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Colors and Emotions: Preferences and Combinations

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ABSTRACT. Within three age groups (7-year-old children, 11-year-old children, and adults), preferences for colors and emotions were established by means of two distinct paired-comparison tasks. In a subsequent task, participants were asked to link colors to emotions by selecting an appropriate color. It was hypothesized that the number of times that each color was tied to a specific emotion would be predictable from the separate preferences for colors and emotions. Within age groups, participants had consistent preferences for colors and emotions, but preferences differed from one age group to another. Especially in the youngest group, the pattern of combinations between colors and emotions appeared to be meaningfully related to the preference order for colors and emotions.

THE ENGLISH LANGUAGE abounds with expressions pointing to connections between colors and emotions. It is possible, for instance, to be purple with rage or green with envy. Sometimes one sees the world through rose-tinted spectacles; at other times one is feeling blue. Not only language but also a large number of studies point to connections between the two seemingly unrelated domains of color and emotion (e.g., Adams & Osgood, 1973; Byrnes, 1983; Kreitler & Kreitler, 1972; Schaie, 1961, 1962; Wexner, 1954).

According to Schachtel (1943), connections between colors and emotions arise from a similarity in subjective experience. In both cases, people are passive recipients in that the influences of colors and emotions come over us. Schachtel's explanation not only is imprecise but also fails to account for the fact that specific colors are tied to specific emotions. Gerard (1957) tried

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to explain some of the specific connections between colors and emotions by referring to common physiological reaction patterns. He maintained, for instance, that the color red and the emotion of anger both have an energizing effect that calls for action and are therefore linked to each other.

Others have referred to cultural roots. In the medieval heraldic system, for instance, the color white was related to purity and the color yellow to hatred. In fact, such a cultural explanation dates the explanation back in time, unless it is assumed that such connections are already given in the human archetype (Kreitler & Kreitler, 1972).

Yet another explanation refers to the phenomenon of synesthesia, that is, reacting to a stimulus that belongs to one sense modality with a sensation that belongs to another sense modality. Thus, dark colors are associated with heaviness, red with warmth, and so on. Ties between colors and emotions then arise through such associations as heavy–negative and warm–comfortable. This explanation is not very satisfying either. It does not explain where synesthesia comes from or how associations between emotions and sense perceptions such as warm and heavy are established. In sum, it is not yet clear why specific colors are tied to specific emotions (Frank, 1976; Levy, 1980).

In examining the question of why specific colors are tied to, or associated with, specific emotions, we started by formulating a simple and parsimonious hypothesis. We hypothesized that colors and emotions are tied to each other on the basis of the preferences given to each of them within their own domain. In other words, we assumed that it is not necesary to refer to a common process, other than people's preferences, to explain connections between colors and emotions.

Any pair of items, be it emotions, colors, or something else (e.g., means of conveyance), can be ordered on a preference scale. Thus, red may be preferred over green, and green may be preferred over black. In the same way, happiness may be preferred over anger and anger over fear. An airplane may be preferred over the train and the train over a bicycle. The reason why one item is preferred over another does not have to be the same for different items. An airplane may be preferred over the train because it is fast, whereas the train may be preferred over a bicycle because it is more comfortable. Eventually the comparisons will lead to an ordering of items. Within these orderings some items will be close to each other, and others will be further apart. It is conceivable that the link between two items from different domains rests on no more than the ordered positions of the items within their respective domains. Items with similar positions on their respective scales will be linked to each other. Thus, red might be linked to happiness and possibly to airplane because all these items hold relatively high positions on their relevant preference scales. Black could be tied to fear and to bicycle in the same way.

If colors and emotions are what they seem to be—two unrelated domains of items—meaningful predictions can be made about how people are likely to combine items from both domains with each other. Specifically, any combination of color and emotion is more likely to occur when both have similar locations on a person's preference scales for those dimensions.

As people grow older, their preferences are likely to change as a result of social and cultural influences. For instance, as children grow up they learn that the expression of anger is often punished. They also learn that the color black (within Western culture) is associated with mourning. In addition to these more or less general age-related changes, people's judgments are also likely to diverge as a result of individual experiences. For these reasons, we included three age groups in our study: 7-year-old children, 11-year-old children, and adults.

The study consisted of two parts. First, the paired-comparison method was used to establish preference scales for colors and emotions within the three groups of participants. The results of the paired-comparison procedures were used to answer the question of whether or not the orderings of colors and emotions would be similar within and between groups. Color preferences have been widely studied (cf. Eysenck, 1941; Frank, 1976; Guilford, 1934, 1940) and have been shown to be age dependent (Birren, 1978; Norman & Scott, 1952). Factor-analytic studies have indicated that emotions can be categorized according to several dimensions. However, almost all studies we know of mention as their first and most influential factor the positive–negative or agreeable–nonagreeable dimensions that Woodworth and Schlosberg identified in 1954. It is quite obvious that this factor is likely to be closely related to the concept of preference. The few studies that have addressed this dimension from a developmental perspective suggest that there are some age-related changes in emotion preferences (Russell & Bullock, 1985; Russell & Ridgeway, 1983).

In the second part of the study, the participants were asked to link colors and emotions. The results of this task were subsequently combined with the results of the previous task to find out whether the separate color- and emotion-preference orders of each age group could be meaningfully related to the color–emotion combinations within that group.

Method

Participants

The sample consisted of 72 participants divided into three age groups. The mean ages in the two groups of youngsters were 7.3 years (range = 6.7–7.8) and 11.2 years (range = 10.5–12.0). The mean age in the adult group was

about 30 years (range = 20–56). Both sexes were equally represented in the three groups.

Material

The colors used consisted of the primary colors red, blue, yellow, and green, supplemented with black and white. According to Osgood's atlas of affective meaning (Osgood, May, & Miron, 1975), all of these colors have a high affective value. The emotions involved were the six basic emotions as defined by Ekman and Friesen (1975): anger, happiness, sadness, fear, surprise, and disgust. These emotions are considered to have distinctive facial expressions. Therefore, their concepts can be easily learned at a young age (Harris, 1989; Meerum Terwogt & Harris, 1993). Instead of the correct Dutch translation of disgust—*walging,* which is rarely used in the Dutch language—we decided to use the more common word *afkeer,* which may be best translated as *aversion.* The colors were presented on small pieces of glossy cardboard measuring 7 cm by 7 cm. The emotions were printed in black on white cards measuring the same size.

Procedure

The participants were treated individually. They were first asked to perform 15 paired comparisons of colors, followed by 15 paired comparisons of emotions. The comparisons were randomly ordered. Both the colored cards and the cards containing emotions were presented on a gray surface approximately 2 cm apart from each other. The questions asked were "Which of these two colors do you feel is the most beautiful one?" and "Which of these two emotions do you like best or feel is less bad?"

Although surprise and aversion are basic emotions, they usually are learned later in life than the other four (Harris, Olthof, Meerum Terwogt, & Hardman, 1987). To check whether the youngest group already had a firm grasp of the meaning of these concepts, we asked each child to give a typical example of a situation in which the emotions were appropriate. Two children in the youngest age group failed to give a clear and appropriate example and were replaced by other children.

After the completion of a buffer task, participants were asked to link colors and emotions to one another.[1] During this part of the study, the six colors were randomly displayed in front of participants. The emotions were

[1] Because some authors (e.g., Birren, 1978) have claimed that cognitive style influences color preferences, we used the short version of the Matching Familiar Figures Task (MFFT–12) for this purpose. The results showed a marginal significant effect: Reflex-

then read aloud, one by one. The order of presentation was randomized across participants. For each emotion, participants were asked to point to the color that they felt fitted best the feeling given. Participants were told that they were allowed to point to the same color on different occasions. In all three tasks, participants were advised to give their responses without too much hesitation.

Results

Analysis of Color and Emotion Preferences

Each participant made 15 paired comparisons of emotions and another 15 paired comparisons of colors. Our first analysis was aimed at establishing the order of preference for colors and emotions. The preference for, let us say, color C_i was operationalized as the probability π_i that color C_i would be chosen if all colors were presented simultaneously. These probabilities (preferences) were estimated from the paired-comparison data by means of the so-called Bradley–Terry model (Fienberg, 1977). This model is based on the assumption that the result of a paired comparison of two items (e.g., two colors) depends on the preference for the individual items. The model is written as

$$\Pr(C_i > C_j) = \pi_i/(\pi_i + \pi_j),$$

where $\Pr(C_i > C_j)$ is the probability that color C_i is preferred when C_i and C_j are compared. The terms π_i and π_j are the preferences for the separate colors as defined above. In the present case, these probabilities are unknown, whereas the results of the comparisons are known. If the Bradley–Terry model is valid, however, the preferences can be estimated. To test the model and to estimate the preferences, we conducted a crossclassification, as represented in Table 1. In this table, x_{12} represents the number of times the color black was preferred over white, x_{13} represents the number times red was preferred over white, x_{21} represents the number of times white was preferred over black, and so on. If the Bradley–Terry model is valid, the column totals in the table represent the color preferences. The probabilities are found by dividing the column totals by the total number of comparisons made.

The Bradley–Terry model is valid when the rows and columns in a crossclassification table are statistically independent of each other. In that case, the Bradley–Terry model is considered to be an adequate description of the

ive people seemed to have a slightly stronger preference for red, as compared with impulsive people. No relations with emotion preferences were found. Therefore, we decided to remove the cognitive style factor from all further analyses.

TABLE 1
Cross-Classification for the Bradley–Terry Model

Color	1	2	3	4	5	6
1. White	—	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}
2. Black	x_{21}	—	x_{23}	x_{24}	x_{25}	x_{26}
3. Red	x_{31}	x_{32}	—	x_{34}	x_{35}	x_{36}
4. Green	x_{41}	x_{42}	x_{43}	—	x_{45}	x_{46}
5. Yellow	x_{51}	x_{52}	x_{53}	x_{54}	—	x_{56}
6. Blue	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	—

paired-comparison data (i.e., the model fits the data). The test of independence used is based on the loglinear model. A full description of the test can be found in Fienberg and Larntz's (1976) article.

All in all, we constructed six tables similar to Table 1: three for the paired comparisons of colors (one for each age group) and three for the paired comparisons of emotions. In all six cases, the Bradley–Terry model appeared to be valid. For colors, the chi-square distributed test statistic ($df = 10$) was 12.49, $p > .25$, for 7-year-olds; 7.40, $p > .69$, for 11-year-olds; and 3.32, $p > .97$, for adults. For emotions, the test statistic was 5.81, $p > .83$, for 7-year-olds; 0.71, $p > .99$, for 11-year-olds; and 0.60, $p > .99$, for adults. A closer look at the statistics reveals that their values decrease with age, indicating that the fit of the model increased with age. Obviously the younger children were less consistent in their preferences than the older children, who in their turn were less consistent than the adults.

Nevertheless, the Bradley–Terry model appears to fit well with all groups for both colors and emotions ($p > .10$ implies a good fit). Given this result, the preferences for colors and emotions could be validly determined. The results are displayed in graph form in Figures 1 and 2.

We performed a chi-square test to determine whether participants' preferences were age dependent. The preferences for the six colors differed significantly between the three age groups, $\chi^2(10, N = 432) = 39.90$, $p < .01$. The preference for yellow decreased with age, whereas the preference for green increased with age (see Figure 1). The age groups also differed significantly with regard to their emotion preferences, $\chi^2(10, N = 432) = 48.30$, $p < .01$. This effect was mainly brought about by a high adult preference for anger and a very low adult preference for fear (see Figure 2).

Analysis of Color–Emotion Combinations

According to the main hypothesis of the present research, links between colors and emotions can be explained on the basis of color preferences and emotion preferences. The number of emotion–color combinations made

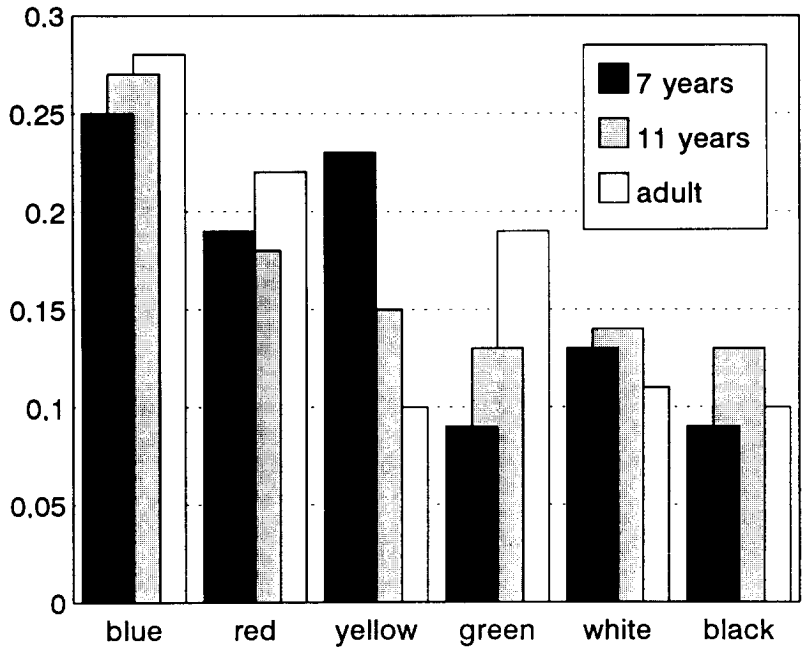

FIGURE 1. Color preferences in all three age groups.

within each age group is displayed in Table 2. According to our hypothesis, highly preferred colors should be tied to highly preferred emotions, whereas nonpreferred colors should be tied to nonpreferred emotions. At the same time, a preferred color is not likely to be tied to a nonpreferred emotion or vice versa. In other words, it is the difference between color and emotion preferences that determines the number of color–emotion combinations. This reasoning led us to use the following model for testing the main hypothesis:

$$\log(m[E_i,C_j]) = \alpha + \beta(\pi_{E,i} - \pi_{C,j})^2 + e_{ij}.$$

The model implies that the log-transformed frequency of emotion–color combinations ($m[E_i,C_j]$) is a function of a constant α and the weighted squared differences between emotion preference $\pi_{E,i}$ and color preference $\pi_{C,j}$. The model was formulated after some preliminary analyses showed that the residuals e_{ij} were normally distributed only after the observed frequencies had been log-transformed. The same analyses revealed that the squared difference between emotion and color preference had a higher predictive value than, for instance, the absolute difference between the preferences.

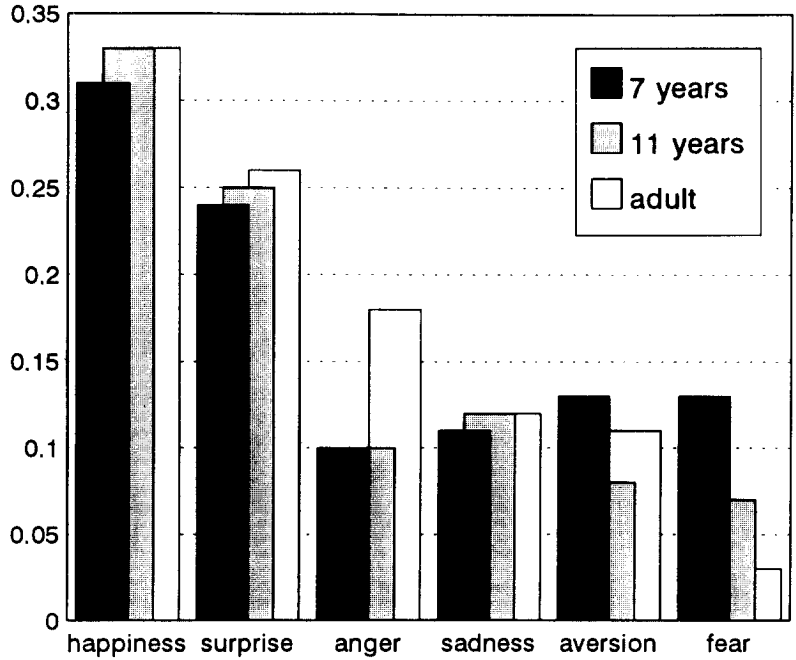

FIGURE 2. Emotion preferences in all three age groups.

The analyses in the previous section revealed marked differences between the three age groups. Therefore, we estimated the parameters α and β separately within each age group. For this purpose, we used the computer program GLIM (Baker & Nelder, 1978). The estimated parameters (including their standard errors) are given in Table 3. According to our hypothesis, the number of emotion–color combinations should decrease when the difference between the emotion and color preferences increases. Because the hypothesis specifies that β should be negative, we used one-tailed significance tests. These tests revealed that β was significantly different from zero in the groups of 7- and 11-year-old children. In other words, colors and emotions that were further apart with respect to their preferences were less likely to be combined. To put it the other way around, colors and emotions that were more similar, as indicated by their preferences, were more likely to be tied to each other.

The results presented in Table 3 suggest that the effect of preference decreased with age. This is not to say that the strength of the association

TABLE 2
Frequencies of Specific Emotion–Color Linkages Within Each Age Group

Emotion	Blue	Yellow	Red	White	Green	Black
			7-year-olds			
Happiness	12	5	6	1	0	0
Surprise	1	4	6	8	5	0
Fear	0	1	3	9	5	6
Sadness	5	3	3	7	3	3
Aversion	2	4	3	2	6	7
Anger	0	0	5	0	3	16
Total	20	17	26	27	22	32
			11-year-olds			
Happiness	9	3	7	3	2	0
Surprise	5	2	6	7	4	0
Aversion	1	4	5	1	8	5
Sadness	2	2	1	4	3	12
Anger	0	7	0	0	1	16
Fear	2	2	1	8	3	8
Total	19	20	20	23	21	41
			Adults			
Happiness	3	9	0	1	11	0
Surprise	6	1	4	10	3	0
Anger	0	10	2	0	2	10
Sadness	3	1	6	3	6	10
Aversion	1	5	4	1	4	10
Fear	2	1	1	1	1	15
Total	15	27	17	16	24	45

Note. Within each age group the emotions as well as the colors are placed in their order of preference (see Figures 1 and 2). Although this presentation does not account for absolute differences, the general claim is that the linkages should mainly be concentrated along the upper left to lower right diagonal.

between colors and emotions decreased with age. To estimate the association between colors and emotions (irrespective of preferences), we calculated ϕ within each age group. It amounted to .65 for adults, .62 for the 11-year-old children, and .64 for the 7-year-old children. The data in Table 2 indicate not only what colors were tied to specific emotions within each age group but also why the model presented did not agree with the data for adults. It appears that adults seldom combined the emotion happiness with the color blue even though both were preferred within their domains. In addition, adults

TABLE 3
Estimated Model Parameters α and β (and Their Standard Errors), Test Statistics (*z*), Descriptive Level of Significance (*p*), and Multiple Correlations (*r*) Within Each Age Group

	Parameter						
Age group	α	*SE*	β	*SE*	*z*	*p*	*R*
7-year-olds	1.61	0.18	−44.97	10.56	−4.25	< .001	−.35
11-year-olds	1.35	0.20	−19.75	11.69	−1.69	< .05	−.08
Adults	1.27	0.22	−13.30	9.36	−1.42	*NS*	−.06

combined happy and yellow with each other, even though happiness was preferred and yellow was not.

Discussion

These results lead to the following three conclusions: (a) Color and emotion preferences change with age; (b) for 7-year-old children and to a lesser extent for 11-year-old children, emotion–color combinations are meaningfully related to emotion preferences and color preferences; and (c) at all ages, colors and emotions are consistently related to each other. We discuss these three conclusions in succession.

First, the order of color preferences found for adults corresponds with the results of previous research by Eysenck (1941) and Frank (1976). Within Western society, the favorite adult color is blue, followed by red and green. White, yellow, and black are less preferred. Normann and Scott (1952) concluded in their review article that young children prefer the colors red and yellow. The present data partially confirm this order. Yellow and red held relatively high preference positions within the group of 7-year-olds but were, even at this age, excelled by blue. In accordance with the findings of Birren (1978) and Norman and Scott (1952), yellow was less favored at older ages. At the same time, the popularity of green increased with age. Choungourian (1969) observed a similar trend. Finally, the so-called anticolors—white and black—were consistently disliked. In agreement with the findings of Adams and Osgood (1973) and Williams, Boswell, and Best (1975), white (light) was somewhat preferred over black.

The order of the emotion preferences reflects the previously mentioned agreeable–nonagreeable dimension. The higher positions were taken by the positive emotions (including surprise), and the lower positions were taken by the four negative emotions (Russell, 1978; Woodworth & Schlosberg, 1954). The observed age trends deviate from the earlier findings by Russell and Bullock (1985), who claimed that surprise and sadness become less preferred

with age. In the present study, the preferences for surprise and sadness appeared to be constant across age.

The data with regard to the negative emotions reveal two small but striking age changes. With increasing age, the valuation of fear became less and less, whereas the valuation of anger increased. For children, fear is part and parcel of their daily life. Signs of fear in children are generally accepted within Western society. Probably as a result of this, the feeling was regarded by the children in this study as less negative than anger, which if not controlled might easily earn them some form of punishment. Adults, however, experience fear as "an inability to handle the situation" (Barendregt & Frijda, 1982, p. 23), an uncommon and very negative threat. Signs of fear are considered expressions of weakness that should be concealed. On the other hand, because adults have learned socially acceptable ways of expressing anger, this emotion often stays unpunished and can even be used strategically. In sum, differences in subjective experiences and environmental reactions both contribute to the changing preference for fear and anger at different ages.

The primary aim of our enterprise was to answer the question of whether links between colors and emotions can be accounted for by preferences for both colors and emotions. To substantiate the general claim that preferences within seperate domains are instrumental to the links that are made between domains, one must extend this study to at least one, randomly chosen, domain of a different nature (for instance, the vehicles suggested in the Introduction). Even so, with respect to colors and emotions, the results suggest a partially positive answer, especially for the youngest group. This does not mean that preferences for colors and emotions fully account for their likely combinations. Within the group of 7-year-old children, the multiple correlation amounted to $-.35$, that is, no more than 12.3% of the explained variance. Though statistically significant, the effect of the preferences within the group of 11-year-old children was rather small ($R = -.08$), and within the adult group the effect of preferences was virtually absent. These results suggest an age trend with respect to the effect of color and emotion preferences on their combinations. To substantiate this claim any further, research involving younger children is needed.

The change in the effect of preferences is probably not the result of individual or idiosyncratic learning experiences. Though the likelihood of specific emotion–color connections changed with age, the overall association was more or less constant across the different age groups (ϕ varied around .60). It can be observed (Table 2), for instance, that the likelihood of combinations between happy and blue decreased with age even though both were placed at the top of their respective preference scales at each age. The increasing number of combinations of happiness and yellow compensates for this trend, notwithstanding the fact that the preference for yellow decreased with

age. At first sight, some plausible local explanations for specific combinations exist. In the group of 11-year-old children, for instance, the combinations red–angry and white–afraid do not agree with our hypothesis about preferences. The combinations could be explained by claiming that 11-year-olds have acquired some knowledge about observable physiological phenomena and the way English speakers refer to them: One is red with anger or white with fear. If we accept this kind of explanation, the next obvious question is why are these combinations not observed for adults?

In sum, this study leads to the conclusion that the likelihood of emotion–color combinations is affected by a number of factors. Those factors affecting children's preferences for specific colors and emotions at an early age also possibly affect the way emotions and colors are combined. At later ages, the effects of preferences, assuming that they are still there, are outweighed by other (as yet unindentified) factors.

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