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The Study of the Potential for Positive and Negative Color Connotation Through Associations

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The Study of the Potential for Positive and Negative Color Connotation Through Associations

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Abstract

This project explored word associations with colors and shades of colors in a controlled manner to test the hypothesis that people associate negative descriptor and emotion words with darker shades and colors and positive descriptor and emotion words with lighter shades and colors. Two parts were completed. In the first, participants saw 8 colors in 3 different shades for a total of 24 colors presented, one at a time. In a first round of trials, participants were instructed to give the first three words that came to mind when they saw each color. In a second set of trials, participants were instructed to give the first three emotion words that came to mind when they saw each color. In the second part of the study, the words gathered from the first part were presented to a new set of participants who ranked the three-word sets on a scale that ranged from negative to neutral to positive. A main effect of color was found, such that brighter colors yielded word sets judged to be more positive. A main effect of shade was also found, such that the lighter colors yielded word sets judged to be more positive. This research provided an opportunity to discover how individuals' perceptions might affect association of colors in guidance with examination of general biases, the larger implication of skin color biases, and an additional route to studying where color biases originate and how expansive they may be.

Acknowledgements

I would first like to thank my research adviser, Dr. Jennifer Stevens, for providing support, believing in me, and encouraging me throughout the process of finalizing the project. It was her support and guidance that led me to continue in the research conducted for the purpose of completing a thesis rather than as an independent research project. I would also like to thank Dr. Bjorg Larson and Dr. Randolph Coleman for their commitment to being a part of my honors committee. I am, finally, incredibly grateful for the support of my friends and family members who listened without complaint as I talked about my research ad nauseam.

Introduction

People respond to color. This is true across a wide range of situations including food, interior design, and skin. Since color is critical in human interaction with the environment and is a main aspect of vision, it has a major impact on human perception of the world. Different colors draw attention in various ways and lead to emotional responses of like or dislike, which alter behavioral choices. Marketing research has specifically focused on color and the effects it can have on consumer practices (Martinson & Bukoski, 2005). Other studies have prioritized research on skin tone bias in the context of society with emphasis on the psychological impact (Abrams et al., 2020). However, studies do not focus on the relationship between positive and negative associations of color and shade using all of the primary colors of the visible light spectrum without regard to specific scenarios.

The present study adopts a unique approach to understanding color preference by examining reactions to colors within the context of color and color alone. The main objective of this work was to simply measure positive and negative word associations to colors. The implications of our findings may be significant. Namely, if positive or negative reactions to color exist in and of themselves, this would inform the origin point of the effects of color bias broadly defined. That is, if a negative bias against darker colors exists within the confines of color alone, might it be considered that color prejudice and bias exists at a basic, and not cultural, level? If this were shown to be the case, our results may inform the processing level at which strategies towards eliminating negative associations towards darker colors – including skin color– may be aimed.

While this study provides an assessment of descriptor and emotion associations to different colors and shades or colors, it cannot elucidate *when* or *why* these associations were

made. Nevertheless, the opportunity to examine descriptor words associated with colors offers an opportunity to gauge general positive and negative associations to colors, regardless of context, thereby providing another spoke in the wheel of understanding color perception in general.

Color Perception

There are various studies that have examined color perception through emotion associations and mood. Jonauskaite et al. found that there was a pattern in the choice of color that participants manipulated to experience a certain mood chose to then describe their mood. The researchers found that participants were more likely to match joy and relaxation to lighter shades while also being more likely to match sadness and fear to darker shades (2018). Additionally, Hanada attempted to understand the connection between color and emotions by comparing a two-dimensional color/hue circle and a two-dimensional emotion circle based on arousal and pleasant axes. The hypothesis was that the two circles would correspond significantly. While the hypothesis was rejected, the perceived temperature of colors and emotions seemed to be more related than the colors themselves (Hanada, 2017). There seems to be an unknown implicit connection between emotion and color that still requires more research.

The association of feelings with different colors can also vary, depending on cultural, personal, and situational factors. Common associations include ideas of love or passion with red or calmness and trust with blue (Güneş & Olguntürk, 2019). Yellow is often linked to happiness, optimism, cheerfulness, energy, and creativity (Hanada, 2017). A study compared color associations of participants from different three countries and six colors - red, orange, yellow, green, blue, and violet - to determine the effect of culture on associations. Participants from the United States, India, and the United Kingdom all significantly showed common associations of “stop” and “danger” with red. However, red was the only color to which there was a significant

common association between the countries (Sun & Vu, 2018). Though differences in associations with color are not entirely cultural, culture may impact what people associate with various colors.

It has also been shown that yellow is somewhat unique in what it is associated with. For example, studies have demonstrated that yellow can be associated with both happiness and disgust. The association of both positive and negative terms may be related to the hue of yellow. Yellow-green was shown to have a more negative association, while yellow-orange elicited a more positive association (Hanada, 2017). Another study found that people associated darker shades of yellow with the most negative connotation (Jonauskaite et al, 2018). Association with yellow seems to be unique in comparison to other colors.

Color in Context

It is known that people associate places with memories, smells, emotions, and the like. Colors and shades of interior spaces are often chosen with the purpose of increasing positive emotions that make the inhabitants feel comfortable. Specific colors and shades are also used in spaces as an attempt to influence human behavior (Lombana & Tonello, 2017). A study first published in 2019 examined emotional reactions to a 3D model living room in which they changed the color of the walls and all other surfaces of the living room being kept a shade of gray. The colors tested on the walls were red, green, blue, and gray, with gray being treated as a neutral and control color. Participants were asked to match facial expressions that represented a neutral posture, anger, disgust, surprise, happiness, fear, and sadness. The findings of the research demonstrated that there was a significant difference in emotional associations to the rooms between all of the different colors. For example, the green room was more associated with positive emotions, and the red room was associated with seemingly conflicting emotions of

disgust and happiness (Güneş & Olguntürk, 2019). With color being the only altered variable in the model living rooms, the results show a definitive example of how color affects emotions in a real-world situation.

Another study focusing on color in the context of direct real-world applications examined implicit bias on the basis of skin complexion in first-year medical students. The study sought to discover if an implicit bias training program developed by the researchers decreased implicit bias. The Harvard Implicit Association Test for Skin Tone and an implicit bias questionnaire were used to determine if the participating medical students demonstrated implicit bias at the beginning and end of the study to assess initial bias and changes in bias. A control group did not participate in the training program and only participated in the assessments, while the experimental group filled out a third questionnaire at the end on the value of the training program. All of the medical students demonstrated bias in favor of lighter skin both at the initial implicit bias assessment and the final assessment, regardless of participation in the training program. Though there did appear to be a decrease in implicit bias in the experimental group compared to the control, the results were not significant (Ruben & Saks, 2020). This shows that skin color bias, a form of bias due to associations of different shades of the same color, persists despite a change in cultural training and may be based on a more inherent factor than societal norms or life experiences.

The Present Study

The present study approaches our understanding of color preference by examining reactions to colors within the context of color and color alone. The main objective was to measure positive and negative word associations to colors. Seven standard colors (red, orange, yellow, green, blue, indigo, and violet), as well as the color white, were presented to participants

in three shades: pastel, medium, and deep. For example, the medium value of white was gray and the deep value was black while the medium value for red was pink and the deep value was burgundy. In terms of word associations, there were two blocks of trials. In the first block, participants generated the first three words that came to mind. In the second block, participants were asked to give the first three emotion words that came to mind. Then, in a second part of the study, the word sets were given to a new set of participants who ranked the words on a negative to positive scale. We hypothesized that lighter colors and lighter shades of colors would yield word sets that would then be judged to be more positive.

Methods

Phase One Survey

Online surveys were created using Qualtrics to discover participants' responses to certain colors and shades of those colors. Two different surveying phases were used during the data collection process. The first phase consisted of a survey in which participants were asked to list the first three words that were thought of into an empty text box when viewing a specific color displayed in a box on the screen. In part one of the survey, participants were requested to enter the first three words that were thought of. Participants were then asked to enter the first three emotion words that were thought of in part two of the survey. Participants could input any words that they wanted to and were not limited by characters or to a list of pre-chosen words. A total of twenty-five colors and shades were shown in the survey when asking for the first three words that the answering participant thought of with one of those colors being a test color. All of the colors and shades from part one of the survey, except for the test color, were then shown in the second part of the survey when asking for the first three emotion words that came to mind.

The colors displayed in the survey were chosen so that there were a total of three shades and eight monochromatic color schemes by design. The monochromatic color schemes were chosen based on the accepted main colors of the visible light spectrum and included grayscale, red, orange, yellow, green, blue, indigo, and violet. Each monochromatic color scheme encompassed a deeper, darker saturation, an average (or medium) saturation, and a lighter saturation to constitute three different shades. All of the shading was done in the same fashion so that the amount of saturation was equal across all of the unique monochromatic color schemes for each of the color shades.

Phase Two Survey

Phase two of surveying participants involved asking the subjects to describe what was the overall connotation of three words given to them as displayed in each question on the online survey. A second survey was written that limited the responses of participants to moving a slider on a scale that offered a range of negative to positive. The labels of the scale were the following: negative, somewhat negative, neutral, somewhat positive, and positive. The slider was automatically set to the far negative side instead of in the neutral position in an attempt to encourage participants to move the slider instead of allowing it to remain in a neutral position. The three words shown to participants in the second survey were the responses given by participants who completed the first survey from phase one. The second survey was written to aid in the determination of overall perception towards certain colors with the goal of limiting the bias that could potentially occur if only one individual were making the same determination from the first survey.

There were a total of eight different surveys in the phase two surveying process in order to prevent participants becoming fatigued and that fatigue impacting the results. Half of the eight surveys were devoted to determining the connotation of the "first three words" which were responses from the phase one survey participants, and the other half to determining the connotation of the "first three emotion words" responses from those same phase one participants. Each of the surveys contained either the "first three words" or the "first three emotion words" of the responses from a different set of twenty of the eighty total phase one participants. The purpose of the phase two surveys was to turn the qualitative data of phase one into quantitative data by assigning an association score with zero being the lowest and most negative and 100 being the highest and most positive.

Survey Verification

Each of the surveys were reviewed by an independent individual prior to being made available to participants through SONA. The reviewers were undergraduate students who were unrelated to the study. They were responsible for checking the surveys for errors and the readability to ensure that the surveys and directions could be easily understood. Reviewers were also asked to offer an estimated time to complete the survey to verify that participants would not experience testing fatigue. The surveys were designed to take approximately thirty minutes to complete, and the reviewers confirmed that to be the case.

Participants

Survey participants were obtained using the William & Mary Psychology Research Participation System through SONA. The population of participants were undergraduate students enrolled in PSYC 201/202 at the College of William & Mary. Students in the system were able to

self-select themselves for the research and volunteered to take the survey for credit. The participants were not required to take the survey and could stop at any time if they did not wish to proceed for any reason. An overall total of 301 students were surveyed throughout the entire study. A total of eighty participant survey responses were used for phase one of the surveying. A total of two hundred participant responses were accepted for phase two of the surveying process.

Response Verification

The original goal was to use eighty responses for phase one of the survey process and twenty-five responses for each of the phase two surveys. To meet that goal, there needed to be two hundred eighty total viable responses across both phases. The exact number of participants needed were listed upon initial release of each survey. When all of the participants were not obtained during the initial release due to incomplete surveys or responses being deemed invalid, surveys were re-opened until the number of viable responses were filled. Responses were deemed invalid when answers given to the phase one survey were not recognized words. Words were considered unrecognized if they could not be defined or if they could not be understood by reviewers or phase two participants. All recognized words that could be defined were accepted, even if the offered words were not commonly associated with emotion words for the “first three emotion words” part two of phase one.

Statistical Analysis

The data was cleaned and analyzed in Microsoft Excel, then IBM SPSS. The incomplete survey responses from phase two were removed from the data and the association score averages were calculated across scores given for the same three words. The data was also organized so

that the association score averages were grouped in columns and rows according to which phase one participant and color/shade the score average referred to. The SPSS generalized linear model with repeated measures and the Bonferroni post hoc test was used to analyze the differences between colors based on the association scores and the difference between shades based on the association scores.

Results

First Three Words

There were significant results between some of the colors after analyzing the data for the condition in which participants were asked to respond with the first three words that came to mind. Of the monochromatic color schemes, the grayscale had the lowest average association score (M = 41.900, SD = 1.041). In contrast, indigo had the highest average association score (M = 66.369, SD = .992). The average association scores for the other colors generally increased following the pattern of the visible light spectrum, from red to violet. All of the average association scores can be found in Table 1. A repeated measures ANOVA revealed a main effect of color, $F(7,73) = 63.358$, $p < .001$. Pairwise comparisons revealed significance between the grayscale versus all other colors ($p < .001$). The colors red, orange, and yellow were not statistically significantly different compared to each other, but each were statistically different from the other colors. Blue and indigo were significantly different from each other ($p < 0.05$, $p = 0.018$); however, blue and indigo were not statistically significantly different from green and violet. The average associations of the colors is graphed in Figure 1. The dip in positivity ratings for the color yellow is notable as it deviates from the overall linear trend from neutral and red to indigo.

The association scores of shade were evaluated separately from color. The deep shade had the lowest average association score (M = 48.709, SD = .835), followed by the medium shade (M = 58.084, SD = .849), and the light shade had the highest average association score (M = 63.635, SD = .825). The means and standard deviations of association by shade can be found in Table 2. Thus, there was also a main effect of shade demonstrated, F (2,78) = 112.551, $p < .001$. Pairwise comparisons revealed significant effects between all pairs ($p < 0.001$). Figure 2 depicts the average association scores of each color by shade to demonstrate the relationship between shade and association score.

Emotion Words

The results from the emotion word association with color also demonstrated significant results. As with the word association score, the grayscale had the lowest average emotion association score (M = 34.231, SD = 1.494). Green had the highest average association score (M = 61.401, SD = 1.693). The average emotion association scores for all of the tested colors can be seen in Table 3. The repeated measures ANOVA test demonstrated that there was a main effect of color on emotion word associations, F (7,73) = 28.665, $p < 0.001$. The pairwise comparison test once again showed that the grayscale was significantly different from all other colors. The colors red, orange, yellow, and blue were not significantly different compared to each other, but they all except for blue were significant to the other colors. Blue was only found to be significantly different from green ($p < 0.05$, $p = 0.015$) and the grayscale ($p < 0.001$). Green, indigo, and violet were not significantly different from each other, but were significantly different from the other colors. Here, again, there is a notable dip in positivity ratings for the color yellow. There is a smaller dip in positivity ratings for the color blue, as well.

The biggest difference in average emotion association score with regards to shade was between deep (M = 42.649, SD = 1.395) and light (M = 60.779, SD = 1.324), with medium between the two (M = 53.512, SD = 1.338). We found a main effect of shade on emotion association score, F (2,78) = 57.823, $p < 0.001$. Similar to the results of the word association scores, the pairwise comparison test or the emotion association scores indicated significance between all of the three shades ($p < 0.001$).

Discussion

It was originally hypothesized that darker shades as the result of greater color saturation would have a more negative association, while lighter shades would have a more positive association. Data analysis supported our hypothesis: there was a statistically significant difference of association between the shades or saturation of a color. There was also a statistically significant difference of association between colors with a demonstration of wavelength and association being negatively correlated. Overall, colors of shorter wavelength and lighter shading were perceived more positively. The results of this study reveal distinct and significant patterns of positivity ratings across the color spectrum. Specifically, white/gray/black and red scored lowest while indigo and violet scored highest. Moreover, the darker the the color shade, or saturation, the lower the ratings for word associations. The finding on shade may provide some indication that there is a bias against dark, regardless of color or context, including skin tone. Thus, bias against dark color tones may extend beyond the context of society. On this view, strategies towards eliminating bias against deeper color tones might be best aimed at levels more inclusive than skin color alone. In other words, color bias may be more tied to color in and of itself, and less related to skin tone per se. A critical question remains, however: does bias against dark color tones precede or result from bias against skin color?

Although the data set is comprehensive and the results are straightforward, there are several limitations to the present work. One potential limitation is that non-emotion words were accepted if included in responses as viable in the part two surveys from phase one. While the majority of words were emotion words, it is unknown how the inclusion of non-emotion words specifically affected the results of the association scores for colors and shades in regards to the emotion words-specific data. Future studies attempting to verify the results could offer a list of emotion words that participants are able to choose from to discourage participants from including non-emotion words when asked to only respond with emotion words.

Going forward, future research may benefit from including a broader variety of participants from various socioeconomic and racial backgrounds. The study was conducted with students from a primarily white university with a majority being Virginia residents. Some words with generational meaning were also offered as responses in phase one, such as “cap”, that could have different interpretations for participants in the second phase depending on their background. Having a participant group with broader age, racial, socioeconomic, and education ranges would allow for the ability of the results to be generalized to a greater population given that the College of William and Mary does attract a specific socioeconomic group.

Conclusions

The results of the study supported the original hypothesis that the darker saturation shades would be associated with more negative terms in comparison to the lighter saturation shades. There was a significant difference of associations between the different main colors and the saturation levels across all of the main colors. This evidence suggests that there is a difference in associations between both colors and shades. The findings also indicate that there may be a pattern of negative or positive associations based on light wavelength, that is an

increasingly positive association traveling along the visible light spectrum from red to violet. Further research should be conducted to determine whether the associations impact behavior, when and why color associations are developed, and explore more deeply into the relationship between light wavelength included in the visible light spectrum and associations.

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Appendix

Table 1.

Descriptive Statistics for Word Associations by Monochromatic Color Scheme

Color	*M*	*SD*
Grayscale	41.900	1.041
Red	50.954	1.068
Orange	54.798	1.123
Yellow	49.956	1.385
Green	62.851	1.189
Blue	62.311	.965
Indigo	66.369	.992
Violet	65.335	.888

Table 2.

Descriptive Statistics for Word Associations by Shade

Shade	*M*	*SD*
Light	63.635	.825
Medium	58.084	.849
Deep	48.709	.835

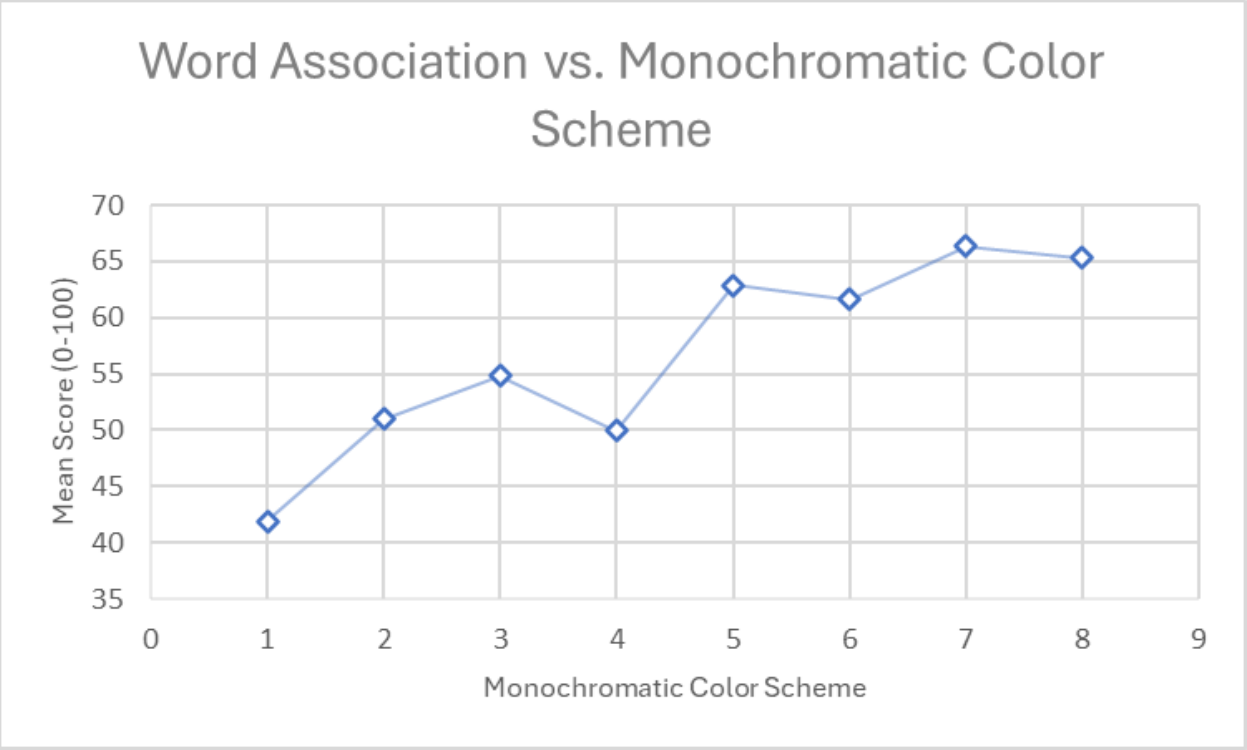
Table 3.

Descriptive Statistics for Word Associations by Monochromatic Color Scheme

Color	*M*	*SD*
Grayscale	34.231	1.494
Red	48.378	1.584
Orange	51.218	1.869
Yellow	49.324	1.633
Green	61.401	1.693
Blue	53.869	1.820
Indigo	59.914	1.709
Violet	60.173	1.820

Figure 1.

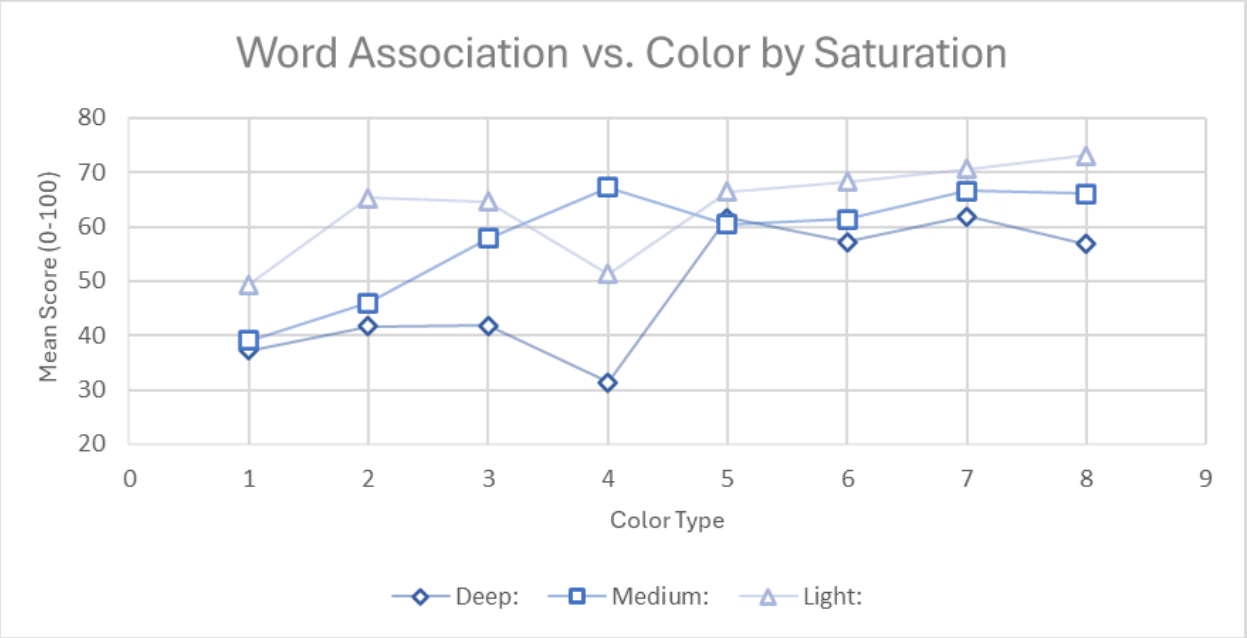
Scatterplot Comparing Association Scores and Color



Note. The score could range 0-100, with 0 being the most negative, 50 being neutral, and 100 being the most positive. For the color type, 1 = grayscale, 2 = red, 3 = orange, 4 = yellow, 5 = green, 6 = blue, 7 = indigo, 8 = violet.

Figure 2.

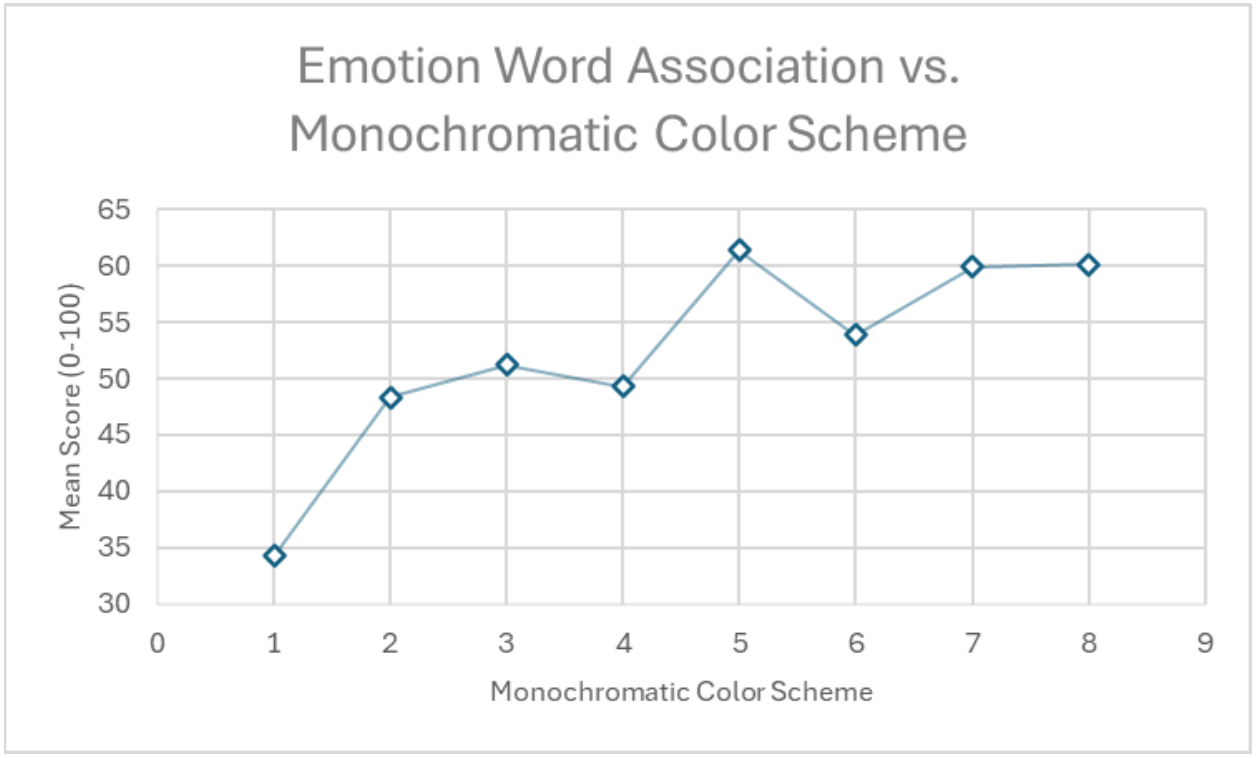
Scatterplot Comparing Association Scores and Color by Shade



Note. The association score could range 0-100, with 0 being the most negative, 50 being neutral, and 100 being the most positive. For the color type, 1 = grayscale, 2 = red, 3 = orange, 4 = yellow, 5 = green, 6 = blue, 7 = indigo, 8 = violet. The color types are separated into shades so that the relationship of association to both shade and color.

Figure 3.

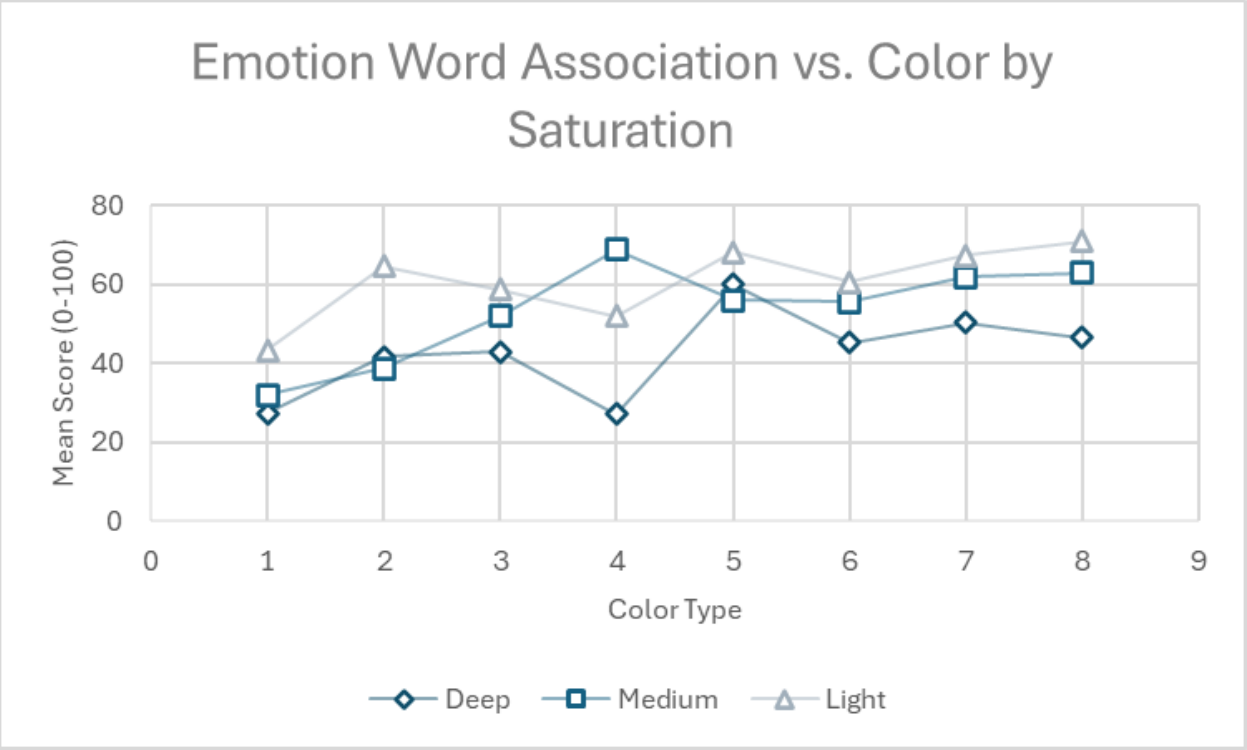
Scatterplot Comparing Emotion Association Scores and Color



Note. The score could range 0-100, with 0 being the most negative, 50 being neutral, and 100 being the most positive. For the color type, 1 = grayscale, 2 = red, 3 = orange, 4 = yellow, 5 = green, 6 = blue, 7 = indigo, 8 = violet.

Figure 4.

Scatterplot Comparing Emotion Association Scores and Color by Shade



Note. The association score could range 0-100, with 0 being the most negative, 50 being neutral, and 100 being the most positive. For the color type, 1 = grayscale, 2 = red, 3 = orange, 4 = yellow, 5 = green, 6 = blue, 7 = indigo, 8 = violet. The color types are separated into shades so that the relationship of association to both shade and color.