Weaving the senses: Learning about color through sound and taste

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Abstract

Recent studies suggest that value and chroma, more so than hue, are what dictate the connection between color and the feelings they evoke and can be explained using Pleasure-Arousal-Dominance (PAD) Theory. As a practical matter, though, lecturing students on PAD Theory may be less efficient than offering them opportunities to discover the dynamic on their own through observation and activities that engage more than just their cognitive faculties. Studies on cross-modal correspondences (CMC), seemingly innate connections between the senses, may facilitate the learning process. The correspondences between color and sound, for example, may enable students to approach the study of color through music or everyday sounds. Although the CMC are less pronounced between taste and color, this sense may also be useful in understanding the process of design where the choice of color "ingredients" and their proportions can create very different types of experiences, just as they can with food. Letting students explore color though other senses, not just vision, opens endless opportunities for creative engagement in design projects that may deepen their understanding of how people feel about color.

Keywords: *Colour Education, Colour Psychology, Design*

Introduction

People are often surprised to learn that most design programs do not have a formal color curriculum, and if they do, it is inconsistent and so limited in scope that it fails to provide designers with the knowledge they need to work with color in a meaningful way (Calvo Ivanovic, 2022). While there are many books on the topic of color, most are either too general or too specific to be much help in the designer's particular field. A formal body of knowledge on the subject of colour as it pertains to design simply does not exist, although the strides already made by the AIC/ISCC Colour Literacy Project promise to change that in the future.

When it comes to color psychology, the topic of this article, there is even less solid information to guide designers in the use of color. In recent years there has been a shift away from traditional thinking about color where hues are the drivers of emotion to an understanding that it is value and chroma that elicit more consistent emotional responses from people. Valdez & Mehrabian (1994) research found this almost thirty years ago, but it has only been in the last decade that

other researchers have begun to notice this dynamic, too (Gao et al, 2007; Dael et al, 2016; Bartram et al, 2017; Jonaskaite et al, 2019; Divers, 2020). Valdez and Mehrabian studied color using Pleasure-Arousal-Dominance (PAD) Theory and found that Dominance (high or low sense of personal control) correlated with the value dimensions of color, that is, low value (dark colors) are associated with low dominance. They also found that Arousal (high or low excitability) correlated with high and low chroma, respectively. Divers (2020) echoes this finding noting that subject descriptions of dark colors, pale colors and vivid color sets were qualitatively very different from each other, e.g., dark colors are serious/hard/mature/strong, pale colors are cheerful/soft/young/delicate, vivid colors are energetic/friendly/cheerful/intense. This approach to understanding the psychology of color is intuitive, yet explaining PAD Theory to undergraduates requires time that is already in short supply in an already packed design curriculum. This article explores ways to awaken this "color intuition" by recruiting other senses: sound and taste.

In his article on multisensory approaches to architectural education, Monshisade (2016) makes the observation that these programs have become "oculo-centric", that is, completely reliant on the sense of vision for the design process, and he argues in favor of engaging the other senses in the process. Although the psychology of color begins with the visual sense, once it reaches the brain, the experience of color evokes feelings in the body and associated thoughts which go beyond our sense of sight. Everyday expressions such as "loud colors" or "sharp flavors" make it apparent that people naturally experience the world through more than one sense at a time, which is not surprising considering that the environment *itself* is a multisensory experience. Establishing links between the senses is a very efficient way to process all the information the brain receives at one time. There exist some specific and well researched links known as cross-modal correspondences (CMC), and leveraging those connections, specifically between color and sound and color and taste, may help deepen (and hasten) learning about color psychology.

Associations, synesthesia and cross-modal correspondence

It seems that humans naturally pair things together and associations people have between colors and objects (or ideas) are well documented. They are often based upon the color of the actual object and one of its properties, are contextual (we like blue skies, but not blue meat) and they influence our preferences (Schloss & Palmer, 2017). That type of pairing is very common in the general population. Another type of pairing which affects about five percent of the population is known as synesthesia where a person automatically and involuntarily experiences two senses simultaneously, e.g., "blue smell". Although this fascinating phenomenon has garnered both research and media attention, its nature and low incidence makes it unsuited to the task of teaching a typical student about color. However, there is a third type of sensory combination known as cross-modal correspondence (CMC) which involves the pairing of

attributes of two senses (as opposed to the senses themselves as happens in synesthesia). These are not involuntary as in synesthesia, and the meanings are shared by a large number of people (Cluskey et al, 2019). In his tutorial on CMCs, Spence (2011) explains that the integration of two senses is most likely to occur when they are presented at the same time, space and/or are semantically congruent, i.e., share a similar meaning, and that the presence of one or more of these strengthens the correspondence. Although most research has focused on auditory and visual stimuli, there is evidence of correspondences in taste-sound, color-texture, pitch-smell, pitch-visual elevation, taste-sound and others. The standard method of studying CMCs typically involves a speeded classification task, i.e., asking subjects to quickly complete a task involving one sense (e.g., light and dark colors) and then introducing a stimulus from the other sense (e.g., high or low pitch sound). If the stimulus is congruent with the color, response is faster and possibly more accurate; if incongruent, response time is slower and possibly less accurate. Spence goes on to say that these correspondences can be linguistically mediated, thus even just saying the words "high" and "low", as opposed to presenting the stimulus, is sufficient to elicit the response.

Sound-Color

One of the strongest and most well-researched correspondences is between pitch and brightness (bright vs dim); pitch and lightness (white vs black) have been studied as well (Zeljko et al, 2019). Examples of high pitch (high frequency) sounds include the chirp of a bird, or the sound of a piccolo; low pitch (low frequency) sound examples are a truck's rumble or the sound of a tuba. These correspondences are dimensional, they run on a low/high continuum just as do value and chroma, so they may be overlayed on a value-chroma chart (Figure 1). Simply put, the lighter the color, the higher the pitch associated with it, and the darker the color, the lower the pitch. There is also evidence that *loudness* of sound corresponds with both value and chroma (Marks, 1997; Caivano, 1994; Anikin & Johansson, 2019) which is not surprising since high pitches are sometimes perceived to be louder than lower pitches even if they are not. When we connect these sensory experiences (pitch with value and loudness with chroma), it is a short jump to connect the sound of a tuba, dark colors and words such as serious/strong/hard/ with low Dominance (personal control). Similarly, the sound of a pipe organ, vivid colors and words such as energetic/cheerful/intense are associated with high Arousal (excitability).
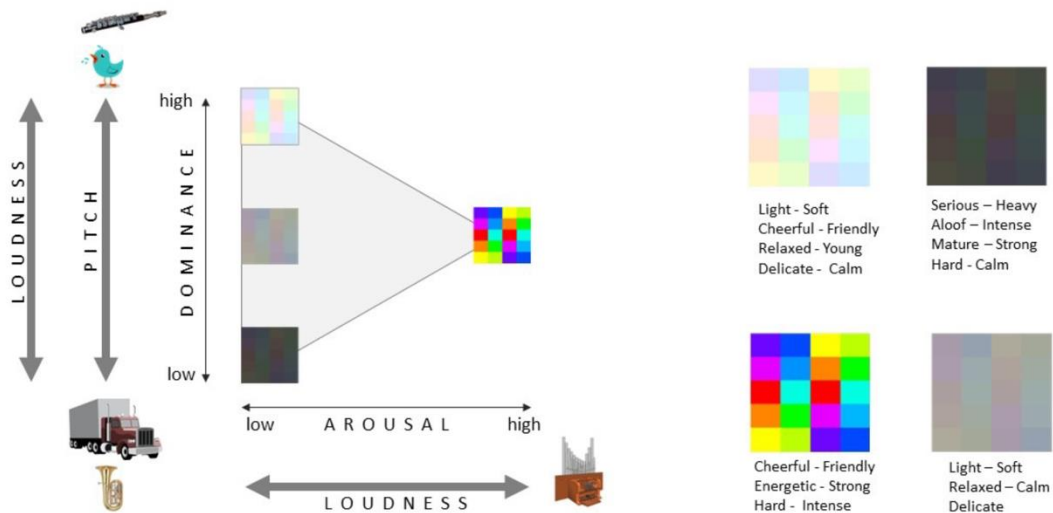
Figure 1. Correspondences between color, dominance/arousal, pitch, loudness, and language.

These findings open the door for students to explore color via their own auditory experiences, which makes learning both fun and relevant. The instructor can introduce pitch, for instance, by playing a sound and informally polling students about which color category (dark, pale, muted, vivid) best matches it. An exercise to reinforce these connections could be for students to collect sounds (instruments, animals, machines, etc.) and combine them with color categories and language to create a digital sound/color/feeling "collage". Or they can freeform a line that depicts the pitch and rhythmic elements from a passage from a favorite musical selection and then apply color in a way that is consistent with the research, e.g., higher pitches being lighter, lower pitches darker, and louder portions increasing in chroma. Hue choices are at the student's discretion. These exercises are springboards for applying color in their class design projects. Having articulated that dark colors and low sounds feel heavy (or that vivid colors are loud, or that light colors are soft), for example, they can experiment with altering the proportion of dark (or vivid, or pale) colors in a visual composition and observe the shifts in emotional tone. In a follow-up exercise they may then notice how the feeling of a composition changes when the proportions are kept constant, but the colors (e.g., dark/light, muted/vivid) are reversed. These exercises involve multiple iterations and retaining this process work will provide a record of their own progress in understanding these color nuances. Comparing projects with other students will demonstrate that these correspondences, these meanings, are shared by most people. Neither the teacher nor the student needs to understand PAD Theory in order to connect the feelings/sensations conveyed by color. And if they are curious to explore PAD Theory, they will understand it

immediately having already "felt" the meanings that shifts in value and chroma impart.

Taste-color

Most of the research on the connection between taste and color not surprisingly comes from the fields of food science and product marketing and has mostly focused on hue (Spence, 2019). We pick up flavor/color associations very early in life. A number of studies have found that dark colors are associated with bitter tastes, green and yellows with sour, white and blue with salty, pinks and reds with sweet (Spence et al, 2015). It is easy to see how people might form these associations from experiences with food, yet this is not especially useful to the design process. The cross-modal correspondences are weaker between taste and color, in part because they don't necessarily go both ways, a requirement for a CMC. In other words, a color paired with a food may influence how it tastes, but the taste of a food may not necessarily affect how a color appears. Similarly, the color of an ingredient does not necessarily predict its flavor (bananas and lemons are both yellow, but taste very different). Complicating matters further, a single food item, such as a banana, may be green, yellow or brown, depending on ripeness. Unlike sound-color correspondences which are dimensional (e.g., high pitch is bright, low pitch is dim), flavors are basically distinct categories of taste (bitter, sweet, sour, fat, pungent, salty, bland) and it is precisely this aspect of taste that makes the process of designing a dish analogous to designing with color: like flavors, colors (dark, pale, muted and vivid) each have a unique character.

There are two lessons we can glean from the culinary world. The first is that food preparation and color design entail using more than one ingredient/color, and that ingredient/color proportions will vary in order to create different taste or color experiences. When preparing kale, for instance, which is often bitter, the chef will temper the dish with smaller amounts of the other flavors (sweet, sour, etc.). How much to use of each of these depends on the chef's understanding of flavor profiles. Similarly, in design it is a common practice to define dominant, subdominant and accent colors in a palette, but to do this successfully the designer needs to understand color "character" profiles. Fortunately, the sound-vision correspondences discussed earlier are one way to gain that understanding.

The second lesson in this taste-color analogy is the fact that each flavor category is represented by more than one ingredient. For example, if a sour flavor is needed and there is no vinegar, it is acceptable to substitute lime juice instead-- that may alter the flavor some, but not so much that it changes the overall experience of the dish. In the same way, a designer can experiment with the hues within a color category without dramatically altering the fundamental character of the design. For instance, when designing a calm restful space, as long as chroma is low, this mood can be achieved using a pale orange, pale green, pale blue, etc. This is a critical distinction between the current view of color

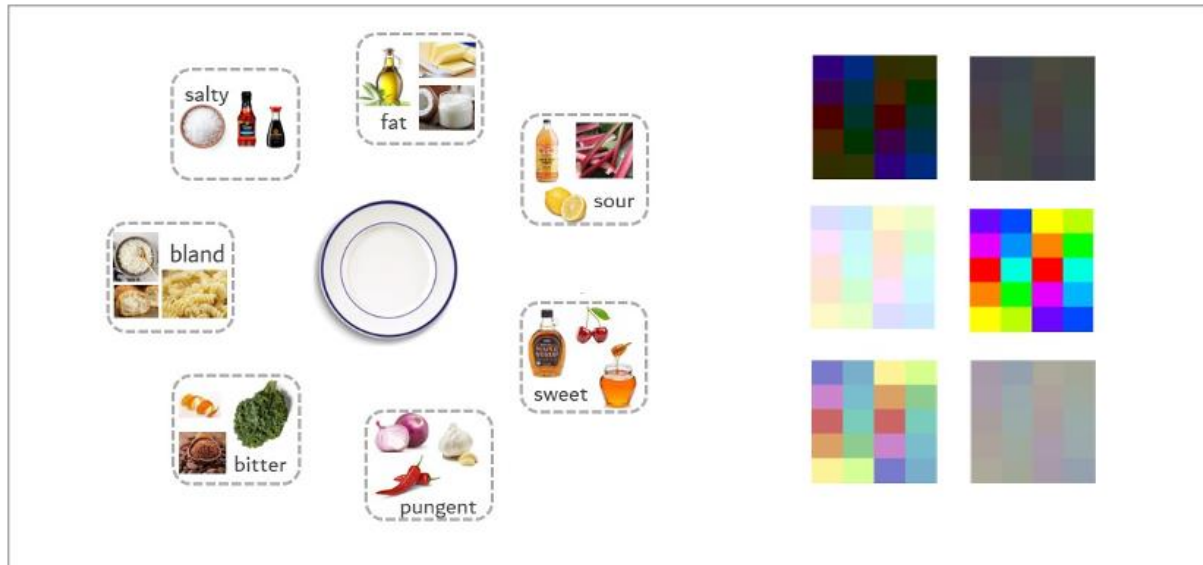and emotion as compared to how it was viewed previously, through the lens of the hues.

Figure 2. Flavor categories represent a variety of ingredients with a similar taste. Color Categories include all the hues within a similar range of value and chroma. Chefs/designers can choose ingredients/colors which may modulate a dish/design without fundamentally changing it.

Although younger students may not yet have sufficient experience as "foodies", they can begin cultivating their sensitivity to flavor by testing recipes and watching cooking shows. They notice that flavors can be complex or simple, and they learn that they can make substitutions within a flavor profile without appreciably affecting the final result. Then they can apply a culinary mindset to a design project where the ingredients are the color categories; they begin by defining the most salient emotional quality drawing on language they have internalized from sound-color exercise or other activity, e.g., "strong" (dark colors). Then they choose complementary color categories for secondary and accent colors, e.g., "relaxed" (muted or pale) and "friendly" (vivid) that develop the nuances in the design. Taking this approach will raise their awareness of the fact that just as an enjoyable meal depends on the careful balancing of flavors in a dish, a successful design involves balancing dark, pale, muted and vivid colors rather than limiting the design to a single category, which runs the risk of being too intense or even boring.

Conclusion

Most humans have innate connections between the senses even if they may be unaware of them. Exposing inexperienced designers to the character of dark, pale, muted and vivid colors by exploring correspondences in sound and taste has the potential to help them access shared connections and strengthen their ability to manage color successfully.

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