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THE COLOR OF MUSIC: CORRESPONDENCE THROUGH EMOTION

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ABSTRACT

College students listened to four song clips. Following each clip, the students indicated which color(s) corresponded to each of the four songs by distributing five points among eleven basic color names. Each song had previously been identified as either a "happy" or "sad" song. Each participant listened to two "happy" and two "sad" songs in random order. There was more agreement in color choice for the songs eliciting the same emotions than for songs eliciting different emotions. Brighter colors such as yellow, red, green, and blue were usually assigned to the happy songs and gray was usually assigned to the sad songs. It was concluded that music-color correspondences occur via the underlying emotion common to the two stimuli.

> Shades of colour, like those of sound, are of a much finer texture and awake in the soul emotions too fine to be expressed in words.
>
> Kandinsky, 1977/1914, p. 41

Synesthesia, or a mixing of the senses, occurs in some individuals. Synesthetes experience a perception in one sense when a stimulus for another sense is present (e.g., seeing a color when hearing a sound). This is what Martino and Marks (2001) call "strong synesthesia" as opposed to "weak synesthesia" which is the simple cross-sensory correspondences that most people experience [e.g., being

able to match a tone of a certain pitch to a light of a certain brightness (Marks, 1974, 1975)]. We will refer to people with "strong synesthesia" as synesthetes. We will not consider those with only "weak synesthesia" to be synesthetes since most individuals experience these correspondences.

It has been reported (Baron-Cohen, Burt, Smith-Laittan, Harrison, & Bolton, 1996) that approximately 1 in 2000 people have some type of strong synesthesia (usually perceiving color in response to hearing musical tones or seeing printed letters or numbers). The rates of strong synesthesia seem to be higher in artists than in the general population. Domino (1989) found that about one in three Fine Art students claim to have some form of strong synesthesia. It has been suggested (Ramachandran & Hubbard, 2005) that such links between the senses might make artists more creative. In fact, Domino found that students with synesthesia scored significantly higher in measures of creativity than students who were not synesthetes.

Many famous artists have been synesthetes and it has been an influence in their art (Day, 2005; Marks, 1984). One of the most common types of synesthesia is that of seeing color while listening to music or musical notes (e.g., Calkins, 1893; Karwoski & Odbert, 1938; Vernon, 1930; Whipple, 1900). The correspondence of certain colors with certain notes of the musical scale was proposed by Newton (1952/1730) in his book, *Opticks.* It has been reported that some artists with music-color synesthesia have used their experiences of cross-modal perception in the creation of their art [e.g., Rimsky-Korsakov and Sibelius (Day)]. An example of a synesthete using synesthesia in the production of his art is the composer Scriabin who wrote a composition, *Prometheus,* which was to be played along with a visual display produced by a color keyboard. The keyboard resulted in the projection of colors that he saw as corresponding systematically with the tones. Similarly, Kandinsky produced a musical drama in which colors and sounds were combined in a production entitled "The Yellow Sound" (Gerstner, 1986). In addition, he saw colors as corresponding to the sounds of different instruments and used those correspondences in his paintings (Kandinsky, 1977/1914).

The use of music-color correspondences by artists who are synesthetes might be appreciated by consumers of that art who are not (Marks, 1984). While most consumers of art are not synesthetes they may still experience cross-modal correspondences or weak synesthesia (Martino & Marks, 2001). Unlike an artist with synesthesia who actually sees a color when hearing music, a non-synesthete consumer of that artist's work might just have the feeling that the color and music "go together." Because strong and weak synesthesia are probably related phenomena (Marks, 1982; Martino & Marks; Ramachandran & Hubbard, 2005) the art that is produced by synesthetes, using the cross-modal correspondences they perceive, might nonetheless be appreciated by those who only feel that the stimuli from the two modalities correspond.

There is some evidence that people without synesthesia report correspondences between music and color. For example, Odbert, Karwoski, and Eckerson (1942)

asked subjects to "describe the color or colors experienced" when they listened to ten musical selections. The colors subjects chose for the musical selections varied with selection and choices were fairly consistent across subjects. So certain colors seemed to correspond with certain musical selections for people without synesthesia.

What determines which colors are chosen as corresponding with musical selections? We propose that the cause of the color experiences in strong synesthesia and the correspondences seen in weak synesthesia is the underlying emotion related to both the music and the color. There have been case studies of individuals with synesthesia who perceived colors in response to stimulation from another modality in which the colors they reported were clearly related to the emotion that is induced by the stimulus [e.g., music—(Calkins, 1893; Collins, 1929; Cutsforth, 1925) and people—(Riggs & Karwoski , 1934; Ward, 2004)]. Such an emotional connection through activation of the limbic system has been proposed as the cause for all strong synesthesia (Cytowic, 1989, 1997). More recently Ramachandran and Hubbard (2001) have suggested limbic connections in some cases of strong synesthesia. Possibly the correspondences seen between music and color in weak synesthesia are the result of such a connection as well (Collier, 1996; Marks, 1984; Odbert et al., 1942).

There is evidence for a stable connection of music with emotion across individuals who are not synesthetes. From a very young age we are able to distinguish between a "happy" song and a "sad" song (Dalla Bella, Peretz, Rousseau, & Gosselin, 2001). Even when we listen to a piece of music from another culture or in another language we can decode its emotional meaning (Balkwill & Thompson, 1999). Rigg (1937) found that 73% of college students agreed on the classification of 18 musical selections as sad or happy. In addition, music has a tremendous impact on our feelings (e.g., Smith & Noon, 1998). Herz's (1998) subjects reported that music had more of an impact on their emotional state than did odors. Music is capable of producing a physiological arousal, for instance, the chills you may feel listening to your favorite song (Rikard, 2004). The mood a song induces is so reliable that music is often used as a mood-inducer in psychological studies (e.g., Clark & Teasdale, 1985; Parrott & Sabini, 1990).

Like music, certain colors have also been linked to certain emotions (see, e.g., Collier, 1996). A general finding in many studies is that brighter colors are more likely to be associated with positive emotions and darker colors are more likely to be associated with negative emotions (Boyatzis & Varghese, 1994; Hemphill, 1996). Other studies have found more specific color-emotion correspondences. For example, Wexner (1954) found that particular sets of adjectives describing specific moods were closely associated with different colors, chosen from a display of eight colors (yellow, orange, red, purple, brown, blue, black, and green pieces of art paper). He found that the mood defined by the adjectives "cheerful, jovial, joyful" was associated with the color yellow significantly more often than it was with other colors. Also, the mood defined by the adjectives "despondent,

dejected, unhappy, melancholy" was associated with the colors brown and black significantly more often than with other colors. Likewise, Kaya and Epps (2004) found that the emotion word "happy" was associated most commonly with yellow, yellow-red, and blue-green. The emotion word "sad" was associated mostly with gray and black, and "boredom" was associated mostly with gray. Also, the emotion word "calmness" was mostly associated with the color blue. Similar results were found by Murray and Deabler (1957). Another study which identified specific color associations with the emotions "happy" and "sad" used both children and college students (Cimbalo, Beck, & Sendziak, 1978). Yellow, orange, and green were designated as happy colors and red, brown and black were sad for both groups of subjects.

So both music and colors have been found to be related to emotions in a consistent manner. In general it appears that positive emotions are associated with bright colors such as yellow, orange, green and blue and negative emotions are associated with dark colors such as black, gray, and brown. Certain musical selections also reliably elicit certain emotions. The question we address here is whether emotion links certain colors to certain musical selections. That is, do people connect sad songs with colors associated with negative affect and do they connect happy songs with colors associated with positive affect?

Odbert et al. (1942) found some evidence for music-color correspondences being the result of an emotional link. In their study people listened to 10 short song clips and were then asked to select a group of emotion-related adjectives that best fit each musical selection and to also indicate which color or colors they thought most appropriate for each musical selection. They found that people tended to have fairly good agreement about both the affective tone of the musical selections and what color(s) were appropriate to what songs. They later had the same participants report what colors they found appropriate to the groups of adjectives and found that people picked the same colors for the emotional adjectives as they had chosen for the music that elicited those emotions. This study suggests that music-color correspondences may have emotion as their source. However, the subjects assigned colors to the musical selections after they assigned emotional adjectives to those musical selections. This might have resulted in participants unconsciously assigning colors to the affective words they thought went with the music rather than the music itself or remembering what color and emotion went with each musical selection. The experimenters also did not pick music that they knew produced different moods. So although they found that subjects chose the color gray for the song they found as sad and the four primary colors (e.g., red, yellow, green, and blue) for the song they found to be "gay" or happy, we do not know if other sad songs or happy songs would elicit the same color responses.

The present research is an extension of the study by Odbert et al. (1942). It investigates whether music-color correspondences have their root in the emotion that both stimuli elicit. To do so, participants listened to song clips which had been, in a pilot study, rated as either "sad" or "happy" (two of each type). Following each

song clip, participants indicated which specific colors they associated with the clip. We expected the two "happy" songs to be associated with the four primary colors (as Odbert et al. found for their "gay" song) and the two "sad" songs to be associated with the color gray (as Odbert et al. found for their sad song).

METHODS

Participants

Participants were 20 female and seven male psychology student volunteers from the Montclair State University psychology department subject pool. The mean age of the participants was 20 years (range was 17-28 years).

Materials

A standard Apple brand I-pod music player was used to play the song clips. The song clips were played to the participants over a pair of Telephonics headphones, model TDH-50P (Farmingdale, NY).

Participants used a color-list data sheet as used by Gilbert, Martin, and Kemp (1996) (from Rader & Tellegen, 1987) to indicate which color(s) corresponded with each song clip. A different data sheet was used for each of the four songs used in the study. Each sheet consisted of a list of 11 basic color names (black, white, gray, pink, red, orange, yellow, blue, green, purple, and brown). Participants were asked to distribute five points across the eleven color names. Subjects were asked to report what colors they associated with each of the songs as they listened to them. This means that they reported the colors that came to mind when they listened to songs that induced certain emotions.

This technique, which was previously used by both Gilbert et al. (1996) and Rader and Tellegen (1987), was chosen rather than having participants select actual color chips for a number of reasons. First, as Odbert et al. (1942) and Rader and Tellegen report, many subjects experience color as some type of visual image when listening to music. In those subjects (almost 20% in Odbert et al.) seeing color chips might interfere with their response. This interference was confirmed by Rader and Tellegen who reported that participants in a pilot study using color chips found that seeing the actual colors was "intrusive and interfered with imagery production." We were afraid of the same problem if we used color chips rather than the list of color words. In addition, we were afraid that the colors themselves might induce moods which might interfere with the mood induced by the music. If the selection of colors for the songs is based on the mood induced by the song this might result in a great deal of confusion for the participant.

The color-word list technique has been demonstrated to be a reliable measure of stimulus-color correspondences (Gilbert et al., 1996). Our list of colors is the same list generated in the research on which the present study is based (Odbert

et al., 1942). The color-word list technique produced the same results as those found when participants were asked to select a color by selecting one of the 1,565 color chips from the *Munsell Book of Color* (Macbeth Division, Kollmorgen Instrument Corp., New Windsor, NY) and the *Supplementary 80-Hue Colors* in response to odors (Gilbert et al.). All these facts led to our selection of the color-word list technique for use in this study.

The song clips started at the beginning of each piece and were all approximately 90 s in length. They were *Morning Mood* (Grieg, 1997, track 4), *Ase's Death* (Grieg, 1997, track 5), *Pictures at an Exhibition* (Mussorgsky/Ravel, 1995, track 5), and *Adagio for Strings* (Barber, 1996, track 7). These songs were selected because in a pilot study both *Morning Mood* and *Pictures at an Exhibition* were rated as happy songs and *Ase's Death* and *Adagio for Strings* were rated as sad songs.

Procedure

After signing consent forms, participants were instructed that segments of four songs would be played for them. Participants sat at a table and, after receiving instructions on how to complete a color survey, were asked to put on the headphones. The four song clips were played to participants in random order. After each selection was played, participants were asked to assign 5 points among a list of 11 basic colors: purple, black, white, gray, red, orange, blue, pink, green, yellow, and brown. For example, for a given song, they could assign 1 point to each of five colors or 2 points to one color and 3 points to another color. After this task was completed they were asked to remove the headphones so further instructions could be explained clearly. They were then asked to rate each of the songs on three emotions, happy, sad, angry, on a scale of 0 (none) to 7 (extreme). Participants were told that an excerpt of each song would be played again until they remembered the song and were able to indicate the emotion that song conveyed. Each of the four song clips was then played back in the same order as the participants had previously heard them until the ratings were completed.

RESULTS

Friedman tests were conducted on the color point distributions for each musical selection in order to determine whether participants tended to assign points to particular colors for particular songs. One participant did not give color information for Grieg's *Ase's Death* and one participant did not give color information for Barber's *Adagio for Strings* and those data were eliminated from analysis. Friedman tests indicated that participants tended to assign more points to some colors than others for Grieg's *Ase's Death* (Friedman χ^2 (10) = 31.41, $p < .001$), Barber's *Adagio for Strings* (Friedman χ^2 (10) = 42.63, $p < .001$), Mussorgsky's *Pictures at an Exhibition* (Friedman χ^2 (10) = 38.47, $p < .001$), and

Grieg's *Morning Mood* (Friedman χ^2 (10) = 69.38, $p < .001$). Kendall's Coefficient of Concordance was computed on the set of four color point distributions for the four songs in order to determine if the pattern of color selection was the same across songs; its value was $W = .45$. However, when the two sad songs and the two happy songs were analyzed separately the Kendall *W*s were .78 and .86, respectively. This indicates that the agreement about colors was stronger for songs of a like mood.

Although the color selection varied somewhat between the two sad songs, the predominant color for the sad songs was gray (25% of the total points assigned for Grieg's *Ase's Death* and 28% for Barber's *Adagio for Strings*) (see Figures 1 and 2). The color selection also varied between the two happy songs; however, here too a few colors were predominantly chosen. For both songs the four predominant colors were red, yellow, green and blue. Mussorgsky's *Pictures at an Exhibition* elicited 21% red, 21% blue, 14% green, and 13% yellow. Grieg's *Morning Mood* elicited 27% green, 16% yellow, 14% blue, and 13% red (see Figures 3 and 4).

The participants' emotional ratings for each of the four songs were analyzed in order to determine if, like the participants in the pilot study, they found Grieg's *Ase's Death* and Barber's *Adagio for Strings* to be sad and Mussorgsky's *Pictures at an Exhibition* and Grieg's *Morning Mood* to be happy. Wilcoxon tests (all $p < .001$) showed that they judged Grieg's *Ase's Death* and Barber's *Adagio for Strings* as significantly more sad than either happy or angry and Mussorgsky's *Pictures at an Exhibition* and Grieg's *Morning Mood* as significantly more happy than either sad or angry. The mean sadness ratings for both Grieg's *Ase's Death* and Barber's *Adagio for Strings* were 5.3 and 5.2, respectively, on the 7-point scale and the mean happiness and angry ratings were less than 1.5. The mean happiness ratings for both Grieg's *Morning Mood* and Mussorgsky's *Pictures at an Exhibition* were 5.8 and 4.2, respectively, and the mean sadness and angry ratings were less than 1.5.

Some of the participants failed to judge the two "sad" songs as sad and the two "happy" songs as happy. When the data were reanalyzed using only the 19 subjects who correctly categorized all of the songs the results of the analyses were similar. Again the agreement of colors was stronger for songs of a like mood. Kendall's $W = .36$ for all four songs but .65 and .75 for the two sad and happy songs, respectively. While these results were similar to those using data for all participants, we were surprised to see a decrease rather than an increase in intersubject agreement and cannot explain it.

Comparing the results for the full set of participants with those for the 19 who correctly categorized the songs, the only difference in the pattern of color selection occurred for the two happy songs. This subgroup of 19 participants predominantly chose blue (23%), red (19%), and yellow (15%) for Mussorgsky's *Pictures at an Exhibition* and they predominantly chose green (27%), yellow (17%), red (13%), and orange(13%) for Grieg's *Morning Mood*. So, although the pattern was a bit

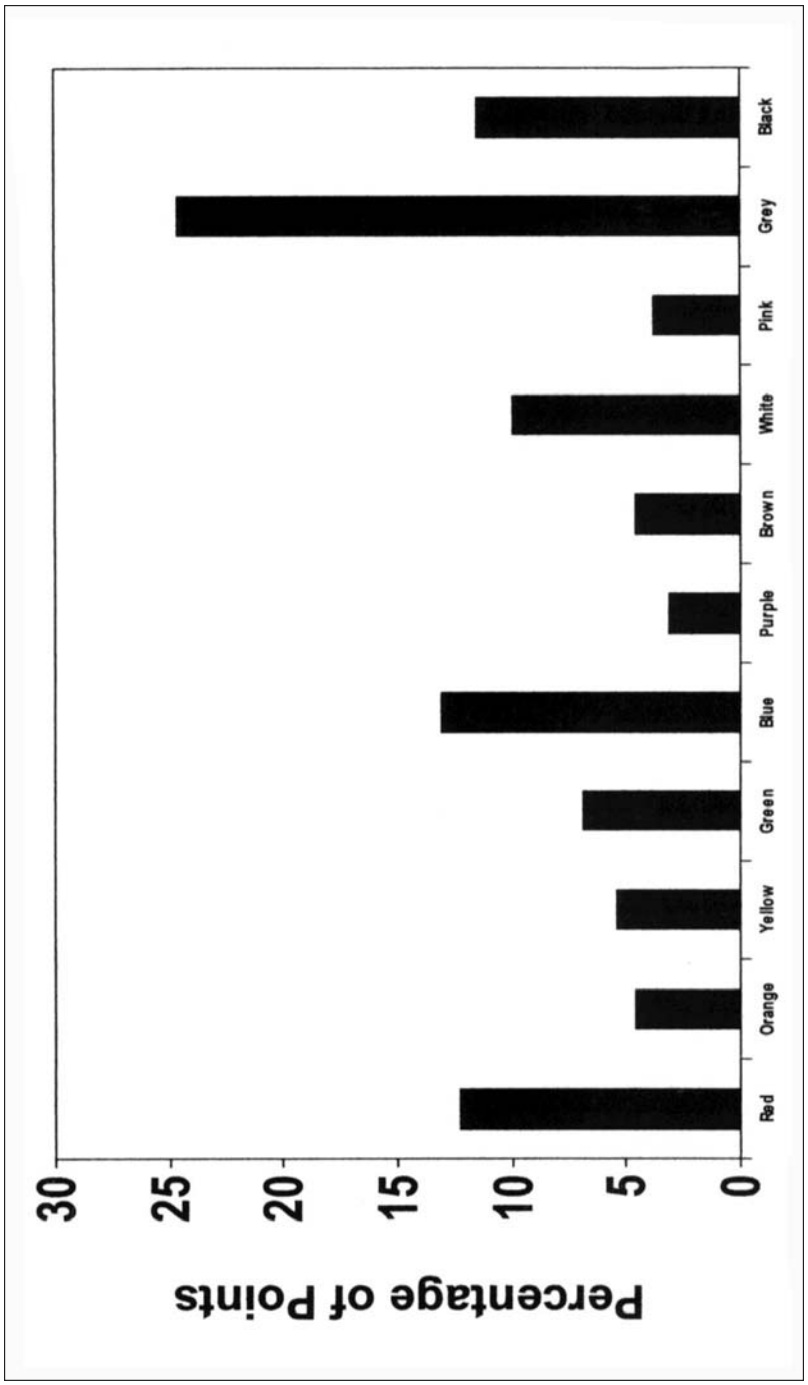

Figure 1. Percentage of points assigned to each color for Grieg's *Ase's Death* (sad song).

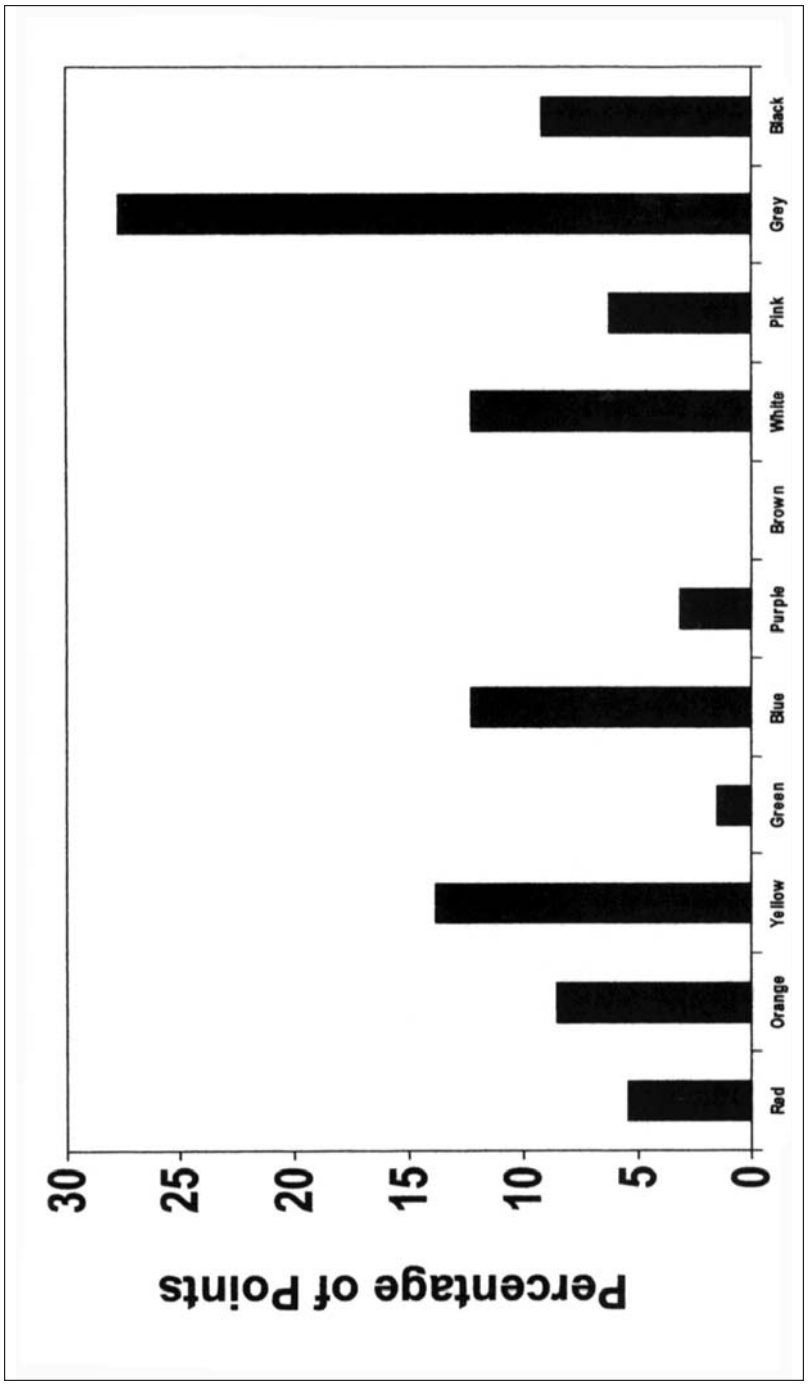

Figure 2. Percentage of points assigned to each color for Barber's *Adagio for Strings* (sad song).

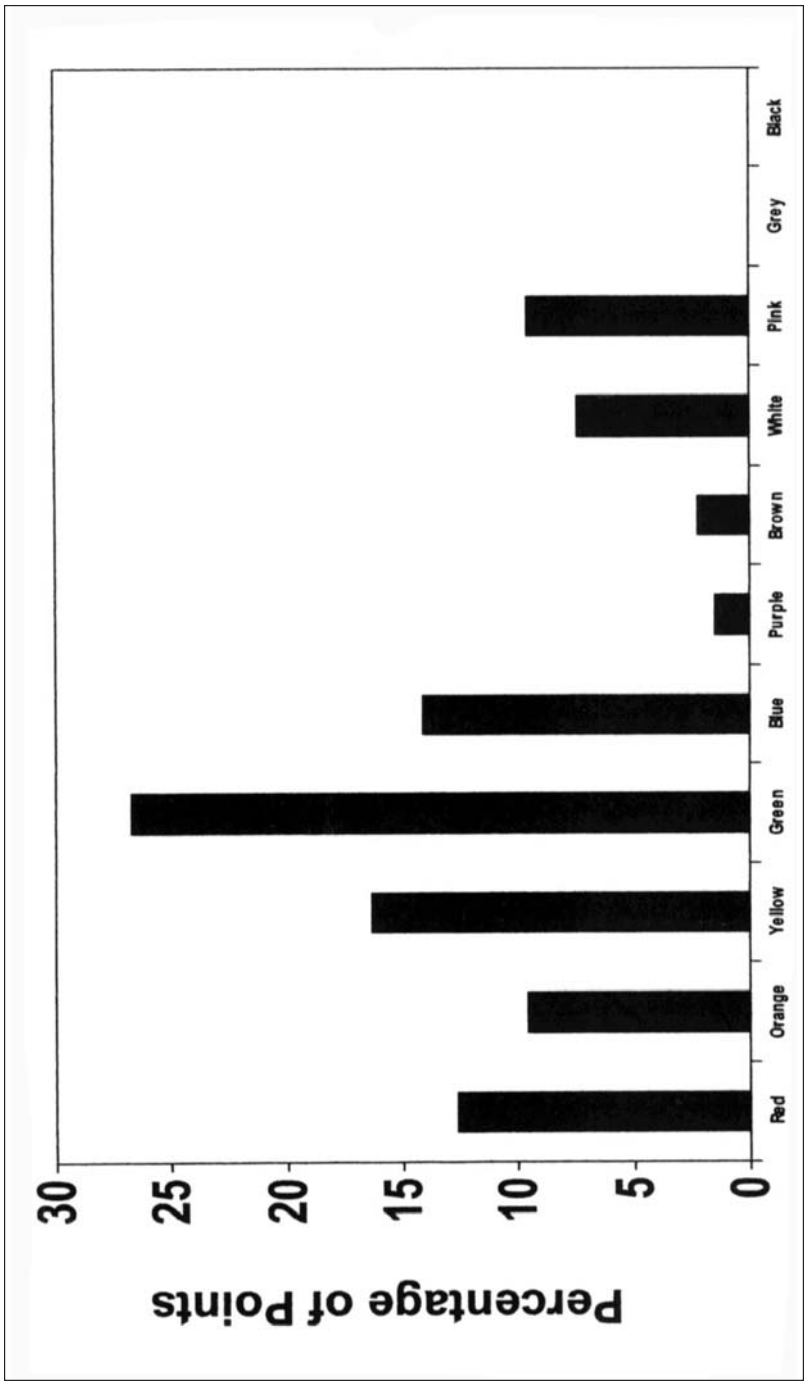

Figure 3. Percentage of points assigned to each color for Grieg's *Morning Mood* (happy song).

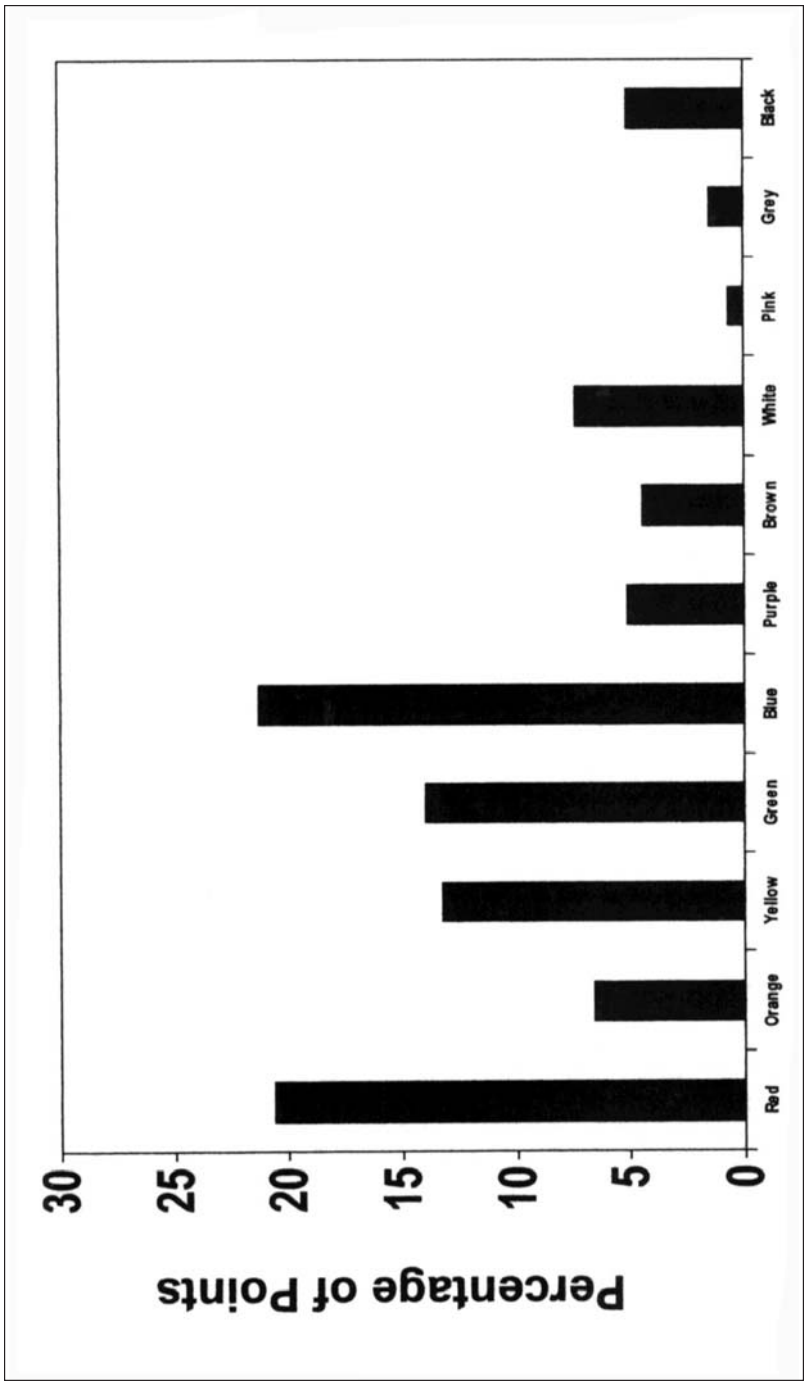

Figure 4. Percentage of points assigned to each color for Mussorgsky/Ravel's *Pictures at an Exhibition* (happy song).

different for these two songs the two predominant colors for each selection remained the same.

DISCUSSION

The number of points assigned to colors that corresponded to the particular musical selections used were not random. People tended to agree which colors corresponded with which musical selections. For all songs most of the points were assigned to fewer than 5 of the 11 colors.

The colors that points were assigned to for each piece of music were related to the emotion people judged the music as conveying. There was more correspondence between the patterns of point assignments for the songs that elicited like emotions (e.g., the two "sad" songs) than for those eliciting different emotions (i.e., the "happy" and "sad" songs).

This was most clearly the case with the two "sad" selections. For both of those pieces people chose the color gray more predominantly than any other color. In both cases 25% or more of the points were assigned to the color gray. The choice of gray for a "sad" song was also found for the one musical selection used by Odbert et al. (1942) which was judged as sad. This choice of gray for the two "sad" songs is consistent with the idea that emotion underlies the music-color correspondence because gray has been found as corresponding to the emotion "sad" (e.g., Kaya & Epps, 2004; Rader & Tellegen, 1987). The choice of gray for the sad songs, rather than blue [blue getting only about half as many points as gray (13.1% for *Ase's Death* and 12.3% for Barber's *Adagio for Strings*)] also indicates that participants were not choosing colors based on the connotative meaning of the word but on the basis of some other connection.

There was also a strong correspondence in the patterns of points assigned to colors for the two "happy" songs. The colors which were assigned the most points for these two songs where the four primary colors (i.e., red, yellow, green, and blue). These are the same four colors participants chose in Odbert et al. (1942) for the song people perceived as "gay." Which of the four colors were predominant were slightly different between the two songs. Once again, the colors assigned the most points appear to be related to the emotion the song produced. All the colors receiving the most points were bright colors (as opposed to black and gray) and have been found to be associated with positive emotions (Boyatzis & Varghese, 1994). Yellow was among the colors assigned the most points for both "happy" songs and was also the color that Rader and Tellegen (1987) reported subjects chose to describe "joyful" music. This is not surprising since many previous studies have found the color yellow relating to happiness. For example, Wexner (1954) found that yellow was chosen as corresponding to "cheerful, jovial, joyful." Others (Kaya & Epps, 2004) found that yellow, yellow-red, and blue-green were all associated with "happy." These are the colors to which participants assigned the most points for these two songs.

Clearly, music-color correspondences occur in people without synesthesia. These correspondences are similar across individuals and appear to be related to the underlying emotion induced by the music. People appear to choose colors not based on the song itself, but on the emotion the song elicits.

It is possible that the effect we are seeing involves a music-brightness association in addition to a music-hue association. Since bright colors are linked to positive emotions and dark colors to negative ones (Hemphill, 1996) it could be that happy songs are associated with brightness and sad songs with darkness. We, of course, do not know the brightness of any of the colors in the present study because only the color word was used. The brightness of any hue was dependent upon the exact color that a participant was imagining.

While we don't know for sure what any given participant imagined when given a color-word, we have some sense of the brightnesses based on findings by Marks (1982). In that study subjects rated the brightness of color words from brightest to least bright as follows: yellow, white, red, green, blue, brown, and black. We do not know where gray falls, however we do see that yellow and red, two of the most frequently chosen colors for the "happy" songs in the present study are those considered to be among the brightest hues.

Although we do not know if the participants are using hue, brightness, or some combination of the two in their judgment of music-color correspondences, we can be confident that the correspondences are at least partly governed by an underlying emotional connection. The fact that people find as natural certain music-color associations because both stimuli are associated with the same emotion should mean that any multimedia presentation where the music and colors correspond to the same emotion should feel "right" to most people. The multiple stimuli should be perceived as "going together" because they are both producing the same emotional experience in the subject. While most people don't actually perceive color when hearing music, they can experience the two as belonging together through the underlying emotion they produce.

Likewise, if an artist with synesthesia produces a painting based on his/her synesthetic connection between music and color (e.g., Robert Strubin produced abstract paintings using colors which he saw when listening to musical selections such as a Bach fugue—Gerstner, 1986) a consumer of the art who is not synesthetic might still experience the emotion of the musical selection when looking at the painting conveyed through the color-emotion association.

Kandinsky (1977/1914) in his book *Concerning the Spiritual in Art* discusses the relationship of colors, music, and emotions and the use of this knowledge in producing paintings. He saw color as related to both music and emotion. In his book he writes "a light blue is like a flute, a darker blue a cello; still darker a thunderous double bass; and the darkest blue of all—an organ" (p. 38). He also describes blue as ". . . the typical heavenly colour. The ultimate feeling it creates is one of rest" (p. 38).

While a connection of music and color seems to occur at the emotional level for people without synesthesia and possibly synesthetes as well (see Cytowic, 1989; Ramachandran & Hubbard, 2001) not all sensory correspondences are necessarily based upon emotion. However, many correspondences such as music-color, music-shape and shape-color correspondences might stem from some underlying emotion (see Collier, 1996).

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REFERENCE

Balkwill, L-L., & Thompson, W. F. (1999). A cross-cultural investigation of the perception of emotion in music: Psychophysical and cultural cues. *Music Perception, 17*, 43-64.

Barber, S. (1996). Adagio for strings [Recorded by New Zealand Symphony Orchestra/ James Sedares]. On *Capricorn: The Samuel Barber Collection* [CD]. Port Washington, NY: Koch International L. P.

Baron-Cohen, S., Burt, L., Smith-Laittan, F., Harrison, J., & Bolton, P. (1996). Synaesthesia: Prevalence and familiality. *Perception, 25*, 1073-1079.

Boyatzis, C. J., & Varghese, R. (1994). Children's emotional associations with colors. *The Journal of Genetic Psychology, 155*, 77-85.

Calkins, M. W. (1893). A statistical study of pseudo-chromesthesia and of mental-forms. *The American Journal of Psychology, 5*, 439-464.

Cimbalo, R. S., Beck, K. L., & Sendziak, D. S. (1978). Emotionally toned pictures and color selection for children and college students. *The Journal of Genetic Psychology, 133*, 303-304.

Clark, D. M., & Teasdale, J. D. (1985). Constraints on the effects of mood on memory. *Journal of Personality and Social Psychology, 48*, 1595-1608.

Collins, M. (1929). A case of synaesthesia. *Journal of General Psychology, 2*, 12-27.

Collier, G. L. (1996). Affective synesthesia: Extracting emotion space from simple perceptual stimuli. *Motivation and Emotion, 20*, 1-32.

Cutsforth, T. D. (1925). The role of emotion in a synaesthetic subject. *The American Journal of Psychology, 36*, 527-543.

Cytowic, R. E. (1989). *Synesthesia: A union of the senses*. New York: Springer-Verlag.

Cytowic, R. E. (1997). Synesthesia: Phenomenology and neuropsychology—A review of current knowledge. In S. Baron-Cohen & J. E. Harrison (Eds.), *Synaesthesia: Classic and contemporary readings* (pp. 17-39). Oxford, UK: Blackwell Publishers Ltd. (Reprinted from *Psyche*, 1995, vol. 2).

Dalla Bella, S., Peretz, I., Rousseau, L., & Gosselin, N. (2001). A developmental study of the affective value of tempo and mode in music. *Cognition, 80*, B1-B10.

Day, S. (2005). Some demographic and socio-cultural aspects of synesthesia. In L. C. Robertson & N. Sagiv (Eds.), *Synesthesia* (pp. 11-13). New York: Oxford University Press.

Domino, G. (1989). Synesthesia and creativity in fine arts students: An empirical look. *Creativity Research Journal, 2*, 17-29.

Gerstner, K. (1986). *The forms of color: The interaction of visual elements*. Cambridge, MA: The MIT Press.

Gilbert, A. N., Martin, R., & Kemp, S. E. (1996). Cross-modal correspondence between vision and olfaction: The color of smells. *American Journal of Psychology, 109*, 335-351.

Grieg, E. (1997). Ase's death [Recorded by Utah Symphony Orchestra/Maurice Abravanel]. On *Grieg Piano Concerto, Peer Gynt Suites Nos. 1 & 2* [CD]. Willowdale, Ontario: Universal Music. (1958)

Grieg, E. (1997). Morning mood [Recorded by Utah Symphony Orchestra/Maurice Abravanel]. On *Grieg Piano Concerto, Peer Gynt Suites Nos. 1 & 2* [CD]. Willowdale, Ontario: Universal Music. (1958)

Hemphill, M. (1996). A note on adults' color-emotion associations. *The Journal of Genetic Psychology, 157*, 275-280.

Herz, R. S. (1998). An examination of objective and subjective measures of experience associated to odors, music, and paintings. *Empirical Studies of the Arts, 16*, 137-152.

Kandinsky, W. (1977). *Concerning the spiritual in art*. New York: Dover Publications, Inc. (Original work published 1914.)

Karwoski, T. F., & Odbert, H. S. (1938). Color-music. *Psychological Monographs, 50* (Whole No. 222).

Kaya, N., & Epps, H. H. (2004). Relationship between color and emotion: A study of college students. *College Student Journal, 38*, 396-405.

Marks, L. E. (1974). On associations of light and sound: The mediation of brightness, pitch, and loudness. *The American Journal of Psychology, 87*, 173-188.

Marks, L. E. (1975). On colored-hearing synesthesia: Cross-modal translations of sensory dimensions. *Psychological Bulletin, 82*, 303-331.

Marks, L. E. (1982). Bright sneezes and dark coughs, loud sunlight and soft moonlight. *Journal of Experimental Psychology: Human Perception and Performance, 8*, 177-193.

Marks, L. E. (1984). Synesthesia and the arts. In W. R. Crozier & A. J. Chapman (Eds.), *Cognitive processes in the perception of art* (pp. 427-447). Amsterdam, The Netherlands: Elsevier Science Publishers, B.V.

Martino, G., & Marks, L. E. (2001). Synesthesia: Strong and weak. *Current Directions in Psychological Science, 10*, 61-65.

Murray, D. C., & Deabler, H. L. (1957). Colors and mood-tones. *Journal of Applied Psychology, 41*, 279-283.

Mussorgsky, M. (1995). Pictures at an exhibition (orch. Ravel) [Recorded by New Philharmonia Orchestra/Lorin Maazel]. On *Ravel* [CD]. New York: EMI Records Ltd. (1963).

Newton, I. (1952). *Opticks or a treatise of the reflections, refractions, inflections & colours of light*. New York: Dover Publications, Inc. (Original work published 1730.)

Odbert, H. S., Karwoski, T. F., & Eckerson, A. B. (1942). Studies in synesthetic thinking: I. Musical and verbal associations of color and mood. *The Journal of General Psychology, 26*, 153-173.

Parrott, W. G., & Sabini, J. (1990). Mood and memory under natural conditions: Evidence for mood incongruent recall. *Journal of Personality and Social Psychology, 59*, 321-336.

Rader, C. M., & Tellegen, A. (1987). An investigation of synesthesia. *Journal of Personality and Social Psychology, 52*, 981-987.

Ramachandran, V. S., & Hubbard, E. M. (2001). Synaesthesia—A window into perception, thought and language. *Journal of Consciousness Studies, 8*, 3-34.

Ramachandran, V. S., & Hubbard, E. M. (2005). The emergence of the human mind: Some clues from synesthesia. In L. C. Robertson & N. Sagiv (Eds.), *Synesthesia* (pp. 147-190). New York: Oxford University Press.

Rickard, N. S. (2004). Intense emotional responses to music: A test of the physiological arousal hypothesis. *Psychology of Music, 32,* 371-388.

Rigg, M. (1937). An experiment to determine how accurately college students can interpret the intended meanings of musical compositions. *Journal of Experimental Psychology, 21*, 223-229.

Riggs, L. A., & Karwoski, T. (1934). Synaesthesia. *British Journal of Psychology, 25*, 29-41.

Smith, J. L., & Noon, J. (1998). Objective measurement of mood change induced by contemporary music. *Journal of Psychiatric and Mental Health Nursing, 5*, 403-408.

Vernon, P. E. (1930). Synaesthesia in music. *Psyche, 10*, 22-40.

Ward, J. (2004). Emotionally mediated synaesthesia. *Cognitive Neuropsychology, 21*, 761-772.

Wexner, L. B. (1954). The degree to which colors (hues) are associated with mood-tones. *The Journal of Applied Psychology, 38*, 432-435.

Whipple, G. M. (1900). Two cases of synaesthesia. *The American Journal of Psychology, 11*, 377-404.

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