts in the 1970s, Cygnus loved the Venus Paradise brand pencils meant to accompany the kits, where “each color was assigned to an evocative name and a specific number in an esoteric sequence” and “the numbers corresponded to the digits on the color-by-numbers outlines.”⁵¹ Inspired by the widespread Internet phenomenon where users (many of whom are crayon and colored pencil

⁴⁸ Meredith Hoy, *From Point to Pixel: A Genealogy of Digital Aesthetics* (Dartmouth College Press, 2017), 12.

⁴⁹ Ibid, 16.

⁵⁰ The blog, Servitor Ludi, includes “thoughts on role-playing games, Hermann Hesse’s Glass Bead Game, and other stuff that I find cool.”

⁵¹ Cygnus, “Venus Paradise: Cyber Edition.” Servitor Ludi, June 15, 2015.

<http://servitorludi.blogspot.com/2015/06/venus-paradise-cyber-edition.html>

collectors) recreate digital color palettes based on classic Crayola shades, the blog post extended this framework to Venus Paradise. The first step involved finding the numerical order and names of the original Venus Paradise colors. Then, with the use of an unidentified “image-grabbing app,” Cygnus provided both the RGB and HEX values of each color. HEX values (short for hexadecimal color), which consist of a six-digit sequence, are used specifically for web design. Though based on RGB, HEX can be seen as a “shortcut” that avoids the conversion from RGB and includes a narrower range of “web-safe colors.” The final result [Figure 18] was a 3 x 9 grid of solid color squares—transforming the colored pencils, already a discretization of the spectrum, into even more abstract and simplified units.

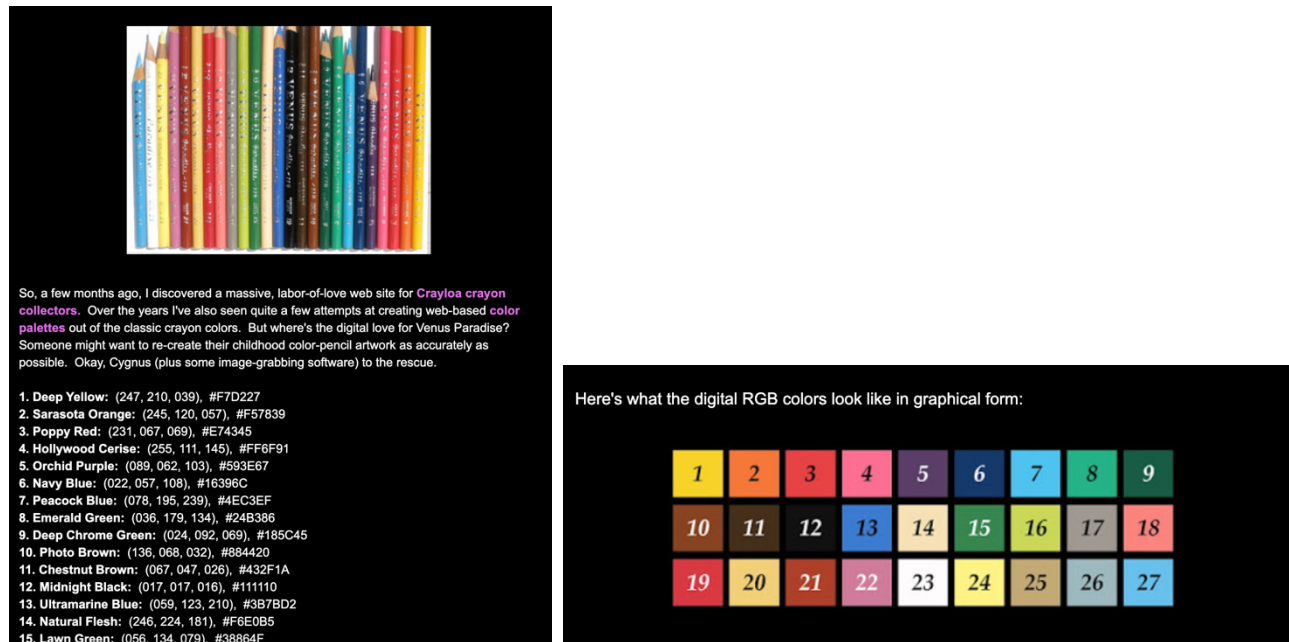


Figure 18. “Venus Paradise: Cyber Edition.” Servitor Ludi. Personal blog. 2015

Cygnus admitted to not knowing the purpose of having engaged in this exercise, noting: “Please do whatever you like with this information. I’m still not sure why it’s ending up on this blog. I just know that I had a blast putting it all together. Right now, that’s enough for me.”⁵² The enjoyment of this process of transformation, of turning colored pencils into a digital grid, mirrors the initial thrill described by some of the original color-by-numbers kits—the magic of “drawing” an image without knowing what the image was in advance.⁵³ Color-by-numbers kits foregrounded reproducibility and consistency in a format where numerical representation preceded color. In this sense, they anticipated the logic of computer color, where input (numbers) results in a particular output (color). And yet, what seems profoundly different about this exercise is that the final product is not a cohesive image or figurative painting but instead an abstract grid of numbers. In a fascinating reversal, color-by-numbers here becomes *number-by-colors*. In the comments to the post, it becomes clear that the “Venus Paradise: Cyber Edition” exercise was above all motivated by a fascination with colors as numerical entities. After someone commented: “You know, for me the whole concept of color as quantifiable is mind blowing. Obviously, it is.

⁵² Ibid.

⁵³ Donald Ingber, “What We Sort: Venus Paradise Coloring Set.” In *Falling for Science: Objects in Mind*, ed. Sherry Turkle (The MIT Press, 2011): 252-261.

Otherwise there would be no colors on my computer screen. Still, my artistic heart wants it otherwise,” Cygnus responded: “Interesting... I don’t know if I’d be so fascinated by colors if they *weren’t* so quantifiable. :-)”⁵⁴

Just a few decades ago, however, this understanding of a supposedly seamless digital image that conceals its underlying grid-based infrastructure was a novel concept. Film scholar John Belton, writing in 2008 (in an essay markedly titled “Painting by the Numbers”) about the digital intermediate—a term that originally referred to the intermediate step when movies were shot on film, scanned digitally and edited, then printed back onto film stock for theatrical release—observed that films such as *Pleasantville* (Gary Ross, 1998) and *Sin City* (Frank Miller, Robert Rodriguez, and Quentin Tarantino, 2005) call the viewer’s attention to the modularity of the digital image vis-à-vis color.⁵⁵ Both of these films would later be cited as examples in Carolyn Kane’s 2014 account of what she calls “The Photoshop Cinema,” or films with a distinctly post-computational aesthetic defined by highly stylized color grading.⁵⁶

Despite the fact that much of each film appears to be black-and-white, both *Pleasantville* and *Sin City* were filmed in color. With *Pleasantville*, the fantastical retro universe of the television show by the same name is entirely achromatic until color begins to encroach, one object at a time [Figure 19]. *Sin City*’s distinctive color palette, designed to resemble the Dark Horse comics on which it is based, includes a limited array of colors, such as red and yellow, which, like *Pleasantville*, appear as individually colored objects or figures within a scene [Figure 20]. Belton notes that whereas there is a long-established tradition in classical Hollywood cinema of using black-and-white and color to signify different diegetic worlds (the most famous example of this is of course *The Wizard of Oz*, which uses both Technicolor and black-and-white film stock), prior to digital color grading it was not possible to include black-and-white and color within the same frame. This “quasi-pointillist control” violates the chromatic cohesion of the filmic image, inviting the viewer to see the image in terms of individual pixels and “picture elements” rather than “whole pictures.”⁵⁷

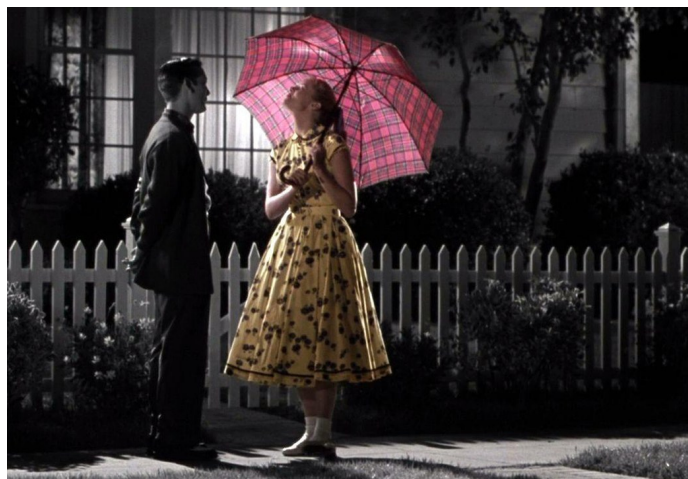


Figure 19. Still from *Pleasantville* (Gary Ross, 1998)

⁵⁴ “Venus Paradise: Cyber Edition.”

⁵⁵ The term “digital intermediate” or DI is still sometimes used, but given that most films today are filmed, edited, and screened digitally, it has come to refer primarily to color grading rather than an intermediate step.

⁵⁶ Carolyn L. Kane, “The Photoshop Cinema.” In *Chromatic Algorithms*, 242-277.

⁵⁷ John Belton, “Painting by the Numbers: The Digital Intermediate.” *Film Quarterly* 61 no. 3 (Spring 2008), 59 and 62.



Figure 20. Still from *Sin City* (Frank Miller, Robert Rodriguez, and Quentin Tarantino, 2005)

Around the same time Belton's article was published, this understanding of digital color as "breaking up" the cinematic image was also circulating within the art world. A few years after Angela Bulloch first created her Pixel Boxes, Cory Arcangel's video installation *Colors* (2006) [Figure 21] took Dennis Hopper's 1988 police thriller of the same name and transformed it into a series of abstract images. The transformation was made possible by a video application designed by Arcangel that emulates "slit scan," a film technique which results in a psychedelic progression of colored lines (historically seen in the opening credits of *Vertigo* and the "star-gate" sequence in *2001: A Space Odyssey*). Though slit-scan, an early example of visual effects in film, originated as an analog technique in which a slide with a slit cut into it was simply placed over the camera lens, Arcangel's app produced a similar effect by algorithmic means.⁵⁸ The app, which works with any QuickTime file, stretches each pixel vertically to resemble lines, and the uploaded film will play one line at a time—a "screening" of *Colors* took a total of 33 days to complete.

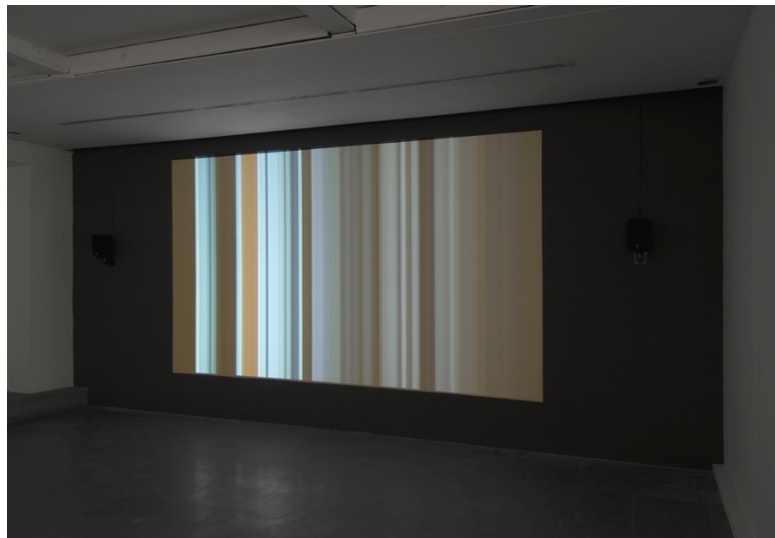


Figure 21. Cory Arcangel, *Colors* (2006). Single channel video, artist software, computer. Courtesy of Lisson Gallery.

⁵⁸ Arcangel has made the personal desktop version of the app, titled Colors PE, available for download here: <http://colors-personal-edition.com/>

In the gallery setting where it debuted, viewers could “watch” *Colors*, experiencing the disconnect between the gradually ebbing striations and the original soundtrack of the Hopper film. By rendering his source material visibly unrecognizable, Arcangel appears less interested in the cinematic origins of slit-scan than this process of digital “translation” from figuration to abstraction—that is, making manifest the composite structure of the digital image’s modular components. The choice to use a film titled *Colors* also highlights Arcangel’s interest in color as code—though the title of Hopper’s film comes from racial tensions between police officers, this context is (perhaps too easily) eliminated by foregrounding its formal, non-human elements.

Arcangel’s *Photoshop Gradient Demonstrations* [Figure 22], which are created through Photoshop’s built-in gradient tool, place his obsession with digital color as code or numbers front and center. At first glance, these large-scale works, with their seamlessly blended bands of color, appear to be derivative of works by Rothko, Frankenthaler, and other Color Field painters, particularly when displayed in a white cube gallery context. Yet the title of each *Photoshop Gradient Demonstration*—as hinted at by the word “demonstration”—functions as a computer demo, exposing to the viewer how each one was made and instructing them how to replicate the process. With long-winded titles such as *Photoshop CS: 84 by 240 inches, 300 DPI, RGB, square pixels, default gradient “Spectrum”, mousedown y=25130 x=35700, mouseup y=0 x= 35700; tool “Wand”, select y=1420 x=4237, tolerance=80, contiguous= off; default gradient “Spectrum”, mousedown y=1230 x=0, mouseup y=1230 x=71710*, Arcangel humorously reveals his artistic process to be formulaic and automatic, making it possible for any user to reproduce these images. Still, while both the Photoshop Gradients and *Colors* foreground the unintelligibility of digital color—these instructions are unlikely to conjure a visual even for coders and programmers—they also indicate a desire to explore the impact of numerical color on perception through this process of translation.

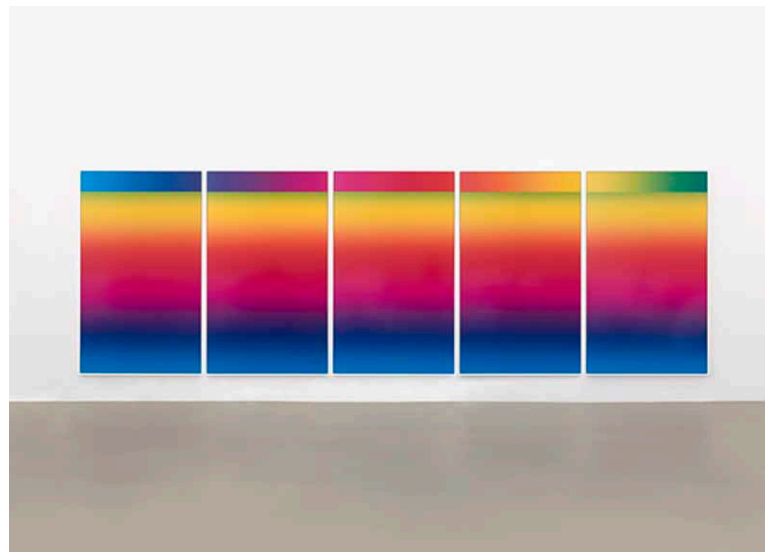


Figure 22. Cory Arcangel, *Photoshop CS: 84 by 240 inches, 300 DPI, RGB, square pixels, default gradient “Spectrum”, mousedown y=25130 x=35700, mouseup y=0 x= 35700; tool “Wand”, select y=1420 x=4237, tolerance=80, contiguous= off; default gradient “Spectrum”, mousedown y=1230 x=0, mouseup y=1230 x=71710* (2018). Chromogenic print. Courtesy of the artist.

Even though these two examples (“Venus Paradise: Cyber Edition” and Arcangel’s works) originated within very different contexts, they are ultimately more similar than they are different. Both demonstrate a fascination—a perverse pleasure, even—with the process of discretization, of

breaking an image down into its constituent parts. When it comes to color, as I have shown, this pervasive tendency of “seeing by numbers” is most evident when it comes to color sampling and extraction. The ability to extract discrete color swatches and samples from a given image (sometimes called “color quantization”) highlights digital color’s status as infinitely divisible and plural, with an inexhaustible number of shades that can be identified, labeled, and subsequently commodified and circulated.

This is not to say that color sampling did not exist prior to the advent of digital technology: as early as 1903, American artist Emily Noyes Vanderpoel experimented with what she called “color analysis charts” in her book *Color Problems: A Practical Manual for the Lay Student of Color*. Vanderpoel takes everyday objects such as textiles as her starting point, dissecting each object into a series of colored swatches. Ultimately, the viewer can only infer what the object is from the title (“Color Analysis from Japanese Cloisonné Vase,” “Color Analysis from an Antique Rug,” and so on), and each composition lists the colors in order of the most to least dominant. The combination of all colors adds up to 100, with the overall chart constituting the whole: for example, “Color Analysis From Arabian Illumination” [Figure 23] consists of 20 percent Blue, Green, and Red, respectively, 10 percent Pale Red, 8 percent Gray, 10 percent Gold, and 13 percent White. In this sense, Vanderpoel’s color analysis charts, with their emphasis on the numerical swatch, can be seen as early manual versions of “digitizing” everyday objects by dissecting them into abstract squares akin to pixels or bits.

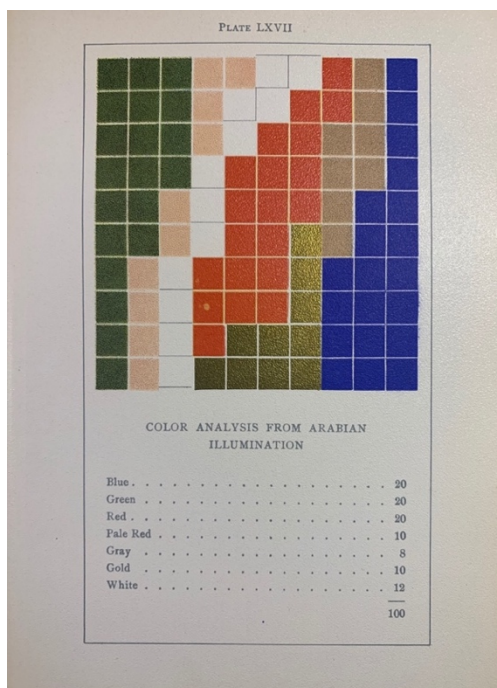


Figure 23. Emily Noyes Vanderpoel, “Color Analysis From Arabian Illumination.” In *Color Problems: A Practical Manual for the Lay Student of Color* (Longmans, Green and Co, 1903). Cooper-Hewitt Research Library.

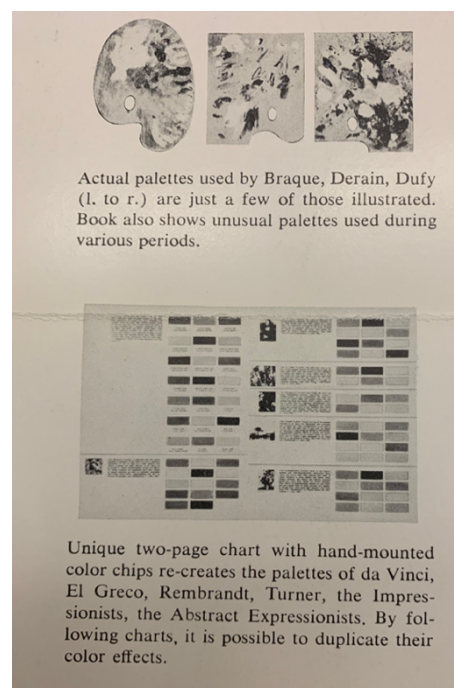


Figure 24. Publication materials for Faber Birren’s *History of Color in Painting* (1965). Box #1. Faber Birren Papers, Manuscripts and Archives Division, The New York Public Library.

This historical parallel has not gone unnoticed: though Vanderpoel (owing much to her exclusion from a male-dominated historical narrative of color theory and design) is still a somewhat obscure figure, *Color Problems* was published in a new edition in 2018 and Vanderpoel has recently been the focus of several popular blogs, one of which describes her charts as

“looking at times like some kind of strange fusion of De Stijl abstraction and Tetris.”⁵⁹ Decades later, in his *History of Color in Painting* (1965), Birren attempted a similar task: “extracting” color palettes from paintings by El Greco, Rembrandt, Turner, and Braque (to name a few) to create color charts that could then be duplicated with a similar logic to paint-by-numbers kits [Figure 24]. Whereas Birren clearly had strong ties to corporate interests and the standardization of color and its supposed psychological and biological properties and is in this sense quite different from Vanderpoel’s avant-garde experiments, both case studies can be seen as manual versions of color sampling prior to the precise, automatic sampling now easily achievable through color capture technologies.

A recent trend on social media involves Twitter and Instagram accounts such as @colorpalette.cinema [Figure 25], as well as websites such as Movies in Color [Figure 26], which sample the colors of film stills into a grid-like format. Using the Eyedropper tool in Photoshop to sample colors, the owners of these accounts then save them as swatches and arrange them from left-to-right in order of the most to least prevalent colors within the image. Movies in Color takes this process one step further and includes four different categories of swatches: colors in the “light,” “medium,” and “dark” range, as well as one called “general spectrum,” a compilation of the first three categories.⁶⁰ Though each feature-length film is ultimately reduced to a single still, these accounts claim that these stills were chosen because their color palettes encompass a greater “mood” or “atmosphere” of the film as a whole. Unlike the examples cited so far, these accounts don’t dispense with the original source material, but instead juxtapose the swatches next to the film still.

In this sense, even though such accounts rely on automated software and would at first glance appear to be a kind of data visualization, they are hardly an “objective” condensation or representation of the constituent colors of the image. A single user chooses a particular set of colors as the most representative and arranges them in an order that they deem the most “appealing.”⁶¹ As such, these accounts, which are geared towards contemporary cinephiles in their focus on auteur-driven films by primarily American male directors such as Kubrick, Scorsese, David Lynch, and Wes Anderson, have been touted as “visually satisfying” and “pure eye candy.”⁶² It seems that both the creators and followers of such accounts take some sort of aesthetic pleasure in seeing these films crunched into modular units, and fans are welcome to submit requests for films that have not yet been included.

Though Wes Anderson—known for his highly stylized and idiosyncratic use of digital color, which he achieves with custom Look-Up Tables (LUTs), or pre-set color schemes that make it possible to control specific color values within a scene—is nearly always present in such social media accounts, many of the films featured on these accounts were neither shot nor edited digitally. However, once they are uploaded into digital format, color becomes pixelated, and the image can be treated like any other file. A post on the style blog *Haute Macabre* refers to the colors of @colorpalette.cinema as “celluloid hues”—the irony here, of course, is that there is no actual

⁵⁹ “Color Analysis Charts by Emily Noyes Vanderpoel (1902).” The Public Domain Review, <https://publicdomainreview.org/collection/colour-analysis-charts-by-emily-noyes-vanderpoel-1902>

⁶⁰ Movies in Color: Color-Mapping the Silver Screen. <https://moviesincolor.com/>

⁶¹ “Extracting Colors from Photos and Video.” *Colormind*. <http://colormind.io/blog/extracting-colors-from-photos-and-video/>

⁶² Leah Pelligrini, “Visually Satisfying Project Shares the Color Palettes of Iconic Film Scenes.” *My Modern Met*, May 26, 2016. <https://mymodernmet.com/cinema-palettes/> and Joe Blevins, “This Twitter account builds gorgeous color palettes from movie scenes.” *The AV Club*, May 17, 2016. <https://news.avclub.com/this-twitter-account-builds-gorgeous-color-palettes-fro-1798247563>

celluloid to be found.⁶³



Figure 25. Color sampling from *The Grand Budapest Hotel* (Wes Anderson, 2015) (left) and *The Shining* (Stanley Kubrick, 1980) (right). @colorpalette.cinema. Instagram.



Figure 26. Color analysis of *Blue Velvet* (David Lynch, 1986). Movies in Color, July 16, 2013.

Elsewhere I have called this distinctly modern understanding of color as alphanumeric representation—a series of discrete swatches or units rather than a continuum or gradient that is most commonly represented as a grid or chart—the “digitization of perception.” The digital is thus an emergent property of perception that precedes the computational and algorithmic technology typically associated with the term “digital” today. Importantly, however, the key moments dissected in this chapter mark a turning point in this trajectory insofar as *the digitization of perception and digital technology begin to merge*. This convergence of digital-as-epistemology and digital-as-technology was not inevitable or coincidental but owes much to the belabored and drawn out process by which twentieth-century color systems (and by extension, the conditions of perception they both reflected and made possible) were adapted and incorporated into color

⁶³ “Savoring the Celluloid Hues of Colorpalette.Cinema on Instagram.” *Haute Macabre*, April 20, 2017. <http://hautemacabre.com/2017/04/savoring-the-celluloid-hues-of-colorpalette-cinema-on-instagram/>

spaces for electronic and digital screens.

It would appear that over a decade since Belton claimed that digital color grading draws the viewer's attention to the modularity of the image, this claim has become self-evident, even anachronistic. Through a combination of technological obsolescence and nostalgia for technologies such as 8-bit color that evoke an earlier era, such structural and historical conditions have made possible the emergence of a pervasive discourse around digital color's organization. Though translations of historical concepts of standardized color have never been effortless or fluid, they do indicate a continuation rather than a rupture in the codification of color between print, analog, and algorithmic media technologies. Most crucially, they point to a widespread, networked experience of seeing and knowing the world through numbers that has become part of our everyday reality.

Chapter Four
Escape into Color:
The Rise of The Experience Economy

“Here we go!” cried Mr. Wonka, and he pressed three different buttons on the side of the machine. A second later, a mighty rumbling sound came from inside it, and the whole machine began to shake most frighteningly, and steam began hissing out of it all over, and then suddenly the watchers noticed that runny stuff was pouring down the insides of all the hundreds of little glass tubes and squirting out into the great tub below. And in every single tube the runny stuff was of a different color, so that all the colors of the rainbow (and many others as well) came sloshing and splashing into the tub. It was a lovely sight.

Roald Dahl, *Charlie and the Chocolate Factory*

If lifestyle as a *pattern of thought and behavior* and lifestyle as a *matter of consumer taste* were once separate, they are now one. The contemporary definition of lifestyle is propped up by the unprecedented visibility of *things* on social media, making individual consumption more public than ever before. In the words of Mark Fisher, “The thing about capitalism is that it provides things that nobody likes.” But the sticking point of capitalism is that people like things quite a lot.

Daisy Alioto, “What is Lifestyle?”

Fabricating Images at the Color Factory

“You made it to the moon!”

These were the words that welcomed me as I turned the corner into the final room at the Houston location of the Color Factory, a self-described “interactive exhibit that celebrates the discovery, serendipity and generosity of color.” The speaker was one of the exhibition’s many “greeters”—gig economy workers who supervise its various participatory installations. Clad in an aggressively purple jumpsuit, the greeter explained to me that I was to take off my shoes before entering the ball pit, and to turn the volume up on my phone (“You can’t imagine how many we’ve lost in there!”). Having already been to the New York location, I knew what to expect: every rendition of the Color Factory culminates in a ball pit of monumental proportions. Exhibition goers wade their way into the pit, lie on their backs, and pose for automated photos taken by cameras mounted on the ceiling. But whereas the ball pits in San Francisco and New York were bright yellow (“in honor of Michael Stanley, the man who only wore yellow”) and powder blue (matched to a Pantone swatch of a New York summer sky), respectively, the Houston location’s was an almost phosphorescent silvery white. The surrounding walls and ceilings were black, and twinkling dots of light hovered above the pit—a rare example of achromatic color in an exhibit otherwise dominated by pops of orange, turquoise, and hot pink. Sponsored by NASA, whose headquarters are in Houston, to commemorate their fiftieth anniversary, the ball pit (titled simply *To the Moon*) [Figure 1] is one of many nods to local geography in an exhibition that claims to be site-specific. In addition to the floating, weightless experience of the ball pit, visitors can listen to a recording of the 1969 Apollo 11 moonwalk. This integration of sound also echoes a central theme of the pop-up across locations: namely, to create a multi-sensory experience linked to

environmental color. For a moment, submerged neck-deep in the pit, gazing up above at the fiber-optic lights, I could almost believe that I *was* in zero-gravity—until the aerial camera’s flash shattered this illusion.

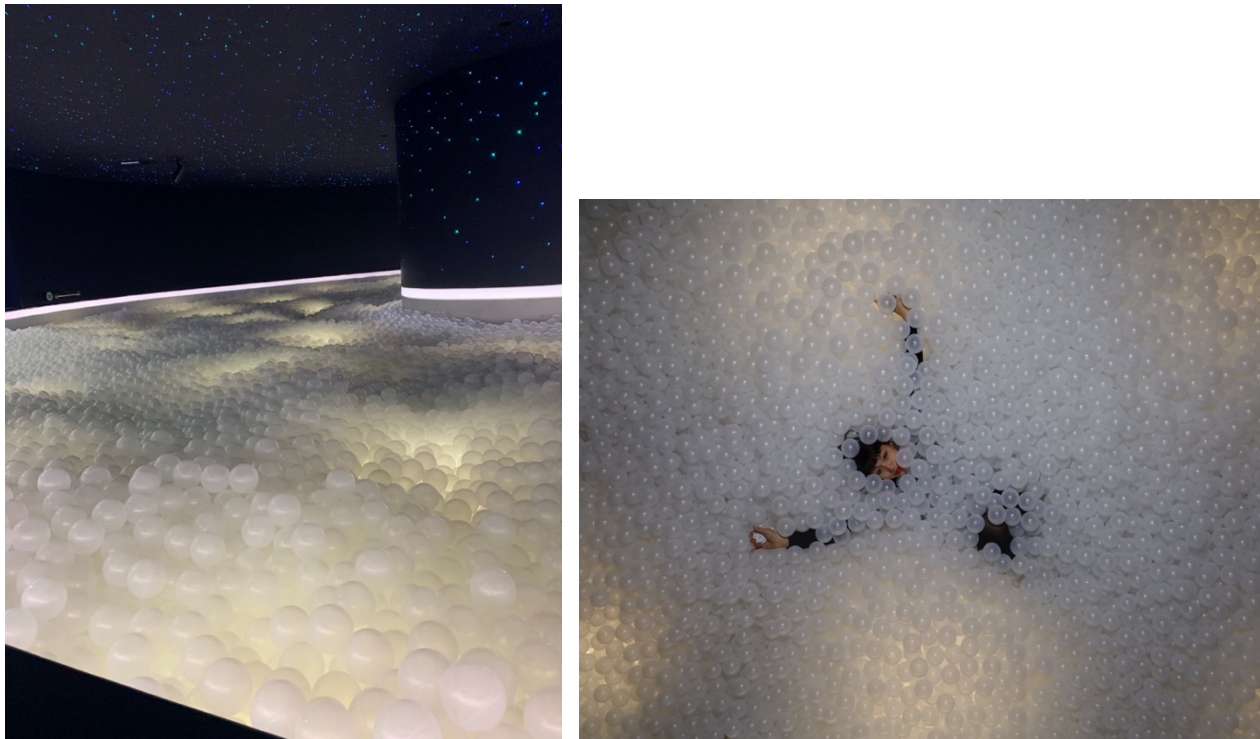


Figure 1. *To the Moon*, an immersive ball pit in Houston featuring fiber-optic lights and recorded sound. Sponsored by NASA. Photo: Lida Zeitlin Wu

The Color Factory is a 20,000 square foot warehouse where every visible surface has been covered with abstract patterns of brightly saturated color. Founded by event planner Jordan Ferney, San Francisco-based artist Leah Rosenberg, and designer Erin Jang, the Color Factory debuted in San Francisco in 2017, where it was only supposed to run for one month. Instead, the exhibition lasted for nearly nine months, and by popular demand, moved to New York the following year, and opened a new location in Houston in 2019. Despite its name, what the pop-up produces isn’t actually color, but digital images of participants that ultimately find their home on photo-sharing apps. Activated by scanning a token or card via QR code [Figure 2], mounted cameras take photos or Boomerangs (moving image loops) of participants and send them directly to their email so that they can then be posted on social media platforms, earning such pop-ups the moniker of “Instagram exhibitions.”

In today’s information economy, where aesthetic value is measured not by singularity or authenticity, but by “eyeballs” (that is, clicks, likes, and reposts), eye-popping, high-contrast colors perform an essential role.¹ Though other competing pop-ups, such as the Rosé Mansion, the Museum of Ice Cream, 29Rooms, the FOMO Factory, and Room for Tea, don’t explicitly take color as their theme, the photographs they produce look strikingly similar to those taken at the

¹ Carolyn L. Kane, “GIFs That Glitch: Eyeball Aesthetics for the Information Economy.” *Communication Design* 4 (2016): 41-62.

Color Factory: flat, brightly saturated colors in simple geometric shapes pop against a white background, and all emphasize the ways in which these colors activate sensory pleasure. Such experiences, which are designed with digital reproducibility in mind, turn embodied experience into data by existing in two places simultaneously: the physical gallery space and networked platforms. On Instagram, where 30,178 images are tagged #colorfactoryco (as of May 2022) [Figure 3], physical color must be reliably and seamlessly translated into numerical code. Specific paint shades chosen for the exhibition's interiors are those deemed the most “photogenic,” requiring the Color Factory’s designers to constantly move between subtractive (pigment-based) color and additive (light-based) color.



Figure 2. At the New York location, visitors are given a card with a QR code, whereas in Houston, each person gets a token. Photo: Lida Zeitlin Wu

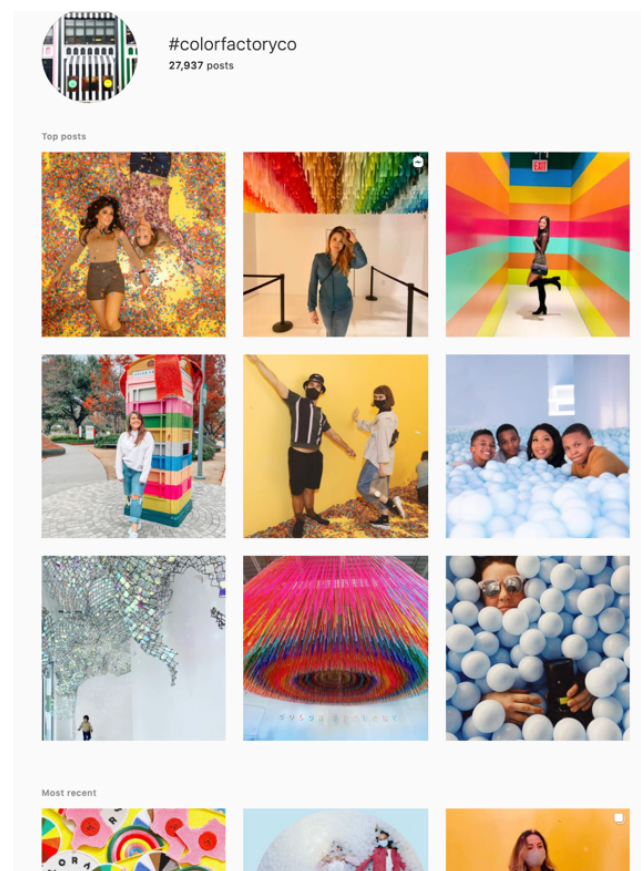


Figure 3. Images tagged #colorfactoryco on Instagram

While few visitors to the Color Factory, where one can dive into piles of confetti or eat color-coded French macarons on a rotating conveyer belt, are likely to see it as anything other than pure entertainment or spectacle, the exhibition is illustrative of a widespread phenomenon that has intensified in recent decades: the relocation of mass-produced, abstract color into the realm of “happiness” and blissful nostalgia under the umbrella of what is frequently referred to as “wellness”

or “self-care.”² According to Color Factory CEO Jeff Lind, the cameras are not the main attraction, just “a happy externality of a good experience.”³ Though the Color Factory is not primarily intended for children, it draws on a much longer tradition whereby brightly saturated colors have come to be associated with happiness, nostalgia, and child-like curiosity and play.⁴ The exhibition’s website states one of its central goals as “[embracing] child-like imagination, while expanding boundaries of perception and understanding.”⁵ Featured on multiple parenting blogs and described as a “playground of pigment,”⁶ language used to describe the Color Factory often presupposes the existence of an “inner child”—a term that has entered the lexicon of pop psychology and self-help literature—with headlines like “Color Factory—Wake Up Your Inner Child” and Instagram captions such as “My inner child was out in full force today at @colorfactoryco!”⁷ Subscribing to the notion that children see color more “innocently” and “purely” than adults, the exhibition treats color as a form of escapism, where excitement and joy need only be “awakened” through complete immersion into a colorful environment. Ultimately, the pop-up suggests that by *escaping into color*, visitors can escape from the never-ending onslaught of new technologies and their increasingly accelerated obsolescence—despite the irony that these dematerialized colors rely on these very technologies to exist in the first place.

Though the equation of nonrepresentational color with transcendent experience and heightened senses or emotions is hardly unique to our contemporary moment, what *has* changed is the increasingly ephemeral nature of both consumption and labor, with constant access to the Internet making it possible to socialize, shop, and eat at any given hour of the day. Outlined at

² Jordan Ferney’s primary project prior to the Color Factory was the still-active “design and lifestyle” site Oh Happy Day!, which sells decorations such as plates, balloons and streamers in color gradient and rainbow patterns. Oh Happy Day! also publishes articles about do-it-yourself cooking, fashion, and design projects—the common dominator here is a wide variety of bright, high-contrast colors (available for purchase, of course) that are said to promote joy and personal fulfillment. Indeed, the site often encourages readers to develop “happy habits” by introducing bright color into every aspect of their lives. “Happy Habits: How to Automate Your Life.” *Oh Happy Day!* January 3, 2020.

<https://ohhappyday.com/2020/01/happy-habits-how-to-automate-your-life/>

³ Quoted in Kenzie Bryant, “The Ball Pit Will Take Some Breaking In, and Other Lessons From The Instagram Experience Decade.” *Vanity Fair*, December 20, 2019.

<https://www.vanityfair.com/style/2019/12/experience-museum-color-factory-museum-of-ice-cream>

⁴ Nicholas Gaskill traces how children came to be associated with bright colors at the turn of the century, resulting in “an aesthetic ideal of the child’s unique experience of bright hues, unbound by convention or even concepts” (113). Modern educators such as Munsell, Louis Prang, and Milton Bradley viewed a child’s view of color as more “innocent” and immediate than that of adults. See “The Production and Consumption of a Child’s View of Color” in *Chromographia: American Literature and the Modernization of Color* (University of Minnesota Press, 2018): 115-161. Additionally, in several excerpts unpublished in his lifetime, Walter Benjamin notes the ways in which children see color more “purely” than adults, since for them color neither obeys outline nor laws. See “Aphorisms on Imagination and Color,” “A Child’s View of Color,” “Notes for a Study of the Beauty of Colored Illustrations in Children’s Books,” “Old Forgotten Children’s Books,” “A Glimpse into the World of Children’s Books,” and “The Rainbow: A conversation about Imagination.” All compiled in the *Walter Benjamin: Selected Writings* series, ed. Michael W. Jennings (Harvard University Press, 2004-2006). Five volumes.

⁵ “Houston.” The Color Factory. <https://colorfactory.co/houston>

⁶ “Color Factory: A Pop-Up Experience in San Francisco.” *Aiga SF*, July 26, 2017. <http://aigasf.org/color-factory-a-pop-up-experience-in-san-francisco/>

⁷ Dagmara Biernacka, “Color Factory—Wake Up Your Inner Child.” *Just Like New York*, October 11, 2018. <http://justlikeny.com/2018/10/color-factory-wake-up-your-inner-child/>

length by Jonathan Crary and more recently by artist and writer Jenny Odell, the “24/7 time” characteristic of today’s attention economy (sometimes also called the “experience economy”) disguises emotional labor and self-surveillance as leisure within a system that has fully eroded the concept of rest and relaxation as an autonomous realm.⁸ It seems hardly coincidental that the Color Factory originated in the heart of Silicon Valley, with Ferney stressing the need for “delightful, real-world experiences” as an antithesis for the “creative and diverse people [in the Bay Area] who spend way too much time online.”⁹



Figure 4. “Have you checked your phone since you entered this room?” New York location



Figure 5. Installations such as Soon Sunny Park’s *Unwoven Light* in Houston have reflective surfaces that make avoiding one’s own image nearly impossible. Houston location. Photo: Lida Zeitlin Wu

Despite the glaring contradictions of this statement—how is an experience designed for social media an antidote to a networked existence?—activities and installations at the pop-up emphasize physical intimacy and engagement with all five senses, stressing the importance of “human connection” on the one hand and fervent individualism on the other. A “Discover Your Secret Color” flow-chart personality quiz made of vinyl floor stickers is scaled to the human body, guiding viewers through the space as a means of self-knowledge. Though questions such as “Have you checked your phone since entering this room?” [Figure 4] would seem to encourage visitors to “stay present” by putting their phones away, this “check-in” process points to the growing bond between color as sensory attraction and the ubiquity of voluntary self-monitoring, where smartphone cameras are replaced by the all-seeing gaze of the mounted cameras. Moving through

⁸ Jonathan Crary, *24/7: Late Capitalism and the Ends of Sleep* (Verso, 2013) and Jenny Odell, *How to Do Nothing: Resisting the Attention Economy* (Melville House Publishing, 2019)

⁹ Samantha Stewart, “San Francisco to Host Pop-up ‘Color Factory’ Art Exhibition.” *Nine Network*, 2017. <https://travel.nine.com.au/destinations/san-francisco-color-factory/fd7fb71c-5575-4248-9177-c2b23fb695ca>

the gallery's multiple rooms, I experienced an acute sense of anxiety and self-consciousness as I was constantly confronted with my own image—both as I posed for photos and as I was caught off guard by the exhibition's numerous reflective surfaces [Figure 5]. I found myself fixating on my own face and appearance rather than the colored walls and floors surrounding me; it was as though the Color Factory had taken the hyper-visibility and performativity of social media platforms such as Instagram and rendered them in three dimensions.

In many ways, the Color Factory is a culmination of the epistemic shifts discussed thus far in this dissertation, including the transition from artisanal to synthetic pigments and the consequent abstraction of color from objects in the natural world (paints at the New York location are provided by Sherwin Williams), as well as an exercise in representing color in geometric form (flat color swatches appear as pie chart-like circles, grids, and other configurations). Crucially, the exhibition also builds on the assumed correlation between mood, color, and personality that emerged with the modern fields of psychophysics and behavioral psychology, as well as the mid-century industrial theories of color conditioning and functional color. By stressing the importance of self-expression and individuality through interacting with color, standardized color becomes both a materially and socially encouraged way of interacting with the world and a means of constructing and defining the self.

Yet the institutionalization and regulation of the self in contemporary networked culture is quite different from the twentieth-century workplace where work/leisure and consumption/production were still largely construed as binaries. Today, even the most seemingly sincere attempts to better oneself through practices of “self-care” (meditating, exercising, napping, altering one's diet, or even doing a “digital detox”) have been coopted by 24/7 capitalism and Big Data. These conversions of everyday behavior into data points as a means of self-improvement are present-day iterations of what Foucault calls “technologies of the self”: a set of standardized practices or “operations” by which individuals seek to “transform themselves in order to attain a certain state of happiness, purity, wisdom, perfection, or immortality.”¹⁰ The popularity of apps that track everything ranging from calories consumed to quality of sleep to hours meditated by collecting biometric data is especially revealing, pointing to the ways in which to improving or “working on oneself” has become inseparable from voluntary self-surveillance and monitoring.

My two main case studies in this chapter, the Color Factory and Pantone's Color of the Year, showcase the ways in which digitally reproduced color on social media platforms are part and parcel of these practices of self-care, whereby color comes to be seen as both emotional reprieve and a tool for self-improvement. Both examples are short-lived, anticipatory phenomena—the Color Factory a temporary installation and the Color of the Year, as its name would suggest, changing annually and commenting on fleeting design trends. Both also play a key role in correlating digitally reproducible color with happiness, nostalgia, and “authenticity,” ultimately revealing how emotions and moods themselves have become commodities.¹¹ Finally, both present color as an intuitive and unmediated experience, an escape from the speed of technological development, economic precarity, and political unrest. The paradox is that such a construction of color as “wellness” or “self-care” ultimately relies on precisely the networked logic and “always-on” mindset of social media it claims to critique. By encouraging individuals to monitor themselves as a means of positive self-transformation, these supposedly emancipating

¹⁰ Michel Foucault, “Technologies of the Self.” In *Technologies of the Self: A Seminar With Michel Foucault*, eds. Luther H. Martin, Huck Gutman, and Patrick H. Hutton (University of Massachusetts Press, 1988), 18.

¹¹ Eva Illouz, ed. *Emotions as Commodities: Capitalism, Consumption and Authenticity* (Routledge, 2018)

colorful experiences and platform economies turn the body into a set of numbers or data points, ultimately normalizing new modes of self-surveillance and quantification.

“Like Walking Through a Rainbow”

The colorful pop-up event or visual spectacle is by no means a new phenomenon—nineteenth-century World’s Fairs that showcased new developments in electric lighting and pyrotechnics, “spectrum spectacular events” in the 1950s advertising color television,¹² and the explosively psychedelic “happenings” of the 1960s, all come to mind. In recent years, installations such as Yayoi Kusama’s *Infinity Rooms* and Random International’s *Rain Room* (2012) indicate a shift towards immersive artworks designed to be photographed, marking a clear departure from site-specific performances such as Marina Abramovic’s *512 Hours* (2014), where audience members had to store their camera phones in lockers before entering the gallery.

Because the Color Factory constantly announces its hyper-mediated nature, it is highly relevant for thinking about how experiences that announce themselves as discrete “events” respond to anxieties surrounding digital technology. Through both visual and temporal cues, the exhibition presents abstract color as a much anticipated and awaited experience that separates itself from everyday life. Unlike the televised media event, where “the referent becomes indissociable from the medium” (is the event being broadcast deemed important because it is considered newsworthy, or because television must assert its importance by covering breaking news stories?), the pop-up installations of the digital age emphasize that such “experiences” must be first and foremost experienced in the flesh.¹³ This focus on in-person interactivity and the notion that a full and memorable experience must activate all five senses is inseparable from widespread anxieties that digitization will eventually render daily existence increasingly detached, impersonal, and ephemeral.

Though the Color Factory claims to be site-specific, it ultimately presents itself as a temporary reprieve from a frenetic urban lifestyle that is devoid of color and its sensuous pleasures. In New York, the Color Factory and its partners assert that the colors they use are drawn from specific locations within the city: wall text states that the Balloon Room is meant to “[conjure] the colors you might see at sundown over the Hudson River or at sunrise, reflected against a skyscraper.” The choice of Houston, a city known for its numerous private collections of postwar American art, may well also have to do with the fact that it is home to permanent color-driven installations by artists such as Dan Flavin, Mark Rothko, and Cy Twombly. At each location, the Color Factory collaborates with local artists and business and attempts to engage with the surrounding city, as with the Manhattan Color Walk in New York, installed in the garden at Cooper-Hewitt in conjunction with their exhibit “Saturated: The Allure and Science of Color” [Figure 6].¹⁴

¹² Susan Murray, *Bright Signals: A History of Color Television*, 129.

¹³ Mary Ann Doane, “Information, Crisis, Catastrophe.” In *Old Media, New Media: A History and Theory Reader*, eds. Thomas Keenan and Wendy Hui Kyong Chun (New York: Taylor & Francis, 2004), 251.

¹⁴ *Saturated* ran until March 2019. <https://www.cooperhewitt.org/channel/saturated/>



Figure 6. The Manhattan Color Walk, a collaboration with Cooper-Hewitt's Saturated: the Allure and Science of Color exhibition (2019)



Figure 7. The Neighborhood Map in Houston.
Photo: Lida Zeitlin Wu



Figure 8. Phone booth installation, Houston. Photo: Lida Zeitlin Wu

Color Factory visitors also receive a supplementary “Neighborhood Map” [Figure 7], linking each of the 256 colors of the Color Walk to a local business or landmark. With the map, they can unlock local “secrets,” such as an ATM installation called “Art Themed Money” in Manhattan that doles out colorful fake bills and a phone booth that has been painted “with colors from Houston’s palette” and includes a transparent panel that generates a rainbow prism on sunny days [Figure 8]. Other sites are more explicitly commercial, offering discounts to customers with the Neighborhood Map in their possession: nail salons offering a special “Color Factory manicure” with each nail a different color and promotions for donuts with rainbow sprinkles, personalized balloons, and temporary tattoos. The map positions the Color Factory as the center of a vast network of colorful “experiences,” describing the pop-up as “where all the color begins: connecting

people to the colors of the city and to each other.” By expanding outwards in physical space, the Color Factory extends its virtual presence beyond the walls of the pop-up itself through the process of geotagging; the map encourages visitors to “share your journey by tagging #colorfactoryco and our participating artists + local businesses. We’ll post our favorites at @colorfactoryco.”

Despite the Color Factory’s expansion into the surrounding city, however, the pop-up presents an inside/outside dichotomy where to enter the colorful exhibition space is to escape from an urban environment that is itself devoid of color. In the tradition of the hermetically sealed white cube gallery, the exhibition space is presented as a place where “the outside world must not come in,” “windows are sealed off,” and “there is no time.”¹⁵ But the Color Factory also turns the white cube on its head by having visitors wait in a lobby where ceilings, walls, and floors are a pristine white, building anticipation for visitors to move from what is essentially a blank canvas into an explosion of color.



Figure 9. Emanuele Moureaux, *100 Colors* (New York)

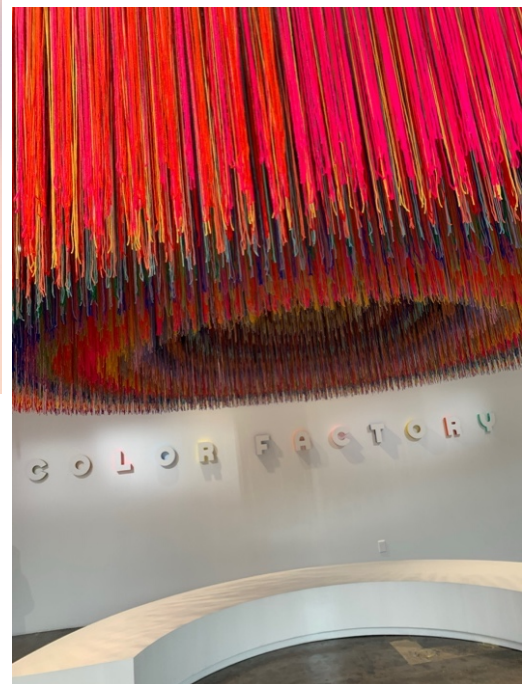


Figure 10. HotTea, *Thirty* (Houston).
Photo: Lida Zeitlin Wu



Figure 11. Rainbow staircase (San Francisco)

¹⁵ Brian O’Doherty, *Inside the White Cube: The Ideology of the Gallery Space* (Berkeley: University of California Press, 1976)

Yet even in this “inverted white cube” situation, white is still understood to be a neutral “non-color,” a stand-in for pure absence. The lobby of each location usually includes a large-scale, eye-catching installation: in New York, visitors wait beneath architect and designer Emanuelle Moureaux’s *100 Colors* (a multicolored canopy of paper streamers mounted on the ceiling) [Figure 9], and in Houston, a textile installation by “yarn bomber” HotTea called *Thirty* [Figure 10] looks like a monochromatic red version of *100 Colors*. In San Francisco, visitors enter the main exhibition hall by descending down a rainbow-striped staircase [Figure 11]—the only splashes of color in a sea of wall-to-wall white. Porthole-like openings on each white door give visitors a glimpse of the colorful space beyond the threshold, building anticipation for the “experience” that awaits them. The Color Factory thus functions as both a site-specific installation and a non-place of waiting and transition.¹⁶

Ultimately, there is always a clear separation between self and environment in which visitors never quite belong to or inhabit its colorful interiors. Just as Dorothy steps out of monochromatic Kansas into Technicolor Oz, for an hour and half (the average amount of time at the Color Factory), exhibitiongoers are invited into a fantastical play-space for adults that is, as one visitor described on Instagram, “like walking through a rainbow.” Color at the Color Factory is not meant to be atmospheric; instead, it is meant to be seen as existentially separate from those who pass through the exhibition space. Though official social media posts often have models coordinate their clothing with the photo background, most photographs taken at the Color Factory feature viewers wearing clothes in more subdued shades or in colors that do not match their surroundings, and the corresponding Instagram posts tagged #colorfactoryco reflect this dissonance:

“Be a pop of color in a black and white world”

“We all need a bit of color now and again”

“Why live and dream in black and white when you can enjoy life in color?”

“Enjoyed having a little more color in my life”

There is thus a clear disconnect between the bright, almost aggressively “cheerful” palette that characterizes the Color Factory and all of its paraphernalia and the way these materials depict the “black-and-white world” outside of the exhibition space.

Returning to the Neighborhood Map, it’s notable that the maps for all three locations present city streets as a series of crisscrossing gray lines that serve as a backdrop for the vibrantly colored numbered circles that mark each “neighborhood secret.” The city is a monochrome backdrop, a foil for the pops of saturated color swarming above it. Similarly, visiting the Color Factory’s current website, the user is immediately confronted with an animated home page that begins with two side-by-side aerial photos of New York City and Houston skyscrapers, both in black-and-white—a world that has been drained of all color.¹⁷ These images are then rapidly obscured by brightly colored, opaque circles as the page loads, the movement finally stopping with the Color Factory logo at its center [Figure 12]. There are several intriguing dichotomies at work here that seem to map onto one another: monochrome versus color, figuration versus abstraction. By rendering color as a series of simplified geometric shapes with no obvious referent, the Neighborhood Map, the Color Factory’s website, and the exhibition hall itself all conceptualize

¹⁶ Amanda Hess, writing for the *New York Times*, notes that what these pop-up exhibitions designed for Instagram have in common is “a central experience... of waiting.” See “The Existential Void of the Pop-Up ‘Experience.’” *The New York Times*, September 26, 2018.

¹⁷ As of September 2020

color as an ephemeral force that seemingly has no direct physical link to our everyday lived reality (despite written statements that suggest the opposite).

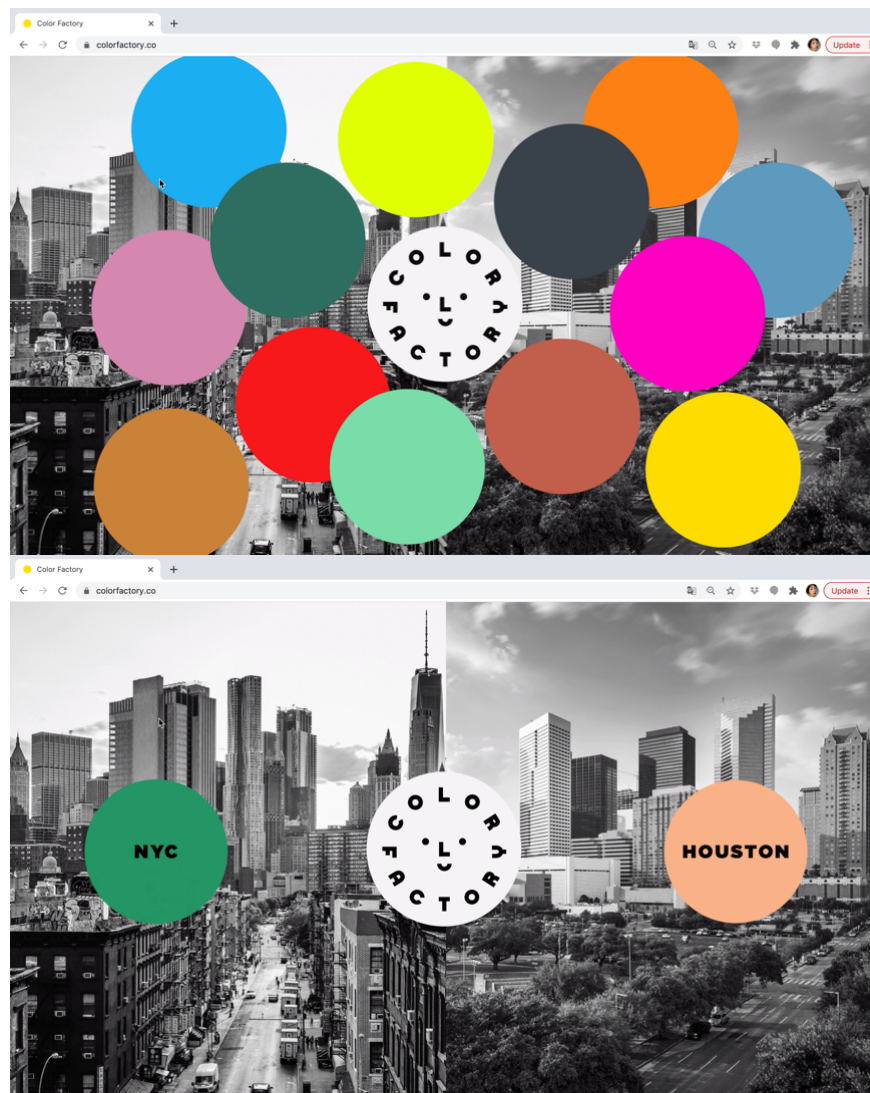


Figure 12. Stills from the Color Factory homepage animated sequence

Of course, it's not as though the Color Factory founders or exhibitiongoers *actually* believe that the world they inhabit in their daily lives is in grayscale, whereas the pop-up and its associated images are in color. Rather, this dichotomy between black-and-white and color is metaphorical and highly ideological: the importance here is not that the world outside is really colorless, but that visitors are encouraged to view it as such. This binary opposition between the colorful and the colorless has a distinctly cinematic (and specifically Classical Hollywood) legacy: though the earliest color films involved hand-painting or tinting individual film strips, thus preserving a black-and-white image with a colored layer above it, with the advent of three-strip Technicolor in the 1930s, “black-and-white” and “color” were codified as opposites. This opposition between monochrome and color often maps onto binaries such as fantasy vs. reality and self vs. other, with films such as the aforementioned *Wizard of Oz* using both black-and-white and three-strip Technicolor stock to designate separate diegetic registers. Famously, in *The Wizard of Oz* (Victor Fleming, 1939), the mundane world of Kansas is rendered in sepia, and Dorothy's journey to polychromatic Oz situates

color firmly in the realm of fantasy. In 1939, color film was a technological novelty, associated with fantasy and spectacle rather than realism; it was also extremely expensive and required hiring consultants from the Technicolor corporation and renting a specialized camera—for these reasons, Technicolor was often reserved for big budget, so-called “unrealistic” genres such as musicals. Powell and Pressburger’s *A Matter of Life and Death* (1946), a fantasy romance in which angels decide the fate of a World War II pilot caught between worlds, reverses the model of *The Wizard of Oz* so that this time the mundane world is in color and the afterlife is in black-and-white. Still, even with this inversion, the film presents the colorful world as more desirable and sensual, with one angel self-reflexively commenting, “We are starved of Technicolor up here.” To take one last example of this dialectic between color and black-and-white in cinemas, the 1998 film *Pleasantville*, as discussed in the previous chapter, marks a departure insofar as it was one of the first films to employ digital color grading throughout, making it possible to include black-and-white and color in the same frame. In the film, the fantastical retro universe of the tv show by the same name (*Pleasantville*) is entirely achromatic until color begins to encroach, one object at a time. Like *A Matter of Life and Death*, the film is highly self-referential, with its characters being aware of whether they are in black-and-white or color (“I’m pasty!”, Reese Witherspoon’s character says when she finds herself transported into Pleasantville). This film likewise positions color as exotic, sensual, embodied, and racialized, a threat to the conservatism of this fictional 1950s society (despite it being problematically an entirely white cast, characters who are “in color” are ostracized in several allusions to Jim Crow, such as “No Coloreds” signs outside businesses).

Thus, much like its cinematic precedents, the Color Factory sets up a clear ideological boundary between spaces that are “in color” and those that are not. Color is a reprieve from the daily grind, from the grayscale mundanity of our daily rhythms and “always-on” mindset of 24/7 capitalism. The not-so-subtle irony is that the Color Factory thrives on exactly the kind of attention-based labor it attempts to critique: the need to constantly report and document one’s location through geotags, hashtags, and social media platforms is what fuels the supposedly “authentic,” “human,” and “connected” experience it promotes. The paper Neighborhood Map is cartoonishly rendered, omitting any street names, and is clearly not meant to be used as a “real” map, which usually requires a general knowledge of the surrounding area before setting out. Instead, the assumption is that visitors will navigate to each “neighborhood secret” using Google Maps, Yelp, or another app that uses GPS or locative data and then geotag their location on Instagram.¹⁸ Colors are always sampled quantitatively into paint swatches and geometric shapes, or those that photograph the best with an iPhone camera. Color thus emerges as a highly mediated entity that one can only access by means of an interface, creating a feedback loop between digital storage technologies and inhabited physical space.

A recent episode of the architecture and design podcast *99% Invisible* dubs this feedback loop between the construction of architectural sites and their subsequent documentation and circulation via photo-sharing platforms “Instagram architecture.”¹⁹ The August 2020 episode, titled “Instant Gramification,” focuses primarily on a collaborative artists’ workspace Sugarhouse Yard (an industrial site in East London) called the Yardhouse. Designed and built by architecture collective Assemble in 2014, the Yardhouse was intended as a temporary structure with a short-term lease, and was thus constructed from inexpensive, mass-produced materials such as timber that could later be disassembled. It was one particular aesthetic choice, however, that led to an outpour of visitors to the building whose photographs of the site made it “Instagram-famous”: a

¹⁸ Jordan Frith, *Smartphones as Locative Media* (Polity Press, 2015), 52.

¹⁹ Many thanks to Carolyn Kane for pointing me towards this episode.

single front-facing wall of multicolored cement shingles that appeared to transform under different lighting conditions [Figure 13]. Assemble architect Joe Halligan described the wall, which became a kind synecdoche for the Yardhouse itself, as “a bit like a lizard’s skin or something but pastel, so quite surreal,” whereas to *99% Invisible* host Roman Mars and producer Emmett Fitzgerald, it looked like “a beautiful tropical fish of a building tucked away in a postindustrial hinterland right next to a highway.”²⁰ I find it striking that both of these organic metaphors depict the Yardhouse as a living entity, the seamless gradient of its chameleon-like “scales” setting it apart from the grayness of the surrounding industrial landscape. This contrast is remarkably similar to the Color Factory’s attempt to render the surrounding world in black-and-white: as I navigated through the muted grays and beiges of Houston’s Upper Kirby neighborhood, I could see the rainbow-striped warehouse where the pop-up was located from several blocks away [Figure 15]. The building seemed to demand that I document it, emphasizing the Color Factory’s sheer photogeneity and “Instagrammability” before I even entered the building.

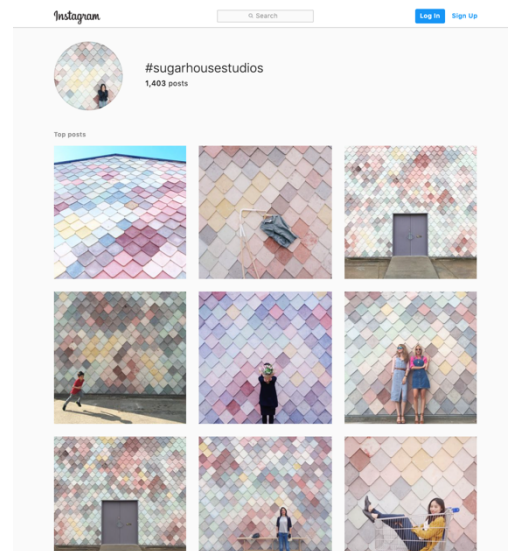


Figure 13. Left: The Yardhouse, designed by Sugarhouse Studios. London, UK. **Right:** Instagram photos tagged #sugarhousestudios

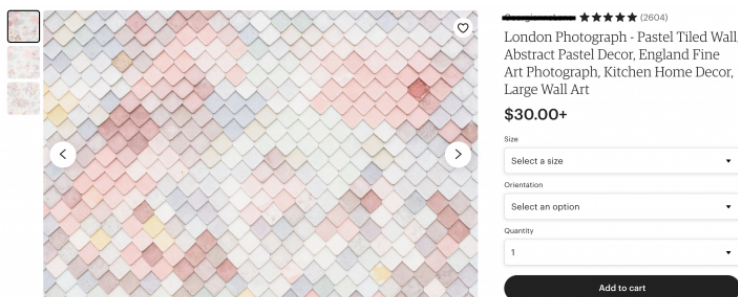


Figure 14. Left: poster print of the Yardhouse wall for sale.

Right: a handwoven “Sugarhouse blanket” woven by blogger Tales From a Happy House.



²⁰ Roman Mars, host, and Emmett Fitzgerald, producer, “Instant Gramification.” *99% Invisible* (podcast), June 16, 2020. <https://99percentinvisible.org/episode/instant-gramification/>



Figure 15. Exterior views of the Houston Color Factory. Photo: Lida Zeitlin Wu

Both the Color Factory and the Yardhouse are examples of how the distinctive photographic aesthetic of Instagram is beginning to influence the design and construction of physical spaces. This aesthetic is characterized by bold colors, accents, and patterns, as well as symmetrical or centered compositions and a shallow depth of field. Like the color swatch, the grid reorganizes material reality into a two-dimensional set of geometrical coordinates.²¹ The result is an overwhelming sense of *flatness* that is only accentuated by the photo-grid format supported by the platform—an aesthetic that becomes paradoxically realized three-dimensionally as “flat photo-op architecture.”²² Though shooting an object from above to flatten out an image (known as a “flat lay”) or arranging objects at right angles to emphasize geometrical precision (called “knolling”) are tactics that have long been used in commercial advertising, these tactics gain new significance when we take into account the question of scale.²³ Considering the size of most smartphone screens, platforms such as Instagram and Pinterest are redefining what “looks good” (that is, what deserves a like, comment, or repost) by emphasizing qualities that make images “pop” when displayed on the screen of a handheld device. Most digital cameras today (including smartphone cameras) record far more information than can possibly be displayed on a small screen; flat backgrounds, bold shapes, and heightened color contrast thus all act to cut down on the visual information contained in a given image.²⁴

²¹ Rosalind Krauss, “Grids,” *October* 9 (Summer 1979), 52.

²² “Instant Gramification.”

²³ Daisy Alioto, “What is Lifestyle?” September 2020. Interactive digital essay. <https://www.whatislifestyle.com/>

²⁴ Lev Manovich, *Instagram and Contemporary Image* (Lev Manovich, 2016), 105.

Similarly, just as white functions as the default “neutral” at the Color Factory, Instagram uses white borders around its images to heighten color contrast for small screens.²⁵ With both Instagram exhibitions and sites such as the Yardhouse wall, the photographs circulating via social media come to take on a life of their own. The more photos of the Yardhouse were posted to Instagram, the more people flocked to take photos in front of the wall [Figure 13], to the point that professional photo crews were calling in to “book the wall.” More crucially, however, Instagram users all over the world who had never even visited the building were consuming and producing their own versions: in a perfect-bordering-on-perverse realization of Benjamin’s “Work of Art” essay, images of the wall were cropped and edited to become stock photos and desktop wallpapers, printed onto laptop cases, rugs, and phone cases [Figure 14].²⁶ One Instagram user, @talesfromahappyhouse, having never visited the Yardhouse, even crocheted a quilt inspired by the scale-like patterns of the wall, which got a shout-out on the podcast.²⁷ When the building was eventually disassembled, bewildered spectators continued to wander around the area in search of a “ghost geotag” now indelibly written into the landscape.²⁸

Homage to the Square Photo

The Yardhouse is an example of the “hybrid spaces,” or places that are located in both physical and virtual space simultaneously, that emerge alongside locative technologies that rely on GPS satellites, Wi-Fi location data, and critical infrastructure.²⁹ Such hybrid spaces are indicative of the shifting ways of relating to one’s surroundings when filtered (quite literally) through the lens of the smartphone camera. Unlike a Walkman, iPod or e-reader, which encloses the user in an immersive “bubble,” locative media provide information *about* a user’s surroundings, inviting them to view digital information and physical space as intertwined.³⁰ This feedback loop means it becomes increasingly difficult to tell the difference between so-called “real” and “virtual” space, as what we often think of as intangible can have very concrete physical and spatial effects. Walking through a neighborhood, phone in hand, searching for “Instagrammable” objects or moments, the surrounding landscape becomes, in the eye of the user, an infinite selection of possible snapshots.

In 1977, decades before the transition to digital photography, Susan Sontag wrote: “A way of certifying experience, taking photographs is also a way of refusing it—by limiting experience [through] a search for the photogenic, by converting experience into an image, a souvenir.”³¹ This desire (Sontag goes so far as to label it a “compulsion”) to move between subjective experience and the image-as-object is so ubiquitous with networked photo-sharing apps that we often take it for granted. Yet Sontag also points to the ways in which experiencing the world through a camera lens is to see it “photographically,” as a set of discrete units. “Photography reinforces the nominalist view of social reality as consisting of small units of an apparently infinite number,” she asserts, “as the number of photographs that could be taken of anything is unlimited. Through photographs,

²⁵ Ibid, 111.

²⁶ “Instant Gramification.”

²⁷ “Sugarhouse Blanket.” *Tales From a Happy House*, October 6, 2019. Blog. <http://www.talesfromahappyhouse.com/2019/10/sugarhouse-blanket.html>

²⁸ “Instant Gramification.”

²⁹ Adriana de Souza e Silva, “From Cyber to Hybrid: Mobile Technologies as Interfaces of Hybrid Spaces.” *Space and Culture* 9, no. 3 (2006): 261-278.

³⁰ Jordan Frith, *Smartphones as Locative Media*, 22.

³¹ Susan Sontag, *On Photography* (New York: Picador, 1977), 9.

the world becomes a series of unrelated, freestanding particles.”³² This discretizing impulse is even more pronounced on Instagram, which presents the user with both diachronic and synchronous viewing options: the “infinite scroll” of individual photos on the home page on the one hand and the grid-based format of each account on the other. Supplementary apps such as Layout also make it possible to create “collages” of multiple images and export them back to Instagram. Part and parcel of the “grid-like logic” of modern perception, lived experience becomes a set of modules to be sampled, numbered, and labeled.

The rigid formalism of Instagram photography encompasses not just flatness, but symmetry and repetition, with the square functioning as its most basic unit. In the platform’s original 2010 incarnation, all images were automatically cropped to become squares. While the square photograph finds its precedent in Polaroids, whose nostalgic “retro aesthetic” informs many of the platform’s formal decisions, this grid-like configuration of uniform shapes in various permutations is also reminiscent of digital bits. In this sense, the order and manner in which photographs are juxtaposed and presented on Instagram encourage the user to see the world not merely “photographically,” as Sontag discusses, but as a set of variables that can be altered and manipulated *ad nauseam*. Color emerges as one of the most malleable variables, indicative of its exhaustive, numerical nature on digital platforms. Built-in filters, or templates with set ratios of brightness, exposure, contrast, saturation, and sharpness (to name a few) encourage users to “edit” a photograph with a single click. Since color on light-emitting screens is inseparable from these settings, different filters will inevitably alter the color palette of a given image [Figure 16]: “Inkwell” converts an image to black-and-white and increases contrast, whereas applying the “Clarendon” filter will result in a “cooler,” higher-contrast photo by adding a cyan tint to lighter areas and darkening shadows. Some filters exaggerate the presence of a single color: “Ludwig” (named after Ludwig Mies Van Der Rohe) desaturates yellows, blues, greens, and magentas while increasing the saturation for red. Filters have become such a ubiquitous part of images that circulate on virtual networks that #nofilter is a common hashtag, indicating that the absence of editing or filtering is the exception rather than the norm.³³



Figure 16. Selected Instagram filters

³² Ibid, 21-22.

³³ Even when users do use #nofilter, there remains a great deal of skepticism around whether the image was in fact edited. There is even a website called Faker Catcher, where you can upload an image and determine if it matches any of Instagram’s filters. <https://filterfakers.com/catcher#> =

Since 2015, Instagram users have been able to post non-square landscape or portrait images in addition to squares. Around this time, the platform also introduced sliders that allowed users to customize different color and brightness settings, instead of having to rely purely on “native filters.”³⁴ Still, whether or not a user chooses to apply a filter or toggle with brightness settings, the cameras that come with most recent smartphone models are precisely calibrated to take “good photos”—that is, images that are high contrast, color balanced, and not washed out. Taking a photo on a typical digital camera’s default settings will activate algorithms that adjust color and gray-scale, as well as automatically sharpen the image and adjust brightness settings.³⁵ The hands-free “selfies” taken at the Color Factory are not meant to be edited (though visitors have the option to do so when posting the images to social media), and the pop-up’s team tested out several different lighting scenarios prior to opening, ultimately investing in mirrorless Canon EOS RP cameras, whose autofocus feature compensates for poor lighting conditions and accentuates the high contrast colors of the exhibition space.³⁶

The combination of aesthetic conventions and technological standardization means that despite these options to further customize photos, images intended to be displayed on handheld devices have been accused of an aesthetic “sameness.” Carolyn Kane notes that while digital color palettes are “bright, fun, [and] easy to use,” built-in features and compression standards result in a “radical homogeneity of use.”³⁷ The same critique has been applied to the architectural and design aesthetic described on *99% Invisible*, where both virtual and physical spaces have begun to display the same set of stylistic features. Wes Anderson, whose cinematic backdrops, despite being meant for the big screen, adhere to many of Instagram’s principles—flatness, symmetry, bold color contrast³⁸—has spurred such a large online following that an Instagram account called @accidentallywesanderson [Figure 17] solicits photographs of architectural sites that look like they could be stills from one of Anderson’s films.³⁹ Though nearly all of the structures depicted in these images were built long before Anderson was even born, the angle from which each image is taken, as well as its subsequent cropping, sharpening, and saturation, allows a contemporary auteur’s visual style to self-replicate through photos taken primarily by amateurs (called “travelers” by the account’s creators). These photos, which range from images of cable cars in Jackson Hole, Wyoming to the vibrant yellow Nordurgardi Lighthouse in Reykjavik, Iceland, are at once geographically specific and utterly indistinguishable: juxtaposed side-by-side on the grid of the account’s homepage, the global gives way to a vague sense of placelessness.

³⁴ Manovich, *Instagram and Contemporary Image*, 145.

³⁵ Ibid, 59.

³⁶ Ashley Carman, “Experience, Experience, Experience! Behind Color Factory, one of the photogenic pop-ups trying to conquer the experience economy.” *The Verge*, November 6, 2019. <https://www.theverge.com/2019/11/6/20949838/color-factory-houston-instagram-pop-up-experience-museum>

³⁷ Kane, *Chromatic Algorithms*, 170.

³⁸ Comically, on an episode of the adult animated series *Bojack Horseman*, a character who has recently had his vision corrected exclaims, “My depth perception is so much better now! I’m going to go watch a Wes Anderson movie and see if I can perceive any depth in it!” (S5E4, 2018)

³⁹ The Instagram account now has an official website and was even published in book form in October 2020.

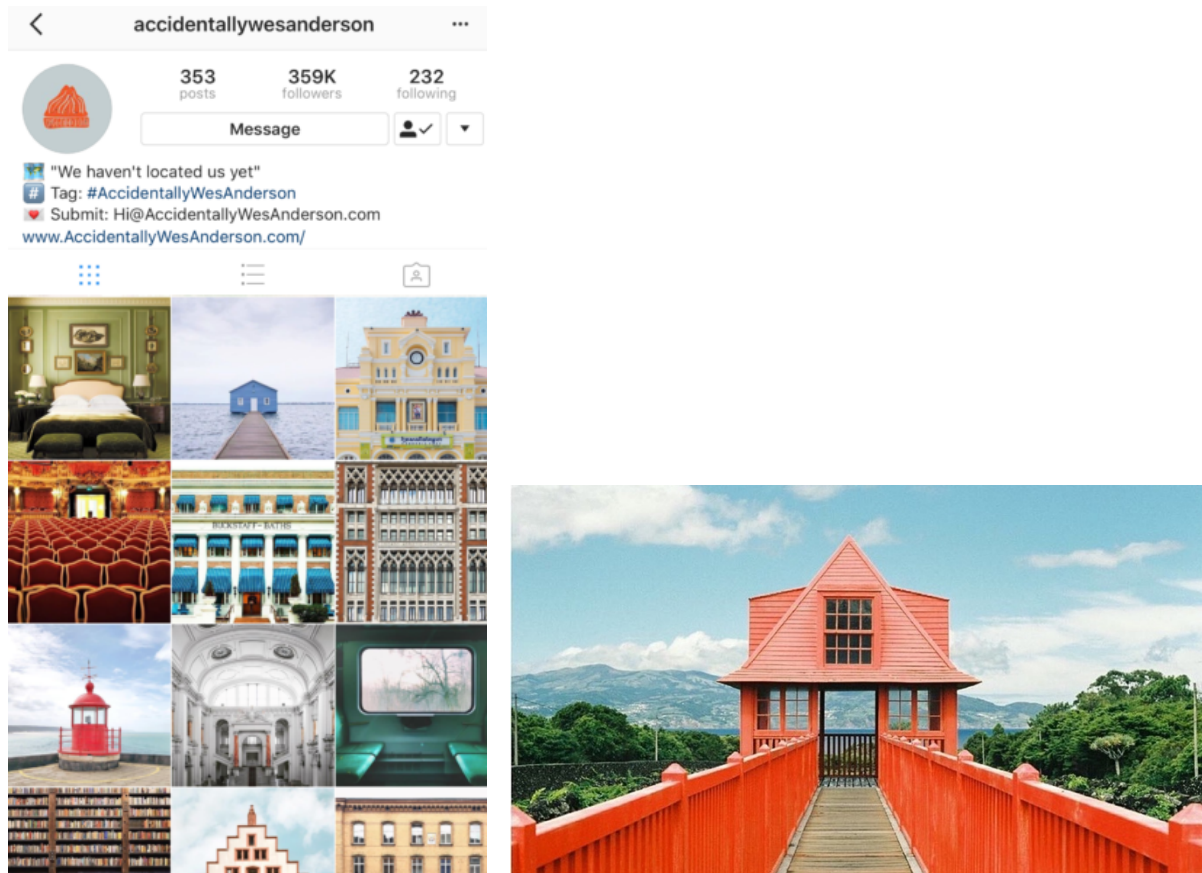


Figure 17. Images from the @accidentallywesanderson Instagram page, which are characterized by flatness, high color contrast, and symmetry.

Journalist Kyle Chayka attributes this “placeless” geographical ambiguity to start-ups such as Airbnb, which emphasize increased mobility and the globalization. In a 2016 article published on *The Verge* titled “Welcome to Airspace,” Chayka laments how spaces such as hotels, cafés, workspaces have begun to look uncannily similar regardless of geographical location—an update of Marc Augé’s “nonplaces” for the digital age. He lists several recurring features of the “global minimalist” style he dubs Airspace: “There are blank white lofts with subway-tile bathrooms, modular furniture, wall-mounted TVs, high-speed internet, and wide, viewless windows in every city, whether it’s downtown Madrid; Nørrebro, Copenhagen; or Gulou, Beijing.” Such patterns, he concludes, indicate that “aesthetic homogeneity is a product that users are coming to demand.”⁴⁰ Airspace is the new nonplace, its homogeneous aesthetic bolstered by algorithms that push users into an echo chamber of look-alike images in the name of personal preference (“if you liked this, you might like...”). Because most taste-based algorithms tend to recommend items (musical artists, social media accounts, objects for purchase on Amazon, etc.) that are similar to what the user has already expressed interest in, customization and individualization give way to the exact opposite. The notion that social media, which we tend to associate with distributability, differentiation, and variability, actually plays a role in standardizing taste, may seem surprising.

⁴⁰ Kyle Chayka, “Welcome to Airspace: How Silicon Valley Helps Spread the Same Sterile Aesthetic to the World.” *The Verge*. August 3, 2016. <https://www.theverge.com/2016/8/3/12325104/airbnb-aesthetic-global-minimalism-startup-gentrification>

Homogenization and standardization are more commonly tied to mass culture and media, which involve a central point of distribution and multiple points of reception. Yet I would argue that this tension between standardization and customization is a key paradox that defines this particular historical moment. With Instagram Architecture, as with Airspace, we find ourselves trapped in a feedback loop where social networks and algorithms both recommend and reshape taste and aesthetic preferences. By making what we already “like” disproportionately visible, other things become invisible through omission or exclusion.⁴¹

Given that color has always been intimately tied to taste-based judgments and cultural associations that morph and evolve across space and time, this shift towards aesthetic homogeneity has crucial ramifications for standardized color and commodity culture in the digital era. Color forecasting agencies that sought to capitalize on trends by predicting a given color’s popularity long before network culture and social media have much to gain by “recommending items according to a global notion of relevance” while simultaneously “satisfying [users] with varying tastes.”⁴² In contrast to the mid-century principles of color harmony endorsed by Faber Birren, which involved pairing colors that, despite having the same white content, were visually different, *likeness*, as opposed to complementarity, emerges as a distinct characteristic of twenty-first century color aesthetics. I now turn to that giant of color forecasting—Pantone—and how the company’s monopoly over standardized color has not merely reshaped what colors are popular, but how the discretization and commercialization of color itself has been reframed in the name of the so-called “global.”

Pantone: A Paragon of Soft Power

On an episode of the extremely popular CW teen drama *Riverdale*, resident “mean girl” Cheryl Blossom is asked about her favorite color. “Red, obvi,” flippantly answers Cheryl, whose auburn hair, red sweaters, and crimson lipstick are all fixtures of her character. “But if I had to specify, it’s Pantone’s Flame Scarlet” (S3E17 “The Raid,” 2019). Though the invocation of Pantone may seem like pure product placement, the fact that Flame Scarlet was not an actual Pantone color at the time but instead an entirely fabricated hue suggests otherwise. Instead, it points to the multitude of ways in which color forecasting agencies and commercialized color systems have become synonymous with color itself. Just as Muriel Blandings was dissatisfied with basic color terms and required further descriptors, it appears that simply “red” is not specific enough to compete with today’s proliferation of patented hues [Figure 19]. Yet while Muriel in 1948 struggled to find the language with which to describe the colors she desired for her home, instead having to rely on various mismatched fabric samples, in 2019, Cheryl Blossom’s favorite color tidily fits into a literal box: the Pantone color swatch.

Though Pantone was already beginning to hold a monopoly on standardized color by the mid-to-late 1960s (the Pantone Matching System having been created in 1963), its commercial success and geographical scope has since increased exponentially, leading the corporation to deem itself the “world’s leading color expert” and the “gold standard of color consistency.”⁴³ Much of Pantone’s success, as I discussed in the previous chapter, is owed to the corporation’s

⁴¹ Tania Bucher, *If... Then: Algorithmic Power and Politics* (Oxford University Press, 2018), 154.

⁴² *Ibid.*, 105.

⁴³ “Pantone Color Systems Explained.” Pantone. <https://www.pantone.com/color-systems/pantone-color-systems-explained>

response to the rise of personal desktop computing and ongoing cooperation with various software companies during the early days of digitization. But beyond this, Pantone also facilitates and engages with the participatory logic of digital platforms and social media, trusting in the existence of the “empowered consumer,” whose choices, preferences, and attention are all subject to data mining and monitoring.⁴⁴ In this sense, Pantone is a clear example of what Sven Brodmerkel and Nicholas Carah call a *brand machine*, or an advertising model typical of today’s information economy in which consumer engagement can be tracked and predicted via algorithmic data. In order to obtain cultural and financial capital, brand machines rely on “a network of human relationships mediated by a digital media environment that coordinates and orchestrates action, generates data and shapes flows of attention over time and space.”⁴⁵ Shortly after the *Riverdale* episode was aired, Pantone announced “Flame Scarlet 18-1662” as one of twelve new shades in their Spring/ Summer 2020 Fashion Trend Color Report, alongside the description “Burning bright, Flame Scarlet exudes confidence and determination” [Figure 18].⁴⁶



Figure 18. Pantone Flame Scarlet, released in Spring 2020



Figure 19. This “Hipster Ariel” meme points to the ways in which Pantone has come to stand in for color itself. Simply “red” is no longer specific enough.

Though *Riverdale* was never explicitly mentioned in the press release, both the timeframe and descriptor (which might as well describe Cheryl Blossom’s self-assured persona) present a particularly on-the-nose instance of the ways in which color trend prediction involves keeping close tabs on art, design, the entertainment industry, and other spheres of cultural production. *Riverdale*’s explicit invocation of Pantone sheds light on the ways in which “in today’s visual and

⁴⁴ Sven Brodmerkel and Nicholas Carah, *Brand Machines, Sensory Media and Calculative Culture* (Palgrave Macmillan, 2016), xiii.

⁴⁵ Ibid, 52.

⁴⁶ Laurie Pressman, “New York Fashion Week Spring / Summer 2020.” *Pantone Color Institute*, September 6, 2019. <https://www.pantone.com/color-intelligence/fashion-color-trend-report/fashion-color-trend-report-new-york-spring-summer-2020>

material culture, mass-produced and reproduced color primarily directs attention to itself.”⁴⁷ Far from the commonly held notion that color forecasting agencies are invisible intermediaries that imperceptibly shape cycles of trends and obsolescence, here the intermediary becomes hypervisible to the point that the color swatch or chip becomes a synecdoche for color as a whole.⁴⁸ Though Pantone generates the bulk of its revenue from color consulting services and manufacturing software and design tools for designers, as of 2015, as much as 15 percent of the company’s business came from their licensed products, also known as “Pantone Lifestyle.”⁴⁹

But nowhere do we see Pantone’s hegemony over standardized color than their Color of the Year, which began in 2000, not coincidentally at the beginning of a new millennium amidst anxieties about Y2K (“We were moving into Y2K and wondering: is the world going to fall apart?” Vice President Laurie Pressman reflected in 2019).⁵⁰ Each year in early December, the Pantone Color Institute (the branding and trend-predicting business unit within the corporation) puts forth a statement introducing a newly named shade they predict will be the most popular or influential beginning in the new year. The announcement, most recently for 2022’s 17-3938 Very Peri, is the culmination of a year-long process of combing various cultural and social spheres (fashion, marketing and branding, social media, politics, the film industry, and so on) for emerging pattern and trends in color.⁵¹

This feedback loop—where Pantone draws on already existing color trends in order to generate cultural and financial capital, thus creating new trends—relies on a distinctly postindustrial logic that consistently blurs the line between consumers and producers. The company’s strong social media presence and interactive promotional content means that even photos of everyday commodities (cosmetics, furniture, clothing) and even objects found in nature (flowers, plants, the sky) can be tagged #coloroftheyear or #pantone, inviting users to view their surroundings in terms of patented Pantone shades. Not only is the hashtag a way to label and categorize colors in a more exacting and rationalized way, but it indicates the ways in which Pantone unofficially “owns” not just unpatented objects, but also our physical surroundings by targeting perception itself. A Twitter caption accompanying a photo of the sky at dusk [Figure 20] reading: “Pantone Colour of the Year 2020 captured in photo I took at Weymouth has inspired me. You will see how soon. Are you feeling the blue tones this year?” makes manifest how we are encouraged to keep tabs on our own lived experience of color by converting it into an infinite number of labeled swatches or modules. A sunset is no longer just a sunset, but a

⁴⁷ Laura Ann Kalba, *Color in the Age of Impressionism: Commerce, Technology, and Art* (The Pennsylvania State University Press, 2017), 212.

⁴⁸ In Regina Lee Blaszczyk and Ben Wubs’s edited volume *The Fashion Forecasters: A Hidden History of Color and Trend Prediction* (Palgrave Macmillan, 2018), they aim to shed light on these processes of color forecasting that, from the late-nineteenth through twentieth centuries, have been concealed. While Blaszczyk and Wubs outline a longer history of these market forces, they don’t acknowledge the ways in which their function as intermediary has shifted greatly in the twenty-first century.

⁴⁹ Pantone Lifestyle includes paraphernalia such as mugs, water bottles, notebooks, and Christmas ornaments, all branded with the color swatch and corresponding number of the consumer’s choice. In addition, marketplace websites such as Etsy and Society6, as well as private retailers such as the Brooklyn-based Uncommon Goods, feature numerous unlicensed products using Pantone iconography.

⁵⁰ Kirsi Goldynia, “Pantone chooses a classic for its 2020 Color of the Year.” *CNN*, December 4, 2019. <https://www.cnn.com/style/article/pantone-color-classic-blue-2020/index.html>

⁵¹ While companies such as Sherwin-Williams and Benjamin Moore have created their own annual color forecasting models, these models have yet to exert the kind of influence as Pantone’s Color of the Year.

patented and measurable unit. The juxtaposition of the hashtags #pantone2020 and #mindfulness also showcases the ways in which being “mindful” about our surroundings ultimately takes the form of free advertising or labor for tech giants and corporations.



Figure 20. Even the sky becomes fair game for matching to a Pantone color swatch. **Left:** Auburn University, “@pantone’s #ColorOfTheYear may finally be blue, but we still have a favorite hue for 2020 and beyond!” December 5, 2019. Tweet. <https://twitter.com/auburnu/status/1202692558784098305>

The Color of the Year is also indicative of Pantone’s attempt to shape personal preferences, tastes, and even emotions under the umbrella of the “global.” All press releases and announcements regarding the Color of the Year emphasize the supposedly universality of color (“a color snapshot of what we see taking place in our global culture”), as well as color as a manifestation of widespread affect or emotion (“an expression of a mood or an attitude”).⁵² Though the cultural associations and symbolic meanings of distinct colors are never static, depending greatly on both geographical and historical context, the Color of the Year naturalizes and universalizes each color as fundamentally soothing and emotionally “authentic.” Ultimately, we are meant to believe that both color itself and the notion that individuals are responsible for monitoring their emotions are ahistorical and apolitical. The ability to exercise influence not through coercion, but rather through mass appeal and seduction, is Pantone’s primary source of soft power. Soft power, as opposed to hard power, which involves dominating by force, is not simply about influence, but when “appeal... leads to acquiescence,” particularly when it comes to accepting culturally specific political and moral values that come to be seen as universal.⁵³

In today’s global information economy, in which private enterprises generate an immense amount of cultural and financial capital, cultural products and corporations have become

⁵² “Introducing Rose Quartz and Serenity.” Pantone Color Institute, December 2016. <https://www.pantone.com/color-intelligence/color-of-the-year/color-of-the-year-2016#:~:text=WHAT%20IS%20THE%20PANTONE%20COLOR,a%20mood%20and%20an%20attitude>

⁵³ Joseph S. Nye, Jr., *Soft Power: The Means to Success in World Politics* (PublicAffairs, 2004), 6.

especially significant sources of soft power.⁵⁴ An American company with physical branches in Hong Kong and the United Kingdom and international web domains such as Pantone.ru (Russia), Pantone.fr (France), Pantone.de (Germany), and Pantone.jp (Japan), Pantone's self-proclaimed label as a "global color authority" ultimately involves erasing cultural differences in the name of global capitalism.⁵⁵ While we shouldn't conflate globalization with Americanization, quintessentially American values such as freedom of choice, individualism, and openness are particularly seductive as a means of global influence.⁵⁶ Pantone's Color of the Year thus has a mythologizing function, encouraging consumers to exert their individual "freedom" and agency to choose colors that are said to transcend geographical and linguistic boundaries.

As Ann Temkin puts it, "The color chart as the foundation of standardization—evident in the success of international color-matching systems such as Pantone—is symptomatic of a global age in which cultural differences in color are being eroded no less than those in language or cuisine."⁵⁷ While some Pantone shades, such as the Colors of the Year, have names (Mimosa, Sand Dollar, Emerald, Tangerine Tango, etc.), each shade always has an identification number (usually a string of digits ending with a series of letters) that makes it possible for the company to "translate" across languages and cultural contexts while participating in a kind of colonization by color standards. Pantone has been described as "the definitive language of color"⁵⁸ and "the authority on color most likely managed by Mr. Roy G. Biv himself"—ROYGBIV being the English-language mnemonic device for remembering the order of classifiable colors in the visible spectrum.⁵⁹ Such a descriptor suggests that this so-called "global" expansion ultimately takes English as its lingua franca.

Part of Pantone's marketing strategy that allows for the "erosion of cultural differences in color" is its treatment of color as a humanistic, universal language that overcomes blockages in communication. A short promotional video title "Why Color Management is Important" breezily explains the importance of having a "universal language of color" in order to obtain the precise shade desired. "Maybe nature inspires your next direction for a dress and you look everywhere for the precise shade of blue," speaks a voiceover in a clipped British accent. "Once you find it, your sample comes out just as you envisioned. Success! So you bundle the dress and send it off to production, hoping they'll duplicate every detail. And you wait... and wait some more... because when you finally find the right color, you want to keep it that way. But sometimes things get lost in translation or words don't do the job, and there's never room for error."⁶⁰ The voiceover accompanies a split-screen graphic that shows two people talking on the phone, struggling to find words to describe a precise shade of blue, as indicated by a pattern of variously blue-colored

⁵⁴ Ibid, 17.

⁵⁵ Pantone has three primary branches: their World Headquarters in Carlstadt, New Jersey, which represents North and South America; Pantone LLC in Kent, which covers Europe, the Middle East, and Africa; and their Asia Pacific branch in Hong Kong.

⁵⁶ Nye, 47.

⁵⁷ Ann Temkin, "Color Shift." In *Color Chart: Reinventing Color, 1950-Today*, ed. Ann Temkin (The Museum of Modern Art, 2008), 18.

⁵⁸ Diana Budds, "How Pantone Became the Definitive Language of Color." *Fast Company*, September 18, 2014. <https://www.fastcompany.com/3050240/how-pantone-became-the-definitive-language-of-color>

⁵⁹ "It's Official: Flame Scarlet is the Official Color of 2020." *Deck of Scarlet*, July 13, 2020. <https://www.deckofscarlet.com/blogs/press/it-s-official-flame-scarlet-is-the-color-of-2020>

⁶⁰ Pantone, "Why Color Management is Important" (video). November 6, 2017. Online. <https://vimeo.com/241581827>

swatches with superimposed question marks. These question marks are soon replaced with a single Pantone number: 19-3952 TCX, indicating that numerical standards are key to preventing things from being “lost in translation” [Figure 21].

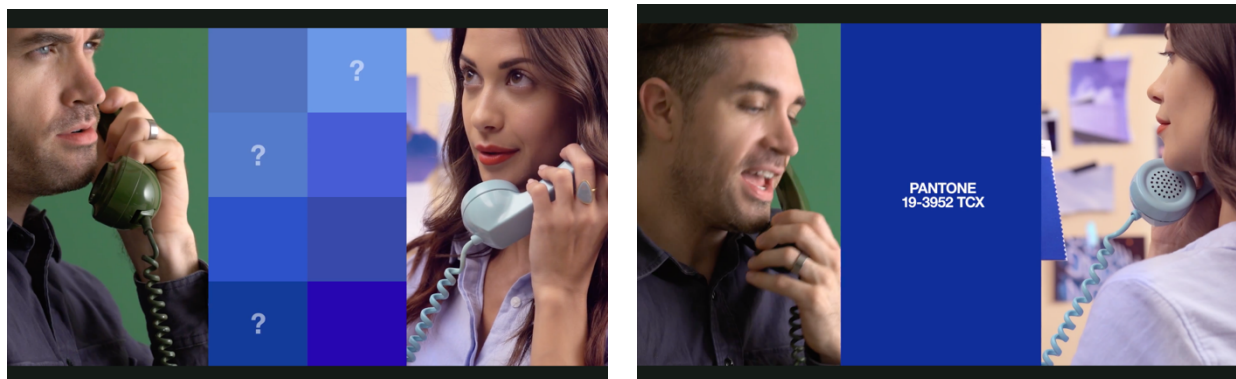


Figure 21. Stills from “Why Color Management is Important.” Pantone promotional video.

Another video introduces two color standards technicians who, according to Pantone, are exceptionally skilled at “translating” color across different technologies and media forms. The same clipped British voiceover introduces the employees as “Joe and James. They speak color.” Joe and James—two common Anglophone names—perform the role of the American working-class “everyman,” dressed in matching car mechanic’s uniforms with “Pantone” written on the nametag.⁶¹ Both of these promotional videos depict color as a universal language, briefly acknowledging the slippery relationship between color and verbal description only to dismiss it as an obstacle to be overcome through standardization and quantification. This universalizing impulse is reminiscent of Berlin and Kay’s 1969 *Basic Color Terms: Their Universality and Evolution*, a once widely accepted text that has since been criticized for its Eurocentric biases. Anthropologist Brent Berlin and linguist Paul Kay (both American) argued that different languages acquire basic color terms in a series of seven stages, beginning with the “non-colors” of black and white and ending with intermediate shades such as pink, orange, and purple.⁶² The more distinct color terms in a language, the more “advanced” it is in terms of linguistic development.⁶³ While the Berlin-Kay theory held sway for decades, since the 1990s and early 2000s the study has since been widely criticized due to its superimposition of Western values—specifically, linear processes of modernization and development—onto other cultures. Furthermore, color in the original study was measured using Munsell color chips as a control variable, indicating the assumed neutrality of Western color standards and scientific paradigms.⁶⁴

⁶¹ Pantone, “Pantone Standards” (video). June 27, 2018. Online. <https://vimeo.com/277349975> This same video exists with Korean, French, Japanese, Mandarin, Spanish, and Italian subtitles, but the names “Joe and James,” as well as all the graphics, are kept the same.

⁶² Berlin and Kay did not claim that all languages have the same number of basic color terms—for example, English has eleven, whereas Russian has twelve, since there are two separate and unrelated words for light blue (*goluboi*) and dark blue (*sinnii*). However, the study did posit that “blue” as a category emerges in different languages at the same stage of development.

⁶³ Brent Berlin and Paul Kay, *Basic Color Terms: Their Universality and Evolution* (University of California Press, 1969)

⁶⁴ Barbara Saunders, “Revisiting Basic Color Terms.” *The Journal of the Royal Anthropological Institute* 6 no. 1 (March 2000): 81-99.

Still, the widespread assumption that color—both as lived experience and linguistic construct—transcends culture, race, and ideology is alive and well today. Anthropologist Christine R. Yano, in her discussion of the “global pinkness” of Hello Kitty and cute commodity culture, points to the Japanese word *mukokuseki*, or “without nationality,” as evidence that Euro-American culture remains invisible or neutral even amidst global or transnational exchange. “What is interpreted as ‘without nationality’ is actually very much imbued *with* Euro-American culture or race,” she observes.⁶⁵ The connotations of pink as an infantile, cute, or highly feminine color, for example, are rooted in a postwar Euro-American context, yet this color symbolism is now associated with gendered commodity culture on a global scale.⁶⁶ *The Pink and Blue Project*, an ongoing photography series by South Korean artist Jeongmee Yoon, is a critical commentary on the regimented relationship between normative gender identity and color in global consumer culture.



Jeongmee Yoon, *The Pink and Blue Project*. **Figure 22 (left):** *SeoWoo and Her Pink Things* (2008) Light jet print.
Figure 23 (right): *Kihun and His Blue Things* (2002). Lightjet print; sheet. Images courtesy of the artist.

Consisting of a cross-cultural comparison of South Korean and American children in their bedrooms posing with their “pink [or] blue things,” Yoon asks each child to color-code all of their toys and possessions, resulting in a truly dizzying array of similarly shaded objects. *Seowoo and Her Pink Things* (2006) [Figure 22] is an image so flattened by toys, pens, dolls (including Hello Kitty), stickers, backpacks, and dresses in minute gradations of pink and red that it takes the viewer a moment to locate Seowoo. Wearing a pink set with matching headband, she camouflages so well among her possessions that she could be just another doll. By contrast, the items in *Kihun and His Blue Things* (2007) [Figure 23] include action figures and toy trucks, Spiderman and Thomas the Tank Engine paraphernalia, all in blue with occasional splashes of red and yellow. The opposite of the restrained color harmony endorsed by Faber Birren, the colors of these photographs are all of similar hue and intensity, the aggregation of objects by similarity inducing an almost numbing effect. After a while, one becomes desensitized to the

⁶⁵ Christine R. Yano, *Pink Globalization: Hello Kitty's Trek Across the Pacific* (Duke University Press, 2013), 17.

⁶⁶ *Ibid*, 34.

aggressive pinkness or blueness of each image: as the narrator of Don DeLillo's *Americana* notes, "every color is essentially gray as long as everyone is wearing it. So I did not hesitate to show up for work in an orange tie, but never more orange than the orange others wore."⁶⁷ In the era of globalized sameness, likeness and similarity—both in term of appearance and cultural associations—become a guiding principle of institutionalized color aesthetics and preferences even as algorithmic culture appears to cater to individualized tastes.

In Search of Authenticity, or Color as Nature

The Color of the Year attempts to express a collective mood or feeling, pointing to a broader tendency in late capitalism for emotions and sensory experiences themselves to become commodities. Color's tendency to escape linguistic description and categorization has historically made it a subject of great interest for philosophers and theorists with a phenomenological bent; in this reading, color is an unmediated, embodied experience that cannot be separated from the senses.⁶⁸ While this romanticized notion of color as a free-floating, pre-technological entity seems at first glance at odds with systems of categorization that seek to harness and commodify individual hues, the marketability of standardized color thrives on precisely this paradox. As I examined in Chapter Two, the exponential rise of mass-produced synthetic color in the postwar period, together with the growth of self-help culture and discourses surrounding personality, reconfigured color as a physiological and sensory variable. Color became inseparable from mood, emotion, and selfhood, thought to be capable of influencing or controlling mood or affect.

In the twenty-first century, this institutionalized correlation between color and mood has not only endured but strengthened, owing much to the fact that the distinction between public and private has all but collapsed, with the market now infiltrating all private and domestic interactions. Effortlessly fusing popular psychology and consumerism, constant access to the Internet makes it possible to shop, browse, and socialize 24 hours a day, turning what had once been associated with privacy—leisure time, individual emotions, the volatility of mood—into trackable entities that can then be monetized.⁶⁹ The Color of the Year reflects Pantone's desire to capture an "immediate" and "authentic" experience unsullied by the frenetic pace of technology. Each chosen color possesses a particular affective potency or charge, which is said to capture the "collective mood" of the upcoming year.

Notably, accompanying press releases rarely mention specific media objects, designers, or geographic regions, but instead focus on the seemingly universal emotional impact color has on consumers. The press releases, which are often accompanied by promotional videos featuring an instrumental soundtrack and impeccably color-coordinated sets, show many of the same rhetorical moves: despite the variety of chosen colors, there is an extreme repetitiveness of phrases and common themes. Whether warm or cool, red or blue, saturated or pastel, press releases describe the Color of the Year using adjectives such as "calming," "peaceful," "tranquil," "joyful," and "nurturing," all of which serve to contrast the fast-paced and stressful

⁶⁷ Don DeLillo, *Americana* (Penguin Books, 1989), 4.

⁶⁸ See the section in *Chromatic Algorithms* titled "Romantic Color in Critical Theory," where Carolyn Kane gives an overview of phenomenologists and critical theorists who have romanticized color for its "intrinsic capacity to undo form and transgress meaning" (41-42).

⁶⁹ Eva Illouz, *Cold Intimacies: The Making of Emotional Capitalism* (Polity Press, 2007) and Jonathan Crary, *24/7: Late Capitalism and the Ends of Sleep* (Verso, 2013)

pace of daily interactions in a technology-saturated world.

Even when Pantone references specific historical events or draws on culturally specific color symbolism, the corporation presents color itself as a fundamentally apolitical entity: 2002's True Red (19-1664) was a patriotic response to 9/11, red supposedly representing love, passion, and strength. Fast forward to 2016, when Pantone chose two Color of the Year for the first time: Rose Quartz (13-1520 TCX), a warmer pale pink, and Serenity (15-3919 TCX), a cooler pale blue. These two shades were meant to complement one another, "reflecting connection and wellness as well as a soothing sense of order and peace."⁷⁰ To quote Pantone Executive Director Leatrice Eiseman, "Rose Quartz is a persuasive yet gentle tone that conveys compassion and a sense of composure. Serenity is weightless and airy, like the expanse of the blue sky above us, bringing feelings of respite and relaxation even in turbulent times."⁷¹

Here, color—loosely linked to a referent in the natural world, "the blue sky"—is meant to rescue consumers from an excess of visual information and stimulation, the phrase "turbulent times" obliquely referring to the then-recent outcome of the 2016 U.S. presidential election. In a fleeting reference to the historically gendered associations of pale pink and other pastel colors, Eiseman emphasized the ways in which Rose Quartz and Serenity "[challenged] traditional perceptions of color association" and should be seen as part of a global "gender blur" across fashion and design that overcomes the binary of pink femininity and blue masculinity. Yet it is consumer products that showcase the supposedly transgressive nature of this pink-and-blue gradient: the Rose Gold iPhone 6S, the album cover for Drake's *Hotline Bling*, Wes Anderson's *The Grand Budapest Hotel*.⁷² Rose Quartz and Serenity, like all other Colors of the Year, are treated as aesthetic rather than political (as though the aesthetic and political have ever been separable), their supposed "quietude [promising] the feeling of total escape from political concerns."⁷³

As much as the Color of the Year is a phenomenon that is inseparable from social media, what we see is a technologically deterministic rhetoric that pits individual personhood and wellbeing against politics, technologically induced stress, existential doubt, and economic collapse. In December 2021, Pantone for the second time announced two Colors of the Year: but unlike Rose Quartz and Serenity, which were similar tones blending in a gradient, the 2021 Colors of the Year, Ultimate Gray (17-5104) and Illuminating (13-0647), are described as opposites that ultimately work together. 2020, which saw both Donald Trump's bid for

⁷⁰ Pantone, "Introducing Rose Quartz and Serenity" (2016). <https://www.pantone.com/color-intelligence/color-of-the-year/color-of-the-year-2016>

⁷¹ "Pantone Color of the Year 2016: Pantone 13-1520 TCX Rose Quartz and Pantone 15-3919 TCX Serenity." December 2015. Press Release. <https://www.pantone.com/articles/color-of-the-year/color-of-the-year-2016>

⁷² Without acknowledging it, Pantone's choice of desaturated pink in 2016 responds to the so-called "Millennial Pink" craze, which refers to a range of chalky, beige-tinted pinks rather than a precise shade. Millennial Pink was initially sometimes called "Tumblr Pink" due to its origins in Internet "pastel" and "pale" communities, where users limit the images they post by color palette. For an in-depth analysis of these "pale blogs" and their ideological weight, see Christine Goding-Doty, "Beyond the Pale Blog: Tumblr Pink and the Aesthetics of White Anxiety." In *A Tumblr Book: Platform and Cultures*, ed. Allison McCracken, Alexander Cho, Louisa Stein, and Indira Neill Hoch (University of Michigan Press, 2020): 244-254.

⁷³ Christine Goding-Doty, "Beyond the Pale Blog: Tumblr Pink and the Aesthetics of White Anxiety." In *A Tumblr Book: Platform and Cultures*, ed. Allison McCracken, Alexander Cho, Louisa Stein, and Indira Neill Hoch (University of Michigan Press, 2020), 253.

reelection and the continued rise of far-right extremist groups in America, the start of the COVID-19 pandemic, the George Floyd protests, and countless environmental disasters, was described by many as the “worst year ever,” making it nearly impossible for Pantone to stick to its typically apolitical presentation of color.

Ultimately, however, the company was still able to capitalize on this contrast between catastrophe and “wellness,” with its chosen colors possessing a supposedly rejuvenating power against a virus that has killed over six million people worldwide.⁷⁴ Just as some have described the pandemic as “the great equalizer” or a universal experience linking all of humanity, despite its blatant exposure and exacerbation of pre-existing racial and economic disparities,⁷⁵ the press release states that the combination of “enduring Ultimate Gray with the vibrant yellow Illuminating... gives us resilience and hope. We need to feel encouraged and uplifted; this is essential to the human spirit.”⁷⁶ In an unprecedented time where previously in-person interactions have moved from the physical to the virtual realm, what we are seeing is an unprecedented clash between constant “connectivity” and individual alienation and isolation.

Note the ways in which the following phrases (taken from Color of the Year press releases from the past four years) encourage consumers to “slow down,” “breathe,” or “take a break” from technology:

Suggestive of the sky at dusk, the reassuring qualities of the thought-provoking PANTONE 19-4052 Classic Blue highlights our desire for a dependable and stable foundation on which to build as we cross the threshold into a new era... As technology continues to race ahead of the human ability to process it all, it is easy to understand why we gravitate to colors that are honest and offer the promise of protection.⁷⁷

Vibrant, yet mellow, PANTONE 16-1546 Living Coral embraces us with warmth and nourishment to provide comfort and buoyancy in our continually shifting environment. In reaction to the onslaught of digital technology and social media increasingly embedding into daily life, we are seeking authentic and immersive experiences that

⁷⁴ While the Houston and New York locations of the Color Factory have since reopened, the new social distancing guidelines are a radical departure from the pop-up’s original incarnation. In fact, the ball pit-as-finale concept could hardly be less ideal, as numerous articles pointing to the unsanitary nature of ball pits even prior to the pandemic have proliferated. The Color Factory has attempted to pass off its revamped locations as simply a new iteration, complete with colorful face masks for sale in their giftshop. Still, in the end, even though the images from Instagram pop-ups may be destined for social media, they rely heavily on the notion that there is something unique or authentic to be found in in-person interaction and sensory experience.

⁷⁵ Stephen A. Mein, “COVID-19 and Health Disparities: the Reality of the ‘Great Equalizer.’” *Journal of General Internal Medicine* 35, vol. 8 (August 2020): 2439–2440.

The phrase “great equalizer” is generally attributed to public figures and celebrities ranging from Governor Andrew Cuomo of New York to Madonna.

⁷⁶ “Pantone Reveals Color of the Year 2021: Pantone 17-5104 Ultimate Gray and Pantone 13-0647 Illuminating.” *Pantone*, December 9, 2020. Press Release. <https://www.pantone.com/articles/press-releases/pantone-reveals-color-of-the-year-2021-pantone-175104-ultimate-gray-and-pantone-130647-illuminating>

⁷⁷ “Pantone Color of the Year 2020: Pantone 19-4052 Classic Blue.” December 2019. Press Release. <https://www.pantone.com/articles/color-of-the-year/color-of-the-year-2020>

enable connection and intimacy.⁷⁸

Illustrative of flourishing foliage and the lushness of the great outdoors, the fortifying attributes of PANTONE 15-0343 signals consumers to take a deep breath, oxygenate and reinvigorate. Greenery is nature's neutral. The more submerged people are in modern life, the greater their innate craving to immerse themselves in the physical beauty and inherent unity of the natural world.⁷⁹

In all the above examples, each color finds a corresponding referent in the physical environment (the sky, the ocean, the forest), despite the fact that these are mass-produced synthetic hues with no immediate material relationship with these spheres [Figure 24]. The Color of the Year press releases treat nature—both the capitalized Nature of nineteenth-century Romanticism and the idealized “authenticity” of so-called “human nature”—as irreconcilable with technology. Here “technology” becomes an amorphous term that encompasses everything that “nature” is not. Technology is speed and frenzy; nature is tranquility and stillness. 2017's Greenery is perhaps the most explicit instance of this constructed opposition between culture and nature; as Pantone Color institute Vice President Laurie Pressman explained to *Forbes*, “There's a growing desire to reconnect with Nature and what is real and find ways to disconnect from technology. We need a break. We need to stop and breathe.”⁸⁰

By capitalizing the word “Nature” in their interview with Pressman, the *Forbes* piece solidifies the word's connection to the “real”—“real” here signifying that which is untouched, unmediated, and singular. Just as the Color Factory invites the viewer to imagine a scenario in which one can step out of a black-and-white world into a color-filled one, the ideological potency of Pressman's statement is not that consumers truly believe that Greenery is natural—and by extension, “real.” Rather, applying Mark Andrejevic's perceptive analysis of reality television to a different medium, “it is not the promised access to the real that participates in this logic so much as the incitation of a savvy response that desperately seeks to preserve the principle of a seemingly threatened reality.”⁸¹ By positing nature and culture as separate, the Color of the Year, like the colorful exhibition space of the Color Factory, seeks to isolate color from the “external world” both spatially and temporally. We feel like we can burrow blissfully into the cocoon that is *color itself*, even when we understand this escapism to be illusory.

Narratives of linear technological progress are thus fabricated only to be critiqued for their impact on mental “wellness”—a classic example of future shock. At the same time, the Color of the Year is fundamentally a future-looking enterprise, and this seemingly paradoxical combination of futurity and stagnation manifests in Pantone's ultimate reliance on precisely the digital technology and mechanisms of accelerated obsolescence it claims to critique. In the promotional video for Greenery, ambient music plays softly over a split screen shot of a matcha

⁷⁸ “Pantone Color of the Year 2019: Pantone 16-1546 Living Coral.” December 2018. Press Release. <https://www.pantone.com/articles/color-of-the-year/color-of-the-year-2019>

⁷⁹ “Pantone Color of the Year 2017: Pantone 15-0343 Greenery.” December 2017. Press Release. <https://www.pantone.com/articles/color-of-the-year/color-of-the-year-2017>

⁸⁰ Karen Hua, “Pantone's Color of the Year 2017 is Inspired By Nature.” *Forbes*, December 9, 2016. <https://www.forbes.com/sites/karenhua/2016/12/09/pantones-color-of-the-year-2017-greenery-symbolizes-a-fresh-start-fashion/?sh=6790785c7e98>

⁸¹ Mark Andrejevic, “When Everyone Has Their Own Reality Show.” In *A Companion to Reality Television*, ed. Laurie Ouellete (John Wiley & Sons, Inc., 2014), 42.

latte on the left and a disembodied pair of hands typing on a MacBook keyboard with a cover in the same green hue. The remainder of the video showcases aerial images of foliage and grass. Through color matching, the supposedly separate spheres of Nature and technology are thus revealed to be part of the same logic of standardization.

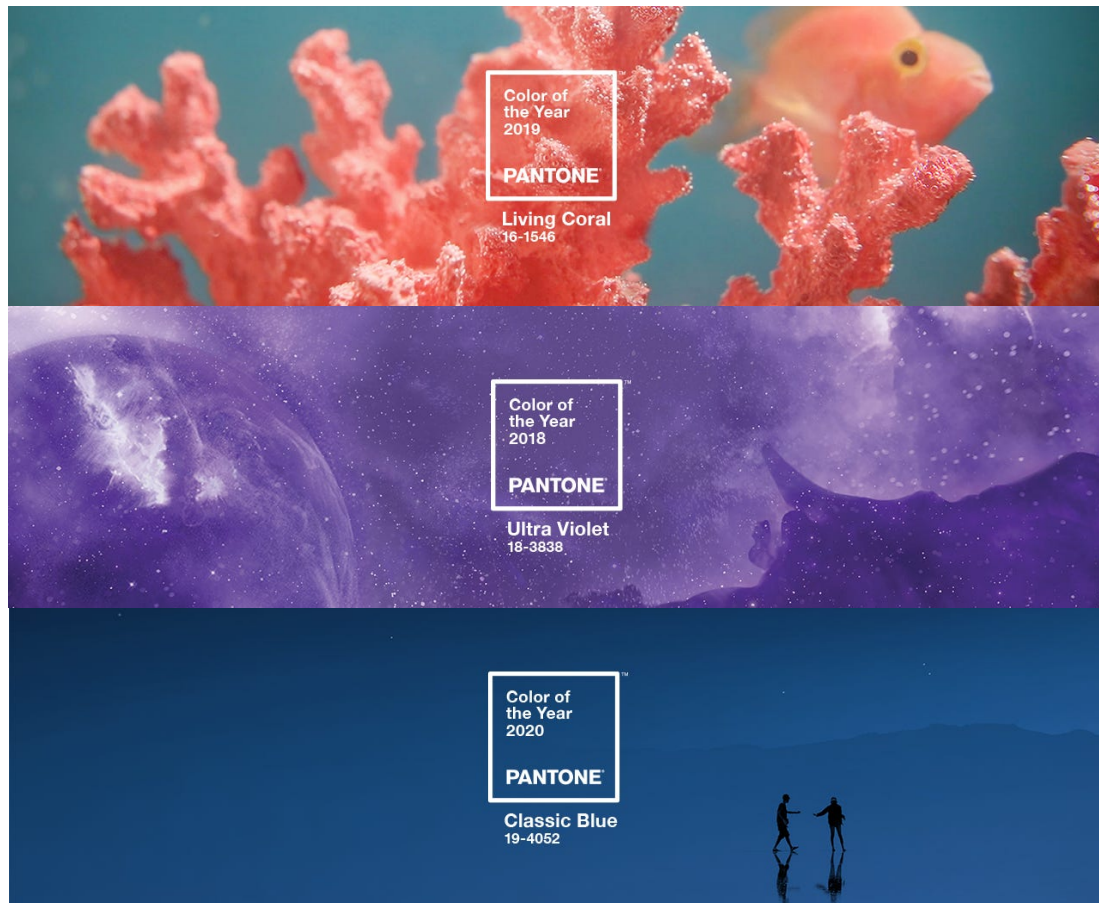


Figure 24. Pantone Colors of the Year for 2018-2020. The background images chosen for each press release are of the natural environment.

In the past few years, users have created several deeply cynical yet astute parody versions of the Color of the Year on social media (turning Pantone’s chosen medium against itself), highlighting the ways in which technology and nature have never been separable, most clearly with respect to climate change and catastrophe. In 2019, Australian creative duo Jack + Huei designed their own fictional Color of the Year for 2020, Pantone P115-U “Bleached Coral,” in protest of what they saw as the “tone-deaf” choice of 2018’s Living Coral. Citing the rapid decline of the Great Barrier Reef, they also wrote a mock “press release”:

Somber, yet uncomplicated, PANTONE P 115-1 U Bleached Coral harkens back to a simpler time. The subtly inoffensive hue offers a harsh reminder for how quickly things change, with a comforting, greyscale undertone that reinforces the inevitability of time. Representing the fusion of modern life with the natural world, while straddling the fine line between hope and despair, PANTONE Bleached Coral asks the age-old question—

where did it all go wrong?⁸²

Jack + Huei's mimicry of the language of Pantone press releases subverts apolitical idealism into dystopian existentialism (albeit with a good dose of dark humor), all the while finding a common denominator in the "inevitability" of technological change. On September 9th, 2020, when wildfire smoke turned the San Francisco Bay Area's skies a lurid and thoroughly "apocalyptic" shade of orange, I was on a plane, watching out the window with horror and fascination as we descended into what looked like a fiery abyss [Figure 25]. Though I knew immediately that this chromatic aberration would result in a social media field day, what I didn't know was that on the ground, users were once again turning to Pantone [Figure 26].⁸³ Widely circulated were posts announcing the 2020 Color of the Year as 09-2020 "End of Days Orange" and "Climate Change," with images of the orange smoke-shrouded San Francisco skyline serving as the backdrop. Another post shows a strip of Pantone color swatches in various shades of yellow and orange. An invisible hand, out of frame, holds the swatches up to a window, the orange sky clearly visible beyond the glass. The caption reads: "Trying to pick out the right shade of apocalypse for the baby's room."



Figure 25. Bird's eye view of the San Francisco Bay Area on September 9th, 2020.
Photo: Lida Zeitlin Wu

⁸² Jack + Huei, "Pantone Color of the Year 2020." <http://jackandhuei.com/pantone-color-of-the-year-2020>

⁸³ In fact, many people experienced frustration that the photos taken on their smartphones were automatically "white balancing" the image, resulting in a less vibrant orange than what they were really seeing. The hue was so "unnatural" that it stretched the limitations of pre-calibrated color.



Trying to pick out the right shade of apocalypse for the baby's room:



Figure 26. Examples of satirical social media posts invoking Pantone’s Color of the Year during the 2020 California wildfire season.

What these posts are critiquing is not just the concealment of climate change or the effacement of politics, but the privatization of wellness more broadly—“wellness” referring to the multi-billion dollar industry that encompasses practices such as meditation and mindfulness, diet, and other methods of emotional and physical self-regulation. Along with buzzwords such as “lifestyle,” and “self-care,”⁸⁴ wellness encompasses a set of cultural practices where individuals

⁸⁴ Though “self-care” may have originated as an act of defiance or rebellion against the status quo—in 1988, Audre Lorde wrote, “Caring for myself is not self-indulgence, it is self-preservation and an act of political warfare”—much like the self-help industry, it has been wholeheartedly embraced by corporate capitalism and neoliberalism. Most recently, Amazon launched a “WorkingWell” initiative, which a March 2021 press release described as “physical and mental activities, wellness exercises, and healthy eating support that are scientifically proven to help [workers] recharge and reenergize, and ultimately reduce the risk of injury.” Employees can visit “AmaZen” stations or “Zenbooths”—individualized kiosks where they

feel a moral imperative to constantly improve and monitor themselves in the name of emotional “authenticity.”⁸⁵ From sensory deprivation tanks to meditation apps to crystal healing, the ideology of wellness, like the Color of the Year, thrives on its allegedly apolitical nature and its “promise to act as a panacea for many of the endemic problems of post-industrial capitalism, such as anxiety, stress and existential insecurity.”⁸⁶ In the press release for 2018’s Ultra Violet, Pantone went so far as to explicitly announce that “The color [violet] is often associated with mindfulness practices, which offer a higher ground to those seeking refuge from today’s over-stimulated world.”⁸⁷ Additionally, many social media posts tagged #PantoneColoroftheYear are also tagged #mindfulness, #selfcare, and #loveyourselffirst.

As is evident from these examples, “alternative practices” associated with Zen Buddhism and Hinduism have been appropriated and absorbed into mainstream Euro-American culture, particularly with regards to color. The New Age obsession with chromotherapy, colored chakras, and “adult coloring books” as a mode of psychological healing demonstrate that even as color becomes increasingly rationalized and quantifiable, it continues to function as a transcendent or metaphysical ideal.⁸⁸ By depoliticizing and privatizing stress, emotional and physical health are re-packaged and marketed as emotional rather than political states, once again cementing the notion that individuals are responsible not only for their own wellbeing, but must constantly work towards improving themselves through self-scrutiny.

Feeling Blue, Tasting Purple: Monitoring the Chromosthetic Self

Thus far, I have primarily focused on how digitally reproducible color has become a surrogate for emotional authenticity, particularly when it comes to branding and marketing on social media. Yet color’s function as an escape from digital technology is not just about emotion, but more specifically, how these emotions are said to originate within the body as a multi-sensory experience. By capitalizing on a centuries-old tradition of chromesthesia—a subset of synesthesia where stimuli such as sound, smell, taste, as well as letters and numbers involuntary conjure color visuals and sensations for the perceiver—as transcendent experience, interactive color-based social media experiences once again encourage an “escape into color.” Bringing my analysis full circle back to the Color Factory, I conclude this chapter by examining the ways in which

can watch meditation videos or listen to affirmations. Each Zenbooth has a tinted blue skylight in a laughable attempt to convince employees that they are outdoors rather than in a windowless warehouse. In this scenario, “wellness” is a means towards greater efficiency or productivity and a way of surveilling individuals rather than an end in itself.

⁸⁵ See André Spicer and Carl Cederström, *The Wellness Syndrome* (Wiley, 2015) and Ronald E. Purser, *McMindfulness: How Mindfulness Became the New Capitalist Spirituality* (Watkins Media, 2019)

⁸⁶ André Spicer and Carl Cederström, *The Wellness Syndrome*, 24.

⁸⁷ “Pantone Color of the Year 2018: Pantone 18-3838 Ultra Violet.” December 2018. Press Release. <https://www.pantone.com/articles/color-of-the-year/color-of-the-year-2018>

⁸⁸ Slavoj Žižek observes that global capitalism thrives on the reconciliation of the mythos of the “exotic” Far East with neoliberal ideology, which come together in the form of what he calls “Western Buddhism.” He writes: “Although ‘Western Buddhism’ presents itself as the remedy against the stressful tension of capitalist dynamics, allowing us to uncouple and retain inner peace and *Gelassenheit* [serenity], it actually functions as its perfect ideological supplement.” Slavoj Žižek, *Cabinet Magazine* 2 (Spring 2001). Online. <https://www.cabinetmagazine.org/issues/2/zizek.php>. See also R. John Williams, *The Buddha in the Machine: Art, Technology, and the Meeting of East and West* (Yale University Press, 2014).

constantly being asked to “tune into” our bodies ultimately normalizes self-monitoring and surveillance.

In an effort to bridge the gap between physical and virtual space, the Color Factory takes part in a long-established tradition of media environments that draw on color-based synesthesia as a source of immersion, listing one of the exhibition’s goals as “to engage all of your senses in unexpected ways.” In New York, an installation designed by artist and musician duo Lakwena Maciver and Abimaro Maciver encourages visitors to play comically large xylophones with colored keys and to experiment with different harmonies; the most “harmonious” intervals, such as the first and fifth notes of a scale, correspond to specific color combinations.⁸⁹ The original San Francisco location featured scratch-and-sniff wallpaper (a nod to Willy Wonka, owner of a very different colorful factory), and all three locations provide edible confections whose colors are meant to accompany various installations, beginning with Mochi ice cream in the lobby and a conveyor belt of French macarons whose shape mirrors the colored dots of the exhibition’s logo [Figure 27]. After climbing out of the powder blue ball pit in New York, a docent offered me a scoop of gelato in precisely that shade (tinted “naturally” with dried butterfly pea flowers), and in Houston, the corresponding frozen treat for *To the Moon* was “Black Hole” ice cream [Figure 28], a coconut milk-based soft serve colored with activated charcoal.



Figure 26. Macaron flavors in New York. Photo: Lida Zeitlin Wu



Figure 27. Coconut milk-based “Black Hole” ice cream in Houston. Photo: Lida Zeitlin Wu

Both these examples appear at first jarring and inedible in their apparent artifice, but owe their appearance to trendy organic substances that are considered health foods and part of the “wellness” culture discussed in the previous section. As I’ll touch on shortly, the Color Factory’s attempts to trigger synesthetic responses in its visitors rely heavily on “matching” objects in similar colors. Operating by a similar logic to mixing and matching mass-produced paints to engineer mood or ambience, senses such as smell and taste are ultimately simulated by sight—

⁸⁹ Robin Young and Karyn Miller-Medzon, “Pop-Up Museum Lets Visitors Take Sensory Plunge into Wide World of Color.” WBUR: Boston’s NPR News Station, April 1, 2018. <https://www.wbur.org/hereandnow/2019/04/01/color-factory-new-york>

and more specifically, eye-catching, bright, often artificial-seeming colors—to varying degrees of success.

While I do want to draw a distinction between synesthesia as a distinct neurological condition as opposed to an idealized aesthetic or metaphysical experience, here I am primarily concerned with the latter, particularly the ways in which it has manifested historically in response to rapid technological change.⁹⁰ Though correlations between color and the non-visual senses certainly predate modern industry—Newton’s use of tonal intervals to design his color wheel being a clear example—it wasn’t until the late nineteenth and early twentieth centuries, and then again in the countercultural movements of the 1960s and 1970s that chromesthesia found itself at the center of artistic and technological experimentation.⁹¹ In the 1920s, intermedial performances involving color, music, and lighting, also known as “mobile color,” stemmed from both “the utopian desire for a synthesis of medial forms” and “the inculcation of a color consciousness in a mass audience.”⁹² “Color consciousness,” or alternately “color sense,” was the belief that feeling and perceiving colors could be cultivated through education and exposure and that “a well-developed color consciousness was an essential part of modern living, of negotiating a world that was rapidly changing.”⁹³ In this way, chromesthesia was not only seen as pleasurable, but associated with heightened emotions and novel modes of collectivity.⁹⁴

Whether in 1900 or 1969, developing one’s color consciousness thus also served as a way of navigating the shifting technological landscape. The multi-sensory “happenings” and acid tests of 1960s and 1970s counterculture involved experimenting with psychedelics (which functioned as one of many gateways into heightened color perception), video synthesizers, and sound-based performance art, all of which pointed to a utopian goal: that such media environments would influence individuals on a psychic level and ultimately result in profound societal change.⁹⁵ By catalyzing individual introspection through a synthesis of color, vision, and sound, this “techno-

⁹⁰ Joshua Yumibe and Sarah Street put it succinctly: unlike “the medical condition in which the sensory nerves literally becoming mixed (for example, hearing colors or tasting sounds),” artistic synesthesia is “a more generalized sense in which... colors [are] thought to induce a range of resonant sensations and stimuli that people [respond] to in diverse ways.” *Chromatic Modernity: Color, Cinema, and Media of the 1920s* (New York: Columbia University Press, 2019), 117-118.

⁹¹ While it would require a book-length study to outline the historical importance of color-based synesthesia for the modernist artistic project—and many people have done precisely that—let me quickly list a few examples. In literature and poetry we have Rimbaud’s “Voyelles” (1883) and Vladimir Nabokov’s vivid description of his own chromesthesia in *Speak, Memory* (1951)—both of these draw a correlation between colors and letters as entry points to heightened, even ecstatic, perception. In painting we have Kandinsky’s musical visual compositions and his corresponding treatise *Concerning the Spiritual in Art* (1912)—this “visual music” would then be translated into cinematic form in the abstract animations of Oskar Fischinger, Mary Ellen Bute, Len Lye, and Walt Disney’s *Fantasia* (1940).

⁹² Joshua Yumibe and Sarah Street, *Chromatic Modernity: Color, Cinema, and Media of the 1920s* (New York: Columbia University Press, 2019), 106. Example of mobile color include color organs designed by Alexander Wilfred Rimington, Alexander Scriabin, Mary Hallock Greenewalt, and Thomas Wilfred and the colorful projection-based dances of Loie Fuller that inspired what is thought to be the first hand-tinted film, Edison’s *Annabelle Serpentine Dance* (1895).

⁹³ *Ibid.*, 139.

⁹⁴ *Ibid.*, 122. Nicholas Gaskill also describes modernist color experiments as “concerned with the emotional power of pure hues” in “The Articulate Eye: Color Music, the Color Sense, and the Language of Abstraction.” *Configurations* 25 no. 4 (Fall 2017), 478.

⁹⁵ Fred Turner, *The Democratic Surround: Multimedia and American Liberalism from World War II to the Psychedelic 60s* (The University of Chicago Press, 2013), 276.

mysticism” would ultimately awaken a new form of collective consciousness.⁹⁶ In this context, synesthesia became synonymous with both psychedelia and audiovisual electronic technologies, seen not as an innate condition but rather a heightened state of perception that could be triggered voluntarily.

While all this occurred before the rise of personal computing and widespread digitization, there are clear connections to be found between the above examples and both the Color Factory and Pantone’s Color of the Year: Fred Turner convincingly argues that these countercultural movements, despite being presented in opposition to the mainstream, were built on the same ideals of liberalism and techno-utopianism that would form the basis of Silicon Valley, and Carolyn Kane points to how “the new psychedelic colors of electronic media” in the late 1970s, “offer[ed]... a utopic reprieve and radical alternative to social and political ills,” where “color abstraction in video synthesis seemed to provide the perfect escape into a world of pure innocent (techné as) poetic transcendence.”⁹⁷ As an origin point for color as somatic experience, emotion and feelings were thought to be located within the body but required “activation” by environmental stimuli to be released.

Is this idealist or utopian desire to escape from political strife not incredibly similar to Pantone’s depoliticization of color as self-care or the Color Factory’s push to escape into color, and therefore, happiness?⁹⁸ Perhaps the key difference is that many of the “social and political ills” of the twenty-first century are discussed in relation to customizable technology that is simultaneously individualized and networked, creating a catch-22 where technology is both the cause of and solution to the problem. While the Color Factory does not pretend to be avant-garde or oppositional to mainstream popular culture in any way, it does, as I have already argued, present digitally mediated color—albeit experienced *through* physical interaction—as a reprieve from the “reality” of urban existence outside of the exhibition space. As with Turner’s analysis of 1960s counterculture, the pop-up’s emphasis on togetherness, connectivity, and social networking is simultaneously fueled by an obsession with individualism and introspection. Specifically, it draws on the transcendent legacy of chromesthesia as a way of “tuning into” the body as a means of perpetually monitoring one’s emotions and conceptions of self.

As a highly personalized and emotional experience, synesthesia similarly emphasizes the contrast between a subjective inner world and an “objective” external reality, thus serving as an emancipation from the physical world.⁹⁹ But as I have asserted again and again, much of post-industrial technological and visual culture is characterized precisely by this tension between embodied experience and quantitative norms, particularly when it comes to color. An article written for the interior design website Apartment Therapy highly recommends the DataColor ColorReader, a small tube-shaped digital spectrophotometer that, when combined with an accompanying app, “reads” colors for their corresponding numerical values and paint swatches. The author of this article compares the device to the popular app Shazam, which “listens” to audio tracks and identifies them for the user based on an extensive database of “audio

⁹⁶ Fred Turner, *From Counterculture to Cyberculture: Stewart Brand, The Whole Earth Network, and the Rise of Digital Utopianism* (The University of Chicago Press, 2006), 49.

⁹⁷ Kane, *Chromatic Algorithms*, 79.

⁹⁸ Nicolas Gaskill draws direct parallels between modernist synesthetic experiences and contemporary color-based installations, listing “present-day descendants... which include not only artists like James Turrell and Doug Wheeler but also the programmers of the iTunes visualizer and the lighting engineers at Las Vegas nightclubs.” (“The Articulate Eye,” 478)

⁹⁹ Kevin T. Dann, *Bright Colors Falsely Seen*, 13.

fingerprints,” pointing to the ways in which color is yet another sense to be conquered through standardization and automation. She writes:

Like most people, I love using Shazam to identify songs I hear on the radio or at a restaurant, and I always joke that I wish there was something similar for other things in life. I mean, how nice would it be to Shazam someone’s perfume, and not have to awkwardly ask what scent they’re wearing? Or what if you could somehow Shazam the awesome lipstick or nail polish that your Uber pool co-rider is wearing? Or even find out the name of the bag you spotted someone using at the grocery store?¹⁰⁰

This fantasy of complete automation—for every color, scent, or sound to be precisely identifiable with a simple scan or swipe—is a clear example of a larger project to standardize or patent experiences thought to be subjective or individualized (and therefore singular). The author even goes so far as to scan her own hair with the ColorReader, which turns out to “most closely resemble a Valspar [paint] shade called Deep Earth.”¹⁰¹ Notably, if this fantasy were to become reality, in-person interaction deemed “awkward” would be minimized, making socially acceptable new forms of voyeurism and surveillance—i.e. “Shazaming” someone’s perfume without their consent and converting it into information to be stored in a vast database. Along similar lines, the Color Factory tries to have its cake and eat it too by attempting to activate individual memories or (positive) emotions through an experience that is the same for everyone: the only agency visitors have is how and where they choose to pose, which photos they choose to post, and how long they spend in the exhibition space. They need not ask fellow exhibition goers to take their photo, instead relying entirely on their individual scannable tokens or cards. Through its apparent connection to positive emotions and synesthetic associations, the exhibition convinces visitors that color must have a physical *presence*, one that is supposedly an escape from the virtuality of social networks and digital images—all the while continuing to normalize algorithmic forms of monitoring that are wholly disembodied.

Because chromesthesia (and synesthesia more broadly) creates unexpected sensory experiences that are ultimately subliminal, it is an ideal marketing tool by which to capitalize on both pleasure and attention elevating its importance in today’s attention or experience economy.¹⁰² Experiences have now arguably usurped physical objects as commodities, where consumption is no longer primarily about acquiring material goods but instead about seeking encounters that have thus far only been realized in the imagination (complete automation and standardization of the senses would be one such fantasy).¹⁰³ Color is uniquely positioned to function as a bridge between large-scale (and therefore commodifiable) collective experiences and individual psychological associations or recollections, owing to its hybrid objective-subjective status and the way standardized patented pigments and color systems have proliferated just as individualism and self-expression have intensified as moral or civic values. The Color Factory is

¹⁰⁰ Sarah Lyon, “We Tried the Gadget That Can Tell You the Paint Color of Literally Anything.” *Apartment Therapy*, October 16, 2019. <https://www.apartmenttherapy.com/datacolor-paint-color-reader-36658039>

¹⁰¹ Ibid.

¹⁰² David Howes, “Hyperesthesia, or, the Sensual Logic of Late Capitalism.” In *Empire of the Senses: The Sensory Culture Reader*, ed. David Howes (New York: Berg, 2005), 293.

¹⁰³ Colin Campbell, *The Romantic Ethic and the Spirit of Consumption: New Extended Edition* (Palgrave MacMillan, 2018), 122-123. See also Sara Ahmed, *The Cultural Politics of Emotion* (Edinburgh University Press, 2014), 145.

certainly not the first color-themed event destined for social media: in conjunction with the Color of the Year, Pantone frequently organizes pop-up restaurants such as the 2015 Pantone Cafe in Monaco and a reveal party for 2020's Classic Blue in Manhattan where "the fragrance of Classic Blue wafted through the air while Classic Blue sounds resounded. Classic Blue-textured cushions littered the floor and Classic Blue drinks were served."¹⁰⁴ By linking branded, mass-produced color to senses such as smell, taste, and sound, Pantone sees chromesthesia as the next frontier. "That is the future of color—the synesthesia reaction," said Leatrice Eiseman, announcing several "multisensory" colors for Spring-Summer 2020 such as "number five: Chive; number seven: Orange Peel; number nine: Sunlight; number 11: Cinnamon Stick, and number 12: Grape Compote."¹⁰⁵

Yet while the *concept* of synesthesia may be easily commodified, this doesn't mean that such marketing endeavors are successful in triggering an actual overlap between color and a given sense. With these examples, it becomes clear that more ephemeral senses like smell and taste are difficult to market without visual aids.¹⁰⁶ Like synthetic dyes and paints, mass-produced food colorants emerged at the turn of the century and saw their heyday in the postwar period, where manufacturers of edible goods found that "color was easier to control, reproduce, and commoditize than other sensory factors."¹⁰⁷ These colorants, which also had alphanumeric names such as Yellow AB, meant that colors were coming to stand in for specific tastes or smells.¹⁰⁸ Consumers learned to expect a correlation between taste or smell and color, even when the food item in question didn't actually exist (blue raspberry, pink lemonade, etc.). At the New York location of the Color Factory, choosing a dusty teal-colored button from the "Wall of Buttons" led me to a room where I was offered a blue, raspberry-flavored gummy banana and a mango-flavored Swedish Fish candy (complementary colors corresponding to the button I had chosen) [Figure 29]. Much like Pantone's Classic Blue cocktail (which disturbingly resembles Windex), "synesthesia" at the Color Factory relies on color-driven artificial flavors such as blue raspberry, which conjures a vivid impression of an imaginary fruit.

¹⁰⁴ Kirsi Goldynia, "Pantone chooses a classic for its 2020 Color of the Year."

¹⁰⁵ Rosemary Feitelberg, "Pantone's Spring-Summer 2020 Colors Led by Flame Scarlet." *WWD*, September 6, 2019. <https://wwd.com/feature/spring-summer-colors-2020-pantone-fashion-trends-1203254943/>

¹⁰⁶ Here I'm also reminded by how Barthes as early as 1955 described a lavish photo spread of a banquet in *Elle* magazine (which would most certainly be labeled "food porn" today) as "a cuisine devoted to sight." Notably, not only are the photos in color, but the meal, titled "The Pink Dinner," is *themed* around color, with even the chicken "color[ed]... a shocking pink." Despite its clear "incongruous artifice," color emerges as a key strategy in activating smell and taste in the realm of advertising and visual representation. Roland Barthes, "Ornamental Cuisine." In *Mythologies: The Complete Edition, in a New Translation*, trans. Richard Howard and Annette Lavers (Hill and Wang, 2013): 142-144.

¹⁰⁷ Ai Hisano, "The Rise of Synthetic Colors in the American Food Industry, 1870-1940." *Business Review* 90 (Autumn 2016), 502. See also Hisano's monograph *Visualizing Taste: How Big Business Changed the Look of What You Eat* (Harvard University Press, 2019) and Caroline Cobbald, *A Rainbow Palate: How Chemical Dyes Changed the West's Relationship With Food* (The University of Chicago Press, 2020).

¹⁰⁸ *Ibid.*

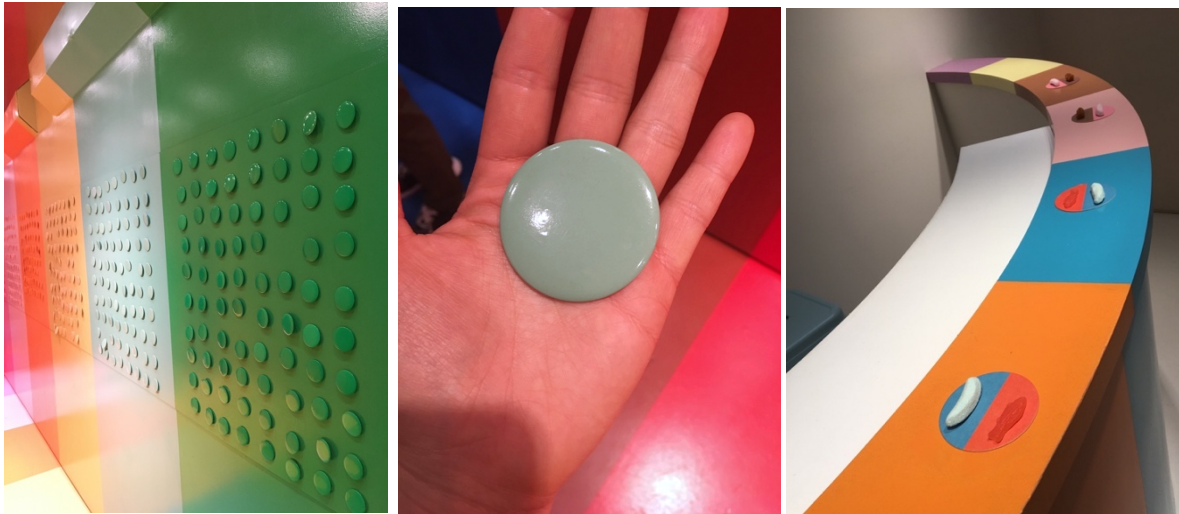


Figure 29. The button I chose from the Wall of Buttons determined what candy I would be given later.
Photo: Lida Zeitlin Wu



Figure 30. *Chromorama*, a smell-based installation by nonprofit Art & Olfaction in Houston.
Photo: Lida Zeitlin Wu

In Houston, a smell-based installation titled *Chromorama* posits a direct correlation between color and smell—that is, color and the unseen origin of the scent, which are intended to activate past memories. A circle of colorful tubes resembling industrial pipes features various verbal “clues” as to what scent the visitor will smell when leaning in and lifting a circular cap [Figure 30]. The sea-green tube corresponds to the clue “Sand Between Your Toes” and the briny scent of the ocean, and the purple tube titled “Home Sick From School” couldn’t be anything other than the smell of grape-flavored cold medicine. Other times, however, the relationship between color and smell is less straight-forward and the prompts left me clueless: red is “First Kiss” (referencing lipstick?), pale gray, “Crying and Frying,” is onions, and green, “Winning the Lottery,” is cash (specifically,

American dollar bills).

Chromorama recalls historical attempts at a multi-sensory cinematic experience such as Smell-O-Vision and Aroma-Rama, which failed in part due to their attempts to universalize sensory experience while simultaneously trying to activate individual memories. Lifting the cap clearly reveals a single answer, yet a docent told me, “The scents are all related to past memories, so whatever comes to your mind is technically correct.” It’s no coincidence that the most successful color and smell pairings are those involving artificial color and flavor: rather than some sort of Proustian revelry, the purple cold medicine smells and tastes *purple* in the same way that blue raspberry candy and pink lemonade evoke objects to be found nowhere in nature. They function as empty signifiers—taste and color in the abstract with no referent to speak of.

Through chromesthesia, the Color Factory urges its visitors to reconcile the disembodied gaze of the cameras and eventual Instagram postings with individualized memories and sensory experiences. Ultimately, the commodification of the senses becomes a way of constructing the self algorithmically in relation to physical space. With signs scattered throughout the pop-up with messages such as “be you!”, Instagram exhibitions “[sell] you you—but a you that’s briefly in a new context.”¹⁰⁹ Two aspects of this sentence’s formulation are worth noting. First, the usage of “you” rather than “me” sidesteps the critique of narcissism that self-help culture is often met with. Additionally, the imperative form is key, where the disembodied “voice” seems to be that of mainstream advertising and branding (“Something’s wrong with you if you’re not *you*,” it whispers). The commodification of “you” is particularly telling of the symbiotic relationship between the self-care industry and the attention economy. As Jenny Odell writes: “When the language of advertising and personal branding enjoins you to ‘be yourself,’ what it really means is ‘be more yourself,’ where ‘yourself’ is a consistent and recognizable pattern of habits, desires, and drives that can be more easily advertised to and appropriated, like units of capital.”¹¹⁰

At the Color Factory, as with networked culture more broadly, self-expression becomes synonymous with self-monitoring or disclosure.¹¹¹ Visitors must constantly monitor and check in with themselves, isolating every sense, and are thus responsible for their own interiority—an interiority that then becomes equated with emotional “authenticity” rather than what it really is: voluntary self-surveillance. Inverting the logic of the selfie, the photos taken at the pop-up with have a unique gaze: one that is disembodied, but paradoxically also self-reflexive. The cameras are designed to take photographs that visitors couldn’t take themselves: wide angle lenses, aerial shots, and so on.¹¹² We can choose how to pose and wait for the ten-second countdown before the flash, but ultimately, the gaze belongs not to us, but to the decentralized vision of social networks and tagged posts. In addition to the cameras, as I mentioned earlier, mirrors and reflective surfaces are everywhere, making self-presentation and monitoring, rather than color, becomes the Color Factory’s primary subject.

This normalization of self-surveillance under the pretense of the positive emotional impact of brightly colored media environments has sinister implications in a time when biometric technologies, such as facial recognition and surveillance cameras that can “see” in color and infrared, make it easier to track and identify individuals with a precision beyond the limits of human vision. Upon entering the exhibition space, an unseen camera takes a photo of each

¹⁰⁹ Kenzie Bryant, “The Ball Pit Will Take Some Breaking In, and Other Lessons From The Instagram Experience Decade.”

¹¹⁰ Odell, 137.

¹¹¹ Mark Andrejevic, “When Everyone Has Their Own Reality TV Show,” 49.

¹¹² Ashley Carman, “Experience, Experience, Experience!”

visitor without their knowledge or consent, which is then used to create a profile picture for them if they decide to check their coat or bags. Additionally, viewers must complete an “orientation” where they register their email in order to receive a personalized QR code, signing a consent form and release of liability [Figure 31].

The figure consists of two side-by-side digital screens. The left screen displays a consent form with the following text:
Electronic Signature Consent
By checking here, you are consenting to the use of your electronic signature in lieu of an original signature on paper. You have the right to request that you sign a paper copy instead. By checking here, you are waiving that right. After consent, you may, upon written request to us, obtain a paper copy of an electronic record. No fee will be charged for such copy and no special hardware or software is required to view it. Your agreement to use an electronic signature with us for any documents will continue until such time as you notify us in writing that you no longer wish to use an electronic signature. There is no penalty for withdrawing your consent. You should always make sure that we have a current email address in order to contact you regarding any changes, if necessary.
☐ Yes, I agree to use an electronic signature for contracts with Happy Factory.
Release Of Liability. Photo
☐ YES, I agree to the terms and conditions of the Release of Liability, Photo Release, and Assumption of Risk
I confirm that I am 16 years of age or older
☐ Yes ☐ No
The right screen displays the following text:
YOU'RE ALL SET LIDA!
Keep track of your token.
Scan it at each photo station.
We'll automatically send the photos to your email.

Figure 31. Left: Visitors must sign an electronic consent form and a release of liability prior to entering the popup. **Right:** The confirmation screen after I registered my email address and QR code. Photo: Lida Zeitlin Wu

During my visit to Houston, my photos failed to send to my email; after asking the staff whether I could still access them, they assured me that every single image is stored off-site. These images belong to the Color Factory and can be used for promotional or other purposes. At the Color Factory, the body itself becomes a computable entity, stored as data in the company’s cloud. With a swipe of a QR code, we go from viewing subject to object viewed: we can only become part of the Color Factory by being converted to pixels ourselves.

Coda

If I hadn't moved to the Bay Area for graduate school, I may well never have written a dissertation on color. Though I wrote my undergraduate thesis on color on Nabokov's novels, my analysis prioritized the abstract and cerebral (I compulsively circled color terms in my copies of *Invitation of a Beheading*, *Invitation of a Beheading* and *Lolita*) over my own lived experience. Moving from the art deco skyscrapers of Chicago and Beijing's faded pastel apartment complexes to Berkeley's candy-colored bungalows and San Francisco's Painted Ladies was a delightful culture shock. My first year at Berkeley, I would jog down Cedar Street in North Berkeley, passing an unabashedly campy house with a "rainbow theme." The house, which remains unchanged, is a warm sunshiny yellow with a peacock blue roof; rainbow arches decorate each window and wrap themselves around the entryway and chimney [Figure 1]. Whether the rainbow house was intended as a symbol of LGBTQ+ pride or merely showcasing a deep love of vibrant colors (likely both, the two being intimately connected in the San Francisco Bay Area) that in other cities might be considered distasteful or gaudy, I'll never know, but soon I found myself on the lookout for other "color-themed" houses in the East Bay. There was the entirely periwinkle structure—front door included—on Virginia Street and the Impressionist-themed houses near the Morcom Rose Garden in Oakland, which had names like "Castle Renoir" and "Maison Monet" with lurid color palettes to match. When I moved next to Lake Merritt, I began to run up Trestle Glen Road towards the city of Piedmont, where so many doors were painted in eye-catching hues that I was inspired to document them and compile them into a digital collage in the spirit of Bernd and Hilla Becher's formalist experiments with lighthouses (I was creating yet another color grid, though I didn't realize it at the time) [Figure 2].



Figure 2. 1717 Cedar St. in Berkeley, CA. May 2021.
Photo: Lida Zeitlin Wu



Figure 1. Multi-colored doors on Trestle Glen Road in the Oakland Lower Hills. Photo: Lida Zeitlin Wu. Collage created with Layout app

Colorful architecture in the Bay Area that might be considered "excessive" or "over-the-top" elsewhere has a rich and controversial history. On the one hand, in 2021, the eclectic properties listed above are evidence of extreme wealth, where the ability to assert one's individuality through customizing the colors of one's (owned rather than rented) home is an

immense privilege in what is now the most expensive place to live in the United States.¹ Many homeowners who can afford to live in the Bay invested in property early during the countercultural movements of the 1960s and 1970s. Significantly, San Francisco's Painted Ladies—a term that refers to Victorian and Edwardian houses that have been repainted in three or more distinct colors—got their name in 1978.² Built in the late-nineteenth century prior to the 1906 earthquake to house a growing bourgeois elite, these structures were initially polychromatic, albeit in shades such as beige, red, and dark green rather than the high contrast, vibrant palettes that later gave them the Painted Ladies moniker. During World Wars I and II, however, many were painted entirely Battleship Gray with surplus military paint, losing their colorful appeal. By the mid-twentieth century, these houses had fallen into disrepair as their predominantly white, wealthy occupants had fled the euphemistically named “inner city” for surrounding suburban areas.³

In the late 1960s and early 1970s, rental prices in neighborhoods known for their Victorians, such as Haight-Ashbury and Alamo Square, had dropped to an all-time low. New inhabitants, many of them part of San Francisco's growing queer community, began to fix up and restore these houses—sometimes to live in, sometimes to re-sell at a higher price.⁴ A multichromatic explosion of paint, influenced by the high-contrast, saturated palette of psychedelia and countercultural ideologies of self-expression and non-conformity, transformed these once drab residences into color-driven experiments. What came to be known as the Colorist movement involved exteriors so polychromatic they were seen as gaudy or in poor taste—the best-known example being Latvian-born artist Maija Peeples-Bright's home at 908 Steiner Street in the Western Addition [Figure 3]. Once known as “The Rainbow House,” Peeples-Bright used every single color manufactured by Dutch Boy Paints on the house's exterior⁵ (the house was eventually sold in 2009 for \$1.6 million and its colorful façade repainted).⁶ Many artists and designers, such as Butch Kardum, Jason Wonders, and Bob Buckter—nicknamed “Dr. Color”—became color consultants to meet the growing demand for the increasingly popular Colorist style.⁷ Not surprisingly, the market value for these houses had already escalated by the mid-1970s, their associated neighborhoods fully gentrified long before the encroachment of Silicon Valley tech.⁸

¹ Occasionally San Francisco and New York will switch places on the list of the most expensive places to live in the U.S., but San Francisco always remains in the top two. As of July 2021, 1717 Cedar St. is valued at \$1,442,500 (https://www.zillow.com/homedetails/1717-Cedar-St-Berkeley-CA-94703/24840797_zpid/), while the price for a house on Trestle Glen Rd. averages out at \$1.73 million (<https://www.redfin.com/neighborhood/2770/CA/Oakland/Trestle-Glen/housing-market>).

² Elisabeth Pomada and Michael Larsen, *Painted Ladies: San Francisco's Resplendent Victorians* (E.P. Dutton, 1978). The gendered implications of the intrinsic connection between color, paint/cosmetics, and femininity in this name are also worth noting.

³ Benjamin Schneider, “An Architectural Rainbow: SF's Colorist Movement.” *SF Weekly*, June 25, 2020. <https://www.sfweekly.com/pride/an-architectural-rainbow-sfs-colorist-movement/>

⁴ Randolph Delehanty, *San Francisco Victorians* (San Francisco: Chronicle Books, 2000), 26.

⁵ Kerri Young, “Rainbow Victorians and the Colorist Era in San Francisco.” *SF Heritage*, April 17, 2000. <https://www.sfheritage.org/features/colorfully-painted-victorians/>

⁶ Dana Perrigan, “‘Painted Lady’ for Sale for \$1.6 Million.” *SF Gate*, February 1, 2009. <https://www.sfgate.com/realestate/article/Painted-Lady-for-sale-for-1-6-million-3252522.php>

⁷ Bob Buckter continues to provide color consulting services for restored Victorians and maintains a website at <https://drcolor.com>.

⁸ John Stover, “Understanding Super-Gentrification in San Francisco.” *ASA Footnotes: A Publication of the*



Figure 4. Left: 908 Steiner Street, a.k.a. “The Rainbow House,” circa 1976. Photo by Judith Lynch. Accessed via Open SF History. **Right:** 908 Steiner Street today. Accessed on August 11, 2021 via Google Street View.

Today, what we are seeing is a new wave of wealth and urban transformation: this time one that manifests visually and spatially in a chromophobic disavowal of color. In October 2019, the *San Francisco Chronicle* ran a feature titled “How San Francisco Lost its Color.” The piece featured an animated graphic showing an oversized, paintbrush dipped in gray, sweeping over the iconic row of Painted Ladies in Alamo Square.⁹ Alongside other similar articles published around the same time, “How San Francisco Lost its Color” points to the increasingly pervasive purging of color in the form of gray exteriors, which have “spread like an oil spill” across the city (and in numerous other cities across the country as well).¹⁰ Sure enough, on my Trestle Glen Road run, I began to notice homes painted in various shades of gray popping up like drab daisies. Rather than blending into their surroundings or appearing “neutral,” as gray is often described, these exteriors felt aggressive, protruding, out of place. Occasionally, I would see a restrained splash of bright color among the gray. A highlighter yellow garage door on an otherwise monochrome house appeared to be a nearly exact match to Pantone’s 2021 Colors of the Year, 17-5104 Ultimate Gray and 13-0647 Illuminating [Figure 5]; according to the press release, this combination of colors is “practical and rock solid but at the same time warming and optimistic”

American Sociological Association, vol. 42 no. 4 (April 2014): 1, 6, 10.

https://www.asanet.org/sites/default/files/savvy/footnotes/apr14/sanfran_0414.html

⁹ Annie Vainshtem, “How San Francisco Lost its Color.” *The San Francisco Chronicle*, October 11, 2019.

<https://www.sfchronicle.com/culture/article/Welcome-to-grayscale-San-Francisco-s-new-14493024.php#photo-18352654> Dr. Color makes an appearance in this article, complaining about the recent surge in demand for gray exteriors.

¹⁰ A month earlier, on September 10, 2019, KALW’s podcast “Crosscurrents” recorded an episode titled “San Francisco is Turning Gray, One House at a Time.” In May 2020, John King published a piece in the *SF Chronicle*, this time titled “Paint it Black, Architecturally Speaking? Better yet, just make it stop” (the piece was a sequel of sorts to his 2014 article, “S.F. Architecture Shifts to Darker Tone”).

and “a union... of strength and positivity.”¹¹ Corporate platitudes aside, and regardless of whether the owners of this house consciously repainted using Pantone swatches as a reference, it becomes exceedingly clear that our surroundings are at once physical and virtual, mediated through the abstract entity that is *color itself*, severed from any referent. This detachment of color from objects in the form of systems of measurement and standardization, as I have shown in the previous chapters, is nothing new. The seeds for the digitization of perception, or a worldview where numerical representation and discreteness are linked to identification and knowledge-making, were planted with the synthetic dyes and psychophysical experiments of the late nineteenth and early twentieth centuries. Today, this tendency to see color as plural, discrete, and measurable is all the more pronounced. In a time of digital brand machines, patented color standards, and alphanumeric labels, the supposed immateriality of the information economy has tangible physical and spatial effects. The usage of lower-case t “technicolor” in the *SF Chronicle* article to describe a lived (rather than filmed) reality reminds us that there is no such thing as an unmediated experience of color.

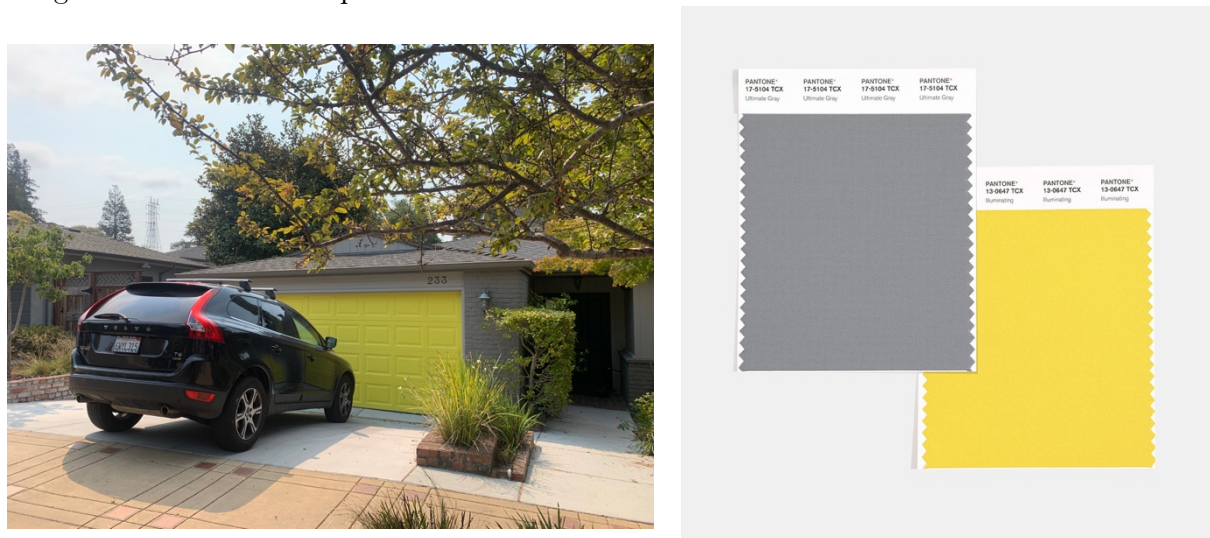


Figure 5. Left: 233 St. James Dr. in Piedmont, CA. August 2021. Photo: Lida Zeitlin Wu
Right: Pantone’s 2021 Colors of the Year, 17-5104 Ultimate Gray and 13-0647 Illuminating

Yet as we now know, color paradoxically thrives on structure while simultaneously resisting rationalization. Neatly compartmentalizing the “grayification” of San Francisco into a battle between rainbow and grayscale, color and non-color, locals and gentrifiers, is ideologically effective, but it also one of many thorny efforts to harness, manage and regulate color. In 1992, Daniel Harris noted that San Francisco’s popular associations with color, as mediated through travel photography and coffee table books, render the city a kind of apolitical aesthetic object, “a color-coordinated compilation of pure geometrical forms free of their everyday associations.”¹² In a similar vein, as we saw with the Color Factory, color must be contained within the walls of the pop-up to serve as a visual and ideological foil to the surrounding city, which is re-imagined as existing in gray-scale.

¹¹ “Announcing the Pantone Color of the Year 2021: PANTONE 17-5104 Ultimate Gray + PANTONE 13-0647 Illuminating.” Press release. <https://www.pantone.com/color-of-the-year-2021>

¹² Daniel Harris, “Off of the Map and onto the Coffee Table: Manufacturing the American City.” *The Threepenny Review* 51 (Autumn 1992), 17.

For David Batchelor, chromophobia, or the widespread fear and disdain of color in the West, stems from precisely this desire to “imagine color away.” Batchelor frequently cites modernist architecture—in particular, the Purism of Le Corbusier and its resurrection in the form of generic minimalist interiors, which he dubs “whitespaces”—as a key site for these chromophobic impulses, where color must be limited, controlled, and rationalized. The apparent unruliness of color is replaced by a more “hygienic” palette of whites and grays (and in this case, the occasional “tasteful” splash of yellow as deemed “appropriate” by color forecasting agencies). Chromophobia manifests in two distinct ways, both of which are at play here. One category involves “colour [being] relegated to the realm of the superficial, the supplementary, the inessential or the cosmetic... it is perceived merely a secondary quality of experience, and therefore unworthy of serious consideration.”¹³ As it turned out, despite various complaints from residents of once colorfully painted neighborhoods, architectural preservation laws do *not* apply to color, only structural integrity, pointing to how color is seen as decorative or surface-level rather than a part of the building itself (though it’s worth noting that this is actually antithetical to the tenants of Purism, which views both light and pigment-based color as building materials).¹⁴ In fact, architectural historians have noted that California light in particular causes bright colors to fade easily; this explains the popularity of beige and the unimaginable upkeep a residence like the Rainbow House would have required.¹⁵ There were no regulations in place to prevent people from re-painting Victorians Battleship Gray in the 1910s, just as owners today are free to blanket their spaces with Ultimate Gray, Pilgrim Haze, or Stormy Sky (two Benjamin Moore colors mentioned in relation to the San Francisco gray trend).¹⁶

Even then, it would be wrong to treat gray or “grayness” as a homogeneous entity. As I have repeatedly argued, if we are dealing not with *color* but *colors*, then it stands to reason that the so called “non-color” of gray is also a set of non-colors—the commodification, standardization and rationalization of color systems allowing them to proliferate infinitely. Indeed, these technologies of rationalized color transform how we engage with color in the world: as the *SF Chronicle* article addresses, despite the overarching ideological underpinnings of the gray trend, there is no one uniform gray paint color that unites these spaces. One longtime Mission resident in the process of repainting the house he rented out was reported to have been so enamored with a specific gray he had spotted on a Bernal Heights Victorian that he rang the doorbell for two straight weeks attempting to get the name (and, one assumes, manufacturer and alphanumeric label) of the precise shade.¹⁷

The other arguably more ideological variant of chromophobia is when “colour is made out to be the property of some ‘foreign’ body—usually the feminine, the oriental, the primitive, the infantile, the vulgar, the queer or the pathological”; thus “colour [becomes] regarded as alien and therefore dangerous.”¹⁸ San Francisco-based artist Sergio De La Torre has been working on an ethnographic photography project called “After the Ashes: The Curious Case of Gray Houses in the Mission,” focusing on the ways in which supposedly “neutral” gray is anything but,

¹³ Batchelor, *Chromophobia*, 22-23.

¹⁴ Annie Vainshtem, “How San Francisco Lost its Color”

¹⁵ Randolph Delehanty, *San Francisco Victorians*, 29-30.

¹⁶ “After The Ashes: The Curious Case of Gray Houses in the Mission, Sergio De La Torre in conversation with Tanu Sankalia.” KADIST, July 19, 2019, San Francisco, CA. Event Promo. <https://kadist.org/program/after-the-ashes-the-curious-case-of-gray-houses-in-the-mission/>

¹⁷ Vainshtem

¹⁸ Batchelor, 22-23.

particularly in the Mission District, a historically working class Latinx immigrant neighborhood known for its colorful homes and murals. Yet while it may be tempting to reduce this phenomenon to a visual manifestation of gentrification, the reality is not as clear cut: many of the newly painted gray homes have been re-painted by owners who have lived there for decades, pointing to broader questions concerning taste, conformity, and the power of color forecasting to reshape aesthetic norms—and indeed, De La Torre acknowledged that out of the sixty gray houses he had investigated, only four were connected to recent evictions.¹⁹

De La Torre uses the term “gray-washing” to describe repainting of houses in the Mission, thus mapping color onto a narrative of gentrification and displacement.²⁰ “Gray-washing” highlights the ever-present slippage between the so called “abstract” color swatch and color as a racial signifier (as in “white-washing”). Eighteenth and nineteenth century race science attempted to link race and ethnicity to features such as skin, hair, and eye color; the fact that categories such as “white,” “black,” and “yellow” were more rhetorical than mimetic exposes the fact that racialized color has always been a construction and an abstraction.²¹ We could thus view “gray-washing” as pointing to a kind of anthropomorphism, whereby repainting a building’s exterior is akin to changing the color of its “skin” (and in fact, “skin” is often used as a synonym for “façade” in contemporary architectural lingo).²² But more productive here, I think, is to consider how color can point to the production of racial (as well as gendered or class-based) difference without the explicit presence of human bodies or skin.

Artistic explorations of this notion of racialized abstract color in urban environments include Amanda Williams’s site-specific *Color(ed) Theory* (2015). Williams, a Chicago South Side native (as is this writer) with an architecture degree from Cornell, was trained in the modernist design theories of figures such as Josef Albers, Johannes Itten, and Le Corbusier, which emphasized the relational and subjective properties of color. Returning to Chicago, she became fascinated the way each color has “racialized spatial corollary” that manifests in everyday urban experience.²³ Unlike the Bay Area, where uninhabited space is hard to come by, Chicago has tens of thousands of vacant houses, many of them in states of decay. Williams and a team of volunteers painted eight derelict houses slotted for demolition in Englewood—a predominantly Black neighborhood in a notoriously racially and socioeconomically segregated city—in specific hues that conjured vivid memories and associations with products historically marketed to Black people.

¹⁹ Ben Trefny, interview with Sergio De La Torre, “San Francisco is Turning Gray, One House at a Time.” Crosscurrents KALW, September 10, 2019. Podcast transcript.

<https://www.kalw.org/show/crosscurrents/2019-09-10/san-francisco-is-turning-gray-one-house-at-a-time>

²⁰ Sergio De La Torre, quoted in Vainshtem.

²¹ For a recent and exciting discussion of infrastructural color that does not mimic skin tone but is nevertheless racialized and politicized, see Anna Watkins Fisher, “Safety Orange.” *Journal of Visual Culture* 20 no. 1 (April 2021): 3-24. Fisher also discusses Williams’s *Color(ed) Theory* in this article.

²² See Petra Gruber and Susanne Gosztanyi, “Skin in Architecture: Towards Bioinspired Facades.” *Design and Nature* 138 (June 2010): 503-513.

²³ Sala Elise Patterson, “Redlining, Green Books, Gray Towns, High Yellow: Artist Amanda Williams on the relationship between color, race, space and value.” *Harvard Graduate School of Design*, June 26, 2020. <https://www.gsd.harvard.edu/2020/06/redlining-green-books-gray-towns-high-yellow-artist-amanda-williams-on-the-relationship-between-color-race-space-and-value/>



Figure 6. Top: An earlier rendition of *Color(ed) Theory* included “Flamin’ Red hot’s” rather than “Flamin’ Hot Cheetos” as one of the eight colors chosen. Exhibited at the 2015 Chicago Architectural Biennial. Photo courtesy of the artist. **Bottom:** Amanda Williams, *Color(ed) Theory: Ultra Sheen* (2014-2015). Photo courtesy of the artist

Each house was painted entirely monochrome (doors, windows, railings and all) in one of the following colors [Figure 6]: 1) “Harold’s Chicken Shack” red (a Chicago fried chicken chain with a red logo); 2) “Newport Squares” blue; 3) “Flamin’ Hot Cheetos” orange; 4) “Pink Oil Moisturizer” pink; 5) “Currency Exchange” and 6) “Safe Passage” yellow (Safe Passage is a Chicago-based program that provides adult chaperones in yellow vests to walk children to and from school); 7) “Crown Royal Bag” purple; and 8) “Ultra Sheen” teal.

Describing Ultra Sheen, a hair moisturizing cream, Williams says:

Ultra Sheen is unique in that it’s this magical blue color that everyone knows but probably only people like me could describe. So it is this cyan-y, turquoise teal, and it just has a kind of sheen to it... Now, if I walked down 79th Street right now, and I asked 50 people for the name of a slightly greener shade of cyan, they would look at me sideways. But if I say, what color is Ultra Sheen, oh, a smile emerges. Stories about their grandmother’s bathroom ensue. I mean, who needs turquoise when you have Ultra Sheen? Who needs teal when you have Ultra Sheen?²⁴

²⁴ “Amanda Williams: How Can Color Bring Life to New Houses?” *Revitalize: Ted Radio Hour*. NPR, April 9, 2021. <https://www.npr.org/programs/ted-radio-hour/985484885/revitalize>

Williams describes an experience of commodified color that is collective, but only up to a point—just as Ultra Sheen unites “people like [her]” (that is, Black women from Chicago’s South Side), it does so through stratification and marginalization. Crucially, this networked experience results from the visually distinctive color branding linked to this *exact* shade—and Williams meticulously relied on Sherwin-Williams matching swatches to pick the precise paint color for each house.²⁵ Ultra Sheen, like the two other shades of blue-green teal (Bianchi Celeste and Tiffany Blue) with which I began this dissertation, invites consumers to see the color spectrum as infinitely divisible into discrete, labeled units. These seemingly innocuous color swatches actively perform neutrality and objectivity. They are symmetrical and visually pleasing. Their corresponding string of numbers encourages us to view them as pure information, a way of making sense of the world around us by equating quantification with knowledge. When we “see by numbers,” color standards and swatches slice and dice the visible world into a monumental grid—a grid that is perception itself.

Yet as *Color(ed) Theory* demonstrates, color is not a static or ideologically neutral phenomenon, but a discursive one that is deeply entwined with systems of power. From Munsell’s Color Tree to the standardization of computer color, from Birren’s Color Equation to Pantone’s Color of the Year, we see that color systems are inseparable from the restructuring of perception itself under industrial capitalism. Today’s numerical digital color standards are not epistemologically novel, but instead represent the culmination of several hundred years of debates and technologies surrounding color’s relationship to systems of measurement on the one hand and lived experience on the other. By reexamining the way color standards have historically responded to technological change while also reshaping perception itself, we can begin to challenge the commonly held notion that embodied experience and quantitative norms are mutually opposed. As such, color gives us a unique set of tools to think through the ongoing negotiation between perception, selfhood, and technologies of quantification in a media saturated society.

²⁵ Arièle Dionne-Krosnick, “What Color is Racism?” *Post: Notes on Art in a Global Context*, The Museum of Modern Art. December 4, 2019 <https://post.moma.org/what-color-is-racism/>

Bibliography

Archival Holdings and Special Collections

Faber Birren Collection of Books on Color, Robert B. Haas Family Arts Library, Yale University, New Haven, Connecticut.

Faber Birren Papers, 1942-1989, Robert B. Haas Family Arts Library, Yale University, New Haven, Connecticut.

Faber Birren Papers, 1924-1935, Manuscripts and Archives Division, The New York Public Library, New York, New York.

Research Library, Cooper Hewitt Smithsonian Design Museum, New York, New York.

Primary Sources

“A Catalogue of Books on Color by Faber Birren.” Westport, CT: The Crimson Press, 1942.

“A Pre-Pantone Guide to Colors: Dutch Book From 1692 Documents Every Color Under the Sun.” *Open Culture*, July 9, 2014. <http://www.openculture.com/2014/07/dutch-book-from-1692-documents-every-color-under-the-sun.html>

Advertisement for Vita-Lite Full Spectrum Daylight Bulbs. n.d. (c. 1960s). Faber Birren Papers, Robert B. Haas Family Library, Yale University. Box #1, Folder, 17.

Albers, Josef. *Interaction of Color: 50th Anniversary Edition*. New Haven: Yale University Press, 2013.

American Color Trends. New York: Faber Birren & Company, 1956.

Babbitt, Edwin D. *Principles of Light and Color: the Classic Study of the Healing Power of Color*, edited by Faber Birren. New York: University Books, 1967.

Berlin, Brent, and Paul Kay. *Basic Color Terms: Their Universality and Evolution*. Berkeley, CA: University of California Press, 1969.

Biernacka, Dagmara. “Color Factory—Wake Up Your Inner Child.” *Just Like New York*, October 11, 2018. <http://justlikeny.com/2018/10/color-factory-wake-up-your-inner-child/>

Biggs, Caroline. “The One Color that Might Actually Make You Calmer, According to Science.” *Apartment Therapy*, February 14, 2020. <https://www.apartmenttherapy.com/baker-miller-pink-effects-36716406>

Birren, Faber. “25 Years of Color Trends in America.” New York: Birren, n.d.

——— “Application of the Ostwald Color System to the Design of Consumer Goods.” *Journal of the Optical Society of America* 34, no. 7 (July 1944): 396-399.

——— “Character Analysis Through Color.” Faber Birren for Paint Merchandising Council, 1956.

- “Choosing the Right Color.” *Machine Design* (August 6, 1959): 100-106.
 - “Choose Your Color.” *Today’s Woman* 13 no. 76 (February 1946): 33-34, 63-65.
 - “Color Conditioning: Aid to Getting Work Done.” *Dun’s Review* (January 1949): 17-20.
 - *Color Dimensions: Creating New Principles of Color Harmony and a Practical Equation in Color Definition*. Chicago: The Crimson Press, 1934.
 - *Color and Human Response: Aspects of Light and Color Bearing on the Reactions of Living Things and the Welfare of Human Beings*. New York: John Wiley and Sons, 1978.
 - “Color and Your Personality.” Faber Birren for Colorizer Paint, 1960.
 - *Color for Interiors, Historical and Modern*. New York: Whitney Library of Design, 1963.
 - *Creative Color*. New York: Reinhold Publishing Corporation, 1961.
 - “Find Yourself in Whose-Hue.” *Bride & Home LXV* (Summer 1959): 70-75.
 - “Forward.” *The Natural System of Colours by Moses Harris: a facsimile edition of what is perhaps the rarest book in the literature of color, with historical notes and commentary by Faber Birren*. New York: privately printed, 1963.
 - *Functional Color: A Book of Facts and Research, Meant to Inspire More Rational Methods in the Solution of Color Problems*. Stoneham, MA: Crimson Press, 1937.
 - *Light, Color and Environment: A discussion of the Biological and Psychological Effects of Color, with Historical Data and Detailed Recommendations for the Use of Color in the Environment*. New York: Van Nostrand Reinhold Company, 1969.
 - “Meet Your Color Mate.” *Woman* 47, no. 1219 (London: October 15, 1960): 9-11.
 - *New Horizons in Color*. New York: Reinhold Publishing Corporation, 1955.
 - *Selling Color to People*. New York: University Books, 1956.
 - “What is Your Favorite Color?” *Better Home and Gardens* 29 no. 14 (October 1951), 57.
- Blevins, Joe. “This Twitter account builds gorgeous color palettes from movie scenes.” *The AV Club*, May 17, 2016. <https://news.avclub.com/this-twitter-account-builds-gorgeous-color-palettes-fro-1798247563>
- Blundell, Danielle. “Could this Bedroom Trend Actually Help You Get a Better Night of Sleep?” *Apartment Therapy*, February 19, 2019. <https://www.apartmenttherapy.com/dark-bedroom-sleep-benefit-266759>
- Bond, Milton E. and Dorothy Nickerson, “Color-Order Systems, Munsell and Ostwald.” *Journal of the Optical Society of America* 32 (December 1942): 709-719.
- Catalogue of the Munsell System. Newburgh, NY: Macbeth, a division of Kollmorgen

- Corporation, April 1981.
- Chevreul, Michel Eugène. *Couleurs d'un Spectre Solaire*. Paris: J.B. Bailliere et Fils, 1864.
- *Des couleurs et de leurs applications aux arts industriels à l'aide des cercles chromatiques* (1864). Engraved by René-Henri Digeon. Aquatint with yellow, blue, red, and black ink on paper.
- *The Principles of Harmony and Contrast of Colors and Their Applications to the Arts: A Newly Revised Edition with a Special Introduction and. Newly Revised Commentary by Faber Birren*. Westchester, Pennsylvania: Schiffer Publishing, Ltd., 1987.
- “Color Analysis Charts by Emily Noyes Vanderpoel (1902).” The Public Domain Review, <https://publicdomainreview.org/collection/colour-analysis-charts-by-emily-noyes-vanderpoel-1902>
- “Color Factory: A Pop-Up Experience in San Francisco.” *Aiga SF*, July 26, 2017. <http://aigasf.org/color-factory-a-pop-up-experience-in-san-francisco/>
- Cooper Hewitt, *The Dynamics of Color*, November 7, 1990. Cooper-Hewitt Museum, New York City. Printed schedule.
- Cygnus. “Venus Paradise: Cyber Edition.” Servitor Ludi, June 15, 2015. <http://servitorludi.blogspot.com/2015/06/venus-paradise-cyber-edition.html>
- DeLillo, Don. *Americana*. New York: Penguin Books, 1989.
- Duff. “Venus Paradise: Paint-by-Number Coloring Sets,” May 9, 2009. *The Baby Boomer E-Museum*. <http://www.mikanet.com/museum/item.php?cat=27&index=172>
- E.I. du Pont de Nemours & Co., “Du Pont Classified Color Selector.” Wilmington, Del.: E. I. du Pont de Nemours and Company, 1957.
- Fechner, Gustav. *Elements of Psychophysics: Volume I*, trans. Helmut E. Adler. Austin, TX: Holt, Rinehart and Winston, Inc., 1966.
- Feller, Robert R. “Rediscovery of the Wheel.” Originally published in *Color Engineering* (November December 1966)
- General Electric. *Electronics: a New Science for a New World*. Schenectady, New York: General Electric, 1942. Trade Catalogue.
- “General Electric has made your Dream House come true!” *Life* 24 no. 26 (June 28, 1948): 78.
- Goethe, Johann Wolfgang von. *Theory of Colors*, trans. Charles L. Eastlake. Mineola, NY: Dover Publications, 2006.
- Goldynia, Kirsii. “Pantone chooses a classic for its 2020 Color of the Year.” *CNN*, December 4, 2019. <https://www.cnn.com/style/article/pantone-color-classic-blue-2020/index.html>
- “Happy Habits: How to Automate Your Life.” *Oh Happy Day!* January 3, 2020. <https://ohhappyday.com/2020/01/happy-habits-how-to-automate-your-life/>

- Holm, Grace. "Public to Inspect Blandings Dream House With Ceremonial Booked for 2 P.M. Saturday." *The Oregonian*, November 6, 1948. Accessed online at <https://vintageportland.files.wordpress.com/2012/01/blandings-house-feature-1948.jpg>.
- "Houston." The Color Factory. <https://colorfactory.co/houston>
- Hua, Karen. "Pantone's Color of the Year 2017 is Inspired By Nature." *Forbes*, December 9, 2016. <https://www.forbes.com/sites/karenhua/2016/12/09/pantones-color-of-the-year-2017greenery-symbolizes-a-fresh-start-fashion/?sh=6790785c7e98>
- Huxley, Aldous. *The Doors of Perception and Heaven and Hell*. New York: Harper Perennial Modern Classics, 2009.
- "ISCC-BNBS Color-Name Charts Illustrated with Centroid Colors." Washington, D.C.: National Bureau of Standards, c. 1964.
- Itten, Johannes. *The Elements of Color: A Treatise on the Color System of Johannes Itten, Based on His Book the Art of Color*. Edited by Faber Birren. Translated by Ernst Van Hagen. New York: Van Nostrand Reinhold, 1970.
- "It's Official: Flame Scarlet is the Official Color of 2020." *Deck of Scarlet*, July 13, 2020. <https://www.deckofscarlet.com/blogs/press/it-s-official-flame-scarlet-is-the-color-of-2020>
- Jack + Huei, "Pantone Color of the Year 2020." <http://jackandhuei.com/pantone-color-of-the-year-2020>
- Jacobson, Egbert. *The Color Harmony Manual and How to Use it*. Chicago, IL: The Color Laboratories Division of the Container Corporation of America, 1942.
- Kuehni, Rolf G. *Philipp Otto Runge's Color Sphere: A translation, with related materials and an essay*. Inter-Society Color Council, 2008. Online. <http://www.iscc-archive.org/pdf/RungeFarben-Kugel.pdf>
- Leal, Samantha. "This is Your Power Color, According to Your Astrological Sign." *Apartment Therapy*, July 31, 2019. <https://www.apartmenttherapy.com/this-is-your-color-power-according-to-your-astrological-sign-36629958>
- Lyon, Sarah. "We Tried the Gadget That Can Tell You the Paint Color of Literally Anything." *Apartment Therapy*, October 16, 2019. <https://www.apartmenttherapy.com/datacolor-paint-color-reader-36658039>
- Marinelli, Gina. "Before Pantone Color Chips, There Was This 300-Year-Old Book." *Refinery 29*, May 22, 2015. <https://www.refinery29.com/en-us/original-pantone-color-book>
- Mars, Roman, host, and Emmett Fitzgerald, producer, "Instant Gramification." *99% Invisible* (podcast), June 16, 2020. <https://99percentinvisible.org/episode/instant-gramification/>
- Mulvey, Kelsey. "Here's What Your Childhood Bedroom Color Says About You." *Apartment Therapy*, July 16, 2019. <https://www.apartmenttherapy.com/heres-what-the-color-of-your-childhoodbedroom-says-about-you-36624167>

- Munsell, Albert Henry. *Atlas of The Color Munsell Color System*. Malden, MA: Wadsworth, Howland & Co., 1915.
- *A Color Notation: An Illustrated System Defining All Colors and Their Relations by Measured Scales of Hue, Value and Chroma Made in Solid Paint for the Accompanying Color Atlas*. Boston, MA: Geo H. Ellis Co., 1905.
- *Munsell Book of Color: A Revision and Extension of 'The Atlas of the Munsell Color System' by A.H. Munsell, Abridged Edition*. Baltimore: Munsell Color Company, Inc., 1929.
- Munsell, A.H. and Thomas Maitland Cleland, *A Grammar of Color: Arrangements of Strathmore Colors in a Variety of Printed Combinations According to the Munsell Color System*. Mittineague, MA: The Strathmore Paper Company, 1921.
- Neglia Design. “What’s the Difference Between PMS, CMYK, RGB and HEX?”
<https://negliadesign.com/ask-a-designer/whats-the-difference-between-pms-cmyk-rgb-and-hex/>
- Newton, Sir Isaac. *Opticks: Or, a Treatise of the Reflections, Refractions, and Inflexions of Light*. Printed for Sam. Smith, and Benj. Walford, London, 1704. Digitized by Smithsonian Libraries.
<https://doi.org/10.5479/sil.302475.39088000644674>
- Nickerson, Dorothy. “History of the Munsell Color Foundation 1942-1974 (Reprinted from ISCC Newsletter, No. 234, 197).” In *Munsell Color System, Company, and Foundation. Color Research and Application* 1 (1976): 7-10.
- “History of the Munsell Color System and its Scientific Application.” *Journal of the Optical Society of America* 30 (December 1940): 575-586.
- Ostwald, Wilhem. *The Color Primer: A Basic Treatise on the Color System of Wilhelm Ostwald, Edited and with a Foreword and Evaluation by Faber Birren*. New York: Van Nostrand Reinhold Company, 1969.
- Pantone. “Announcing the Pantone Color of the Year 2022: PANTONE 17-3938 Very Peri.” Press release. December 2021. <https://www.pantone.com/color-of-the-year-2022>
- “For Immediate Release: Richard Herbert Appointed Vice President of Electronic Color Systems Division for Pantone, Inc.” Press Release, 1984.
- “Introducing Rose Quartz and Serenity.” December 2016. <https://www.pantone.com/color-intelligence/color-of-the-year/color-of-the-year-2016#:~:text=WHAT%20IS%20THE%20PANTONE%20COLOR,a%20mood%20and%20an%20attitude>
- “Pantone is Color Communication.” (Pantone: Moonachie, New Jersey, 1990). Press release. Cooper Hewitt Research Library, Smithsonian Museums.
- “Pantone Color of the Year 2016: Pantone 13-1520 TCX Rose Quartz and Pantone 15-3919 TCX Serenity.” December 2015. Press Release. <https://www.pantone.com/articles/color-of-the-year/color-of-the-year-2016>
- “Pantone Color of the Year 2018: Pantone 18-3838 Ultra Violet.” December 2018. Press Release. <https://www.pantone.com/articles/color-of-the-year/color-of-the-year-2018>
- “Pantone Color of the Year 2019: Pantone 16-1546 Living Coral.” December 2018. Press Release.

- <https://www.pantone.com/articles/color-of-the-year/color-of-the-year-2019>
- “Pantone Color of the Year 2020: Pantone 19-4052 Classic Blue.” December 2019. Press Release. <https://www.pantone.com/articles/color-of-the-year/color-of-the-year-2020>
- “Pantone Color Systems Explained.” Pantone. <https://www.pantone.com/color-systems/pantone-color-systems-explained>
- “Pantone Reveals Color of the Year 2021: Pantone 17-5104 Ultimate Gray and Pantone 13-0647 Illuminating.” December 9, 2020. Press Release. <https://www.pantone.com/articles/press-releases/pantone-reveals-color-of-the-year-2021-pantone-175104-ultimate-gray-and-pantone-130647-illuminating>
- “Pantone Standards” (video). June 27, 2018. Online. <https://vimeo.com/277349975>
- “Why Color Management is Important” (video). November 6, 2017. Online. <https://vimeo.com/241581827>
- Pelligrini, Leah. “Visually Satisfying Project Shares the Color Palettes of Iconic Film Scenes.” *My Modern Met*, May 26, 2016. <https://mymodernmet.com/cinema-palettes/>
- Perrigan, Dana. “‘Painted Lady’ for Sale for \$1.6 Million.” *SF Gate*, February 1, 2009. <https://www.sfgate.com/realestate/article/Painted-Lady-for-sale-for-1-6-million-3252522.php>
- Pressman, Laurie. “New York Fashion Week Spring / Summer 2020.” *Pantone Color Institute*, September 6, 2019. <https://www.pantone.com/color-intelligence/fashion-color-trend-report/fashion-colortrend-report-new-york-spring-summer-2020>
- Rood, Ogden. *Modern Chromatics, With Applications to Art and Industry*. New York: D. Appleton and Company, 1879.
- “Savoring the Celluloid Hues of Colorpalette.Cinema on Instagram.” *Haute Macabre*, April 20, 2017. <http://hautemacabre.com/2017/04/savoring-the-celluloid-hues-of-colorpalette-cinema-on-instagram/>
- Semple, Stuart. “The world’s Pinkest Pink- 50G Powdered Paint by Stuart Semple.” *Culture Hustle by Stewart Semple*, <https://www.culturehustleusa.com/collections/powders/products/pink-50g-powdered-paint-by-stuart-semble>
- Shoup, Richard. “SuperPaint: An Early Frame Buffer Graphics System.” *IEEE Annals of the History of Computing* 14 no. 3 (April-June 2001): 32-37.
- Smith, Alvy Ray. “Digital Paint Systems: An Anecdotal and Historical Overview.” *IEEE Annals of the History of Computing* 14 no. 3 (April-June 2001): 1-11.
- Schiffermüller, Ignaz. *Versuch eines Farbensystems*. Vienna: Augustin Bernardi, 1772.
- Stewart, Samantha. “San Francisco to Host Pop-up ‘Color Factory’ Art Exhibition.” *Nine Network*, 2017. <https://travel.nine.com.au/destinations/san-francisco-color-factory/fd7fb71c-5575-4248-9177-c2b23fb695ca>

- “Sugarhouse Blanket.” *Tales From a Happy House*, October 6, 2019. Blog.
<http://www.talesfromahappyhouse.com/2019/10/sugarhouse-blanket.html>
- Syme, Patrick. *Werner’s Nomenclature of Colors: Adapted to Zoology, Botany, Chemistry, Minerology, Anatomy, and the Arts*. London: The Trustees of the Natural History Museum, 2018.
- Taylor, Helen D., Lucille Knoche, and Walter C. Granville, editors. *Descriptive Color Names Dictionary: A Supplement to the Third Edition of the Color Harmony Manual*. Chicago, IL: Container Corporation of America, 1950.
- Tiffany & Co. “Our Story: Tiffany Blue.” *Tiffany & Co Newsroom*.
<https://press.tiffany.com/ourstory/tiffany-blue/>.
- “Trademarks & Copyrights.” <https://www.tiffany.com/policy/trademarks-copyrights/>
- Vanderpoel, Emily Noyes. *Color Problems: A Practical Manual for the Lay Student of Color*. City: Longmans, Green And Co., 1903.
- Vankevich, Olessia. “The Dress: More Than Just a Meme.” *Medium*, February 2, 2017.
<https://medium.com/rta902/the-dress-more-than-just-a-meme-6773578304d4>
- Young, Robin, and Karyn Miller-Medzon, “Pop-Up Museum Lets Visitors Take Sensory Plunge into Wide World of Color.” WBUR: Boston’s NPR News Station, April 1, 2018. <https://www.wbur.org/hereandnow/2019/04/01/color-factory-new-york>

Secondary Sources

- “After The Ashes: The Curious Case of Gray Houses in the Mission, Sergio De La Torre in conversation with Tanu Sankalia.” KADIST, July 19, 2019, San Francisco, CA. Event Promo.
<https://kadist.org/program/after-the-ashes-the-curious-case-of-gray-houses-in-the-mission/>
- Ahmed, Sara. *The Cultural Politics of Emotion*. Edinburgh, SCT: Edinburgh University Press, 2014.
- Alioto, Daisy. “What is Lifestyle?” September 2020. Interactive digital essay.
<https://www.whatislifestyle.com/>
- “Amanda Williams: How Can Color Bring Life to New Houses?” *Revitalize: Ted Radio Hour*. NPR, April 9, 2021. <https://www.npr.org/programs/ted-radio-hour/985484885/revitalize>
- Andrejevic, Mark. “When Everyone Has Their Own Reality Show.” In *A Companion to Reality Television*, edited by Laurie Ouellete: 40-56. Hoboken, NJ: John Wiley & Sons, 2014.
- Agoston, G.A. *Color Theory and its Application in Art and Design: Second Completely Revised and Updated Edition*. Berlin and Heidelberg: Springer Verlag, 1987.
- Baldwin, Peter C. *In the Watches of the Night: Life in the Nocturnal City, 1820-1930*. Chicago, IL: The University of Chicago Press, 2012.
- Ball, Philip. *Bright Earth: Art and the Invention of Color*. Chicago, IL: The University of Chicago Press, 2001.

- Barnouw, Jeffrey. "Goethe and Helmholtz: Science and Sensation." In *Goethe and the Sciences: A Reappraisal*, edited by Frederick Amrine, Francis J. Zucker, and Harvy Wheeler: 24-82. Dordrecht, Holland: D. Reidel Publishing Company, 1987.
- Barthes, Roland. *Camera Lucida: Reflections on Photography*, trans. Richard Howard. New York: Hill and Wang, 1981.
- *Mythologies: The Complete Edition, in a New Translation*, trans. Richard Howard and Annette Lavers. New York: Hill and Wang, 2013.
- Batchelor, David. *Chromophobia*. London, UK: Reaktion Books, 2000.
- Baudrillard, Jean. *The System of Objects*, translated by James Benedict. Brooklyn, NY: Verso, 1996.
- Bazin, André. "The Ontology of the Photographic Image." In *What is Cinema? Vol. 1*, translated by Hugh Gray, 9-16. Berkeley, CA: University of California Press, 1967.
- Behrens, Roy B. *False Colors: Art, Design and Modern Camouflage*. Dysart, Iowa: Bobolink Books, 2001.
- Belton, John. "Painting by the Numbers: The Digital Intermediate." *Film Quarterly*, vol. 61, no. 3 (Spring 2008): 58-65.
- Benjamin, Walter. *The Arcades Project*, translated by Howard Eiland and Kevin McLaughlin. Cambridge, MA: The Belknap Press, 1999.
- *Walter Benjamin: Early Writings (1910-1917)*, translated by Howard Eiland, 214-223. Cambridge, MA: Harvard University Press, 2011.
- *Walter Benjamin: Selected Writings, 1: 1913-1926*, edited by Michael W. Jennings. Cambridge, MA: Harvard University Press, 2004-2006.
- "The Work of Art in the Age of Mechanical Reproduction." In *Illuminations: Essays and Reflections*, edited and with an introduction by Hannah Arendt; preface by Leon Wieseltier; translated by Harry Zohn: 217-251. New York: Schocken Books, 1987.
- Beyes, Timon. "Colour Chart." In *The Oxford Handbook of Media, Technology, and Organization Studies*, edited by Timon Beyes, Robin Holt, and Claus Pias, 125-135. Oxford University Press, 2020.
- Bird, William L. Jr, ed. *Paint by Numbers: The How-to Craze that Swept the Nation* (Princeton Architectural Press, 2001). Exhibition catalogue.
- Blaszczyk, Regina Lee. *The Color Revolution*. Cambridge, MA: The MIT Press, 2012.
- "The Importance of Being True Blue: The Du Pont Company and the Color Revolution." In *Cultures of Commerce: Representation and American Business Culture, 1877-1969*, edited by Elspeth H. Brown, Catherine Gudis, and Marina Moscowitz, 27-50. New York: Palgrave Macmillan, 2006.
- "The Rise of Color Forecasting in the United States and Great Britain." In *The Fashion Forecasters: A Hidden History of Color and Trend Prediction*, edited by Regina Blaszczyk and Ben Wubs, 35-62. London, UK: Bloomsbury Visual Arts, 2018.

- Bock von Wülfigen, Bettina. "The Periodic Tableau: Form and Colors in the first 100 Years." In Lykknes, Annette and van Tiggelen, Brigitte, eds. *The Periodic system as an icon in chemistry and a typology of science. Special Issue in Centaurus, International Journal of the History of Science and its Cultural Aspects* (2019): 379-404.
- Bowker, Geoffrey C. and Susan Leigh Star. *Sorting Things Out: Classification and Its Consequences*. Cambridge, MA: The MIT Press, 1999.
- Braham, William W. "Solidity of the Mask: Color Contrasts in Modern Architecture." *RES: Anthropology and Aesthetics* 39 (Spring, 2001): 192-214.
- Brodmerkel, Sven, and Nicholas Carah. *Brand Machines, Sensory Media and Calculative Culture*. London, UK: Palgrave Macmillan, 2016.
- Brown, Elspeth H. *The Corporate Eye: Photography and the Rationalization of American Commercial Culture, 1884-1929*. Baltimore: The Johns Hopkins University Press, 2005.
- Bryant, Kenzie. "The Ball Pit Will Take Some Breaking In, and Other Lessons From The Instagram Experience Decade." *Vanity Fair*, December 20, 2019. <https://www.vanityfair.com/style/2019/12/experience-museum-color-factory-museum-of-ice-cream>
- Bucher, Tania. *If... Then: Algorithmic Power and Politics*. Oxford, UK: Oxford University Press, 2018.
- Budds, Diana. "How Pantone Became the Definitive Language of Color." *Fast Company*, September 18, 2014. <https://www.fastcompany.com/3050240/how-pantone-became-the-definitive-language-of-color>
- Busch, Lawrence. *Standards: Recipes for Reality*. Cambridge, MA: The MIT Press, 2011.
- Bush, Donald J. *The Streamlined Decade*. New York: George Braziller, 1975.
- Campbell, Colin. *The Romantic Ethic and the Spirit of Consumption: New Extended Edition*. London, UK: Palgrave MacMillan, 2018.
- Carman, Ashley. "Experience, Experience, Experience! Behind Color Factory, one of the photogenic pop-ups trying to conquer the experience economy." *The Verge*, November 6, 2019. <https://www.theverge.com/2019/11/6/20949838/color-factory-houston-instagram-pop-up-experience-museum>
- Chayka, Kyle. "Welcome to Airspace: How Silicon Valley Helps Spread the Same Sterile Aesthetic to the World." *The Verge*. August 3, 2016. <https://www.theverge.com/2016/8/3/12325104/airbnb-aesthetic-global-minimalism-startup-gentrification>
- Cheng, Anne Anlin. *Ornamentalism*. Oxford, UK: Oxford University Press, 2018.
- Chun, Wendy Hui Kyung. *Control and Freedom: Power and Paranoia in the Age of Fiber Optics*. Cambridge, MA: The MIT Press, 2006.
- . *Programmed Visions: Software and Memory*. Cambridge, MA: The MIT Press, 2001.

- “On Software, or the Persistence of Visual Knowledge,” *Grey Room* (Winter 2005): 26-51.
- *Updating to Remain the Same: Habitual New Media*. Cambridge, MA: The MIT Press, 2016.
- Coates, Paul. *Cinema and Colour: The Saturated Image*. London, UK: Bloomsbury, 2010.
- Cobbald, Caroline. *A Rainbow Palate: How Chemical Dyes Changed the West's Relationship With Food*. Chicago, IL: The University of Chicago Press, 2020.
- Colomina, Beatriz. *Privacy and Publicity: Modern Architecture as Mass Media*. Cambridge, MA: The MIT Press, 1994.
- Crary, Jonathan. *24/7: Late Capitalism and the Ends of Sleep*. Brooklyn, NY: Verso, 2013.
- *Suspensions of Perception: Attention, Spectacle, and Modern Culture*. Cambridge, MA: The MIT Press, 1999.
- *Techniques of the Observer: On Vision and Modernity in the 19th Century*. Cambridge, MA: The MIT Press, 1990.
- “Your Colour Memory: Illuminations of the Unforeseen.” In *Olafur Eliasson: Minding the World*, edited by Olafur Eliasson and Gitte Ørskou, 2019-225. Aarhus, DK: ARoS Aarhus Kunstmuseum, 2004.
- Cubitt, Sean. *The Practice of Light: A Genealogy of Visual Technologies from Prints to Pixels*. Cambridge, MA: The MIT Press, 2014.
- Dann, Kevin T. *Bright Colors Falsely Seen: Synaesthesia and the Search for Transcendental Knowledge*. New Haven, CT: Yale University Press, 1998.
- Daston, Lorraine and Galison, Peter. *Objectivity*. Brooklyn, NY: Zone Books, 2007.
- De Heer, Jan. *The Architectonic Colour: Polychromy in the Purist Art of Le Corbusier*. Rotterdam, NL: 010 Publishers, 2009.
- de Souza e Silva, Adriana. “From Cyber to Hybrid: Mobile Technologies as Interfaces of Hybrid Spaces.” *Space and Culture* 9, no. 3 (2006): 261-278.
- Delechanty, Randolph. *San Francisco Victorians*. San Francisco: Chronicle Books, 2000.
- Dionne-Krosnick, Arièle. “What Color is Racism?” *Post: Notes on Art in a Global Context*, The Museum of Modern Art. December 4, 2019. <https://post.moma.org/what-color-is-racism/>
- Doane, Mary Ann. *The Emergence of Cinematic Time: Modernity, Contingency, the Archive*. Cambridge, MA: Harvard University Press, 2002.
- “Information, Crisis, Catastrophe.” In *New Media, Old Media: A History and Theory Reader*, ed. Wendy Hui Kyong Chun and Thomas Keenan, 252-264. Oxfordshire, UK: Routledge, 2006.
- Doniger O’Flaherty, Wendy. *Dreams, Illusion, and Other Realities*. Chicago, IL: The University of Chicago Press, 1984.

- Dyer, Richard. *White: Essays on Race and Culture*. Oxfordshire, UK: Routledge, 1997.
- Eaton, Natasha. *Color, Art and Empire: Visual Culture and the Nomadism of Representation*. London: I.B. Tauris & Co, Ltd, 2013.
- Emre, Merve. *The Personality Brokers: The Strange History of Myers-Briggs and the Birth of Personality Testing*. New York, NY: Doubleday, 2018.
- Eskilson, Stephen. "Color and Consumption." *Design Issues* 18, no. 2 (Spring 2002): 17-29.
- Daravath, Haji Nik and Uttam Kokil, "Effect of pre-defined color Rendering Intents (CRI) on the Hue attributes in a Color Managed Workflow (CMW). *The Journal of Technology Studies* 40 no.1/2 (Spring/Fall 2014): 12-25.
- Fer, Briony. "Color Manual." In *Color Chart: Reinventing Color, 1950-Today*, ed. Ann Temkin, 28-38. New York: The Museum of Modern Art, 2008.
- Feuer, Jane. "The Concept of Live Television: Ontology as Ideology." In *Regarding Television: Critical Approaches—an Anthology* (American Film Institute, 1983): 12-22.
- Finley, Gerard. "The Deluge Pictures: Reflections on Goethe, J.M.W. Turner and Early Nineteenth-Century Science." *Zeitschrift Für Kunstgeschichte* 60, no. 4 (1997): 530-48.
- Fisher, Anna Watkins. "Safety Orange." *journal of visual culture* 20 no. 1 (April 2021): 3-24.
- Flueckiger, Barbara. Timeline of Historical Film Colors. Digital Database
- Fraser, Pamela. *How Color Works: Color Theory in the 21st Century*. Oxford University Press, 2019.
- Frith, Jordan. *Smartphones as Locative Media*. Cambridge, UK: Polity Press, 2015.
- Foucault, Michel. *The Order of Things: An Archaeology of the Human Sciences*. New York, NY: Random House, Inc., 1970.
- *Technologies of the Self: A Seminar with Michel Foucault*, edsited by Luther H. Martin, Huck Gutman, And Patrick H. Hutton. Amherst, MA: University of Massachusetts Press, 1988.
- Gaboury, Jacob. "The Random-Access Image: Memory and the History of the Computer Screen." *Grey Room* 70 (Winter 2018): 24-53.
- Gage, John. *Color and Meaning: Art, Science, and Symbolism*. Berkeley, CA: The University of California Press, 1999.
- *Color in Turner: Poetry and Truth*. New York, NY: Frederick A. Praeger, Inc., 1969.
- Galloway, Alexander. *The Interface Effect*. Cambridge, UK: Polity Press, 2012.
- *Laruelle: Against the Digital*. Minneapolis, MN: The University of Minnesota Press, 2014.
- "Language Wants to Be Overlooked: On Software and Ideology." *journal of visual culture* vol. 5

- (2006): 315-331.
- . *Protocol: How Control Exists After Decentralization*. Cambridge, MA: The MIT Press, 2004.
- Gaskill, Nicholas. “The Articulate Eye: Color Music, the Color Sense, and the Language of Abstraction.” *Configurations* 25 no. 4 (Fall 2017): 475-505.
- . *Chromographia: American Literature and the Modernization of Color*. Minneapolis: The University of Minnesota Press, 2018.
- . “Fugitive Colours” (Conference presentation, “Towards a History of Modern Colour.” The University of Cambridge, Cambridge, UK/ hybrid remote format, June 9-11, 2021)
- Goding-Doty, Christine. “Beyond the Pale Blog: Tumblr Pink and the Aesthetics of White Anxiety.” In *A Tumblr Book: Platform and Cultures*, edited by Allison McCracken, Alexander Cho, Louisa Stein, and Indira Neill Hoch, 344-355. Ann Arbor, MI: University of Michigan Press, 2020.
- Grisard, Dominique. “‘Real Men Wear Pink’? A Gender History of Color.” In *Bright Modernity: Color, Commerce and Consumer Culture*, edited by Regina Blaszczyk and Uwe Spiekermann, 77-96. London, UK: Palgrave Macmillan, 2017.
- Hardin, C.L. *Color for Philosophers: Unweaving the Rainbow, Expanded Edition*. Indianapolis, IN: Hackett Publishing Company, 1988.
- Harris, Daniel. “Off of the Map and onto the Coffee Table: Manufacturing the American City.” *The Threepenny Review* 51 (Autumn 1992): 17-19.
- Harris, Diane. *Little White Houses: How the Postwar Home Constructed Race in America*. Minneapolis: University of Minnesota Press, 2013.
- Hentschel, Klaus. *Mapping the Spectrum: Techniques of Visual Representation in Research and Teaching*. Oxford, UK: Oxford University Press, 2002.
- Hess, Amanda. “The Existential Void of the Pop-Up ‘Experience.’” *The New York Times*, September 26, 2018.
- Hisano, Ai. “The Rise of Synthetic Colors in the American Food Industry, 1870-1940.” *Business Review* 90 (Autumn 2016): 483-504.
- . *Visualizing Taste: How Big Business Changed the Look of What You Eat*. Cambridge, MA: Harvard University Press, 2019.
- Higgins, Scott. *Harnessing the Technicolor Rainbow: Color Design in the 1930s*. Austin, TX: University of Texas Press, 2007.
- Hochman, Brian. *Savage Preservation: The Ethnographic Origins of Modern Media Technology*. Minneapolis, MN: The University of Minnesota Press, 2014.
- Hoy, Meredith. *From Point to Pixel: A Genealogy of Digital Aesthetics*. Hanover, NH: Dartmouth College Press, 2017.

- Howes, David. "Hyperesthesia, or, the Sensual Logic of Late Capitalism." In *Empire of the Senses: The Sensory Culture Reader*, edited by David Howes, 281-303. New York, NY: Berg, 2005.
- Hui, Alexandra. *The Psychophysical Ear: Musical Experiments, Experimental Sounds, 1840-1910*. Cambridge, MA: The MIT Press, 2012.
- Illouz, Eva. *Cold Intimacies: The Making of Emotional Capitalism*. Cambridge, UK: Polity Press, 2007.
- . *Emotions as Commodities: Capitalism, Consumption and Authenticity*. London, UK: Routledge, 2018.
- Ingher, Donald. "What We Sort: Venus Paradise Coloring Set." In *Falling for Science: Objects in Mind*, ed. Sherry Turkle, 252-261. Cambridge, MA: The MIT Press, 2011.
- Isenstadt, Sandy. *Electric Light: An Architectural History*. Cambridge, MA: The MIT Press, 2018.
- . *The Modern American House: Spaciousness and Middle-Class Identity*. Cambridge University Press, 2006.
- Jablonski, Nina. "The Evolution of Skin Colour: An Anthropological Approach." (Presentation, "Towards a History of Modern Colour." The University of Cambridge, Cambridge, UK/ hybrid remote format, June 9-11, 2021)
- Jarman, Derek. *Chroma: A Book of Color*. New York, NY: The Overlook Press, 1995.
- Kalba, Laura Ann. *Color in the Age of Impressionism: Commerce, Technology, and Art*. University Park, PA: The Pennsylvania State University Press, 2017.
- Kane, Carolyn L. *Chromatic Algorithms: Synthetic Color, Computer Art and Aesthetics After Code*. Chicago, IL: The University of Chicago Press, 2014.
- . "GIFs That Glitch: Eyeball Aesthetics for the Information Economy." *Communication Design* 4 (2016): 41-62.
- . *High-Tech Trash: Glitch, Noise, and Aesthetic Failure*. Berkeley, CA: The University of California Press, 2019.
- Keevak, Michael. *Becoming Yellow: A Short History of Racial Thinking*. Princeton, NJ: Princeton University Press, 2011.
- Kern, Stephen. *The Culture of Time and Space, 1880-1918*. Cambridge, MA: Harvard University Press, 1983.
- Kittler, Friedrich. *Optical Media: Berlin Lectures 1999*, trans. Anthony Enns. Cambridge, UK, Polity Press, 2010.
- King, John. "Paint it Black, Architecturally Speaking? Better yet, just make it stop." *San Francisco Chronicle*, May 22, 2021. <https://www.sfchronicle.com/bayarea/article/Paint-it-black-architecturally-speaking-Better-15290427.php>
- . "S.F. Architecture Shifts to Darker Tone." *San Francisco Chronicle*, January 20, 2014. <https://www.sfgate.com/bayarea/place/article/S-F-architecture-shifts-to-darker-tone->

- Krauss, Rosalind. "Grids." *October*, vol. 9 (Summer 1979): 50-64.
- Kuehni, Rolf G. *Color Space and Its Divisions: Color Order from Antiquity to the Present*. Hoboken, NJ: John Wiley & Sons, 2003.
- Kuehni, Rolf G., and Andreas Schwartz. *Color Ordered: A Survey of Color Systems from Antiquity to the Present*. Oxford, UK: Oxford University Press, 2008.
- Kulper, Perry. "The Calculus of Paint." *The Journal of Architecture* 14, vol. 3 (2009): 377-386.
- Kurgan, Laura. *Close Up at a Distance: Mapping, Technology, and Politics*. New York: Zone Books, 2013.
- Lafer-Sousa, Rosa, Katherine L. Hermann, and Bevil R. Conway. "Striking Individual Differences in Color Perception Revealed by 'The Dress' Photograph." *Current Biology* 25, no. 13 (May 2015).
- The *Leader Ladies Project*. The Chicago Film Society (2011-the present).
<https://www.chicagofilmsociety.org/projects/leaderladies/>
- Lehmann, Claire. "Color Goes Electric." *Triple Canopy*, May 31, 2016. Online.
<https://www.canopycanopycanopy.com/contents/color-goes-electric>
- Leslie, Esther. *Synthetic Worlds: Nature, Art, and the Chemical Industry*. London: Reaction Books, 2005.
- Levitt, Theresa. *The Shadow of Enlightenment: Optical and Political Transparency in France, 1789-1848*. Oxford University Press, 2009.
- Manovich, Lev. *The Language of New Media*. Cambridge, MA: The MIT Press, 2001.
- . *Instagram and Contemporary Image*. Lev Manovich, 2016.
- Marling, Karal Ann. *As Seen on TV: The Visual Culture of Everyday Life in the 1950s*. Cambridge, MA: Harvard University Press, 1994.
- McDermott, Kathleen and Davis Dyer. *America's Paint Company: A History of Sherwin-Williams*. Cambridge, MA: the Winthrop Group, Inc., 1991.
- McLuhan, Marshall. *Understanding Media: The Extensions of Man*, edited by Terrence Gordon. Berkeley, CA: Gingko Press Inc., 2005.
- Mein, Stephen A. "COVID-19 and Health Disparities: the Reality of the 'Great Equalizer.'" *Journal of General Internal Medicine* 35, vol. 8 (August 2020): 2439-2440.
- Mirzoeff, Nicholas. "On Visuality." *journal of visual culture* 5 no. 1 (2006): 53-79.
- Misek, Richard. *Chromatic Cinema: A History of Screen Color* (Wiley-Blackwell, 2010)
- Montaña, Ricardo Cedeño. "Encoding Color: Between Perception and Signal." In *Science in Color: Visualizing Achromatic Knowledge*, edited by Bettina Bock von Wülfigen, 99-115. Berlin, DE: Walter De Gruyter, 2019.

- Mulvin, Dylan. *Proxies: The Cultural Work of Standing In*. Cambridge, MA: The MIT Press, 2022.
- Murray, Susan. *Bright Signals: A History of Color Television*. Durham, NC: Duke University Press, 2018.
- Ngai, Sianne. *Our Aesthetic Categories: Cute, Zany, Interesting*. Cambridge, MA: Harvard University Press, 2012.
- Rossi, Michael. "Green is Refreshing: Techniques, Technologies, and Epistemologies of Nineteenth Century Color Therapies." In *Science in Color: Visualizing Achromatic Knowledge*, edited by Bettina Bock von Wülfinen: 117-132. Berlin: Walter De Gruyter, 2019.
- . *The Republic of Color: Science, Perception, and the Making of Modern America*. Chicago, IL: The University of Chicago Press, 2019.
- . "Ten Short Notes on Color, Anthropology, and Makeup." *Grey Room* 76 (Summer 2019): 6-23.
- Saunders, Barbara. "Revisiting Basic Color Terms." *The Journal of the Royal Anthropological Institute* 6 no. 1 (March 2000): 81-99.
- Sepper, Dennis L. *Goethe Contra Newton: Polemics and the Project for a New Science of Color*. Cambridge, UK: Cambridge University Press, 1988.
- Schivelbusch, Wolfgang. *Disenchanted Night: The Industrialization of Light in the Nineteenth Century*, translated by Angela Davies. Berkeley: The University of California Press, 1988.
- Schneider, Benjamin. "An Architectural Rainbow: SF's Colorist Movement." *SF Weekly*, June 25, 2020. <https://www.sfweekly.com/pride/an-architectural-rainbow-sfs-colorist-movement/>
- Siegert, Bernard. *Cultural Techniques: Grids, Filters, Doors, and Other Articulations of the Real*, translated by Geoffrey Winthrop-Young. New York, NY: Fordham University Press, 2015.
- Smith, Terry. *Making the Modern: Industry, Art, and Design in America*. Chicago, IL: The University of Chicago Press, 1993.
- Somaini, Antonio. "Walter Benjamin's Media Theory: The *Medium* and the *Apparat*." *Grey Room*, vol. 62 (Winter 2016): 6-41.
- Sontag, Susan. *On Photography*. New York: Picador, 1977.
- Spicer, André, and Carl Cederström, *The Wellness Syndrome*. Hoboken, NJ: Wiley, 2015.
- Spigel, Lynn. *TV By Design: Modern Art and the Rise of Network Television*. Chicago, IL: The University of Chicago Press, 2008.
- . *Welcome to the Dreamhouse: Popular Media and Postwar Suburbs*. Durham, NC: Duke University Press, 2001.
- Sterne, Jonathan. *MP3: The Meaning of a Format*. Durham, NC: Duke University Press, 2012.
- Sterne, Jonathan and Dylan Mulvin. "The Low Acuity for Blue: Perceptual Technics and American Color Television." *Journal of Visual Culture*, vol. 13, no. 2 (2014): 118-138.

- Steyerl, Hito. "In Defense of the Poor Image." In *The Wretched of The Screen* (Sternberg Press/ e-flux journal, 2012): 31-45.
- . "In Free Fall: A Thought Experiment on Vertical Perspective." *e-flux*, no. 24 (April 2011)
- Stover, John. "Understanding Super-Gentrification in San Francisco." *ASA Footnotes: A Publication of the American Sociological Association*, vol. 42 no. 4 (April 2014): 1, 6, 10.
https://www.asanet.org/sites/default/files/savvy/footnotes/apr14/sanfran_0414.html
- Street, Sarah. *Colour Films in Britain: The Negotiation of Innovation, 1900-55*. London, UK: Palgrave Macmillan, 2010.
- Stutz, Olivia Kristina. "Such (Dye-)Stuff as Dreams Are Made On: Material Interactions between the Photography, Film, and Fashion Industries." In *Color Mania: The Materiality of Color in Photography and Film*, edited by Barbara Flueckiger, Eva Hielscher, and Nadine Wietlisbach, 121-132. Fotomuseum Winterthur: Lars Müller Publishers, 2020.
- Susman, Warren. *Culture as History: The Transformation of American Society in the Twentieth Century*. New York: Pantheon Books, 1984.
- Taussig, Michael. *What Color is the Sacred?* Chicago, IL: The University of Chicago Press, 2009.
- Temkin, Ann. "Color Shift." In *Color Chart: Reinventing Color, 1950-Today*, ed. Ann Temkin, 16-27. New York: The Museum of Modern Art, 2008.
- Trefny, Ben. Interview with Sergio De La Torre, "San Francisco is Turning Gray, One House at a Time." Crosscurrents KALW, September 10, 2019. Podcast transcript.
<https://www.kalw.org/show/crosscurrents/2019-09-10/san-francisco-is-turning-gray-one-house-at-a-time>
- Turner, Fred. *The Democratic Surround: Multimedia and American Liberalism from World War II to the Psychedelic Sixties*. Chicago, IL: The University of Chicago Press, 2013.
- . *From Counterculture to Cyberculture: Stewart Brand and the Whole Earth Network*. Chicago, IL: The University of Chicago Press, 2006.
- Vainshtem, Annie. "How San Francisco Lost its Color." *The San Francisco Chronicle*, October 11, 2019.
<https://www.sfchronicle.com/culture/article/Welcome-to-grayspace-San-Francisco-s-new14493024.php#photo-18352654>
- Wigley, Mark. *White Walls, Designer Dresses: The Fashioning of Modern Architecture*. Cambridge, MA: The MIT Press, 1990.
- Williams, John. *The Buddha in the Machine: Art, Technology, and the Meeting of East and West*. New Haven, CT: Yale University Press, 2014.
- Williams, Raymond. "Personality." In *Keywords: A Vocabulary of Culture and Society*, 232-235. New York: Oxford University Press, 1983.
- . *Television: Technology and Cultural Form*. London: Routledge, 1975.

- Wittgenstein, Ludwig. *Remarks on Color*, translated by Linda L. McAlister. Hoboken, NJ: Wiley-Blackwell, 1991.
- Yano, Christine R. *Pink Globalization: Hello Kitty's Trek Across the Pacific*. Durham, NC: Duke University Press, 2013.
- Young, Kerri. "Rainbow Victorians and the Colorist Era in San Francisco." *SF Heritage*, April 17, 2000. <https://www.sfheritage.org/features/colorfully-painted-victorians/>
- Yue, Genevieve. "The China Girl on the Margins of Film." *October*, no. 153 (Summer 2015): 96-116.
- . *Girl Head: Feminism and Film Materiality*. New York, NY: Fordham University Press, 2020.
- Yumibe, Joshua and Sarah Street. *Chromatic Modernity: Color, Cinema and Media of the 1920s*. New York: Columbia University Press, 2019.
- Žižek, Slavoj. "From Western Marxism to Western Buddhism." *Cabinet Magazine* 2 (Spring 2001). Online. <https://www.cabinetmagazine.org/issues/2/zizek.php>.

