Pink for Girls, Red for Boys, and Blue for Both Genders: Colour Preferences in Children and Adults

Domicele Jonauskaite, Nele Dael, Laetitia Chèvre, Betty Althaus, Alessandro Tremea, Laetitia Charalambides, and Christine Mohr

University of Lausanne

Author Note

Domicele Jonauskaite, Institute of Psychology, University of Lausanne; Nele Dael, Institute of Psychology, University of Lausanne; Laetitia Chèvre, Institute of Psychology, University of Lausanne; Betty Althaus, Institute of Psychology, University of Lausanne; Alessandro Tremea, Institute of Psychology, University of Lausanne; Laetitia Charalambides, Institute of Psychology, University of Lausanne; Christine Mohr, Institute of Psychology, University of Lausanne

The present research was made possible thanks to the support of the Swiss National Science Foundation, providing a Doc.CH fellowship grant to DJ (P0LAP1_175055). We wish to thank Richard Klein for contributing to the translation of the survey instructions in French and Michael Quiblier for collecting part of the data. We also wish to thank Dr Jean-Philippe Antonietti for statistical support throughout the project.

Correspondence concerning this manuscript should be addressed to Domicele Jonauskaite, Institute of Psychology, University of Lausanne, Quartier Mouline, Bâtiment Géopolis, CH-1015, Lausanne, Switzerland. Email: Domicele.Jonauskaite@unil.ch

Abstract

Colours carry social connotations like pink for girls and blue for boys. In a cross-sectional study, we investigated whether such early gender coding might be reflected in absolute colour preferences in children and adults of both genders. In two studies, participants selected their favourite (and least favourite, Study 2) colour from an unrestricted sample of colours. We tested 129 Swiss children (Study 1, 10–14 years-old, 68 boys) and 180 Swiss adults (Study 2, 17–48 years-old, 88 men). In children, we observed that girls chose pink/purple as their favourite hue more often than boys did, the most common favourite hue in girls and boys was blue, and boys chose red as their favourite more often than girls did. In adults, we observed that both genders almost never choose pink as their favourite, blue was a common favourite colour, and women were more likely to favour red than were men. In an additional study (n = 183 Swiss participants, 47 men), we tested whether liking of pink, blue, and red was related to emotion associations with these colours. Pink was associated with positive emotions to the same extent as blue and red. Women further associated more positive emotions with pink than did men. We conclude that some commonalities (blue) and gender differences (pink and red) exist in absolute colour preferences. These differences, however, cannot be fully accounted by emotional associations. We speculate about these gendered colour preferences in relation to gender stereotypes and status differences between men and women.

Keywords: Gender differences, colour cognition, aesthetic preferences, affect, emotion, individual differences

Pink for Girls, Red for Boys, and Blue for Both Genders: Colour Preferences in Children and Adults

Finding clothes for children or toys that are free of stereotyped colours is challenging, at least in Western countries. Commonly, we find many light blue objects for boys, and pink objects for girls (Cunningham & Macrae, 2011). Colour is used as a proxy to refer to gender: pink for girls and blue for boys. Interestingly, this gender coding is a rather new invention. Before the 1920s, pink could be used to refer to girls as well as to boys (Del Giudice, 2012, 2017). An observational study showed that by the age of two, girls are proportionally over-exposed to pink objects (toys, clothes) when compared to boys (Pomerleau, Bolduc, Malcuit, & Cossette, 1990). Even parents who consciously avoided gendered colours for their children nonetheless reported that their 3–6 year-old children selected items of gendered colours (Halim et al., 2014). Thus, we experience gendered colours from an early age. In a cross-sectional design in a Western context (Switzerland), we investigated whether these gendered colour experiences are still reflected in colour preferences in later childhood and adulthood.

Colour preferences can be defined as "relatively stable evaluative judgments in the sense of liking or disliking a [colour], or preferring it or not over other [colours]" (Scherer, 2005, p. 703). In order to infer preferences, a comparison between at least two colours has to be made. Important to our study, we wish to highlight how such preferences are assessed. To start, the majority of published studied assessed *relative* colour preference, that is, liking/disliking of certain colours when compared to some other colours (e.g., Eysenck, 1941; Hurlbert & Ling, 2007; Palmer, Schloss, & Sammartino, 2013). In such cases, pre-selected colours are chosen from a restricted sample of colours, giving little information whether these colours are liked or disliked in absolute terms. Studies report less frequently on *absolute* colour preferences, the

liking/disliking of colours when considering an unrestricted range of colours. One option is a production task (Palmer et al., 2013) such that participants select the most or least preferred colours from among all colours that can be presented to a participant (e.g., Fortmann-Roe, 2011; Jonauskaite et al., 2016). Although favourite colour is likely a good indicator of real life colour choices (Yu et al., 2018), absolute colour preference limits knowledge about the extreme ends of a colour preference continuum, leaving intermediate preferences unassessed. For the remainder of the manuscript, we discuss relative colour preference if not otherwise stated.

When looking at actual colour preferences of boys and girls, researchers concluded there were no gender differences in infancy (Franklin, Bevis, Ling, & Hurlbert, 2010; Jadva et al., 2010). Between four and 24 months, both genders like red (Franklin et al., 2008, 2010, 2012; Jadva et al., 2010; Taylor, Schloss, Palmer, & Franklin, 2013; Zemach, Chang, & Teller, 2007) or dark yellow (Taylor, Schloss, et al., 2013). At that early age, both girls and boys dislike light blue (Franklin et al., 2010; Taylor, Schloss, et al., 2013) and sometimes pink and brown (Franklin et al., 2008; Zemach et al., 2007). These and other studies demonstrate that infants' colour preferences are very different from adults' colour preferences (also see Taylor, Schloss, et al., 2013).

At around two years of age, boys start to prefer blue items over pink and girls pink items over blue (Cunningham & Macrae, 2011; LoBue & DeLoache, 2011; Wong & Hines, 2015) but see Zentner, 2001). When entering school age, girls preferred pink to a greater extent than did boys (Park, 2013; Pranckevičienė, Žardeckaitė-Matulaitienė, & Soikinaitė, 2009; but see Child, Hansen, & Hornbeck, 1968). Boys as compared to girls, on the other hand, liked blue, green, red, black, and orange (Pranckevičienė et al., 2009). In adulthood, women prefer pinkish-reddish colours more than men do (Al-Rasheed, 2015; Bonnardel, Beniwal, Dubey, Pande, & Bimler,

2017; He et al., 2011; Hurlbert & Ling, 2007; Sorokowski, Sorokowska, & Witzel, 2014; but also see Eysenck, 1941; Ou, Luo, Woodcock, & Wright, 2004; Taylor & Franklin, 2012). In sum, a female bias for pinkish hues starts around two years of age, an age when children become aware of their own gender and what is (or is not) considered appropriate for girls and boys (Zosuls et al., 2009). Women's relative preference for pinkish-reddish colours, as compared with men, seems to persist in adulthood.

Males' colour choices indicate that they do not choose pink. The development of gender identity might lead boys to avoid pink in order to dissociate themselves from the female stereotype. The literature on the development of gender identify shows that around the age of 5–7 years-old, the belief that boys/girls must stick to boyish/girly activities, behaviours, and appearances seems to reach a peak (Dafflon Novelle, 2010). Colour preferences and colour choices may be one of the many ways (e.g., toys, clothing, decorations) to reinforce one's gender identity (Halim et al., 2014). Chiu and colleagues (2006) studied children with gender identity disorder and showed that boys who identified as girls preferred pink/purple more than did boys who identified as boys. Girls who identified as boys avoided pink/purple and chose blue more than did girls who identified as girls. Thus, understanding and complying with gender stereotypical behaviours may lead to avoiding gender incongruent behaviours or preferences (Halim et al., 2014). In the case of colour preferences, LoBue and DeLoache (2011) demonstrated that two-year-old girls chose pink over other colours and did that more often than did boys. However, by the age of four, girls no longer chose pink over other colours, whereas boys continued to avoid pink. Consequently, boys were much less likely to choose a pink toy than were girls, which could be interpreted as girls liking pink or, alternatively, as boys avoiding pink.

The previous literature shows a relative preference of females for pink and a relative anathema of males for pink. However, we do not know whether the same conclusions can be drawn when males and females select their favourite colour from an unrestricted colour range. Favourite colours may give better insight into real-life colour choices (Yu et al., 2018). Thus, we tested *absolute* colour preferences in children and adults in a Western context. In the first study, we assessed favourite colours of children between 10 and 14 years-old during their visit of our campus during open days. In the second laboratory study, we tested favourite and least favourite colours of adults between 18 and 48 years-old. In both cases, participants selected colours from an unrestricted sample of colours, that is, all the colours a computer screen could produce. We grouped hues into the three relevant categories of pink, blue, and red. We coded all remaining hues (including green, orange, yellow, etc.) into the category "other." We also accounted for the other colour parameters chroma (i.e., colour purity) and lightness because they are important predictors of colour preferences (Jonauskaite et al., 2016; Palmer & Schloss, 2010).

If absolute colour preferences followed the same pattern as relative colour preferences, we expected to observe gender differences in colour preferences in children (Chiu et al., 2006; LoBue & DeLoache, 2011) and in adults (Bonnardel et al., 2017; Hurlbert & Ling, 2007; Sorokowski et al., 2014). In particular, we hypothesised that women would show a tendency to select pinkish-reddish hues, whereas men would not select them. We also predicted that blue would be equally liked by men and women (e.g., Bonnardel et al., 2017; Eysenck, 1941). One important result from previous literature was that the gender difference in preference for pink was higher in girls than in women. Therefore, we further elaborated whether pink might have low positive valence in adulthood, whereas other liked colours might have positive valence. To do so, we extracted colour-emotion associations for pink, red, and blue gathered from an adult

sample collected within a larger project on international colour-emotion associations (Mohr, Jonauskaite, Dan-Glauser, Uusküla, & Dael, 2018). We chose these data because emotion associations might be one of the explanatory factors of why colours are liked or disliked (Palmer & Schloss, 2010). We tested whether gender differences in absolute colour preferences would be reflected by associating positive (liked) and negative (disliked) emotions with those hues.

Study 1: Colour Preferences in Children

Method

Participants. Our data were collected from a convenience sample during the Science Open Days at our University. We collected data from 131 Swiss children (68 boys) aged between 10 and 14 years in total. Groups of school classes covering this age range were most common during this event. Of these 131 participants, we excluded two participants due to missing gender information. The final sample's mean age was 11.58 years (SD = 1.22). The average age of boys (M = 11.60, SD = 1.26) did not differ from the average age of girls (M = 11.52, SD = 1.16), $t(127) = 0.37$, $p = .72$, $d = .066$. None of the participants reported being colour blind. All participants were proficient French speakers living in Switzerland. The experiment was conducted in accordance with the principles expressed in the Declaration of Helsinki (World Medical Association, 2013), and informed consent was collected from the accompanying adult (parent or teacher).

Colour picker. We worked with a colour picker, which was similar to the one described in previous studies (Jonauskaite et al., 2016) and can be accessed online (https://www2.unil.ch/onlinepsylab/ColourPicker/html/colorpicker.html). Using this colour picker, participants can choose colours varying in hue, chroma, and lightness and presented on a computer screen. At the beginning, participants see nine square colour patches (red, orange,

yellow, yellow-green, green, green-blue, blue, purple, and grey) in front of a white background rectangle (Figure 1s in the online supplement). Participants are instructed to imagine their favourite (and least favourite for adults, Study 2) colours and click on one of the nine patches that resembles their target colour the most. After this choice, the selected colour patch reappears in the centre with variations of hue and chroma depicted around it (Figure 1s, 2). After the next choice, again the chosen patch reappears in the centre with variations, now smaller, of this colour shown around it, etc. (Figure 1s, 3-6). When the differences between the patches become almost indistinguishable, the outer patches disappear and the centre patch is identified as the final colour choice (Figure 1s, 7). After the last choice, the RGB values of the selected colour are presented and recorded together with the number of clicks taken to reach the final choice.

Procedure. Participants attended the experiment as a class activity or as an individual activity. Those attending the class activity were seated in a dark room with only computer monitors being lit. Children were sitting next to each other at approximately two arms-length distance. A male and a female experimenters were available for questions and to verify that each child chose their favourite colour independently, not consulting with neighbours. Those who did not choose their colour independently were excluded from our subsequent analyses (e.g. when the class was big, we did not have enough monitors and more than one child performed the task on the same monitor). All participants used the colour picker to choose their favourite colour for no specific context (i.e., in general). Their colour choices were recorded in the RGB colour space. Participants' demographic information was collected before the colour selection. The experiment took under 10 minutes to complete.

Apparatus and conversion of colour parameters. The task was performed on seven similar monitors (Colour Edge CG243W 24.1" Widescreen LCD display), which were linearized

with in-built sequence before each session. The monitor parameters were set to 6500 K, gamma: 2.2, contrast: 100%, and brightness: 25%, 1920 x 1200 pixels resolution, and they were confirmed by the experimenters before each session. Due to inherent limitations of LCD screens (i.e. emitted colours vary as a function of viewing angle; Sharma, 2002), we instructed our participants to keep their head in front of the centre of the screen. The colour selections were recorded in RGB monitor-dependent format. In order to convert these colour values into monitor-independent CIE LCh values, we used the Konica Minolta CS-100A chroma meter to measure the parameters of red, green, and blue guns of each of the monitor. We then estimated the gamma curve for each monitor and linearised the RGB values with regard to the monitor used for colour selections. We applied existing formulae (Lindbloom, 2017) to the linearized RGB values and converted them into CIE LCh values. CIE LCh values described hue, chroma, and lightness of each colour selection: CIE LCh hue (range 0°-360°), CIE LCh chroma (1-141), and CIE LCh lightness (1-100).

Design and analysis. We analysed colour selections separately for hue, chroma, and lightness. Hue angles were binned into nine perceptually relevant categories. The discrete ranges for each hue category were based on the results from Parraga and Akbarinia (2016), who compiled a physiologically plausible colour categorization model and identified, by using the method of adjustment, which hue ranges matched specific colour terms (for more information, see Jonauskaite et al., 2016; Parraga & Akbarinia, 2016, and our online supplement). From these nine categories, we selected and regrouped (in the case of Pink/Purple) only the hue categories that were pertinent for the research question: Red (Hue angle = 346°–40°, lightness < 70), Blue (Hue angle = 166°–275°), Pink/Purple (Hue angle = 275°–346°, or Hue angle = 346°–40° and lightness ≥ 70); and binned the remaining hues into a single category: Other (the remaining hue

angles and/or when chroma < 5 for achromatic choices). We chose to analyse hue as a categorical variable rather than a continuous variable because (a) of ecological validity—hue is perceived (Robinson, Liu, & Bair, 2015) and conceptualised (Lindsey & Brown, 2014) in categories rather than as a continuous spectrum which is the case for chroma and lightness and (b) our predictions were driven by more or less large hue ranges reported in the literature (i.e., pink/red vs. blue). Chroma and lightness were analysed as continuous variables.

To test for gender differences in hue choices, we used a generalised model of binomial logistic regression and bootstrapping. For the binomial logistic regression, we categorized hue choices into two categories as either chosen (coded 1) or not chosen (0) for each hue category separately (i.e., Red, Pink/Purple, Blue, and Other). We then used gender as a predictor variable and binomial hue category (i.e., chosen vs. not chosen) as an outcome variable. This procedure gave us information about the differences between boys' and girls' preferences for each hue category (e.g., whether boys were more likely to choose blue as their favourite colour than were girls). To identify the most (or least) common hue choice within each gender and type of preference (i.e., most and least, for adults only in Study 2), we used bootstrapping technique (Efron, 1979; Piegorsch & Richwine, 2001). Bootstrapping was chosen because of a low expected frequency in each cell. From the initial hue distribution, we randomly drew 100,000 samples with replacement. We then determined the distribution of the differences in hue choice proportions between all possible hue pairs ($p_i - p_j$, i.e., 6 pairs in total) on these bootstrapped samples and calculated confidence intervals for each pair of hues. We employed a Bonferroni correction for multiple comparisons to reduce Type I error (alpha/(k*(k-1)), where alpha corresponded to the threshold of significance (0.05) and k corresponded to the number of

possible hue categories (here k = 4). We used the letter-based representations (Piepho, 2004) to compare hue distributions and visually present the differences.

Gender differences in chroma, lightness, and the number of clicks were analysed with independent-samples *t*-tests, Bonferroni corrected for multiple comparisons. Alpha level was set to 0.05. All analyses were performed and graphs created with the R (R Core Team, 2018) and SPSS v.24 (IBM Corp, 2013) statistical software programs.

Results

Figure 2s (in the online supplement) displays colour choices as favourite colours by boys (A.1) and girls (B.1). The binomial logistic regression models showed gender was a significant predictor for Pink/Purple, $\chi^2(1) = 19.93$, $p < .001$, $V = .390$, Red, $\chi^2(1) = 7.56$, $p = .006$, $V = .240$, and Other, $\chi^2(1) = 9.43$, $p = .002$, $V = .268$, but not for Blue, $\chi^2(1) = 2.74$, $p = 0.099$, $V = .145$, hue categories. More girls ($p < .001$, 26.2%) chose Pink/Purple as their favourite hue than did boys (1.5%), whereas more boys chose Red ($p = .006$, 23.5%) or Other ($p = .002$, 33.8%) as their favourite hue than did girls (Red, 6.6%; Other, 11.5%). The same proportion of boys ($p = 0.099$, 41.2%) and girls (55.7%) chose Blue as their favourite hue (Figure 2s, A.2 vs. B.2, and Table 1).

We then continued with our bootstrapping analysis to identify which hue choices were most common for girls and boys. Girls most frequently chose their favourite colour from the Blue followed by the Pink/Purple hue category. Boys were equally likely to choose their favourite colour from the Blue, Red, or Other hue categories whereas they almost never chose it from the Pink/Purple hue category (see Table 1). Judging from the supplementary analyses including all hues (Other category broken down into separate hues), a common choice for favourite boys' hue was green and orange (see Figure 3s and Table 1s in the online supplement).

Finally, we looked at gender differences in lightness and chroma values of the chosen colours (see Table 2). Boys on average chose more chromatic colours than did girls whereas there was no gender difference in lightness values. There was also no difference in the number of clicks boys and girls took to find their favourite colour.

Study 2: Colour Preferences in Adults

Method

Participants. One hundred and eighty Swiss university students (88 men) participated in the experiment in return for course credit. One man was colour-blind as confirmed with the Ishihara (1993)colour blindness test; he was excluded from subsequent analyses. The final sample consisted of 179 students (87 men), with a mean age of 21.86 (SD = 4.15, range 17–48). The mean age of men (23.08, SD = 4.71) was higher than the mean age of women (20.69, SD = 3.15), $t(149.2) = 3.96$, $p < .001$, $d = .597$. Despite a significant difference in age between genders, age did not significantly correlate with any of the other outcome measures (all ps > .098). The present sample of men includes data from 22 men reported previously (Jonauskaite et al., 2016). In this previous contribution, gender differences were of no interest and were not reported. All other participants were newly tested participants. All participants were proficient French speakers living in Switzerland. The experiment was conducted in accordance with the principles expressed in the Declaration of Helsinki (World Medical Association, 2013), and informed consent was collected from all participants.

Materials and procedure. Materials and procedure in Study 2 were very similar to those of Study 1 except that Study 2 was run in the laboratory. Participants in Study 2 used the same monitors as in Study 1. Colour conversion was performed in the same way as in Study 1 after measuring the strength of red, green, and blue monitor guns of computer monitor under the

laboratory conditions. Participants selected their favourite as well as least favourite colours, in a counter-balanced order, using the already described colour picker.

Design and analysis. We analysed gender differences in participants' colour selections in terms of hue (CIE h value), chroma (CIE C value), and lightness (CIE L value) as well as the number of clicks (see Study 1 for details).

Results

Figure 2s (in the online supplement) displays colour choices for favourite (C.1 & D.1) and least favourite (E.1 & F.1) colours by men and women respectively. First, we tested whether gender could predict the frequency of chosen hues. For favourite colours, gender was a significant predictor for Red, $\chi^2(1) = 4.52$, $p = .034$, $V = .158$, and Other hues, $\chi^2(1) = 7.48$, $p = .006$, $V = .203$, and not significant for Pink/Purple, $\chi^2(1) = 0.88$, $p = .35$, $V = .070$, or Blue, $\chi^2(1) = 0.02$, $p = .88$, $V = .010$, hue categories. More women ($p = .034$, 29.3%) chose their favourite colour from the Red hue category than did men (16.1%), whereas more men ($p = .006$, 37.9%) chose their favourite colour from the Other hues category (visually, they seemed to be green and orange) than did women (19.6%, Figure 2s). An equal number of men and women chose their favourite colour from Pink/Purple ($p = .35$, men, 6.9%; women, 10.9%) and Blue ($p = .88$, men, 39.1 %; women, 40.2 %) hue categories, which was an uncommon and a common choice, respectively (Figure 2s, C.2 vs. D.2, and Table 1). For least favourite hues, gender was not a significant predictor for any of the hue categories: Pink/Purple, $\chi^2(1) = 0.14$, $p = .71$, $V = .028$; Red, $\chi^2(1) = 0.17$, $p = .684$, $V = .031$; Blue, $\chi^2(1) = 0.25$, $p = .62$, $V = .037$; or Other, $\chi^2(1) = 0.07$, $p = .79$, $V = .020$. Therefore, men and women chose least favourite colours from the same hue categories (Figure 2s, E.2 vs. F.2).

Next, we used bootstrapping analysis to identify which hue choices were most common for men and women as favourite and least favourite. Women most frequently chose their favourite colour from the Blue and Red hue categories, followed by Other, whereas men most frequently chose favourite colour from the Blue and Other hue categories (see Table 1). Men and women most frequently chose their least favourite colour from Other hue category (see Table 1). Some men also chose Pink/Purple as their least favourite hue. Based on supplementary analyses including all hues (Other category broken down into separate hues), the most frequent least favourite colour came from the yellow hue category (see Figure 4s and Table 2s in the online supplement).

Finally, we looked at gender differences in lightness and chroma values of the chosen colours as favourite and least favourite (see Table 2). We found no measurable gender differences. We also found no gender difference for the number of clicks to decide on a colour choice.

Study 3: Emotions Associated with Colours

Method

Participants. We extracted the data from 183 participants (47 men) from a larger dataset collected in an online study (https://www2.unil.ch/onlinepsylab/colour/main.php). In this ongoing international online survey, we are assessing emotion concept associations with colour terms (Mohr et al., 2018). We selected data from native French speakers who completed the survey in French and were also from Switzerland. Thus, their language and country information matched that of the participants in Studies 1 and 2. No participant reported being colour. A priori, in this online study, we were interested in colour-emotion associations from individuals covering a wide age range. In our selected French-speaking sample here, participants' mean age

was 32.65 (*SD* = 17.89, range 18–88). The mean age of men (39.57, *SD* = 20.05) was higher than the mean age of women (30.24, SD = 16.49), $t(68.9) = 2.87$, $p = .005$, $d = .508$. To evaluate whether this age difference impacted our results, we entered an interaction term between age and gender in the linear logistic regression. Other demographic variables such as ethnicity or socio-economic status were not recorded.

Geneva Emotion Wheel. We assessed emotion associations for colour terms with the Geneva Emotion Wheel (GEW, version 3.0; Scherer, 2005; Scherer, Shuman, Fontaine, & Soriano, 2013)**.** The GEW depicts 20 discrete emotions displayed in a circular shape. The emotions can be grouped along a valence dimension (positive/negative) and a dominance dimension (high power/low power). Also, the emotion associations can be analysed as discrete categories. In our study, based on our research question, we grouped emotions by valence into positive (interest, amusement, pride, joy, pleasure, contentment, admiration, love, relief, and compassion) and negative (sadness, guilt, regret, shame, disappointment, fear, disgust, contempt, hate, and anger) emotions. Circles of increasing size, mapped from the hub to the rim of the wheel, signify five degrees of intensity of these emotions (i.e., bigger circles signify stronger intensities). These intensity ratings were later converted into values of 1 (smallest circle) to 5 (biggest circle). Options “No emotion” and “Different emotion” appear in the centre of the wheel. All emotions that were not chosen were coded as 0. If participants clicked on “Different emotion,” they were invited to name the emotion(s) in the pop-up window. We did not further analyse eight emotions from six participants that were included in the “Different emotion” category in the current study.

Materials and procedure. The online survey assessed emotional associations with colour terms (https://www2.unil.ch/onlinepsylab/colour/main.php). After the consent form,

instructions, and manipulation check (for more information, see Mohr et al., 2018), participants saw 12 colour terms (RED, ORANGE, YELLOW, GREEN, BLUE, TURQUOISE, PURPLE, PINK, BROWN, BLACK, GREY, and WHITE) in their native language (i.e., French), one at a time appearing above the GEW in a randomised order. Participants selected one or several emotions from the GEW they thought were associated with the given colour term and rated the intensity of the associated emotions. Afterwards, participants completed a short demographic questionnaire, were thanked for their participation, and received results from a previous related study in graphic format.

Initial data selection and cleaning. In addition to previously mentioned selection criteria (i.e., native language, country of origin, and colour blindness), we excluded participants who took less than 3 or more than 90 minutes to complete the survey. We also excluded participants who took less than 20 seconds to provide responses for the first four colour terms. The underlying reasons for these cut-off points was that respondents who take too little time (< 3 min) may not have paid full attention to the survey and rushed their responses whereas respondents who take too much time (> 90 min) may have interrupted the survey and thus not dedicate their full attention. Only participants who fulfilled all of the requirements were included in the study. Finally, we made sure that there were no missing emotion ratings for RED, BLUE, and PINK colour terms and no missing age or gender information.

Design. In the context of the current study, we are only interested in the emotional associations with three colour terms: RED (*rouge*), PINK (*rose*), and BLUE (*bleu*). We looked at two outcome variables for these emotional associations: (a) the number of associated emotions (regardless of the intensity of associated emotions) and (b) the average intensity of associated emotion(s), when an association was reported. We calculated the number of associated emotions

and the average intensity of associated emotions separately for positive and negative emotions associated with RED, PINK, and BLUE colour terms.

To test for gender differences, we compiled a mixed ANOVA model with colour (three levels: RED, PINK, and BLUE) and valence (positive and negative) as within-subjects independent variables and gender (male and female) as a between-subjects variable on the number of associated emotions. We were unable to compile an analogous mixed ANOVA model for the intensity of associated emotions because a rather large number of participants did not report an association with a given colour term and consequently did not provide the intensity rating. Therefore, we compiled six separate independent *t*-tests with gender as a between-subjects variable and the intensity of associated positive and negative emotions with each colour term as dependent variables (Bonferroni corrected for multiple comparisons). Each *t*-test had a different number of data points due to missing data.

Additionally, we tested if there were any age differences in the number or the intensity of reported associations. For age effects on the number of associated emotions, we compiled six linear regression models (Bonferroni corrected) with age as a predictor variable and the number of positive and negative emotions associated to RED, PINK, and BLUE colour terms as outcome variables. For age effects on the intensity of associated emotions, we again compiled six linear regression models (Bonferroni corrected) with age as a predictor variable and the intensity of associated emotions as outcome variables. The latter models had a different number of participants each time due to some participants not reporting an association with a given colour term.

Results

Number of associated emotions with colour. The ANOVA on the number of associated emotions showed a significant main effect of colour, $F(2, 360) = 18.08$, $p < .001$, $\eta_p^2 = .091$. RED ($M = 2.19$, $SE = .15$) was overall associated with a larger number of emotions than was PINK ($M = 1.65$, $SE = .13$, $p < .001$) or BLUE ($M = 1.70$, $SE = .14$, $p < .001$), with the latter two not differing from each other ($p = 1.00$). There was also a main effect of valence, $F(1, 180) = 98.0$, $p < .001$, $\eta_p^2 = .352$, with participants associating more positive ($M = 2.50$, $SE = .16$) than negative ($M = 1.20$, $SE = .13$) emotions to the three colour terms. There was no significant main effect of gender, $F(1, 180) = .98$, $p = .32$, $\eta_p^2 = .005$.

There were significant two-way interactions between gender and valence, $F(1, 180) = 4.7$, $p = .032$, $\eta_p^2 = .025$, and between colour and valence, $F(2, 360) = 36.6$, $p < .001$, $\eta_p^2 = .169$, but not between colour and gender, $F(2, 360) = 2.5$, $p = .082$, $\eta_p^2 = .014$. Finally, there was a three-way interaction among gender, colour, and valence, $F(2, 360) = 3.8$, $p = .025$, $\eta_p^2 = .020$. When we broke down these interactions, women associated a larger number of positive emotions to PINK than did men ($p = .002$) whereas all other comparisons were not significant (all $ps \geq .364$; see Table 3a). Finally, *t*-tests comparing the intensity of associated emotions did not show any significant gender effects (all $ps \geq .61$; see Table 3b).

Intensity of associated emotions with colour. Linear regression models showed that age was a significant predictor of the number of positive emotions associated with PINK and the number of negative emotions associated with RED and BLUE (see Table 4a). The negative beta values indicated that participants associated fewer emotions as they got older. In these models, there were no interactions between age and gender (all $ps > .348$). As with gender, there were no age differences in the intensity of associated emotions (see Table 4b) or interactions with gender (all $ps > .140$). We draw the readers' attention to the fact that sample size was reduced in these

comparisons due to only some participants reporting an emotion association with a given colour term (see sample sizes in Table 4).

General Discussion

In the current study, we investigated whether early gender stereotyping of colours can still be observed when looking at gender differences in absolute colour preferences in children and adults. In the first of two studies, children (10–14 year-old) and adults (17–48 years-old) were asked to use a computerised colour picker (Jonauskaite et al., 2016) to select their favourite colour and least favourite colour (adults only) from the entire range of colours a computer screen could display. As their favourite hue, (a) girls chose pink/purple more often than boys did, (b) boys chose red more often than girls did, and (c) women chose red more often than men did. Apart from these gender differences, females and males in both age ranges chose blue very often as their favourite hue. Absolute colour preferences did not vary by lightness in children or adults. There was a variation in chroma in children but not in adults with boys as compared to girls choosing more chromatic colours as their favourite.

Whereas girls favoured pink more than boys did, adult women did not favour pink more than adult men did, and overall rarely chose this colour as their favourite. Preference for pink may be rooted in colour-emotion associations because liked colours are hypothesised to be associated with positive emotions and disliked colours with negative emotions (Palmer & Schloss, 2010). Therefore, in the third study, we further elaborated whether pink had low positive valence in adulthood, as well as blue and red had high positive valence. To do so, we extracted colour-emotion associations for pink, red, and blue gathered from a Swiss adult sample collected within a larger project on international colour-emotion associations (Mohr et al., 2018). These data demonstrated that participants of both genders evaluated pink as being very positive,

actually equally positive as blue and red. Opposite to evaluating pink negatively, women associated even a larger number of positive emotions with pink than did men. We observed no gender differences in colour-emotion associations with red and blue. Before discussing results in more detail, we briefly conclude that gender differences in absolute colour preferences (i.e., favourite colours) exist and follow a similar pattern as gender differences in relative colour preferences (i.e., evaluating liking of one colour over other colours). Importantly, disliking of pink was not explained by pink being associated with negative emotions. Rather, we might speculate that disliking pink can be explained by the negative female stereotype associated with the otherwise positive colour pink.

Many of the current findings on absolute colour preferences replicated results obtained using relative colour preference techniques. For instance, girls chose pink/purple hues more often as their favourite compared to boys, whereas boys seemed to have little liking for pink/purple (Chiu et al., 2006; Cunningham & Macrae, 2011; LoBue & DeLoache, 2011; Pranckevičienė et al., 2009; Wong & Hines, 2015). In our adult population, we confirm that red was very much liked, but still more so by women than by men. These results on red are in line with other studies on relative (Al-Rasheed, 2015; Hurlbert & Ling, 2007; Sorokowski et al., 2014; Witzel, 2015) and absolute (Fortmann-Roe, 2011) colour preferences. In addition to these gender differences, we observed that blue was the most common favourite colour by both genders of all ages. Hence, despite the popular notion that blue is for boys (Cunningham & Macrae, 2011), our and other empirical studies indicate that blue (or blue-green, which was included in the blue hue category in the current study) is the most popular hue for both genders when genders were considered together (Eysenck, 1941; Hemphill, 1996; Jonauskaite et al., 2016; Palmer & Schloss, 2010) or separately (Bonnardel et al., 2017; Ou et al., 2004). Other developmental studies have also

shown that blue is a liked colour by boys and girls, with few gender differences (Chiu et al., 2006; Terwogt & Hoeksma, 1995).

People of both genders liked blue, which meant that boys were not more likely than were girls to choose blue as their favourite colour. Blue might be a masculine colour when contrasted to pink (Weisgram, Fulcher, & Dinella, 2014), but it is not necessarily as gender-typed when considering blue among other colours. Global liking of blue is reflected in applied settings, where large companies like Facebook, LinkedIn, Twitter, Skype, IBM, HP, and others have blue logos. Thus, we can infer that pink/purple rather than blue was the gendered colour. Because pink/purple was only the second favourite hue of girls, the gendered effects of pink/purple should probably be best explained by boys not selecting this colour (see also LoBue & DeLoache, 2011). Women and men in the current study did not select pink very often either. In fact, our women choose pink as favourite hue as rarely as they chose pink as least favourite hue. Thus, we can conclude that one of the least likely favourite colours of boys, men, and women is pink/purple.

On a theoretical level, we would like to reiterate that this low preference for pink and high preferences for red and blue in adults cannot be explained by negative and positive colour-emotion associations, respectively (Palmer & Schloss, 2010). Red, pink, and blue were all associated with positive concepts in our third study. Additionally, red was equally often associated with positive and negative concepts, blue was less associated with negative concepts, and pink was the least associated with negative concepts. The connotation of red with both positive and negative emotions is not new. Red carries connotations of sexual attractiveness (Elliot & Niesta, 2008) as well as passion and love (Clarke & Costall, 2008; Elliot & Maier, 2007). Red also signals danger and aggression (Pravossoudovitch, Cury, Young, & Elliot, 2014;

Wiedemann, Burt, Hill, & Barton, 2015). Blue is associated with mainly positive objects or concepts (Palmer & Schloss, 2010) as well as positive emotions (Adams & Osgood, 1973; Valdez & Mehrabian, 1994). Of interest, however, is pink because, contrary to theory-driven expectations (Palmer & Schloss, 2010), low liking of pink (in one sample) did not mean that pink associated with negative emotions (in another sample), but actually with positive emotions (see also Gil & Le Bigot, 2014; Kalay-Shahin, Cohen, Lemberg, Harary, & Lobel, 2016; Simmons, 2011). We conjecture that gender differences in colour preferences are not primarily explainable by differences in colour-emotion associations. Potentially, pink is associated with being a girl and red with being a grown-up woman, and gender-related stereotypes drive liking (or rather disliking) of these colours.

Practice Implications

Given our results, therefore, it seems safe to conclude that in middle childhood boys stay away from "girly" pink/purple colours more than girls seek to be surrounded by them and that both genders have little interest in pink as a favourite colour in adulthood. The idea that both genders seek to eschew pink—although boys/men to a greater extent and from an earlier age than girls/women—would corroborate results from earlier studies, which have shown that males tend to shun stereotypically feminine activities more than females avoid stereotypically masculine activities. Early on in childhood boys tend to avoid girls' toys more than girls avoid boys' toys (Carter & Levy, 1988; Hartup, Moore, & Sager, 1963; Muller & Goldberg, 1980; O'Brien, 1992). From middle childhood, around the age of 6 years onwards, girls begin to shift toward actively endorsing more masculine behaviours and preferences, whereas there seems to be no similar shift towards femininity for boys (McHale, Kim, Dotterer, Crouter, & Booth, 2009; Thorne, 1993). During adolescence, girls aspire to occupy male-dominated professions more

frequently than their masculine peers aspire to occupy female-dominated professions (Gianettoni, Simon-Vermot, & Gauthier, 2010). This tendency is equally present in adulthood. Although women have made headway in endorsing traditionally masculine roles, conversely, men's incursions into traditionally female roles have remained comparatively minimal (Croft, Schmader, & Block, 2015).

This global shift towards masculinity in both genders is readily explained in the light of the literature examining status differences. Status is an indicator of the social value and prestige of a given group or individual, and both groups and individuals tend to pursue it. In fact, status pursuit has been identified as a fundamental drive, common to both genders, and a reliable predictor of people's mental and physical health (Anderson et al., 2015). Despite some social progress for women, men are still globally found to hold higher-status positions than women do in the vast majority of today's existing societies (United Nations Development Programme, 2013) and are viewed as cultural ideals (Cuddy et al., 2015). Thus, the female gender globally tends to be perceived as a less prestigious social category when compared with the male gender (Fiske, 2010). Consequently, cross-gender behaviour has a very different meaning depending on the gender of the person expressing it. A feminine man is essentially lowering his status, whereas a masculine woman is essentially upgrading hers (Moss-Racusin, Phelan, & Rudman, 2010; Rudman, Moss-Racusin, Phelan, & Nauts, 2012). This pattern would explain why males continue to be stigmatized to a much greater extent than females for their endorsement of cross-gender preferences (Raag & Rackliff, 1998) and why females, on the contrary, endorse a pro-active approach to expressing cross-gender preferences.

Although pink and femininity remain associated in adulthood (Cunningham & Macrae, 2011), it is likely that expressing a preference for this colour might prove equally undesirable for

women and men as well as for girls who have reached a certain age. Because pink signals femininity (and perhaps also infancy and homosexuality, which are similarly low-status groups; (Hughes, 2006; Pomerleau et al., 1990), it is likely to be the mark of a lower-status social category when it is compared to more masculine colours. Thus, it makes sense that people of both genders who are aware of the fact that pink indicates lower-status (inferior) taste should prefer to endorse a higher-status (superior) taste for colours, and so more or less consciously eschew pink.

Despite these negative connotations, many feminine items on the market (e.g., hygiene products) or female causes (e.g., breast cancer ribbon) remain marketed in pink. The fact that pink is a feminine colour and that it carries positive connotations does not necessarily imply that pink items or marketing campaigns will appeal to the target audience and bring across the desired message. They might reinforce the idea of women being lower-status and needing protection as well as their causes being in some sense childish. A marketing research study has demonstrated numerous negative outcomes associated with pink (as compared to gender-neutral) breast cancer campaigns, such as women perceiving breast cancer as less of a risk and being less willing to donate money (Puntoni, Sweldens, & Tavassoli, 2011). Considering that red is a liked colour by women, as shown here and previously (Hurlbert & Ling, 2007), red could be an alternative choice for feminine products or campaigns. Prior to any such implementation, future research should identify the precise shades of red to avoid additional undesirable negative connotations of red.

Limitations and Future Directions

Because empirical studies, by default, suffer from experimental limitations, we will highlight some obvious ones (absolute versus relative colour preference, cross-sectional versus

longitudinal designs), and focus on important future directions (culture). In the first two studies, we tested absolute colour preferences in males and females. We asked participants to use a computerized colour picker to choose their favourite colour (and least favourite colour in Study 2) from an unrestricted colour range (what a computer screen can display). Results might give insight into real life choices (Yu et al., 2018). Yet, the assessment of absolute colour preferences provides information on the extreme ends of a likely continuum of colour preferences. It would be possible to assess both these ends and their intermediate content by combining absolute and relative colour preference procedures.

Previous cross-sectional studies demonstrated that relative colour preferences differ between younger and older populations (Dittmar, 2001; Gong & Lee, 2017; Saito, 1996). Here, using a cross-sectional design, we observed that gender differences in absolute colour preferences were expressed differently in children and adults. Moreover, we aimed to understand preferences through colour-emotion associations, the latter tested in the third independent sample. It would be interesting to infer causality and change (e.g. ageing, gender stereotyping) but it was not possible to make such inferences with a cross-sectional design. To understand how absolute colour preferences and colour-emotion associations change within a person and across time, a longitudinal design needs to be performed.

In the current report, we tested a Western population, and we referred mainly to the literature reporting on results gathered from Western populations. However, culture might play an important role in shaping one's colour preferences (Taylor, Clifford, & Franklin, 2013). If gendered colours are shaped by cultural experience, gender differences in colour preferences might differ between societies. A recent study in China showed that 5–8 year-old girls preferred pink over blue whereas boys preferred blue over pink (Yeung & Wong, 2018). Adult women in

Saudi Arabia, China, India, and Papua New Guinea also preferred reddish-pinkish or purple hues to a greater extent than did men (Al-Rasheed, 2015; Bonnardel et al., 2017; He et al., 2011; Sorokowski et al., 2014; Witzel, 2015). Several other studies, however, did not report such a gender difference in China, Namibia, or Japan (Ou et al., 2004; Taylor, Clifford, et al., 2013; Yokosawa, Schloss, Asano, & Palmer, 2016). Judging from this diverse body of literature, it is unclear how strongly gender difference in liking of pink is shaped by culture (Taylor, Clifford, et al., 2013) or rather determined by biology (Hurlbert & Ling, 2007). It is crucial to assess whether participants were exposed to these gendered colours in their infancy and childhood before drawing conclusions about the origins of gender differences. Future studies should systematically assess explanatory factors of gender differences in colour preferences to estimate the influence of culture and biology.

Conclusion

We assessed whether gender stereotypes of early infancy colours (i.e., pink for girls and blue for boys) are reflected in absolute colour preferences in later childhood and adulthood. We observed that blue was not a gendered colour. Blue was a common favourite colour of both genders in children and adults. Pink, on the other hand, was a gendered colour. Girls chose pink/purple as favourite hue, whereas boys, men, and women rarely chose pink/purple. We could not explain this low liking for pink with negative colour-emotion associations (Palmer & Schloss, 2010). On the contrary, pink was an exclusively positively valenced colour. Red, in contrast, was associated with positive as well as negative emotions. To explain our findings, we speculated that pink is a positive colour, but highly charged with a feminine gender stereotype. This stereotype is in turn associated with undesirable features such as weakness and low social dominance. To understand causality and change over time, we suggest that our findings should

be replicated and extended using a longitudinal design. We can conclude that pink may be a colour for girls more than for boys, but it is blue that appeals to (almost) everyone.

References

Adams, F. M., & Osgood, C. E. (1973). A cross-cultural study of the affective meanings of color. *Journal of Cross-Cultural Psychology*, *4*(2), 135–157. http://doi.org/10.1177/002202217300400201

Al-Rasheed, A. S. (2015). An experimental study of gender and cultural differences in hue preference. *Frontiers in Psychology*, *6*, 1–5. http://doi.org/10.3389/fpsyg.2015.00030

Anderson, C., Hildreth, J. A. D., Howland, L., Anderson, C., Hildreth, J. A. D., & Howland, L. (2015). Is the desire for status a fundamental human motive ? A review of the empirical literature. *Psychological Bulletin*, *141*(3), 574–601. http://doi.org/10.1037/a0038781

Bonnardel, V., Beniwal, S., Dubey, N., Pande, M., & Bimler, D. (2017). Gender difference in color preference across cultures: An archetypal pattern modulated by a female cultural stereotype. *Color Research and Application*, *43*, 1–15. http://doi.org/10.1002/col.22188

Carter, D. B., & Levy, G. D. (1988). Cognitive aspects of early sex-role development: The influence of gender schemas on preschoolers' memories and preferences for sex-typed toys and activities. *Child Development*, *59*(3), 782–792. http://doi.org/10.2307/1130576

Child, I. L., Hansen, J. a, & Hornbeck, F. W. (1968). Age and sex differences in children's color preferences. *Child Development*, *39*(1), 237–247.

Chiu, S. W., Gervan, S., Fairbrother, C., Johnson, L. L., Owen-Anderson, A. F. H., Bradley, S. J., & Zucker, K. J. (2006). Sex-dimorphic color preference in children with gender identity disorder: A comparison to clinical and community controls. *Sex Roles*, *55*(5–6), 385–395. http://doi.org/10.1007/s11199-006-9089-9

Clarke, T., & Costall, A. (2008). The emotional connotations of color: A qualitative investigation. *Color Research and Application*, *33*(5), 406–410.

http://doi.org/10.1002/col.20435

Croft, A., Schmader, T., & Block, K. (2015). An underexamined inequality: Cultural and psychological barriers to men's engagement with communal roles. *Personality and Social Psychology Review*, *19*(4), 343–370. http://doi.org/10.1177/1088868314564789

Cuddy, A. J. C., Wolf, E. B., Glick, P., Crotty, S., Chong, J., & Norton, M. I. (2015). Men as cultural ideals: Cultural values moderate gender stereotype content. *Journal of Personality and Social Psychology*, *109*(4), 622–635. http://doi.org/10.1037/pspi0000027

Cunningham, S. J., & Macrae, C. N. (2011). The colour of gender stereotyping. *British Journal of Psychology*, *102*(3), 598–614. http://doi.org/10.1111/j.2044-8295.2011.02023.x

Dafflon Novelle, A. (2010). Pourquoi les garçons n'aiment pas le rose ? Pourquoi les filles préfèrent Barbie à Batman ? Perception des codes sexués et construction de l'identité sexuée chez des enfants âgés de 3 à 7 [Why do boys not like pink? Why do girls prefer Barbie to Batman? Perception of gender codes and construction of gender identity in children aged 3 to 7 years]. In *Genre et socialisation de l'enfance à l'âge adulte* (pp. 25–40).

Del Giudice, M. (2012). The twentieth century reversal of pink-blue gender coding: A scientific urban legend? *Archives of Sexual Behavior*, *41*(6), 1321–1323. http://doi.org/10.1007/s10508-012-0002-z

Del Giudice, M. (2017). Pink, blue, and gender: An update. *Archives of Sexual Behavior*, *46*(6), 1555–1563. http://doi.org/10.1007/s10508-017-1024-3

Dittmar, M. (2001). Changing colour preferences with ageing: A comparative study on younger and older native Germans aged 19-90 years. *Gerontology*, *47*, 219–226. http://doi.org/10.1159/000052802

Efron, B. (1979). Bootstrap methods: Another look at the jackknife. *The Annals of Statistics*, *7*(1), 1–26. http://doi.org/10.1214/aoms/1177692541

Elliot, A. J., & Maier, M. A. (2007). Color and psychological functioning. *Current Directions in Psychological Science*, *16*(5), 250–254.

Elliot, A. J., & Niesta, D. (2008). Romantic red: red enhances men's attraction to women. *Journal of Personality and Social Psychology*, *95*(5), 1150–64. http://doi.org/10.1037/0022-3514.95.5.1150

Eysenck, H. J. (1941). A critical and experimental study of colour preferences. *The American Journal of Psychology*, *54*(3), 385–394. http://doi.org/10.2307/1417683

Fiske, S. T. (2010). Interpersonal stratification: Status, power, and subordination. In *Handbook of Social Psychology*. Hoboken, NJ, USA: John Wiley & Sons, Inc. http://doi.org/10.1002/9780470561119.socpsy002026

Fortmann-Roe, S. (2011). Effects of hue, saturation, and brightness on color preference in social networks: Gender-based color preference on the social networking site Twitter. *Color Research & Application*, *38*(3), 196–202. http://doi.org/10.1002/col.20734

Franklin, A., Bevis, L., Ling, Y., & Hurlbert, A. (2010). Biological components of colour preference in infancy. *Developmental Science*, *13*(2), 346–354. http://doi.org/10.1111/j.1467-7687.2009.00884.x

Franklin, A., Gibbons, E., Chittenden, K., Alvarez, J., & Taylor, C. (2012). Infant color preference for red is not selectively context specific. *Emotion*, *12*(5), 1155–1160. http://doi.org/10.1037/a0025333

Franklin, A., Pitchford, N., Hart, L., Davies, I. R. L., Clausse, S., & Jennings, S. (2008). Salience of primary and secondary colours in infancy. *British Journal of Developmental*

Psychology, *26*(4), 471–483. http://doi.org/10.1348/026151007X256672

Gianettoni, L., Simon-Vermot, P., & Gauthier, J.-A. (2010). Orientations professionnelles atypiques: transgression des normes de genre et effets identitaire[Atypical career choices: Breaking the gender norms, and their effects on the identities of people]. *Revue Française de Pédagogie*, *173*, 41–50. http://doi.org/10.4000/rfp.2535

Gil, S., & Le Bigot, L. (2014). Seeing life through positive-tinted glasses: Color-meaning associations. *PLoS ONE*, *9*(8). http://doi.org/10.1371/journal.pone.0104291

Gong, S.-M., & Lee, W.-Y. (2017). Colour preference model for elder and younger groups. *Journal of the International Colour Association*, *18*, 33–42. Retrieved from http://www.aic-colour.org/journal.htm%0Ahttp://www.aic-color.org/journal.htm

Halim, M. L., Ruble, D. N., Tamis-LeMonda, C. S., Zosuls, K. M., Lurye, L. E., & Greulich, F. K. (2014). Pink frilly dresses and the avoidance of all things "girly": Children's appearance rigidity and cognitive theories of gender development. *Developmental Psychology*, *50*(4), 1091–1101. http://doi.org/10.1037/a0034906

Hartup, W. W., Moore, S. G., & Sager, G. (1963). Avoidance of inappropriate sex-typing by young children. *Journal of Consulting Psychology*, *27*(6), 467–473. http://doi.org/10.1037/h0047940

He, W., Zhang, Y., Zhu, J., Xu, Y., Yu, W., Chen, W., … Wang, W. (2011). Could sex difference in color preference and its personality correlates fit into social theories? Let Chinese university students tell you. *Personality and Individual Differences*, *51*(2), 154–159. http://doi.org/10.1016/j.paid.2011.03.035

Hemphill, M. (1996). A note on adults' color-emotion associations. *The Journal of Genetic Psychologyenetic Psychology*, *157*(3), 275–280.

http://doi.org/10.1080/00221325.1996.9914865

Hughes, H. L. (2006). *Pink tourism: holidays of gay men and lesbians*. CABI. http://doi.org/10.1079/9781845930769.0000

Hurlbert, A. C., & Ling, Y. (2007). Biological components of sex differences in color preference. *Current Biology*, *17*(171), 623–625. http://doi.org/10.1016/j.cub.2007.06.022

IBM Corp. (2013). IBM SPSS Statistics for Macintosh. Armonk, NY: IBM Corp.

Ishihara, S. (1993). *Album-test pour la recherche des dyschromatopsies congenitales, 38 plates edn. [Ishihara's Test for Colour Deficiency: 38 Plates Edition]*. Tokyo: Kanehara (Original work published 1917).

Jadva, V., Hines, M., & Golombok, S. (2010). Infants' preferences for toys, colors, and shapes: Sex differences and similarities. *Archives of Sexual Behavior*, *39*, 1261–1273. http://doi.org/10.1007/s10508-010-9618-z

Jonauskaite, D., Mohr, C., Antonietti, J.-P., Spiers, P. M., Althaus, B., Anil, S., & Dael, N. (2016). Most and least preferred colours differ according to object context: New insights from an unrestricted colour range. *Plos One*, *11*(3), 1–22. http://doi.org/10.1371/journal.pone.0152194

Kalay-Shahin, L., Cohen, A., Lemberg, R., Harary, G., & Lobel, T. E. (2016). Seeing the world through "pink-colored glasses": The link between optimism and pink. *Journal of Personality*, *84*(6), 726–736. http://doi.org/10.1111/jopy.12195

Lindbloom, B. (2017). Useful colour equations. Retrieved September 9, 2017, from http://www.brucelindbloom.com/

Lindsey, D. T., & Brown, A. M. (2014). The color lexicon of American English. *Journal of Vision*, *14*(2), 17. http://doi.org/10.1167/14.2.17

LoBue, V., & DeLoache, J. S. (2011). Pretty in pink : The early development of gender-stereotyped colour preferences. *British Journal of Developmental Psychology*, *29*, 656–667. http://doi.org/10.1111/j.2044-835X.2011.02027.x

McHale, S. M., Kim, J.-Y., Dotterer, A. M., Crouter, A. C., & Booth, A. (2009). The development of gendered interests and personality qualities from middle childhood through adolescence: A bio-social analysis. *Child Development*, *80*(2), 482–495. http://doi.org/10.1111/j.1467-8624.2009.01273.x.

Mohr, C., Jonauskaite, D., Dan-Glauser, E. S., Uusküla, M., & Dael, N. (2018). Unifying research on colour and emotion: Time for a cross-cultural survey on emotion associations to colour terms. In L. W. MacDonald, C. P. Biggam, & G. V Paramei (Eds.), *Progress in Colour Studies: Cognition, Language, and beyond*. Amsterdam/Philadelphia: John Benjamins (forthcoming). Retrieved from https://benjamins.com/catalog/z.217.11moh

Moss-Racusin, C. A., Phelan, J. E., & Rudman, L. A. (2010). When men break the gender rules: Status incongruity and backlash against modest men. *Psychology of Men & Masculinity*, *11*(2), 140–151. http://doi.org/10.1037/a0018093

Muller, R., & Goldberg, S. (1980). Why William doesn't want a doll: Preschoolers' expectations of adult behavior toward girls and boys. *Merrill-Palmer Quarterly of Behavior and Development*, *26*(3), 259–269. Retrieved from http://www.jstor.org/stable/23083619

O'Brien, M. (1992). Gender identity and sex roles. In *Handbook of Social Development* (pp. 325–345). Boston, MA: Springer US. http://doi.org/10.1007/978-1-4899-0694-6_13

Ou, L.-C., Luo, M. R., Woodcock, A., & Wright, A. (2004). A study of colour emotion and colour preference. Part I: Colour emotions for single colours. *Color Research & Application*, *29*(3), 232–240. http://doi.org/10.1002/col.20010

Palmer, S. E., & Schloss, K. B. (2010). An ecological valence theory of human color preference. *Proceedings of the National Academy of Sciences of the United States of America*, *107*(19), 8877–82. http://doi.org/10.1073/pnas.0906172107

Palmer, S. E., Schloss, K. B., & Sammartino, J. (2013). Visual aesthetics and human preference. *Annual Review of Psychology*, *64*, 77–107. http://doi.org/10.1146/annurev-psych-120710-100504

Park, J. G. "Phillip." (2013). Correlations between color attributes and children's color preferences. *Color Research & Application*, *39*(5), 452–462. http://doi.org/10.1002/col.21801

Parraga, C. A., & Akbarinia, A. (2016). NICE: A computational solution to close the gap from colour perception to colour categorization. *PLoS ONE*, *11*(3). http://doi.org/10.1371/journal.pone.0149538

Piegorsch, W. W., & Richwine, K. A. (2001). Large-sample pairwise comparisons among multinomial proportions with an application to analysis of mutant spectra. *Journal of Agricultural, Biological, and Environmental Statistics*, *6*(3), 305–325. http://doi.org/10.1198/108571101317096532

Piepho, H.-P. (2004). An algorithm for a letter-based representation of all-pairwise comparisons. *Journal of Computational and Graphical Statistics*, *13*(2), 456–466. http://doi.org/10.1198/1061860043515

Pomerleau, A., Bolduc, D., Malcuit, G., & Cossette, L. (1990). Pink or blue: Environmental gender stereotypes in the first two years of life. *Sex Roles*, *22*(5–6), 359–367. http://doi.org/10.1007/BF00288339

Pranckevičienė, A., Žardeckaitė-Matulaitienė, K., & Soikinaitė, I. (2009). Pradinių klasių

mokinių spalviniai prioritetai ir spalvų pasirinkimas spalvinant žmogaus piešinius [Children's color preferences and color choices for completing drawings of human figures in primary school]. *Psichologija*, *39*, 31–44.

Pravossoudovitch, K., Cury, F., Young, S. G., & Elliot, A. J. (2014). Is red the colour of danger? Testing an implicit red–danger association. *Ergonomics*, *57*(4), 503–510. http://doi.org/10.1080/00140139.2014.889220

Puntoni, S., Sweldens, S., & Tavassoli, N. T. (2011). Gender identity salience and perceived vulnerability to breast cancer. *Journal of Marketing Research*, *48*(3), 413–424. http://doi.org/10.1509/jmkr.48.3.413

Raag, T., & Rackliff, C. L. (1998). Preschoolers' awareness of social expectations of gender: Relationships to toy choices. *Sex Roles*, *38*(9/10), 685–700. http://doi.org/10.1023/A:1018890728636

R Core Team. (2018). R: A language and environment for statistical computing. R Foundation for Statistical Computing. Vienna, Austria. Retrieved from https://www.r-project.org/

Robinson, M. D., Liu, T., & Bair, J. L. (2015). Affect-related influences on color perception. In A. J. Elliot, M. D. Fairchild, & A. Franklin (Eds.), *Handbook of Color Psychology* (pp. 660–676). Cambridge: Cambridge University Press. http://doi.org/10.1017/CBO9781107337930.033

Rudman, L. A., Moss-Racusin, C. A., Phelan, J. E., & Nauts, S. (2012). Status incongruity and backlash effects: Defending the gender hierarchy motivates prejudice against female leaders. *Journal of Experimental Social Psychology*, *48*(1), 165–179. http://doi.org/10.1016/j.jesp.2011.10.008

Saito, M. (1996). Comparative studies on color preference in Japan and other Asian regions, with

special emphasis on the preference for white. *Color Research & Application*, *21*(1), 35–49. http://doi.org/10.1002/(SICI)1520-6378(199602)21:1<35::AID-COL4>3.3.CO;2-5

Scherer, K. R. (2005). What are emotions? And how can they be measured? *Social Science Information*, *44*(4), 695–729. http://doi.org/10.1177/0539018405058216

Scherer, K. R., Shuman, V., Fontaine, J. R. J., & Soriano, C. (2013). The GRID meets the Wheel: Assessing emotional feeling via self-report. In J. R. J. Fontaine, K. R. Scherer, & C. Soriano (Eds.), *Components of emotional meaning: A sourcebook* (pp. 281–298). Oxford: Oxford University Press. http://doi.org/10.13140/RG.2.1.2694.6406

Sharma, G. (2002). LCDs versus CRTs-color-calibration and gamut considerations. *Proceedings of the IEEE*, *90*(4), 605–622. http://doi.org/10.1109/JPROC.2002.1002530

Simmons, D. R. (2011). Colour and emotion. In C. P. Biggam, C. A. Hough, C. J. Kay, & D. R. Simmons (Eds.), *New Directions in Colour Studies* (pp. 395–413). Amsterdam/ Philadelphia: John Benjamins Publishing Company. http://doi.org/10.1075/z.167.44sim

Sorokowski, P., Sorokowska, A., & Witzel, C. (2014). Sex differences in color preferences transcend extreme differences in culture and ecology. *Psychonomic Bulletin & Review*, *21*(5), 1195–201. http://doi.org/10.3758/s13423-014-0591-8

Taylor, C., Clifford, A., & Franklin, A. (2013). Color preferences are not universal. *Journal of Experimental Psychology: General*, *142*(4), 1015–1027. http://doi.org/10.1037/a0030273

Taylor, C., & Franklin, A. (2012). The relationship between color-object associations and color preference: further investigation of ecological valence theory. *Psychonomic Bulletin & Review*, *19*(2), 190–7. http://doi.org/10.3758/s13423-012-0222-1

Taylor, C., Schloss, K., Palmer, S. E., & Franklin, A. (2013). Color preferences in infants and adults are different. *Psychonomic Bulletin & Review*, *20*(5), 916–22.

http://doi.org/10.3758/s13423-013-0411-6

Terwogt, M. M., & Hoeksma, J. B. (1995). Colors and emotions: preferences and combinations. *The Journal of General Psychology*. http://doi.org/10.1080/00221309.1995.9921217

Thorne, B. (1993). *Gender play: girls and boys in school*. Rutgers University Press.

United Nations Development Programme. (2013). 2013 Human development report. Retrieved January 29, 2018, from http://hdr.undp.org/en/2013-report

Valdez, P., & Mehrabian, A. (1994). Effects of color on emotions. *Journal of Experimental Psychology. General*, *123*(4), 394–409. http://doi.org/10.1037/0096-3445.123.4.394

Weisgram, E. S., Fulcher, M., & Dinella, L. M. (2014). Pink gives girls permission: Exploring the roles of explicit gender labels and gender-typed colors on preschool children's toy preferences. *Journal of Applied Developmental Psychology*, *35*(5), 401–409. http://doi.org/10.1016/j.appdev.2014.06.004

Wiedemann, D., Burt, D. M., Hill, R. A., & Barton, R. A. (2015). Red clothing increases perceived dominance, aggression and anger. *Biology Letters*, *11*(5), 20150166–20150166. http://doi.org/10.1098/rsbl.2015.0166

Witzel, C. (2015). Commentary: An experimental study of gender and cultural differences in hue preferences. *Frontiers in Psychology*, *6*(1840), 1–3. http://doi.org/10.3389/fpsyg.2015.00030

Wong, W. I., & Hines, M. (2015). Preferences for pink and blue: The development of color preferences as a distinct gender-typed behavior in toddlers. *Archives of Sexual Behavior*, *44*(5), 1243–1254. http://doi.org/10.1007/s10508-015-0489-1

World Medical Association. (2013). World Medical Association declaration of Helsinki. Ethical principles for medical research involving human subjects. *The Journal of the American*

Medical Association, *310*(20), 2191–2194. http://doi.org/10.1001/jama.2013.281053

Yeung, S. P., & Wong, W. I. (2018). Gender labels on gender-neutral colors: Do they affect children's color preferences and play performance? *Sex Roles*, *78*(1), 1–13. http://doi.org/10.1007/s11199-017-0875-3

Yokosawa, K., Schloss, K. B., Asano, M., & Palmer, S. E. (2016). Ecological effects in cross-cultural differences between U.S. and Japanese color preferences. *Cognitive Science*, *40*(7), 1–27. http://doi.org/10.1111/cogs.12291

Yu, L., Westland, S., Li, Z., Pan, Q., Shin, M. J., & Won, S. (2018). The role of individual colour preferences in consumer purchase decisions. *Color Research and Application*, *43*(2), 258–267. http://doi.org/10.1002/col.22180

Zemach, I., Chang, S., & Teller, D. Y. (2007). Infant color vision: Prediction of infants' spontaneous color preferences. *Vision Research*, *47*(10), 1368–1381. http://doi.org/10.1016/j.visres.2006.09.024

Zentner, M. R. (2001). Preferences for colours and colour-emotion combinations in early childhood. *Developmental Science*, *4*(4), 389–398. http://doi.org/10.1111/1467-7687.00180

Zosuls, K. M., Ruble, D. N., Tamis-LeMonda, C. S., Shrout, P. E., Bornstein, M. H., & Greulich, F. K. (2009). The acquisition of gender labels in infancy: Implications for gender-typed play. *Developmental Psychology*, *45*(3), 688–701. http://doi.org/10.1037/a0014053

Table 1

Bootstrapped Pairwise Comparisons Between Hue Choices, Studies 1 and 2

	Favourite				Least Favourite	
	Study 1		Study 2		Study 2	
	Boys	Girls	Men	Women	Men	Women
Colours	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)
Blue	28 (41.2%)$_{a}$	34 (55.7%)$_{a}$	34 (39.1%)$_{a}$	37 (40.2%)$_{a}$	5 (5.8%)$_{a}$	7 (7.6%)$_{ab}$
Pink/Purple	1 (1.5%)$_{b}$	16 (26.2%)$_{ab}$	6 (6.9%)$_{b}$	10 (10.9%)$_{b}$	19 (21.8%)$_{c}$	18 (19.6%)$_{a}$
Red	16 (23.5%)$_{a}$	4 (6.6%)$_{c}$	14 (16.1%)$_{b}$	27 (29.3%)$_{a}$	6 (6.9%)$_{ac}$	5 (5.4%)$_{b}$
Other	23 (33.8%)$_{a}$	7 (11.5%)$_{bc}$	33 (37.9%)$_{a}$	18 (19.6%)$_{ab}$	57 (65.5%)$_{b}$	62 (67.4%)$_{c}$
Total	68 (100%)	61 (100%)	87 (100%)	92 (100%)	87 (100%)	92 (100%)

Note. We compared the proportions of males and females choosing each of the four hue categories. The table shows the number of participants who chose a particular hue and percentage of participants (from the total sample) making this selection. Shared subscripts indicate similar preferences across colour choices within each gender (column). Shared subscripts in each column indicate no significant difference between the pairs of hue categories (Piepho, 2004).

Table 2

Lightness and Chroma of Chosen Colours and Number of Computer Clicks by Participants' Gender, Studies 1 and 2

	Favourite								Least Favourite			
	Study 1				Study 2				Study 2			
	Boys	Girls			Men	Women			Men	Women		
	M (SD)	*M (SD)*	*t*	*d*	*M (SD)*	*M (SD)*	*t*	*d*	*M (SD)*	*M (SD)*	*t*	*d*
Lightness	68.54 (20.94)	63.94 (27.81)	1.05	.197	56.69 (24.63)	56.94 (20.47)	0.08	.011	59.58 (20.60)	57.86 (23.29)	-0.52	.078
Chroma	89.31 (33.50)	64.29 (31.84)	4.35***	.766	73.06 (32.74)	68.91 (33.26)	-0.84	.126	59.74 (34.94)	55.34 (33.97)	-0.86	.128
Number of clicks	14.53 (15.03)	11.84 (7.86)	1.29	.224	9.30 (5.63)	8.98 (5.88)	- 0.37	.056	8.90 (6.48)	8.04 (12.00)	- 0.59	.089

*** $p < .001$, Bonferroni corrected.

Table 3

Number of Emotions and Intensity Ratings by Adult Participants' Gender, Study 3

		Men			Women				
Valence	Colour	*n*	*M*	*SD*	*n*	*M*	*SD*	*t*	*d*
				(a) Number of Emotions					
Positive	Red	47	2.02	2.18	182	2.29	2.31	0.71	.120
	Pink	47	2.26	1.99	182	3.51	2.54	3.45***	.548
	Blue	47	2.40	2.20	182	2.50	2.37	0.24	.044
Negative	Red	47	2.26	2.20	182	2.21	2.13	0.13	.023
	Pink	47	0.53	1.8	182	0.30	1.3	0.78	.146
	Blue	47	0.85	1.78	182	1.04	1.83	-0.64	.105
				(b) Intensity					
Positive	Red	35	3.90	1.04	112	4.05	0.99	-0.81	.148
	Pink	41	3.51	0.78	125	3.77	0.87	-1.65	.315
	Blue	40	3.70	0.92	109	3.75	0.90	-0.33	.055
Negative	Red	39	3.86	0.86	108	3.85	0.99	0.05	.011
	Pink	9	3.23	1.09	15	2.5	1.35	1.38	.595
	Blue	17	2.84	0.97	53	2.90	1.04	-0.21	.060

***$p < .001$, Bonferroni corrected.

Table 4

Age as a Predictor of Number of Emotions and Intensity Ratings, Study 3

Valence	Colour	Total *n* (*n* men)	β	*adj.* R^2
		(a) Number of Emotions		
Positive	Red	182 (47)	-.04	.00
	Pink	182 (47)	-.30***	.08
	Blue	182 (47)	-.07	.00
Negative	Red	182 (47)	-.29***	.08
	Pink	182 (47)	-.08	.00
	Blue	182 (47)	-.23*	.05
		(b) Intensity		
Positive	Red	147 (35)	.04	.00
	Pink	166 (41)	.11	.01
	Blue	149 (40)	.20	.04
Negative	Red	147 (39)	.07	.00
	Pink	24 (9)	.35	.08
	Blue	70 (17)	-.07	.00

***$p < .001$, Bonferroni corrected.

Online supplement for Jonauskaite, D., Dael, N., Chèvre, L., Althaus, B., Tremea, A., Charalambides, L., and Mohr, C. (2018). Pink for girls, red for boys, and blue for both genders: Colour preferences in children and adults. *Sex Roles*. Domicele Jonauskaite, University of Lausanne. Email: Domicele.Jonauskaite@unil.ch

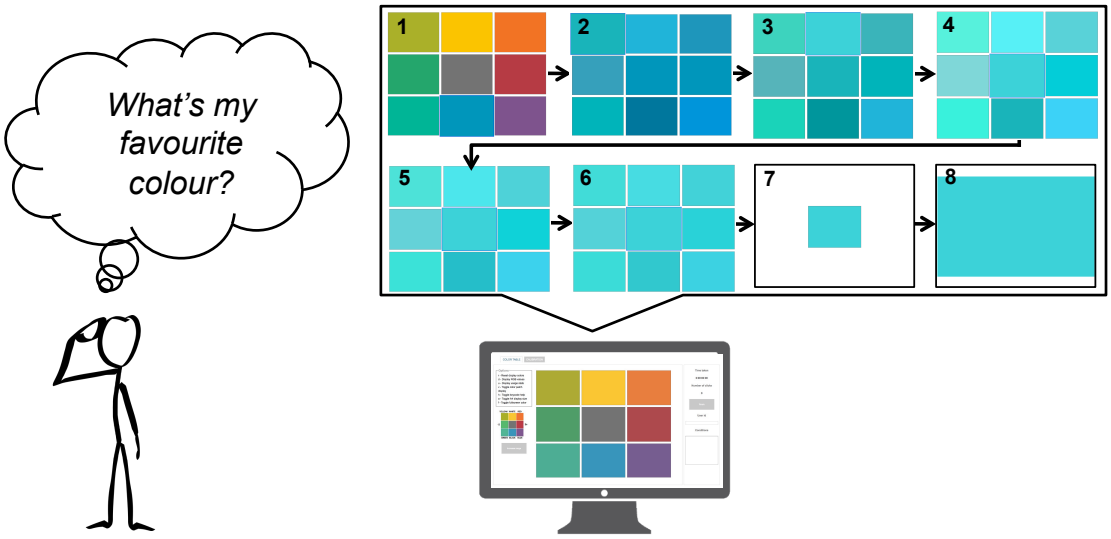

Figure 1s. Illustration of procedure for Studies 1 and 2. Participants were asked to choose their favourite (also least favourite in Study 2) colour from an unrestricted colour range using a colour picker. (1) Initial screen of the colour picker. A slightly larger square (here the blue one) indicates a chosen colour. (2) – (6) subsequent colour refinement screens, the number of which is unrestricted. (7) Final colour selection screen. (8) Screen with the enlarged chosen colour for verification. Participants could always return to the previous selection screens and refine the colour choice. This particular example of the colour selection took 6 clicks to make. The colour picker can be accessed via https://www2.unil.ch/onlinepsylab/ColourPicker/html/colourpicker.html

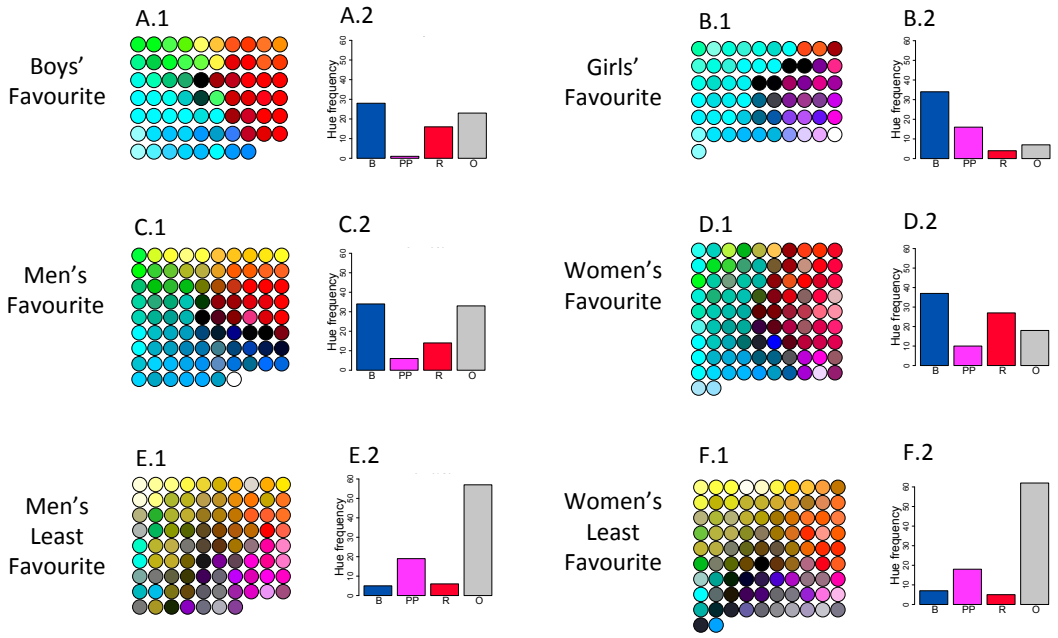

Figure 2s. Colour selections using an unrestricted colour picker. Selections done by boys (A.1) and girls (B.1) for their favourite colours in Study 1, men (C.1) and women (D.1) for their favourite colours, and men (E.1) and women (F.1) for their least favourite colours in Study 2. Each circle indicates one participant's colour choice. Graphs marked with number 2 (i.e., A.2 – F.2) display histograms of colour choices grouped by hue: Blue (B), Pink/Purple (PP), Red (R), and Other (O). Colour representations are for illustrative purposes only and may differ from the actual colour selections

For the supplementary analyses, we grouped hues into a larger number of categories: red (346°-40°), orange (40°-72°), yellow (72°-105°), yellow-green (105°-130°), green (130°-166°), green-blue (166°-220°), blue (220°-275°), purple (275°-346°), and achromatic (chroma less than 5, any hue angle). Bootstrapped comparisons (equivalent to Study 1) on nine hue categories indicated that boys' most common favourite hues were red and green-blue followed by green whereas girls' most common favourite hues were green-blue followed by purple (Table 1s and Figure 1s).

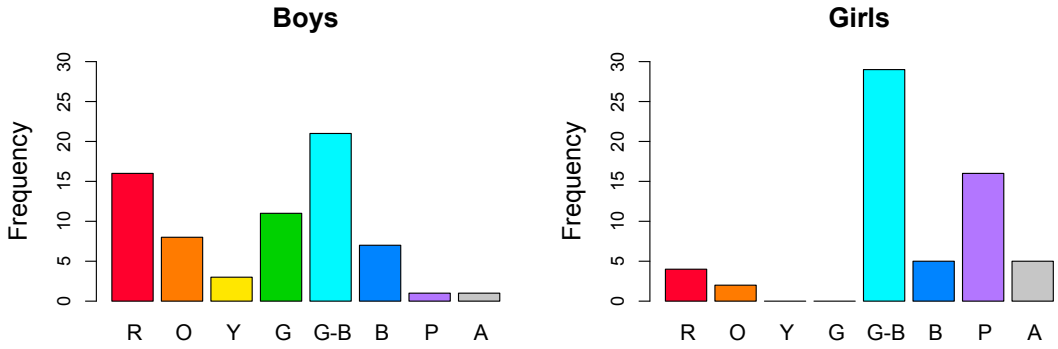

Figure 3s. The distribution of hues chosen as the most preferred colour by boys and girls. R = red, O = orange, Y = yellow, G = green, G-B = green-blue, B = blue, P = purple, and A = achromatic (shades of grey). Note that the category yellow-green (Y-G) is missing because no one chose a colour from this hue range.

	Favourite			
	Boys		Girls	
Hue	n (%)	Letter	n (%)	Letter
Red	16 (23.5)	*a*	4 (13.1)	*ab*
Orange	8 (11.8)	*abc*	2 (3.3)	*a*
Yellow	3 (4.4)	*bc*	0 (0.0)	*a*
Yellow-Green	0 (0.0)	*NA*	0 (0.0)	*NA*
Green	11 (16.2)	*ab*	0 (0.0)	*a*
Green-Blue	21 (30.9)	*a*	29 (47.5)	*c*
Blue	7 (10.3)	*abc*	5 (8.2)	*ab*
Purple	1 (1.5)	*c*	16 (26.2)	*bc*
Achromatic	1 (1.5)	*c*	5 (8.2)	*ab*
Total	68 (100)		61 (100)	

Table 1s. Bootstrapped pairwise comparisons between hue choices. We compared the proportions of hues chosen as favourite colours by boys and girls. The table shows the number of participants that chose a particular hue (n), and percentage of participants (from total N) making this selection (%). Common letters indicate that there is no significant difference between the hue pair. No common letters indicates that there is a significant difference between the hue pair in the frequency of choice. NA indicates that this hue (yellow-green) was not entered into bootstrapping as none of the participants selected a colour from this hue range.

For adult colour choices, we used an equivalent bootstrapping method. It can be seen from Table 2s and Figure 2s that men selected green-blue somewhat more often than other hues, but in particular than yellow-green as their favourite. Women most frequently selected red and green-blue hues, followed by blue and then purple as their favourite hue. When it came to least preferred hues, yellow was the most common least preferred hue by both men and women. Women also chose orange and purple hues as their least favourite but less often than yellow. Blue hue was nearly never chosen as least liked by neither men nor women.

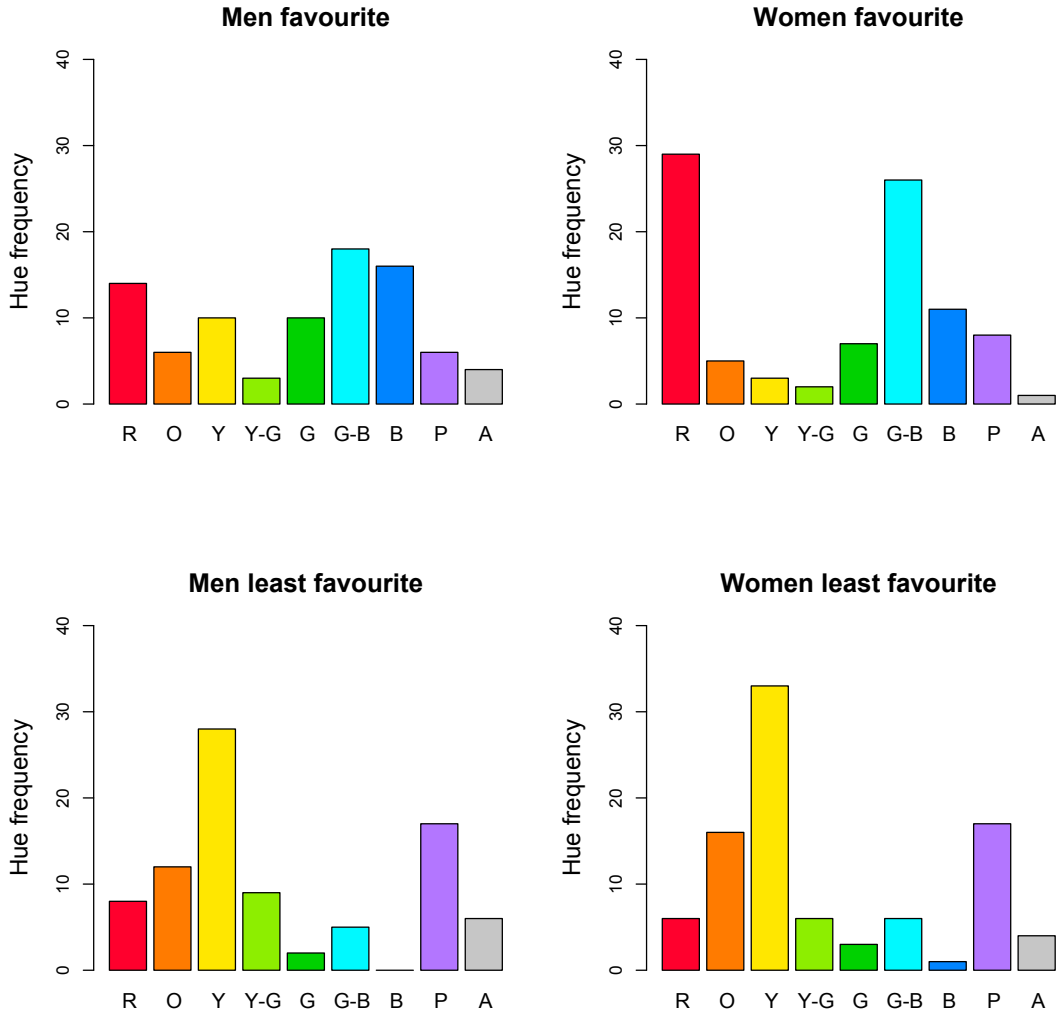

Figure 4s. Hue distributions of most and least preferred colours in men and women. R = red, O = orange, Y = yellow, Y-G = yellow=green, G = green, G-B = green-blue, B = blue, P = purple, and A = achromatic (shades of grey varying from white to black).

	Favourite				Least favourite			
	Men		Women		Men		Women	
Hue	n (%)	Letter	n (%)	Letter	n (%)	Letter	n (%)	Letter
Red	14 (16.1)	*ab*	29 (31.5)	*a*	8 (9.2)	*abc*	6 (6.6)	*abc*
Orange	6 (6.9)	*ab*	5 (5.5)	*b*	12 (13.8)	*abd*	16 (17.4)	*abd*
Yellow	10 (11.5)	*ab*	3 (3.3)	*b*	28 (32.2)	*d*	33 (35.9)	*d*
Yellow-Green	3 (3.4)	*a*	2 (2.2)	*b*	9 (10.3)	*abcd*	6 (6.6)	*abc*
Green	10 (11.5)	*ab*	7 (7.7)	*b*	2 (2.3)	*ac*	3 (3.3)	*ac*
Green-Blue	18 (20.7)	*b*	26 (28.3)	*ac*	5 (5.7)	*abc*	6 (6.6)	*abc*
Blue	16 (18.4)	*ab*	11 (12.0)	*abc*	0 (0.0)	*c*	1 (1.1)	*c*
Purple	6 (6.9)	*ab*	8 (8.8)	*bc*	17 (19.5)	*bd*	17 (18.5)	*bd*
Achromatic	4 (4.6)	*ab*	1 (1.1)	*b*	6 (6.9)	*abd*	4 (4.4)	*abc*
Total	87 (100)		92 (100)		87 (100)		92 (100)	

Table 2s. Bootstrapped pairwise comparisons. The comparisons were made between the proportions of chosen hues as most preferred and least preferred separately for males and females. The number of participants who chose a particular hue (n), and percentage of participants (from total N) making this selection (%) are displayed. Common letters indicate that there was no significant difference between the hue pairs. Different letters indicate that there was a significance difference between the hue pairs. In other words, hues were no chosen at the same frequency. All comparisons were Bonferroni corrected for multiple comparisons.