Eye Colour is More Important than Skin Colour for Clothing Colour Aesthetics

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Abstract

Fashion advice for clothing colour is most often based on the wearer's skin colour, though hair and eye colour are also considered. More saturated, warm (e.g. orange red) colours have been found to be judged more aesthetic for White women with a relatively tanned (high melanin) skin complexion than for those with a relatively light complexion. Melanin levels in the skin, hair and iris are correlated but the relative importance of these features for aesthetic judgments of clothing is unclear. I first replicated the preference for warm garment colour for women with a darker complexion (Experiment 1 Task A). I then tested the relative importance of skin, eye and hair colour by transforming skin colour between low and high melanin levels (Experiment 1 Task A), and by transplanting eyes between facial images (Experiment 2). Results revealed a dominant role of iris colour with warmer, more saturated, and darker clothing colours being chosen for faces with darker eyes. Skin colour had little influence. Even when participants were instructed to match clothing to skin colour, they used eye colour as a basis for clothing colour choice. The results indicate that the emphasis on skin colour for personal clothing colour choice may be misplaced.

Key words: Eye colour; skin colour; hair colour; clothing colour; melanin

Introduction

The fashion industry is worth trillions of dollars per year (US Congress Joint Economic Committee Report, 2019). Not surprisingly there is considerable advice available through the internet and fashion magazines on how individuals should choose clothing colour to match their complexion. Despite the market value, aesthetic advice for garment colour choice is notoriously difficult for ‘non-experts’ to follow (Burton, 1984; Collin, 1986; Nasr, 2018; Yu et al., 2012). Perhaps because of the obscurity of the ‘rules’, there has been scant scientific evaluation of any system of matching garment colour to complexion (Francis & Evans, 1988; Radeloff, 1990). More generally, there has been little study of the principles of clothing colour aesthetics (Gray et al., 2014).

Colours advised for given skin types are largely inconsistent across stylists (Collin, 1986). Nonetheless, one of the more consistent aspects of stylistic advice suggests that clothing with warm colours (yellow, orange, red, maroon) is best suited to those with a warm skin tone whereas clothing with cool colours (green, blue, violet) is best for those with a cool skin tone (Burton, 1984). This presents the more complex issue as to how warm and cool skin tones are differentiated. Differences in melanin pigmentation appear to underlie the stylists’ differentiation of skin tones: warm skin tones reflect more melanin and the skin appears darker and yellower. That cool/warm skin tones are attributable to levels of melanin or suntan is evident at style websites, for example, “If you're constantly getting sunburned, especially in the summer months, you're likely to have cool-toned skin. In contrast, those with warm skin often tan instead of burning” (Pennersinc.com, 2020, Section 3. How your skin reacts to sun).

By allowing participants to choose any colour from the full spectrum of hues for simulated clothing (an opaque area covering chest, shoulders and lower parts of the neck), Perrett and Sprengelmeyer (2021) found that 75% of observers chose warm colours (i.e. orange and red) more often for White women with a tanned skin complexion than for White women with a fair (light) complexion. Reciprocally, observers chose cool colours (i.e. blue) more often for White women with a light skin complexion than for White women with a tanned complexion. The driver for such consistent aesthetic choice of clothing colour could be skin tone (high vs low melanin) but given that skin colour, hair colour and eye colour are all correlated it is not clear which feature or features of the wearer have most influence on the aesthetics of clothing colour selection. Therefore this study evaluates the relative contributions of skin, eyes and hair in clothing colour preferences.

Colour Preferences and Colour Associations

A different question about colour preferences is how they originate. Several studies have observed popularity of reds and blues and unpopularity of yellows (Guilford & Smith, 1959; Hurlbert & Ling, 2007; O'Donovan et al., 2011; Palmer & Schloss, 2010). Palmer and Schloss (2010) argue that colour preferences derive from emotional associations made during a person's lifetime, "The more enjoyment and positive affect an individual receives from experiences with objects of a given color, the more the person will tend to like that color" (p. 8878). The theory that colour associations underlie preferences can be traced back to Fechner (1866) with his "Aesthetic Association Principle" (see Ortlieb et al., 2020). This theory explains the *consistency* of colour preferences of groups of individuals who have had similar experiences (e.g., blue sky with positive associations). Indeed, the general preference for blue and red colours may be explained by such positive associations (Hurlbert & Ling, 2007; Strauss et al., 2013). By contrast, the dislike of desaturated yellow or chartreuse may be because of the numerous negative associations. Taylor and Franklin (2012) argue that "Dark chartreuse is associated with many disliked objects, such as bile, mucus, mould, sewage…." (p. 193).

The same theory can account for *differences* in colour preferences between groups (Strauss et al., 2013). Palmer and Schloss (2010) found that presenting one group of participants with images of desirable red items (such as strawberries) and undesirable green items (such as mould) shifted preferences towards red colours. Conversely, presenting another group of participants with images of green items with pleasant associations (e.g., trees) and red items with negative connotations (e.g., blood) shifted preferences towards green and away from red. This shows that colour preferences can be shifted through experience and salient emotional associations.

Skin Pigmentation and Climate Associations

Melanin has protective properties against UV damage from sunlight exposure, although too much melanin can prevent the sunlight-aided synthesis of vitamin D in the skin. The costs (inadequate vitamin D) and benefits (UV protection) of melanin have established a Polar-Equatorial gradient in skin melanin, with highest levels in populations closer to the Equator (Jablonski & Chaplin, 2000; López & Alonso, 2014) where there is more UV radiation. Hence, natural selection has ensured that darker skin colours are associated with a warmer climate closer to the Equator and fair skin is associated with a cooler climate further from the Equator.

The preference for warm-coloured clothing for White individuals with a darker complexion (Perrett & Sprengelmeyer, 2021) may emerge from this association between warm Mediterranean climates and the higher melanin pigmentation in these regions. Reciprocally, lower levels of melanin pigmentation will be associated with the cooler climate of higher latitudes. Observers may choose orange/red hues preferentially for darker skin because both these hues and tanned skin are associated with heat; reciprocally, blue/green hues may be chosen for light skin because both are associated with cold. Here colour preferences would follow environmental associations rather than emotional associations.

Pigmentation of Facial Features

Skin tone is related to eye colour and to hair colour (Lagouvardos et al., 2013; Spichenok et al., 2011; Sturm, 2009). Faces with dark skin tend to have dark-coloured eyes, eyebrows and hair. Hence, any association between a dark complexion and a warm environment could well extend to dark hair and dark eyes. Conversely, faces with fair skin tend to have light-coloured eyes, eyebrows and hair. Thus, blonde hair and light-coloured eyes are just as likely to be associated with colder climates as fair skin. These considerations suggest that iris, or eyebrow and hair colour could bias clothing colour judgments in a manner similar to that postulated for skin colour.

In the experiments reported here, I explore the extent to which different features of the face bias choices in aesthetic judgments for clothing colour. At the outset it was assumed that dark skin tone would favour a choice of warm-coloured clothing because this is stressed by the stylists (Burton, 1984; Collin, 1986; Nasr, 2018; Yu et al., 2012) and empirically confirmed by Perrett and Sprengelmeyer (2021). Hence, a baseline replication task (Experiment 1 Task A) was run to confirm this expectation and to define the repeatability of previous findings. Using a subset of the real facial stimuli employed by Perrett and Sprengelmeyer (2021) the hypothesis H1A was that participants would choose garments with warm colours (hues 0°– 90° and 270°– 360°) more frequently for faces that were naturally tanned in complexion (with relatively dark eyes, hair and skin) compared with faces that were naturally fair (with relatively light eyes, hair and skin).

The correlation between eye colour and skin tone is not perfect. For example, in European populations both dark and light skin-coloured individuals can have dark eyes and dark hair. This natural variation allowed the production of realistic facial stimuli with dark and light skin accompanied by dark or light eyes. In Experiment 1 Task B, the skin colour of facial stimuli was artificially transformed while leaving eye and hair colour constant, to determine if clothing colour preferences change accordingly. For these stimuli with artificially transformed skin colour it was hypothesised (H1B) that making the facial skin darker would result in an increase in the proportion of warm hues chosen for garments. Participants adjusted garment hue and value in one set of trials and garment hue and saturation in a second set of trials. Hence, there were two hypotheses: H1B_1, making the facial skin darker would increase the proportion of warm colours chosen for garments in hue and value trials and H1B_2, making the facial skin darker would increase the proportion of warm colours chosen for garments in the hue and saturation trials.

In Experiment 2, a different manipulation was made. The colour of facial skin, hair and eyebrows was kept constant and, using an image editor, eye colour was changed from light to dark or vice versa. For example, the image of light grey eyes was transplanted into a facial image originally with dark eye colour. Since skin colour was not manipulated there was no a priori hypothesis. Exploratory analysis examined whether eye colour and/or hair colour could influence the selection of garment hue.

Methods

Sample Size and Power Considerations

This study began with a replication of Perrett and Sprengelmeyer (2021) Experiment 1. Replication was deemed desirable to establish the robustness of findings and to provide a basis for comparison with Experiment 1 Task B. The effect size (Cohen's *d*) of Experiment 1 of Perrett and Sprengelmeyer (2021) was calculated as 0.547. Several authors note that effect size estimates depend not only on the number of participants but also the number of stimuli or number of trials (Brysbaert & Stevens, 2018; Westfall et al., 2014). With the planned reduction in number of trials and stimuli (from 12 to 8), the anticipated effect size was correspondingly reduced to 0.367.

With this effect size (0.367), a 2-tailed probability for the difference between two dependent means (matched pairs), an a priori power analysis, G*Power suggested for a sample size of 99 to achieve a power of 0.95, a false positive alpha error of 0.05, and a false negative beta error of 0.05. The desired sample size of 99 was rounded up to 100 for recruitment.

Experiment 1 Tasks A and B employed the same (100) participants. Task B had 16 trials (double that of Experiment 1 Task A). Therefore, assuming the same underlying effect size of skin tone (or larger effect given the doubling of trial number) means that with the sample size of 100, the Experiment 1 Task B should by no means be underpowered.

Participants

All participants gave their informed consent and ethical approval (Code PS13155) for the experiment was granted by the relevant University Ethics Committee (details omitted for review). One hundred participants were recruited from Prolific.co, (an online recruiting platform) with the following selection criteria: Prolific approval rating >= 83%; a minimum of

10 Prolific submissions in other experiments; UK nationality and normal or corrected vision without colour vision anomalies. Participants were asked to complete both experimental tasks (Task A and Task B) and a questionnaire which asked for self-report of ethnic group and colour vision status (“As far as you know do you have normal colour vision? Please select: No, I have anomalous colour vision/ I am ‘colour blind’; Yes, I have full colour vision; Do not know; Prefer not to say”). After exclusions for not completing questionnaire (n = 4) and not reporting normal colour vision (n = 1). This left a sample of 95 participants (gender: 66 female, 29 male; age: *M* = 26.8, *SD* = 4.7, range 19 – 36 years). Ethnicity reported was White (n = 83), South Asian (n = 5), African (n = 1), East Asian (n = 2), Mixed ethnicity (n = 3) and Other (n = 1).

Remuneration

Participants were paid £1.50. The whole Experiment including Task A, Task B and questionnaire took an average of 12 minutes to complete (giving a remuneration rate of £7.50 per hour). Remuneration was above the minimum rate (£6.00 per hour) set by Prolific at the time of the study.

Stimuli

Experiment 1 Task A utilised eight facial stimuli from a previous study (Experiment 1 of Perrett & Sprengelmeyer, 2021). Four were images of women that were naturally fair (with light skin, eyes and hair) and four were images of women that were naturally tanned (with dark skin, eyes and hair). The eight images were masked with a light grey border (red, green, blue, R,G,B values = 191/255, 191/255, 191/255) to obscure most of the background and hair. These images were processed with Adobe Photoshop®. Matte white was overlaid to occlude the original clothes and adjusted in shape to simulate that of clothing. The white area was converted to an alpha or transparent layer. Images were exported in GIF format with the transparent area saved as a 2^{nd} layer. A colour picker was used to manipulate hue and saturation in the 2^{nd} layer colour of the simulated clothing.

Experiment 1 Task B used a collection of 94 White female faces photographed by Talamas et al. (2016) under standard lighting with a neutral expression, hair off the face, and no make-up. The images were sorted into those with a dark complexion and those with fair skin. Twelve women with dark skin and 12 women with fair skin were selected. Composite face stimuli were made from averaging the shape, colour and texture of three images of different women with comparable skin tone. The procedure for averaging images is described elsewhere (Tiddeman et al., 2001). Averaging creates realistic facial images which are no longer recognisable as familiar individuals but which maintain the image properties consistent within the group of faces that are averaged together. Composite images are more suitable for skin colour transformation than the natural images used in Experiment 1 Task A. The averaging created eight facial composites; four from the 12 faces with a light complexion and four from the 12 darker complexion faces (for example composite faces see Figure 1 top left and bottom right).

(Figure 1 about here)

The skin colour was assessed for each of the eight composite facial images from a rectangular patch of the image in the forehead region. The four dark complexion faces had darker skin (lightness in International Commission on Illumination (abbreviated CIE L*) M = 51.22, SD = 0.63) than the four light complexion faces (CIE L* M = 56.62, SD = 1.04; $t(6)$ = 8.86, $p < .001$, d = 6.27; Shapiro–Wilk(8) = .85, p = .099 indicated the assumption of normality was met). Iris colour was assessed similarly from a square region of the image of the left eye including the pupil, iris and a small amount of sclera. The irises of the dark complexion faces were darker (CIE L* M = 19.58, SD = 1.82) than those of the light complexion faces (M = 29.12, SD = 2.18; $t(6)$ = 6.74, p = .001, d = 4.75; Shapiro–Wilk(8) = .90, p = .311). Eyebrow colour was measured in similar way after each of the eight original composite images had been reshaped to the average shape of all eight faces (Perrett et al., 1994). Reshaping brought the eyebrows into alignment. A rectangular image patch was then cut in the centre of the left eyebrow. The eyebrows of the dark complexion faces (CIE L* M = 21.09, SD = 5.13) were darker than eyebrows of the light complexion faces (M = 38.68, SD = 5.06; $t(6)$ = 4.88, p = .003, d = 3.06; Shapiro–Wilk(8) = .91, p = .345).

The average difference in skin colour between the two sets of composites in CIE L* a* b* colour space was -5.5, 1.8, 2.9, with the dark complexion composites having skin that was lower in luminance (L*), higher in the green-red colour axis (a*) and higher in the blue-yellow colour axis (b*).

Using skin colour data and procedures from previous studies (Stephen et al., 2011), the eight stimuli were transformed to simulate an increase or a decrease in melanin pigment levels. Briefly, a spectrophotometer was used by Stephen et al. (2011) to measure skin colour of Caucasian individuals at a more sun-exposed body site (upper arm close to the elbow), and from a body region that was less sun-exposed (close to the shoulder). The mean CIE L*a*b* values for the upper arm and shoulder were used to create low- and high-melanin colour masks, respectively. The masks were uniform in colour. Following Stephen et al. (2011), the skin portion of each of the composite face images was manipulated by the difference between the pair of low- and high-melanin colour masks. Hair, eye and background regions of the images remained constant in colour during transformation. Transformation was aimed to simulate an increase in melanin pigmentation if the face image was initially light complexion and to simulate a reduction in melanin pigmentation if the face image was initially dark complexion (Figure 1).

Rectangular image regions of the forehead were measured to check the colour transformation products numerically. The difference between the skin colour of the lighter (melanin lowered) skin transformation images and the original dark complexion faces was CIE delta L*a*b* of 5.3, 2.0, -8.3. The skin difference between original light complexion composites and the transformed darker skin images was CIE delta L*a*b* 5.5, 1.8, -7.9. The light - dark skin difference for the images used in Experiment 1 Task A was CIE delta L*a*b*, 4.1, -0.7, -5.4. These measurements confirm that the image transformation had shifted the skin colour appropriately from fair to tanned or vice versa.

For Experiment 1 Task B, image processing created a total of 16 images. This total was comprised of the original eight composite images (four faces with naturally dark skin, eyes and hair, and four faces with naturally light skin, eyes and hair). Additionally there were four transformed face images with dark skin (with the original light eyes and hair) and there were four transformed face images with light skin (with the original dark eyes and hair).

Procedure

Instructions were given prior to a block of trials “Please adjust the colour of the clothing using the rainbow colour block”. On each trial participants were reminded “Move left-right and up-down to alter the clothing colour and brightness/saturation. Please change the colour of the simulated clothing so that it most suits the skin tone of the face. Please explore the full range of colour and brightness (or saturation).”

For Experiment 1 Task A, the eight stimuli from Perrett and Sprengelmeyer (2021) were used (four images with light skin, eyes and hair, four with darker skin, eyes and hair). These faces were presented in hue vs saturation trials where participants could choose any value of hue (0-360°) and any saturation of colour (0-1.0). Colour value or brightness was held constant at 1.0.

For Experiment 1 Task B, the 16 face stimuli faces were arranged into two blocks (1 and 2) so that each of the eight composite face identities was present only once in each block. All face stimuli were presented in two blocks for hue vs saturation choice trials. Separately, all 16 faces were presented in two blocks for hue vs value trials where participants could choose any hue (0-360°) and any value (0-1.0) while saturation was held constant at 1.0. The order of the two trial types (hue vs saturation or hue vs value) was counterbalanced across participants. Blocks 1 and 2 were also counterbalanced in order across participants.

Analysis

Colours chosen were split into cool and warm hues (cool hues: 90–270°, and warm hues representing the remainder: 0–90° and 270–360°). For Experiment 1 Task A, the proportions of warm hues chosen for the groups of fair and tanned faces were compared in a 1-way repeated measures ANOVA (Analysis of Variance). Thus the independent variable complexion had 2 levels (fair, tanned) which were varied within participants. A separate

ANOVA was conducted for the two groups of faces with colour saturation as the dependent variable.

For Experiment 1 Task B, the mean proportion of warm colours chosen was computed for each participant and for each of the four conditions. These involved the four originally fair complexion faces (with light, low-melanin skin colour), the same four faces with skin transformed to a darker, high-melanin skin colour, the four originally darker complexion faces (with high melanin skin colour) and the same four faces with skin transformed to a lighter, low melanin colour.

In the untransformed original faces, skin colour and eye colour were related: dark-skinned faces had dark-coloured irises and hair, while light-skinned faces had light-coloured irises and hair. Since the skin colour transform does not affect the colour of the eyes or hair, the four groups of faces can be identified by reference to eye/hair colour (light or dark) and to skin colour (light or dark).

The proportion of warm colours chosen was analysed with a 2-way repeated measures ANOVA with independent variables eye/hair colour and skin colour. Thus analysis was a 2 (eye/hair colour: light, dark) x 2 (skin colour: light, dark) design in which both independent variables were varied within participants. Two-way ANOVAs were computed for the hue vs saturation and the hue vs value trial types, separately.

Results

Colour Hue

Experiment 1 Task A, Hue vs Saturation for Natural Face Images

Confirming hypothesis H1A, in the hue vs saturation trials, warm colours were more frequently chosen for faces with dark skin and eyes compared with faces with light skin and eyes (proportion warm colours chosen dark complexion M = 0.66, SD = 0.29, light complexion M = 0.50, SD = 0.31, respectively; $F(1, 94) = 15.24$, $p < .001$, ηp^2 (Partial Eta Squared) = .14). The impact of complexion on colour warmth seems mainly to reflect selection of warm colours for faces with a dark complexion. For face stimuli with a light complexion, the participants' choices seem evenly divided between cool and warm colours (see Figure 2).

(Figure 2 about here)

The division of colours into cool warm hues provides only a limited view of the preferences. For more details, Figure 3 plots the choice of hue in 12, 30° hue ranges. Figure 3 shows that colour preferences for individuals with a dark complexion peak in the red end of the spectrum (hue angle 0°– 60°). For individuals with a light complexion, hues chosen show a bimodal pattern with preferences in the both the 0°– 60° and the 180 – 240° hue ranges.

(Figure 3 about here)

Experiment 1 Task B, Melanin Skin Tone Transformations

For the hue vs value trials, a 2-way ANOVA showed no main effect of high/low melanin skin colour on the proportion of warm colours chosen for simulated clothing colour ($F(1, 94) = 0.04$, $p = .84$, $\eta p^2 < .001$). Faces with darker skin had a similar proportion of warm colours chosen ($M = 0.57$, $SD = 0.26$) compared to stimuli with light-coloured skin ($M = 0.57$, $SD = 0.24$). The failure of melanin transformation to influence colour choice does not support hypothesis H1B_1. There was a main effect of eye/hair colour ($F(1, 94) = 15.48$, $p < .001$, $\eta p^2 = .14$); faces with darker eye and hair colour had a higher proportion of warm colours chosen ($M = 0.63$, $SD = 0.25$) than for stimuli with light-coloured eyes and hair ($M = 0.51$, $SD = 0.28$). These two variables interacted ($F(1, 94) = 7.38$, $p = .008$, $\eta p^2 = .073$) reflecting an increase in the effect of eye and hair colour when the skin was lighter (see Figure 4 left).

(Figure 4 about here)

For the hue vs saturation trials, a 2-way ANOVA with proportion of warm colours chosen for simulated clothing as the dependent variable showed no main effect of skin colour on clothing colour ($F(1, 94) = 0.03$, $p = .86$, $\eta p^2 < .001$). Faces with darker skin had a similar proportion of warm colours chosen ($M = 0.59$, $SD = 0.25$) compared to stimuli with light-coloured skin ($M = 0.58$, $SD = 0.24$). The absence of main effect of skin colour on choice does not support hypothesis H1B_2. There was a trend towards an effect of eye/hair colour (F(1, 94) = 3.90, p = .051, ηp^2 = .040); faces with darker eyes and hair tended to have a higher proportion of warm colours chosen (M = 0.62, SD = 0.27) than for stimuli with light-coloured eyes and hair (M = 0.55, SD = 0.27). The interaction between skin colour and eye/hair colour was non-significant (F(1, 94) = 0.62, p = .433, ηp^2 = .007, Figure 4 right).

Colour Saturation

In Experiment 1 Task A the influence of face complexion extended to the saturation with more saturated colours chosen for faces with a darker complexion (M = 0.57, SD = 0.18) than for faces with a light complexion (M = 0.52, SD = 0.18; F(1, 94) = 8.65, p = .004, ηp^2 = .084). Likewise in Experiment 1 Task B for the hue vs saturation trials, there was a main effect of hair and eye colour (F(1, 94) = 17.62; p < .001; ηp^2 = .158). Dark-coloured hair and eyes were associated with a choice of more saturated clothing colours (M = 0.59, SD = 0.16) compared to light hair and eyes (M = 0.53, SD = 0.16). There was no main effect of skin colour (F(1, 94) = 1.78; p = .19; ηp^2 = .019) or interaction between eye/hair colour and skin colour (F(1, 94) = 0.78; p = .38; ηp^2 = .008) on clothing colour saturation.

Colour Value

For the hue vs value trials in Experiment 1 Task B, there was a main effect of eye and hair colour (F(1, 94) = 16.24; p < .001; ηp^2 = .147). Dark-coloured eyes and hair were associated with a choice of lower value (darker) clothing colours (M = 0.52, SD = 0.16) compared to stimuli with lighter eyes and hair (M = 0.57, SD = 0.16). There was no effect of skin colour on value chosen (F(1, 94) = 0.12; p = .730; ηp^2 = .001) and no interaction (F(1, 94) < 0.001; p = .99; ηp^2 < .001).

Discussion of Experiment 1

Experiment 1 Task A replicated previous work (Perrett & Sprengelmeyer, 2021) and showed as hypothesised (H1A) that warmer clothing colours were chosen for individual faces with a dark complexion. Here, complexion refers to the colour of skin, eyes, eyebrows and hair. When skin, eye and hair are congruently low or congruently high in melanin pigment (as in Experiment 1 Task A), one cannot differentiate the relative contributions of facial features to colour of clothing choice. When skin pigmentation is transformed as in

Experiment 1 Task B, the transformations break this correspondence. After skin colour transformation, dark skin can accompany light eyes and hair and, reciprocally, light skin can accompany dark eyes and hair. Originally it was hypothesised (hypotheses, H1B_1 and H1B_2) that skin colour would drive clothing colour choices and that naturally tanned skin or fair skin transformed to appear tanned would both bias choice of garment colour to warm hues. The results contradict the hypotheses H1B_1 and H1B_2 and indicate that eye and hair colour are more effective drivers of the clothing hue than skin colour. The influence of eyes and hair on clothing colour choice was apparent in hue, saturation and value. For faces with dark eyes and hair, participants chose clothing with colours that were warmer in hue, greater in saturation but lower in value than for faces with light eyes and hair. By contrast, skin colour had no main effect on clothing colour warmth, saturation or value.

The lack of influence of skin colour was surprising as, in stylist advice literature, skin tone is identified as of primary importance in guiding clothing colour selection (Burton, 1984; Collin, 1986; Nasr, 2018; Yu et al., 2012). The results of Experiment 1 Task B are even more surprising considering that the instructions directed participants to use the skin colour: "Please change the colour of the simulated clothing so that it most suits the skin tone of the face". Despite this instruction, skin tone was effectively ignored by the majority of participants seeking a clothing colour match and more attention seemed to be placed on the eyes and/or hair.

These comparisons show that clothing colour choices for natural face images are equivalent to those made with composite facial images. More importantly, they demonstrate that eyes and hair have greater influence over clothing colour choice than skin tone.

Given the unexpected results of Experiment 1 Task B, Experiment 2 was conducted to explore further the role of eye and/or hair colour in influencing the clothing colour choice.

Experiment 2

In Experiment 1 Task A, warm-coloured clothes (reds and orange) were associated preferentially with images of faces with a dark complexion (i.e. dark-coloured skin, eyes and hair). Experiment 1 Task B was designed to show the role of skin colour in influencing colour choice by artificially raising or lowering the apparent level of skin melanin, yet the modification of skin colour was spectacularly ineffective in driving clothing colour choice.

This points to a role of the face parts unchanged by the skin colour transforms, namely hair and eye colour. Experiment 2 used a different technique to assess the role of skin, hair and eye features.

Experiment 2 involved four faces with naturally dark hair, brows and eyes and four with light hair, brows and eyes. Notably the two groups of faces were chosen so that they did not differ in skin tone. Since there was no difference in skin tone there was no a priori hypothesis. Instead exploratory analysis was used to determine if eye and/or hair colour influenced garment choice. If the eyes, hair and brows are sufficient to influence clothing colour choice, then it would be expected that clothing colour choice would be different between the two groups of stimuli. If the eyes are the most important feature for driving clothing colour choice, then when these features are swapped between images one would expect that the clothing colour choices will also switch. If hair colour and brow colour are the most powerful drivers of choice, then the eye swapping should have no effect.

In Experiment 1 Tasks A and B, the participants' instruction was to "change the colour of the simulated clothing so that it most suits the skin tone of the face". Despite the explicit instruction to use the skin tone as a basis for clothing colour choice, participants appear to have ignored skin tone and have chosen on the basis of the colour of the eyes and hair. In Experiment 2 the instruction was switched to one of judging the aesthetics of a colour match between the clothing and the depicted person. The change in instructions increases the chance of finding an influence of the hair and eyes by not requiring a focus on the skin.

Methods

Sample Size and Power Considerations

There are several potential bases from which the potential effect size for Experiment 2 can be estimated. One can use the effect size for the impact of complexion on preference for warm clothing colour (Cohen's d = 0.55) from Perrett and Sprengelmeyer (2021).

Alternatively, an effect size can be calculated from Experiment 1 Task A where Cohen's *d* = 0.41. In these experiments complexion was defined by differences conjointly in skin, hair and eye colour.

Complexion for the stimuli in Experiment 2 was defined by eye and hair colour alone rather than additionally from skin colour. Therefore a more relevant estimate for effect size is from Experiment 1 Task B because the combined effect of eye and hair colour can be calculated independent of skin tone. Experiment 1 Task B and Experiment 2 also used the same number of stimuli and trials per participant.

The effect size (Cohen's *d*) for the influence of eye and hair colour on the proportion of warm colours chosen was calculated as 0.31 for the hue value trials of Experiment 1 Task B. Similarly, the effect size for the influence of complexion was calculated as d = 0.34 for hue and saturation trials of Experiment 1 Task B. Taking the smaller estimate of effect size d = 0.31, a 2-tailed probability for the difference between a matched pair of means, an a priori power analysis, G*Power suggested a sample size of 96 to achieve a power of 0.85, and a false positive alpha error of 0.05, and a false negative beta error of 0.15. These considerations suggest that a sample of 100 participants provides Experiment 2 with appropriately power.

Participants

All participants gave their informed consent and ethical approval (Code PS13155) for the experiment was granted by the relevant University Ethics Committee. One hundred and one participants (women, White/Caucasian, UK nationality, age range 19 – 36, normal or corrected vision and without colour anomalies) were recruited from Prolific.co. None had participated in Experiment 1 Tasks A or B. Their Prolific approval rating was >= 83%, and all participants had a minimum of 10 Prolific submissions. Data from one participant were rejected because they completed the task too quickly (0.6 seconds per stimulus) whereas others took an average of 12.3 (range 2.3 – 42.3) seconds per stimulus. This speed is likely to reflect clicking without consideration for the task. Therefore an exclusion criterion was set at *M* +/- 3 *SD* of Log average time. The criterion affected only one participant's data. A further participant omitted to report whether their colour vision was normal in an online questionnaire (see Experiment 1) and was excluded. This left a sample of 99 female participants (age: M = 26.5, SD = 5.4, range 18 – 36 years).

Stimuli

From the collection of natural images of female faces used in Experiment 1 Task B, 12 were chosen with light-coloured eyes, and 12 with dark-coloured eyes. All 24 of these faces were selected to have an intermediate skin colour (neither dark nor light). Despite a similar intermediate skin lightness, the 12 faces with dark brown eyes tended to have dark eyebrows and hair and the 12 with light-coloured eyes tended to have light brows and hair.

These two categories are henceforth labelled 'light' and 'dark' complexion where complexion refers to eye, hair and brow colour. The 12 images in each category were divided into four sets of three images, and each set of three images was blended together into a composite image (see Experiment 1 Task B).

Confirmation of Stimuli Image Characteristics

To confirm that the images had the desired characteristics, the eight composite faces were all warped into the same average shape. This meant that an equivalent area could be cut from each face image. Analysis of skin colour averaged from two rectangular patches in the left and right cheeks showed that the skin was comparable in lightness across the two categories of composite faces (light complexion faces CIE L* M = 59.15 SD = 1.45, dark complexion faces M = 58.47 SD = 1.83; $t(6)$ = 0.58, p = .584, d = 0.41; Shapiro–Wilk test (8) = .87, p = .163 indicated the assumption of normality was met). Similar analysis of a rectangular patch in the right eyebrow confirmed that the lightness of the eyebrow colour differed across the two categories of faces: those composite faces in the light complexion category had a higher brow lightness (CIE L* M = 38.09, SD = 5.15) than those faces in a darker complexion category (M = 25.11 SD = 4.35; $t(6)$ = 3.85, p = .009, d = 2.72; Shapiro–Wilk test (8) = .89, p = .213). Lightness of the eye region was also different across the categories. Here a square image patch was selected which contained the iris, pupil and some sclera. Faces with a light complexion had lighter irises (CIE L* M = 27.08, SD = 1.98) compared with those with a dark complexion (M = 18.98, SD = 1.38; $t(6) = 6.78$, $p < .001$, d = 4.79; Shapiro–Wilk test (8) = .92, p = .401).

Eye Transplantation

The eyes of the four dark-eyed face composites were swapped with the four light-eyed composite face images. To achieve this end, each of the composite face images in one colour category was warped in shape (using Psychomorph https://users.aber.ac.uk/bpt/jpsychomorph/ see Tiddeman et al., 2001) so that all the facial features (brows, eyes, mouth and so on) were in register with a composite face image of the other colour category. The aim of this reshaping was so that the eyes transplanted from one face image would fit the other face image.

GIMP - GNU Image Manipulation Program https://www.gimp.org was employed to make the feature swaps. The transplantation involved drawing around the outer perimeter of the sclera of the left and right eyes, using the ‘free select’ function in GIMP. The ‘pencil’ function was used to change all image regions other than the eye region of the donor face to a uniform colour. This uniform colour was converted to an alpha plane and removed, leaving an image containing only eyes (sclera and irises). This image of the eyes was stacked above the corresponding face image from the other complexion category and ‘merged down’ leaving, for example, the light eyes on top of an originally dark complexion face (see images in Figure 5). The procedure was repeated for each of the eight original composites.

Following Experiment 1, a uniform grey background was used to mask out much of the ears, hair and background. Finally, a separate alpha plane was introduced to host the uniform colour of simulated clothing. The images were saved in GIF format at 750 by 750-pixel resolution. The final 16 images included the original four light and four dark complexion composites, and eight grafted images (four originally dark complexion faces with light eyes, and four originally light complexion faces with dark eyes) (for examples, see Figure 5). The grafted images are identified by referring to the ‘recipient’ facial image complexion (light and dark) and the ‘donor’ eyes (light or dark).

(Figure 5 about here)

Procedure

The 16 stimuli were split into two lists, 1 and 2 (each with two light-eye transplants, two dark-eye transplants, two light-eye originals, and two dark-eye originals). Both lists were presented to each participant but the order of the two lists was randomised between subjects and stimulus order within each list was randomised. The two lists were used in both the hue vs value and the hue vs saturation trials. List order was randomised. Each participant saw all 16 of the stimuli in the hue vs value trials and all 16 of the stimuli in the hue vs saturation trials. Hence the design was within subject. List order and trial order were not variables of interest.

Instructions

Instructions to participants were changed from those of Experiment 1 to “Alter the colour so that it looks most aesthetically pleasing for the PERSON DEPICTED”.

Analysis

The data were analysed in a 2 (donor eye colour: light, dark) x 2 (recipient hair and eyebrow colour: light, dark) repeated measures ANOVA design in which both independent variables were varied within participants. The dependent variables were the proportion of warm hues chosen, colour saturation and value. One type of trial included adjustments of hue and value and a second type of trial included adjustment of hue and saturation. Following Experiment 1 Task B, separate 2-way ANOVAs were conducted for each trial type.

Results

Colour Hue

For the hue vs value task, there was a main effect of donor eye colour on the proportion of warm colours selected ($F(1, 98) = 18.34$; $p < .001$; $\eta p^2 = .158$). Warmer clothing colours were preferred more for stimuli with dark eyes ($M = 0.59$, $SD = 0.20$) than for stimuli with light-coloured eyes $M = 0.45$, $SD = 0.22$). There was no main effect of light-dark eyebrows and hair in the recipient face ($F(1, 98) = 0.09$; $p = .766$; $\eta p^2 = .001$), the proportion of warm clothing colours preferred for stimuli with dark hair ($M = 0.52$, $SD = 0.19$)

being equivalent to that for stimuli with light hair (*M* = 0.52, *SD* = 0.18). Furthermore, there was no interaction between recipient face complexion and donor eye colour ($F(1, 98) = 0.003$; $p = .839$; $\eta p^2 < .001$). Hence, eye colour but not hair colour is important for garment colour selection.

For the hue vs saturation task, there was a main effect of donor eye colour on the proportion of warm colours selected ($F(1, 98) = 14.78$; $p < .001$; $\eta p^2 = .131$). Warmer clothing colours were again preferred more for stimuli with dark eyes (*M* = 0.59, *SD* = 0.21) than for stimuli with light-coloured eyes (*M* = 0.46, *SD* = 0.25). There was no main effect of light/dark eyebrows and hair in the recipient face ($F(1, 98) = 0.061$; $p = .806$; $\eta p^2 = .001$), the proportion of warm clothing colours preferred for stimuli with dark hair (*M* = 0.52, *SD* = 0.18) being equivalent to that for stimuli with light hair *M* = 0.53, *SD* = 0.21). Furthermore, there was no interaction between recipient face complexion and donor eye colour ($F(1, 98) = 0.03$; $p = .874$; $\eta p^2 < .001$). Thus again, the analysis shows eye colour to be important for colour choice of garments and hair colour to have no effect.

As noted above, the separation of hues into cool and warm tones hides the distribution of colour choice within the spectrum. Figure 6 shows the selection of hues for the two tasks. It parallels the results for Experiment 1 Task A (see also Figure 3, Perrett & Sprengelmeyer, 2021). For the hue vs value task, participants select blues (195°) for faces with light-coloured eyes and orange/reds (15 – 45° and 345°) for those with dark-coloured eyes. In the hue vs saturation tasks, results are similar although for faces with light-coloured eyes the most selected blue is 225°.

(Figure 6 about here)

Colour Saturation

For the hue vs saturation task, there was a main effect of donor eye colour ($F(1, 98) = 11.64$; $p = .001$; $\eta p^2 = .106$). Dark-coloured eyes were associated with a choice of more saturated clothing colours (*M* = 0.61, *SD* = 0.16) compared to light-coloured eyes (*M* = 0.57, *SD* = 0.16). There was also a main effect of recipient face complexion ($F(1, 98) = 8.85$; $p =$

.002; ηp^2 = .09). Dark hair and brows were associated with a choice of more saturated clothing colours (*M* = 0.61, *SD* = 0.16) compared to light hair and brows (*M* = 0.57, *SD* = 0.15). There was no interaction between main effects of donor eye colour and recipient face complexion ($F(1, 98) = 1.55$; $p = .22$; ηp^2 = .016).

Colour Value

For the hue vs value task, there was a main effect of donor eye colour ($F(1, 98)$ = 8.89; $p = .004$; ηp^2 = .083). Dark-coloured eyes were associated with a choice of lower value (darker) clothing colours (*M* = 0.39, *SD* = 0.14) compared to stimuli with lighter eyes (*M* = 0.42, *SD* = 0.15) . There was trend to an effect of recipient face complexion ($F(1, 98) = 2.87$; $p = .093$; ηp^2 = .028). A dark recipient face complexion with dark hair and brows tended to be associated with a choice of lower value (darker) clothing colours (*M* = 0.40, *SD* = 0.14) compared to a lighter recipient face complexion (*M* = 0.42, *SD* = 0.15). There was no interaction between main effects of eye colour and complexion ($F(1, 98) = 0.30$; $p = .59$; ηp^2 = .003).

Discussion of Experiment 2

The results of Experiment 2 are complementary to those of Experiment 1 Task B yet rely on quite different methods for stimulus production. In Experiment 1 Task B, skin colour was transformed, yet this proved ineffective in changing colour choice; instead hair and eye colour appeared to control garment colour selection. In Experiment 2, the eyes were transplanted from a donor face into a recipient face. The results of Experiment 2 showed change in eye colour was sufficient to change aesthetic clothing colour choices. Dark-coloured eyes were associated with an aesthetic preference for warmer yellow-red clothing colours, higher in saturation and darker in tone. Conversely, light-coloured eyes were associated with an aesthetic preference for cool (blue), less saturated, and brighter clothing colours.

When eyes were transplanted into a recipient image face, there was a small effect of recipient face complexion on clothing colour choice. Recipient complexion was mainly determined by eyebrow and hair colour. When the recipient face had darker hair and brows, then clothing with a saturated colour was more likely to be selected for an aesthetic match. This influence of dark hair/brow is congruent with the effect of darker eye colour on colour saturation choice, yet hair and eyebrow colour were not found to affect the hue of clothing chosen.

General Discussion

Experiment 1 Task A replicated previous work showing that clothing with warm hues and more saturated and darker colours was chosen preferentially for faces with a dark complexion. Experiment 1 Task B began to explore which aspect of complexion was influential in the aesthetic selection of clothing colour. It was expected (hypothesis H1B) that skin tone would be a key facial attribute, yet skin colour transformations were not found to have a consistent effect on clothing colour preferences. This finding went against expectations. Instead, Experiment 1 Task B showed a clear indication of the influence of eye and/or hair colour. Dark eyes and hair rather than dark skin were associated with the preferential selection of warm-coloured clothing. Furthermore, Experiment 2 showed that changing the colour of just the eyes was sufficient to bias the colour of clothing selected for an aesthetic match to the wearer.

A colour dimension that is central to stylist advice is that of the distinction between cold and warm hues. Cool or cold refers to blue hues whereas warm refers to orange/red hues. This cold-warm colour dimension appears salient in participants' selections of clothing colours in the experiments here. Stylists' focus on the cold-warm colour dimension for clothing seems entirely apt and supported now by empirical evidence. Yet the findings here are inconsistent with the prevailing advice from fashion stylists which give primacy to skin colour as a basis for advising clothing colour (Jackson, 1980; Collin, 1986; Burton, 1984; Nasr, 2018; Yu et al., 2012). The results here show an unexpectedly large effect of eye colour; darker eyes are associated with an increase in the proportion of warm-coloured clothes chosen. Eye colour is considered by fashion stylists, but this cue is usually listed as a subordinate influence (e.g., Jackson, 1980; Nasr, 2018).

Bernat Klein (1922-2014) was an artist born in Serbia, who set up a textile design business in Galashiels, Scotland. Klein produced innovative fabrics for the couture houses of Europe and worked as a colour consultant and industrial designer. Klein is unusual in providing garment colour advice that stressed the importance of the wearer's eyes. Taylor (2010) quotes Klein (1976) as writing, "It is my belief that it is to her eyes that she should try to match her clothes, and not to her hair or her skin" (p. 57). Klein's emphasis on the eyes appears correct. Yet knowing the eyes are important does not specify the nature of a colour match between the eyes and garments. It is important to establish empirically what clothing colours the public think are a good match for a given eye colour. The current study begins this task.

Skin and Hair Colour Influences

There was a small effect of skin colour influencing clothing colour choice but not in the predicted manner (i.e. where dark skin is expected to be associated with warm-coloured clothing). In Experiment 1 Task B, eye colour had most impact when the skin was light in complexion. This may reflect the greater salience of eye colour when other aspects of the face are pale.

There was also an effect of hair colour on choice of garment colour saturation. In Experiment 2, faces with dark-coloured hair and brows were associated with a choice of more saturated clothing colours compared to faces with light-coloured hair and brows. Note that the effect of hair colour was relatively small and did not influence the chosen hue of the simulated clothing.

Skin and hair colour may influence clothing colour when the eyes are not visible. Eye colour is evident in close social interactions, but for a person at a greater distance the eyes will be less visible. Under such circumstances skin and hair colour may become influential. Investigating garment colour choice for distant views of people could confirm this possibility and may resolve the apparent discrepancy between the prevailing stylist advice and the current findings. Note that viewing distance effects will add complexity to advice since a decision needs to be taken as to whether clothing colour is chosen for an aesthetic look at a distance (e.g., on a catwalk) or for close proximity (e.g., for a romantic meal).

Demand Characteristics

Skin colour is a salient aspect of the facial images and participants were explicitly instructed to use skin tone as the basis of the clothing colour selection. Despite this, participants appear to have ignored skin colour (and the instructions in Experiment 1 Task B) and made consistent colour selections for the clothing on the basis of eye colour of the garment wearer. This makes it unlikely that the results simply reflect the participants trying to conform to what they thought the experimenters expected to find.

Skin, Hair and Eye Colour Associations

Fair skin is most often accompanied by light-coloured blue or grey eyes and light-coloured hair, while tanned skin tones are usually accompanied by dark brown eye colour and dark hair (Lagouvardos et al., 2013; Spichenok et al., 2011; Sturm, 2009). Image analysis (see Methods) showed that the fair skin, light eyes and light hair associations held for the natural face images used in Experiment 1 Task B. The association is not invariant and Experiment 2 was conducted with faces that differed in iris and hair colour but not in skin tone. Hence, individuals can have dark or light eye colour accompanying an intermediate skin tone.

The explanation offered by Perrett and Sprengelmeyer (2021) for biases in garment colour choice was the association between colder climates and paler skin. Participants choose cool colours for individuals with pale skin because of the geographical association between low melanin skin pigmentation and low environmental temperature. Although skin tone may not influence clothing colour choice, the same geographical association exists for eye colour and environmental temperature. So the associative explanation of garment colour selection may be valid although the focus was on the wrong aspect of pigmentation.

Limitations

The current experiments showed a minor role of skin colour in clothing colour choice but the stimuli used were of young Caucasian White women. In European populations, hair and eye colour show considerable variation. Asian populations, where eye colour varies less, have not been tested. It is possible that in Asian populations skin colour has more importance for clothing colour. In general there is a need to explore a greater diversity in demographics of stimuli and participants (including age, gender, ethnicity), particularly as there are some differences in colour preferences across cultures and across gender (e.g., Bonnardel et al., 2018; Hurlbert & Ling, 2007) with blue clothing being more popular for men (Fornazarič & Toroš, 2018). Participants may have been predominantly students and have a restricted range in socio-economic status. Such demographic variables may affect opinions about garment colour. It will also be interesting to explore a greater age range in stimuli including individuals with grey or white hair to assess potential influences of hair colour.

The simulated clothing was designed to allow maximal choice of colour but the interface lacks realism which could be improved in future work. Also decisions about aesthetics are made explicitly. Future investigations could be set up to define the (implicit) impact of the clothing choice on impression of attractiveness. Afterall people choosing their clothing will want to know whether or not clothing colour choice makes a difference to their attractiveness. Work on clothing colour (e.g., red) and attractiveness has not produced consistent findings (Elliot & Niesta, 2008; Francis, 2013; Hesslinger et al., 2015; Peperkoorn et al., 2016; Roberts et al., 2010; Sidhu et al., 2021) but maybe one colour does not suit all, as the current investigations indicate.

One might think that the colour choice made by participants when maximising the aesthetic match to the face reflects an attempt to match the clothing colour to the hue of the iris. This explanation fits the choice of warmer, more saturated and darker colours for faces with dark irises which are predominantly brown in colour. Examining the facial stimuli with light-coloured eyes reveals that the iris colour is more aptly termed grey than blue. It is not clear what clothing hue should be chosen to match grey irises. The grey irises here might reflect the blending used to construct composite face stimuli from three original images. Future research should examine natural images of faces with different eye colours.

Conclusion

The current results contradict expectations from ubiquitous fashion advice. Stylist colour advice invariably focuses on skin colour to assign a personal category which is then the basis of garment colour recommendations. The stylist's advice is virtually never put to an empirical assessment of what the public like. The results of the experiments here show no impact of a change in skin tone on garment colour choice. Instead, the experiments here point to the importance of eye colour. Dark eyes are associated with more frequent selection of warmer orange and red colours for clothing. By contrast, cooler (blue) colours are selected more frequently for faces with light-coloured eyes. Thus the experiments reported here indicate the focus of stylists on skin colour may be inappropriate.

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Data Availability

https://doi.org/10.6084/m9.figshare.20795986.v1

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Figures

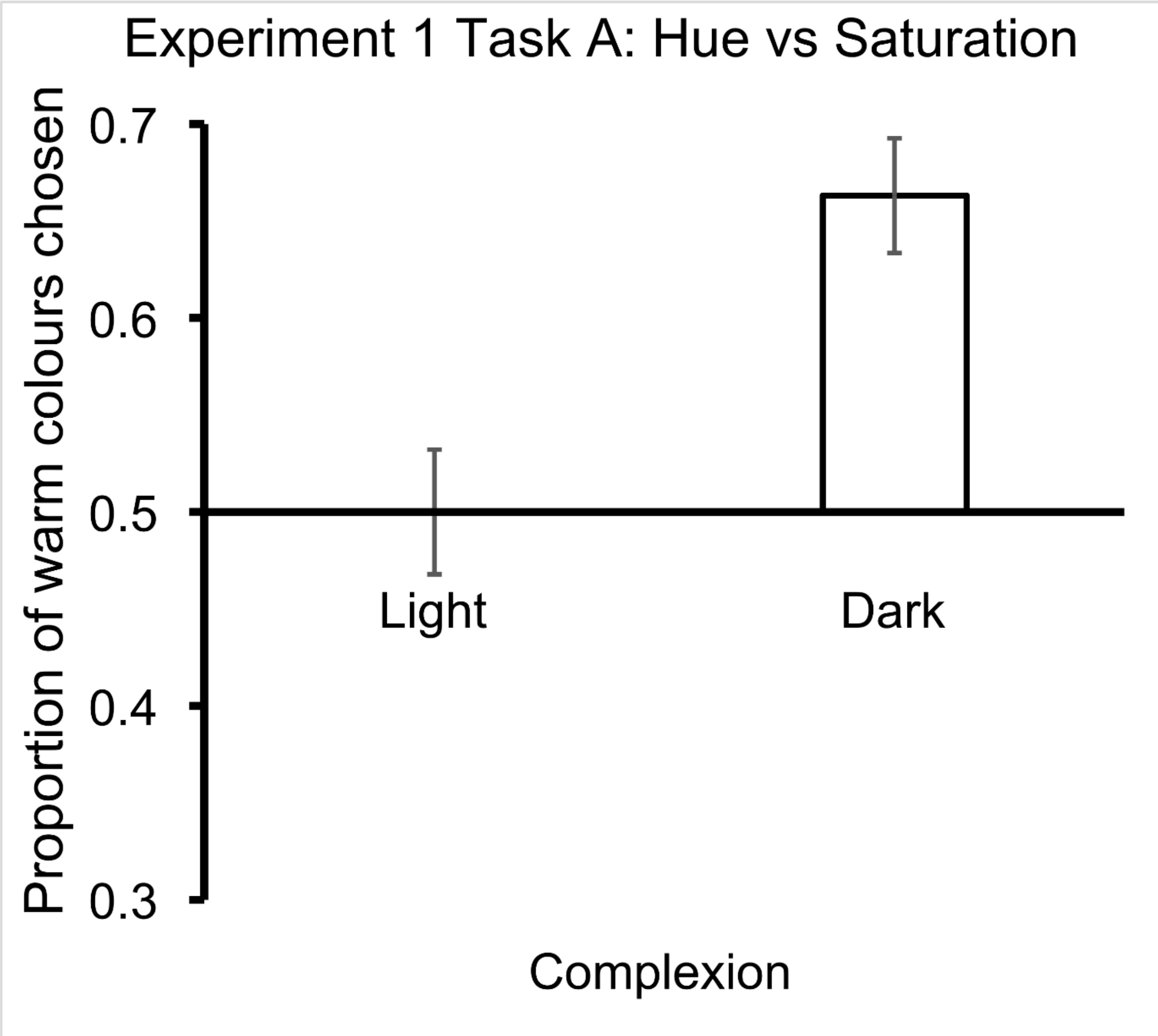
Figure 1

*Skin Pigmentation Transformed Composite Facial Stimuli for Experiment 1 Task B***.**

Note. Top left: naturally fair complexion (light skin, light-coloured eyes and hair). Bottom left: same image transformed to simulate increased melanin pigmentation. Bottom right: naturally dark complexion (darker skin, dark-coloured eyes and hair). Top right: same image transformed to simulate decreased melanin pigmentation. Note that the melanin transform does not affect eye colour. Each stimulus is a composite of three face images.

Figure 2

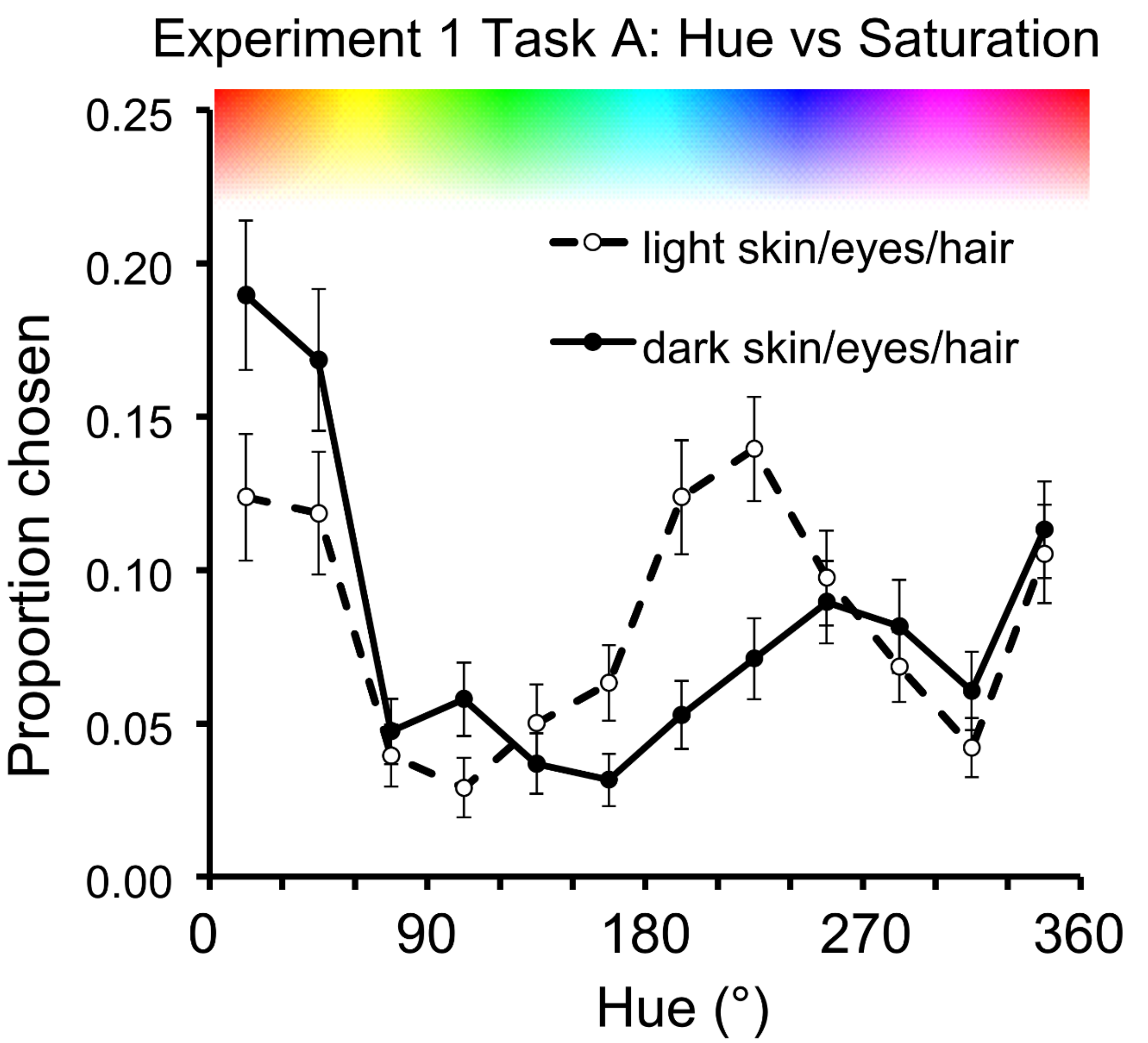
Experiment 1 Task A, Proportion of Warm Clothing Colours Chosen for Natural Face Images with Light and Dark Complexions.



Note. Warm hues are chosen more frequently for faces with a darker complexion (darker skin, eyes and hair). Error bars are +/- 1 *SE*.

Figure 3

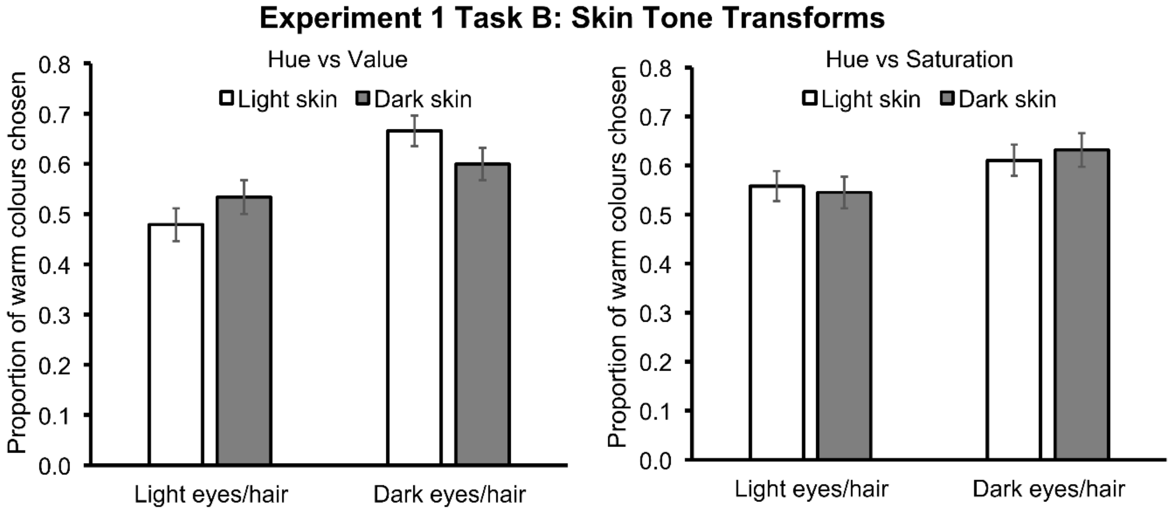
Clothing Colour Chosen to Match Skin Colour in Experiment 1 Task A.



Note. Participants selected hue (and saturation) from a rainbow rectangle like that shown at the top (where hue changes horizontally from 0 to 360 degrees and saturation increases vertically from 0 to 1, see Perrett & Sprengelmeyer, 2021, Figure 6). Mean proportion of trials (+/- 1 *SE*) where 95 participants chose a given hue is plotted at 30° intervals across the hue range. Solid symbols and lines represent the average choice for the four women's faces with dark complexion (dark skin/eyes/hair). Open symbols and dashed lines represent the average clothing colour chosen for the four women's faces with light complexion (light skin/eyes/hair).

Figure 4

Effect of Eye/Hair Colour and Skin Colour on Clothing Colour Choice in Experiment 1 Task B.



Note. Left: hue and value were manipulated for face stimuli with light or dark eyes and hair. Skin tone was darkened for faces with light eyes and hair and lightened for faces with dark eyes and hair. Skin tone adjustment had no consistent effect on colour warmth chosen for clothing but warmer colours were chosen for faces with dark eyes and hair. Right: similar figure for manipulations of hue and saturation. Skin tone had no effect, but eye and hair tone showed a trend (p = .055) in the direction of more warm colours chosen for faces with dark eyes and hair. Error bars denote standard error.

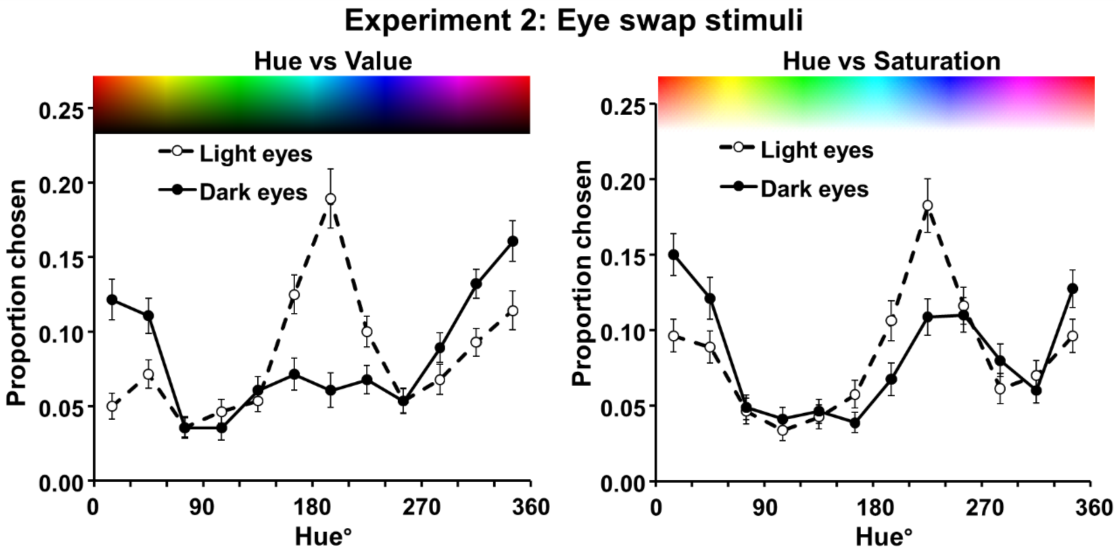
Figure 5

Light and Dark Eye Swap Stimuli for Experiment 2

Note. Top left: original light complexion composite face with light eyes. Top right: light composite face with dark eyes transplanted in. Bottom left: dark complexion composite face with light eyes transplanted in. Bottom right: original dark complexion composite with dark eyes. The white shape under the face is the area where participants chose a colour for simulated clothing.

Figure 6

*Proportion of Colours Chosen for Faces with Light and Dark Eyes in Experiment 2***.**



Note. (Conventions as Figure 3). Left: hue vs value task in which participants selected a colour from a rainbow rectangle like that shown at the top (where hue angle changes horizontally from 0 to 360° and value increases vertically from 0 to 1). Clothing colour is chosen to match faces with light and dark eyebrows. Mean proportion of trials (+/- 1 *SE*) on which 99 participants chose a given hue is plotted at 30° intervals across the hue range. Solid symbols and lines represent the proportion chosen for the faces with dark eyes. Open symbols and dashed lines represent the proportion of clothing colours chosen for the faces with light eyes. Right: data from the hue vs saturation task in which participants selected a colour from a rainbow rectangle like that shown at the top (where hue angle changes horizontally from 0 to 360° and saturation increases vertically from 0 to 1).