The compass and the map: colour meaning and the colour design process

Ellen Divers

Ellen Divers Design, USA
Email: ellen.divers@gmail.com

Colour Theory in the design world generally refers to topics of interest to a designer, such as colour combinations and colour interaction. The first addresses various options for assembling a palette (analogous, complementary, etc.), and the second involves structured observations about both subtle and striking effects that occur when placing colours next to each other, information which is useful to know. However, neither of these explain, in an evidence-based way, how palette choices will affect the recipients of the design. Further complicating matters, colour is frequently taught as a standalone subject, not presented within the context of a design thinking process, so there is little tangible guidance for the designer as to how to apply this knowledge in a project. This is especially true in the field of interior design, which is the primary concern in this paper, but it applies to other design specialties as well. We have been asking designers to map a colour direction for their projects without the benefit of a "compass" to point the way forward, and without this compass, colour interaction and colour relationships become a series of academic exercises rather than useful tools for design. At the core of the issue is Colour Meaning, usually presented as colour associations and symbolism, but which is considerably more complex and dimensional. In recent years, a new paradigm has emerged that offers designers an intuitive and evidence-based approach to navigating colour. This article presents this paradigm as a Colour Compass and illustrates how incorporating these topics into a human-centred design model can facilitate the colour design thought process.

Introduction

"*If you don't know where you're going, any road will take you there.*"[1]

Most design students are introduced to the colour wheel as a way of surveying colour combinations (e.g., analogous, complementary, warm/cool); a few students have the opportunity to explore colour interaction, which alerts them to the vagaries of colour and Josef Albers' observation that colour "deceives continually" [1, p.1]. But neither the colour wheel nor the exercises with coloured paper instruct designers on how to choose certain colours, and not others, for the benefit of the recipients of their designs. It's like being offered a map, the lay of the land, without any indication of which way is north. Designers have been navigating colour design without a compass for too long. The good news is that there is a compass; we just need to embed it into a design thinking process so that designers understand how to use it.

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[1] This quote is commonly attributed to Lewis Carroll, author of Alice in Wonderland, and although the Cheshire cat does say something to this effect, the literal quote appears nowhere in the book itself. It does appear in George Harrison's song "Any Road", so he gets the credit.

Colour theory

An internet search for the definition of "colour theory" yields an array of answers involving terms such as cool/warm, tints/tone/shades, colour combinations (monochromatic, analogous, complementary, etc.), hue/value/chroma (or saturation), and colour interaction. Yet if a theory is "an explanation of facts" [2], as stated by the National Center for Science Education, colour theory as it exists today is less a theory than it is a collection of ways to categorise and describe colours and ways to combine them, with an undefined goal of attaining "colour harmony", whatever that means. Colour theory is a more suitable description of the science of colour where there is evidence to explain how things work, such as additive and subtractive colour or how people physically see colour. The emerging field of colour design, though, is sorely lacking the organising structure of a theory, and until there is one, colour design will remain a hit-or-miss proposition. The purpose of this paper is to introduce a theory supported by research into the process of colour design, instilling a measure of rationality into what can be a confusing and complicated process.

Colour design is sufficiently challenging in two dimensions, and vastly more so in the three-dimensional world of architectural colour, where designers must contend with the added variable of lighting. Yet when Calvo Ivanovic (2022) investigated what is being taught on the subject of colour in design programs, she found a wide inconsistency in curricula, suggesting that students are ill-prepared to face the challenges of colour application in their fields, "Most of the courses are not focused on reflection or critical design thinking related to colour, but mostly on application tasks. In other words, in several cases, students are not being taught to design with colour but to retain, know and apply colour techniques." [3, p.119]. Similarly, Calvo Ivanovic notes that low scores on the Conceptual and Metacognitive knowledge dimensions "could mean that students are not being sufficiently trained to master the interrelationships of the elements of colour (Conceptual) or to develop a more advanced strategic understanding of how to work with colour in the context of design (Metacognitive)" [3, p.119]. Clearly, designers require more guidance in order to understand and apply colour, which is an extremely complex element of design. Table 1, drawn from Calvo Ivanovic's study, provides a useful inventory of the topics that fall under the heading of Colour Fundamentals, and note that Colour Theory and Colour Combinations are, appropriately, separate categories.

Colour fundamentals				
Topics Colour perception	Colour theory	Colour combination	Colour relativity	Colour language
Sub-topics • Colour vision • Colour and light • Colour in objects	• Colour properties • Colour synthesis • Colour typologies • History of colour	• Colour harmony • Colour contrast • Colour scales • Chromatic variations	• Interaction of colour • Visibility and readability • Colour effects • Colour illusions	• Synaesthesia • Colour naming • Colour associations

Table 1: Topics included under colour fundamentals [3].

Colour meaning

Conspicuously absent in the above list of topics – and missing only because its development is still in its infancy – is the question of colour as it relates to human experience, beyond the simple one-to-one correspondences of colour associations referenced under the Colour Language category in Calvo

Ivanovic's chart. Colour Meaning is the term used in this article because meaning precedes language; finding the word for something comes after we have a meaningful experience that we wish to articulate. So why Colour Meaning instead of existing terms such as "colour psychology" or "emotion"? "Colour psychology" has a long history, and its roots are firmly planted in the view that hues are the drivers of colour experience (a.k.a. Hue Paradigm [4]), the very mindset that has kept us from progressing our understanding of how people actually respond to colour. Also, psychology encompasses every aspect of human consciousness, so it is too broad to be useful. The word "emotion" in everyday parlance refers to feelings such as anger, joy, fear, or sadness. The American Psychological Association defines it as "a complex reaction pattern, involving experiential, behavioural, and physiological elements, by which an individual attempts to deal with a personally significant matter or event" [5]. Emotion in this sense is far beyond a designers purview. "Colour impressions" is a closer match for responses which are not as intense as emotions, but which are just quick judgments people make about anything and everything they encounter every minute of their life (people, places, products, weather, food, entertainment etc.). These responses are relevant for businesses concerned with the impressions that a product or service leaves with consumers, and in the world of retail it is not unusual to apply Pleasure-Arousal-Dominance Theory (a theory of affect, akin to emotion) to gauge customer responses [4]. If designers understand this theory, too, might they be able to better navigate – even predict – the impressions people will form about their designs? An impression can be a simple like/dislike (Pleasure), and anyone who engages with social media understands the influence (and unpredictability) of this thumbs-up/thumbs-down dimension. Another type of impression has to do with Arousal, an energetic signature, which ranges from excitement all the way to sleepiness. A third type of response is called Dominance which has to do with our survival instinct; people continually assess who is in charge in situations so they know whether they should raise or relax their guard. Colour, and design in general, can trigger all three of these responses at once. These conscious and unconscious feelings and thoughts may not be dramatic, but they do carry meaning. If designers understand that meaning, they can incorporate congruent colour messaging in their designs. Colour Meaning in this paper refers generally to the feelings and thoughts that people in response to colour.

The traditional and prevailing view of "colour psychology" is that hues are the drivers of colour experience [6]. It is common to see books or articles on the subject neatly organised by full-chroma hue where the author presents associations (e.g., historical, environmental) that people have with each hue, occasionally pointing to research findings that suggest a particular hue can influence physiological responses such as heart rate and blood pressure. With the exception of colour associations, none of this is especially useful to a designer when it comes time to choose a colour palette, and there are several reasons for that. First, research findings are of limited use because colours are typically studied one at a time, in isolation, in order to control for the effects of colour interaction – yet managing the interaction of multiple colours is precisely what designers are tasked with. Second, generalisations about hues usually apply to the full-chroma versions; red may be "exciting" in its most vivid form, but it is less so in muted, pale or dark versions of it (Figure 1). Ironically, designers use muted colours to a larger extent than the vivid ones, so once again, looking to research for guidance leaves them empty-handed.

Fortunately, recent years have seen the beginning of a paradigm shift in how we can understand colour which accounts for these colour varieties. Valdez and Mehrabian's "Effects of Color on Emotion" [6] found that *value* and *chroma* are stronger predictors than is hue when it comes to understanding the meaning colours.
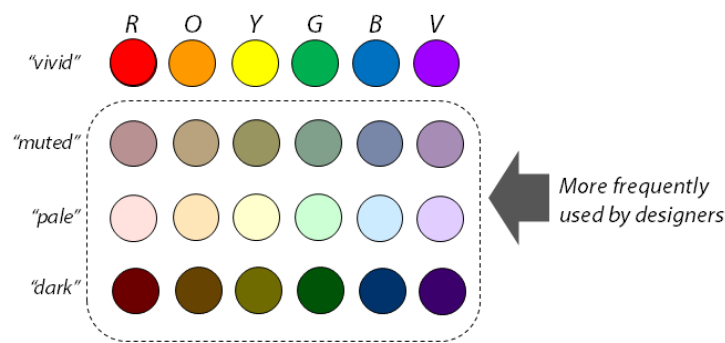
Figure 1: Illustration of how a hue-based colour paradigm neglects a wide range of colours.

In a nutshell, Valdez and Mehrabian correlated hue, value and chroma with Pleasure-Arousal-Dominance Theory (described earlier) and found that the higher a colour's chroma, the higher the subjects' Arousal, and the lower the chroma the lower the arousal. Value is associated with Dominance, with darker colours being experienced as more dominant, stronger or more powerful, than lighter ones [7]. In a survey exploring the language people use to describe variations of value and chroma, Divers (2020) found consistent agreement among subjects who were asked to choose from word pairs the word that best described dark, pale, muted and vivid versions of a graphic image, and their responses echo the findings of Valdez and Mehrabian [6]. Similarly, Maggio and Green-Armitage in their work with the ISCC/AIC Colour Literacy Project, have observed that teachers will naturally organise colour not only according to hue, but also according to the vivid/muted/pale/dark categories, and when these teachers are asked to use words to describe colours in each of these categories; their responses align with the above findings [8]. This new way of understanding colour meaning offers designers a theory-based tool for colour direction, and it is presented below in the form of a Colour Compass (Figure 2).
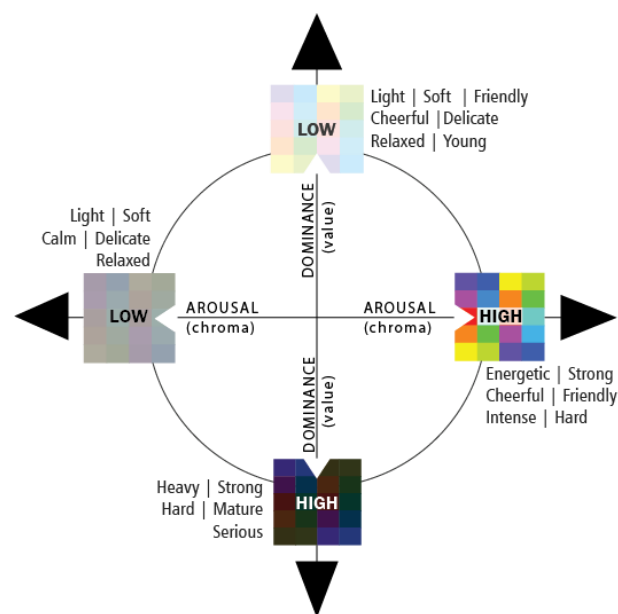

Figure 2: Evidence-based Colour Compass for use in establishing a direction with regard to colour meaning.

The colours in this compass are a small subset of the universe of colour, and it is only natural to ask where all those other colours fit in this tool. The Colour Compass is intended to be used as a general reference that informs designers about the meaning of colour extremes, a quick way to verify that the messaging in their design dovetails with the colour direction they are choosing. This happens early in the process of design, perhaps before the designer even has an idea about the hues she or he will choose. The compass reminds them, for example, that low chroma colours are relaxing (although not necessarily cheerful) and that high chroma colours are cheerful, but can also be experienced as hard and intense. These are impressions that a designer must bear in mind when making decisions about how much to use of each type of colour, or whether it might be prudent, for example, to lower chroma in order to reduce its intensity. It is anticipated that once designers grasp the concepts of Arousal and Dominance, and reflect on the language that describe their extremes, that knowledge will deepen their understanding of colour meaning and eventually the Colour Compass will become part of their intuitive colour thinking process. That said, a designer does not necessarily need to understand Arousal or Dominance, as long as they understand the meaning of their respective extremes. Obviously missing in the model is the Pleasure dimension, which is omitted because an individual's response to colour is easily influenced by other elements of design, e.g., style, shape, form, scale, material, etc.) and this is particularly true within an architectural context. It is worth noting, though, that in the context of samples Valdez and Mehrabian's subjects rated the range of colours from vivid to pale as the most pleasing.

Thinking about colour dimensionally dovetails beautifully with the design process because designers do a lot of "calibrating" with the elements of design, increasing or decreasing their amount or intensity until they get it just right. This iterative and experimental aspect of design makes colour a perfect fit for inclusion in the design process.

The design process

Every aspect of our lives is shaped by the invisible hand of a designer. From the clothes we wear, to the phone and laptop we use, to the car/bike/other transportation we use to get around, to the roads we travel, to our home and every building (including furniture) we occupy, to the products we use (e.g., a hairbrush, lawnmower), these are all the result of design.

There are many who view design as a "creative" endeavour, imagining the process to be impulsive, mysterious, random. In reality, design is a rational and structured process that includes opportunities to think outside the proverbial box, but which is always focused on the goal of delivering something people can use. The earliest human design effort would have been tools, for example, a sharpened rock for cutting hides or fibrous plants. The purpose of design has always been to make life easier for people, so it is not surprising that today human-centred design (HCD) is the term used to describe the design process for anything that shapes or affects the life of people. Tim Brown of IDEO Design Thinking defines human-centred design as,

"*. . . a process that starts with the people you're designing for and ends with new solutions that are tailor made to suit their needs. Human-centred design is all about building a deep empathy with the people you're designing for; generating tons of ideas; building a bunch of prototypes; sharing what you've made with the people you're designing for; and eventually putting your innovative new solution out in the world.*" [9]

Designers who work with colour are shaping human experience – for better or for worse. Architectural designers are tasked with preserving the health, safety and welfare of those occupying their spaces [10] which comprises not just physical comfort, but also mental and emotional aspects of human experience. Thus, *empathy*, as described in human-centred design, plays a key role in the design thought process. Architectural designers follow a rigorous and rational process to bring an idea of a space to fruition, yet when it comes to colour they rely strongly on trends and subjective opinions to make decisions, and these approaches do not always serve the best interest of people who use the spaces. What if we could incorporate the Colour Compass into the design process to help bring some measure of objectivity into colour decision-making?

There are many design models to draw from which normally begin by understanding the users and design requirements, then proposing a direction, and then arriving at a solution through a process of experimentation – testing and tweaking ideas – until the goal is achieved. Figure 3 is an amalgam of two models, one from IDEO Design Thinking [11] and the other from Interaction Design Foundation [12], adapted for the purpose of colour design. The central theme that runs through the process is empathy; designers can easily slip into the habit of making subjective colour choices, and this is a reminder that human-centred design looks beyond one's own aesthetic bias to what is *best for the user*, in the particular application.
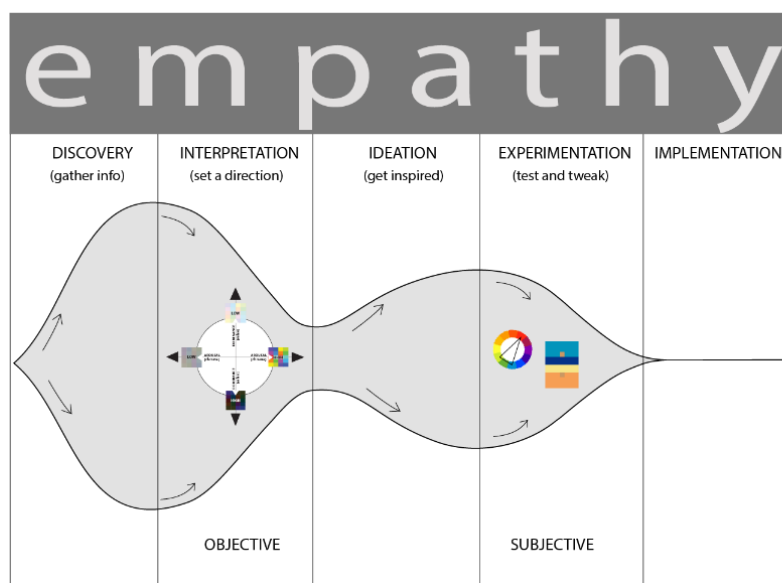

Figure 3: Human-centered design process illustrating the stages where objective and subjective design thinking are required.

The graphic shape illustrates the type of thinking that is employed at each step: *divergent* thinking involves casting a wide net for information or ideas and *convergent* thinking is the process of analysing and winnowing that information into clear guideposts which will keep the design on track. There is no resource to advise designers about "right" or "wrong" colour choices, but rather colour design involves viewing possibilities, both evidence-based and subjective, and using critical thinking to assemble a colour palette. There are two places in the design process where the designer is faced with choices. The first happens during INTERPRETATION phase where the designer who now has a clear understanding of the user's needs, can establish a *general* colour direction that will support stated design goals. There may be hue constraints (e.g., branding, design context or client preferences), or the designer may not yet have an idea about which hues will be employed, but *value* and *chroma* ranges can nonetheless be

defined, which will begin to narrow the universe of colour choices. Successful design requires a balance of pale, dark, muted and vivid colours, but a decision must be made as to which type of colour will be dominant, since its meaning sets the primary tone for the design. The remaining colour categories may be used to temper or modulate that central meaning.

The second phase of colour design happens after IDEATION, where inspiration and imagination have brought forth a design concept and it is time to once again consider the matter of colour. It is during the EXPERIMENTATION phase that colour combinations and colour interaction come into play. The designer proposes a scheme, mocks it up, evaluates it, then makes changes based on the specific assessment of "too much ___", "too little ___", or the general observation such as "too intense" or "too bland"; this part of the process is intuitive, subjective, the designer is the judge of what is or isn't working, and this is as it should be because it introduces the designer's unique point of view. Many different options may be tested; in our compass and map analogy, there are many routes one can map out in order to go "north", for example. One designer may take the highway and another the back roads, and both will arrive at the destination eventually, even if their designs are executed using different hues. This is a major advantage of the Colour Compass; making value and chroma decisions does not restrict the designer's creativity, it simply focuses it. It is the application of evidence-based colour reasoning at the INTERPRETATION stage of the colour design process that frees up the designer to be confidently creative in the EXPERIMENTATION stage which follows.

Conclusions

Many colour professionals have succeeded in their craft despite lacking a systematic colour design process; a sensitivity to colour, honed by a lifetime of experience, can take a person far in this field. But there are also talented designers with underdeveloped colour know-how who could also succeed (and more quickly) with colour if they had access to thinking tools such as the Colour Compass. This tool is based upon evidence that Colour Meaning is more consistent when interpreted though the lens of value and chroma rather than hue. This is not to say that hue does not play a role; it most certainly does, but in the context of how people respond to colour, the role of hue is secondary. This way of thinking has only recently begun to take root in colour education, and it will take some time for the prevailing Hue Paradigm to loosen its hold over the collective psyche; it has very deep roots that have developed over its long history. The first step in any major change is to acknowledge that there is a problem, and this void in colour design education has been largely overlooked by architectural professionals who are most deeply affected by it. Change takes time, and bringing evidence-based thinking into the design process as early as kindergarten is a stated goal of the Colour Literacy project. In the meantime, there is nothing stopping individual designers and instructors from using the knowledge that has already begun to emerge with regard to Colour Meaning and its role in design. As this knowledge is integrated into the design process across all the creative fields, colour meaning may naturally morph into an intuitive language of colour that will require no teaching at all. Until then, tools such as the Colour Compass can help point the way forward.

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