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## Special Collection: Color and Emotion

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Most people have direct, intimate, persistent, and pervasive experiences with both color and emotion. We appreciate color in nature and art <sup>1</sup>. We use color to make decisions (e.g., choosing paint for our walls, determining the ripeness of fruit at the grocery store), and we communicate information with color (e.g., interpreting stoplights and financial trends) <sup>2</sup>. Likewise, we know when we experience emotion (we can ‘feel’ it when we are happy), and we can see when others are experiencing emotion (we might infer that a shouting person is angry) <sup>3,4</sup>. Emotions often guide behavior, as we make choices expected to make us (or those around us) feel happy or lessen sadness. Importantly, these two seemingly unrelated entities – colors and emotions – have a robust connection.

The topic ‘color and emotion’, broadly endeavoring to uncover links between the two phenomena, has a long scholarly history. Aristotle posited that colors had affective powers, some being a source of pleasure and delight and others being a source of pain (e.g., brilliant colors) <sup>5</sup>. Johann Wolfgang von Goethe described his Theory of Colors in 1810 <sup>6</sup>, whereby affective properties were assigned to colors. For example, Goethe considered yellow to be agreeable and gladdening, red to convey an impression of gravity and dignity, and blue to connote excitement or repose.

In current times, there remains substantial public interest in understanding how colors might be used to shape emotional experiences. For instance, one can frequently read how to employ color to regulate emotion in fashion, décor, and design. Sometimes, colors are purported to modulate physiology, such as changes in heart rate, perspiration, or respiration patterns. Despite the vast public interest and extent of popular beliefs, there is a relative dearth of empirical evidence in this domain. Thus, popular claims and intuitions about emotional correspondence with color should be considered with caution until sufficient scientific evidence has been collected <sup>7</sup>.

Fortunately, empirical work in this area has been gradually accumulating. Among others, studies have linked color with cognitive representations of emotion <sup>8–11</sup>, facial and bodily expression of emotion <sup>12–16</sup>, and emotion experiences <sup>17–19</sup>, while also considering these across diverse cultural groups <sup>11,20,21</sup>. Research has revealed systematic inter-connections between dimensions of color and dimensions of emotion, that is, by linking hue, saturation, and lightness with valence, arousal, and dominance <sup>18,20,22–24</sup>. Research has also identified a mechanistic role of emotion, such that emotion associations can explain color preferences<sup>25</sup> as well as cross-modal color correspondences <sup>26,27</sup>. Given the recent uptick in both empirical and popular interest, it is expected (and encouraged) that more and more researchers will be motivated to pursue related work to bolster our knowledge in this area.

Yet, researchers beginning their study in the domain of either color or emotion (independently), may be surprised, or even overwhelmed, to learn of the complex empirical and technical challenges in each of these fields. Such challenges are exacerbated when endeavoring to study color and emotion jointly. It is our hope that calling for increased interdisciplinary collaboration between color-centric and emotion-centric researchers will foster advances in the joint research topic of ‘color and emotion’.

Advances in any research area necessitate precise conceptual and operational definition of the phenomenon being studied. The readership of *Color Research and Application* is likely familiar with the myriad complexities surrounding definitions of ‘color’. One might describe color in terms of spectra varying continuously as a function of wavelength; as triplets or locations among discrete notation systems and color spaces (e.g., NCS, Munsell, XYZ, LAB, LCH, LUV, RGB, HSL); or perhaps as discrete labels (e.g., hue categories, basic color terms) <sup>28,29</sup>, since the latter reflect how most people normally conceptualize and communicate about their color experiences. All of these approaches have merits and limitations, and so every researcher’s decision will have important implications for research methodology, statistical analysis, inference, and application.

The same readership may be less familiar with the nuances surrounding definitions of ‘emotion’, which, like color, can be incredibly challenging. All humans experience, convey, and communicate about emotion. Despite, or perhaps owing to, our everyday experiences of emotion, it might be surprising that ‘emotion’ eludes a clear consensus scientific definition<sup>3,30–32</sup>. Instead, there exists a continuum of perspectives regarding the nature of emotion, each of which shaping how it might be studied<sup>33,34</sup>. For instance, some argue that emotions comprise basic, discrete states with unique and culturally universal physiological indicators<sup>35,36</sup>. Others hold that emotions are socially and psychologically constructed, emerging from flexible adaptive processes, which are not unique from other mental states and are shaped by context<sup>37,38</sup>. Some others suggest that emotions are best understood as episodes of “interrelated, synchronized changes in the state of (...) organismic subsystems in response to the evaluation of an external or internal stimulus event as relevant” (p. 697)<sup>3</sup>. These subsystems, namely, cognition, motivation, motor expression, neurophysiology, and subjective feeling, can be studied individually or in combination. Like color, perhaps emotion is usefully described using basic terminology (e.g., *anger*, *sadness*, *disgust*) to align with how people typically conceptualize and communicate about their emotional experiences, even though these descriptors may be imprecise or incomplete with respect to the nature of emotion<sup>32</sup>. Or perhaps, also like color, emotion could be more precisely described along continuous underlying dimensional components, like valence, arousal, dominance, and/or novelty<sup>39</sup>.

There exist other affective processes, states, and traits that are considered related to, but fundamentally distinct from emotion<sup>3</sup>. Examples include but are not limited to preferences (e.g., liking/disliking), moods (e.g., feeling down, feeling uplifted), affective predispositions (e.g., extroversion, neuroticism) or affective disorders (e.g., depression, anxiety). While such broader affective phenomena can also be linked to color (e.g., see refs<sup>25,40–44</sup>), they are not strictly considered ‘emotions’. To further scientific advancement in the field of ‘color and emotion’, it becomes paramount to make distinctions among the affective phenomena being studied.

Thus, this Special Collection aims to report the latest research that advances scientific knowledge and theory regarding the interplay between color perception, color cognition, and emotional processes. Topics considered for this special collection might include, but are not limited to, conceptual correspondences between color and emotion, the effects of perceiving color on emotion processes, and the application of color toward enhancing emotion-regulation, well-being, or emotive communication. We particularly welcome submissions that aim to elucidate mechanisms driving color-emotion correspondences, which we expect can meaningfully inform research and application beyond descriptive work.

Clearly, there are numerous ways to conceptualize and operationalize ‘color’ as well as ‘emotion’. Here, we do not endorse any one specific definition. Rather, it is key that researchers choose approaches that align with their particular research questions. At the same time, to advance research and theory, to increase reproducibility, and to ease inter-disciplinary communication and collaboration, we encourage authors to be precise in their definitions of color as well as emotion. This concerns both how they are implemented as well as how these might inform or preclude inferences for other related work. We invite prospective authors to particularly attend to the following aspects:

- Precise descriptions about how color information is measured, displayed, or otherwise conveyed, with particular attention to scientific reproducibility.
- Explicit descriptions regarding decisions about color operationalization (e.g., choices to employ specific color models, spaces, and metrics) and how these are justified by the particular research questions.
- Explicit conceptualization and operationalization of emotion, ideally by grounding the work using existing contemporary emotion perspectives.

- Precise definitions of the phenomena being studied (e.g., do the current methods address abstract color-emotion correspondences, emotion experiences, preferences, or other affective processes?).

We are hopeful that this Special Collection on Color and Emotion in *Color Research and Application* will promote interdisciplinary cross-talk and collaboration. We expect that through such collaborative efforts we will be able to better understand how color and emotion are interconnected, and work toward satiating the great public interest in this area with renewed empirical evidence. The call for this Special Collection is currently open and ongoing, meaning that manuscripts may be submitted at any time. Accepted peer-reviewed articles will be immediately included in the Special Collection.

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