

Makeup Works by Modifying Factors of Facial Beauty

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Makeup is known to increase female facial attractiveness, but it is unclear how. To investigate how makeup enhances beauty, we took a theoretically driven approach, borrowing from the rich literature on facial attractiveness and testing the proposal that cosmetics increase attractiveness by modifying 5 known visual factors of attractiveness: symmetry, averageness, femininity (sexual dimorphism), age, and perceived health. In 6 studies using 152 carefully controlled images of female faces with and without makeup, participants rated the faces on attractiveness and on each of the 5 factors. We analyzed the effect of makeup on these factors and analyzed whether the factors mediated the effect of makeup on attractiveness. Makeup affected all the factors. Averageness, femininity, and health individually mediated the effect of makeup on attractiveness. Finally, with all five factors as mediators in a multiple mediation model, we observed full mediation of the effect of makeup on attractiveness, almost entirely via femininity and health. These findings support a scientific understanding of how makeup works based on the manipulation of visual factors of facial beauty.

Keywords: face perception, person perception, adornment, beautification, cosmetics


Facial cosmetics, or makeup, is a form of body art that has been used for millennia to change the appearance of the face, with the purpose of enhancing beauty (Corson, 1972). Though styles of cosmetics have varied through time and between cultures, the actual modification of the face tends to be strikingly similar, with an emphasis on making the skin appear more even and the facial features more prominent (Russell, 2010). Research has found that cosmetics alter the perception of a variety of social traits, such as trustworthiness (Etcoff et al., 2011), earning potential (Nash et al., 2006), sociosexuality (Aguinaldo & Peissig, 2021; Batres et al., 2018), and dominance (Mileva et al., 2016). But the majority of work has focused on whether cosmetics increase the perceived attractiveness of faces. Numerous studies have found that faces are


seen as more attractive when wearing makeup (Aguinaldo & Peissig, 2021; Batres et al., 2018, 2021; Bielfeldt et al., 2013; Cash et al., 1989; Etcoff et al., 2011; Graham & Jouhar, 1981; Guéguen & Jacob, 2011; Huguet et al., 2004; A. L. Jones et al., 2014; A. L. Jones & Kramer, 2015, 2016; Mulhern et al., 2003; Osborn, 1996; Workman & Johnson, 1991). Faces wearing cosmetics also elicit positive implicit responses (Comfort et al., 2021; Richetin et al., 2004) and increase activation of reward circuitry in viewers' brains (Ueno et al., 2014).


It is thus clear that makeup changes the way that faces are perceived and, in particular, that makeup increases attractiveness. However, it is unclear exactly how makeup affects attractiveness. In order to build an account of how makeup works, we take a theoretically driven analytical approach to address the question of how makeup affects the perception of facial attractiveness. Specifically, we investigate whether makeup modifies the visual factors known to underlie perceptions of facial attractiveness.

Factors of Beauty

Evidence has emerged for several biologically based visual factors of attractiveness, including preferences for bilateral symmetry, averageness (i.e., proximity to the average of the faces of a given population), sexual dimorphism (e.g., femininity for female faces), youth, and health. We describe each of these five factors in turn, describing the evidence that each factor plays a role in the perception of attractiveness, and noting reasons to believe that makeup could affect the factor. There is at least some evidence that femininity, age, and health are affected by makeup, and that symmetry

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is not affected by makeup. The effect of makeup on the perception of averageness has not been tested.

Bilateral symmetry of the face is positively associated with perceived attractiveness (Grammer & Thornhill, 1994; B. C. Jones et al., 2004; B. C. Jones et al., 2001; Penton-Voak et al., 2001; Scheib et al., 1999), albeit weakly (Rhodes, 2006). Manipulating facial symmetry in faces produces versions that are perceived as more attractive (Perrett et al., 1999; Rhodes et al., 1998), indicating that facial symmetry is a contributor to attractiveness. There are reasons to suspect that cosmetics can be used to “correct” asymmetries in facial appearance. For instance, females with greater asymmetry of the lower face area spend a significantly longer time applying cosmetics, and use a wider palette of colors during application (Korichi et al., 2011). However, a study testing the effect of makeup on a physical measurement of facial symmetry found no significant change in asymmetry as a result of makeup (Killian et al., 2018).

Facial averageness indicates the extent an individual’s facial features conform to the average of a population. Average faces are perceived as attractive across a range of studies whether the trait is measured or manipulated (Langlois & Roggman, 1990; Rhodes, 2006; Rhodes et al., 1999, 2001). It is unknown whether cosmetics could alter perceived averageness, though some findings suggest it might be capable of doing so. Cosmetics can smooth skin texture (Batres et al., 2019), which is a likely contributor to the appeal of average faces (Alley & Cunningham, 1991), though averageness still affects attractiveness when texture remains unchanged (Rhodes & Tremewan, 1996).

In women, femininity is positively related to judgements of attractiveness, whether the trait is measured or manipulated (Rhodes, 2006; Rhodes et al., 2000; Smith et al., 2006). There is evidence that women appear more feminine when wearing makeup (Cox & Glick, 1986; Graham & Jouhar, 1981). Cosmetics are believed to increase perceived femininity in part through their effect on two sexually dimorphic features. The first is *facial contrast*, which refers to the luminance and color contrast between the facial features (specifically the eyebrows, eyes, and lips) and the surrounding skin (Russell, 2003, 2009). Facial contrast is naturally higher in female faces (A. L. Jones et al., 2015; Russell, 2009; Russell et al., 2017), and makeup increases facial contrast (Etcoff et al., 2011; A. L. Jones et al., 2015; Russell, 2009). The second is the size of the facial features. Eye size is proportionately larger in females than males (Bruce & Young, 1998), and makeup has been found to make the eyes appear larger (A. L. Jones et al., 2018; Matsushita et al., 2015; Morikawa et al., 2015).

Age is negatively related to judgments of attractiveness (Ebner, 2008; Henss, 1991; Korthase & Trenholme, 1982; Kwart et al., 2012; Lennon, 1988). There is some evidence that cosmetics make middle-aged and older faces look younger (Dayan et al., 2015). But there is also evidence that makeup makes girls look older (Egan & Cordan, 2009). A recent study found that the effect of cosmetics on age judgments depends on the age of the wearer (Russell et al., 2019). Specifically, 20-year-old women look older with makeup, 30-year-old women look no different in age with or without makeup, and 40- and 50-year-old women look younger with makeup. Thus, there is evidence that the effect of makeup on apparent age depends on the age of the face.

Perceived health is strongly linked with attractiveness (Kalick et al., 1998; Rhodes et al., 2007). There is direct evidence from

one study that faces are perceived to be healthier when wearing cosmetics (Nash et al., 2006), though only four target faces were used in the study. Cosmetics are believed to increase perceived health in part through their effect on skin appearance. One recent study found that faces manipulated to have redder cheeks and lighter undereye regions (similar to what is achieved by blush and concealer/foundation) were perceived as healthier (A. L. Jones et al., 2016), while another found that artificially increased facial contrast—which is increased by makeup (Etcoff et al., 2011; A. L. Jones et al., 2015; Russell, 2009)—increases apparent health (Russell et al., 2016).

Does Makeup Work by Modifying These Factors of Beauty?

As symmetry, averageness, femininity, youth, and health determine female facial attractiveness, it is possible that makeup enhances attractiveness by modifying these factors of beauty. This would support the idea that some practices of beautification, rather than being arbitrary, function by manipulating biologically-based visual factors of beauty (Russell, 2010). Here we tested the proposal that makeup makes faces look more attractive because it enhances these factors of beauty. The studies reported here were designed to test this proposal in three ways. First, we sought to determine experimentally whether makeup affects each factor of beauty. Second, we sought to test the significance and effect size of each individual factor as a mediator of the effect of makeup on attractiveness. Finally, as a holistic test of the proposal, we used a multiple mediation model to test the significance and effect size of all five factors together as mediators of the effect of makeup on attractiveness.

Each of the studies here used two different sets of women photographed under carefully controlled conditions both wearing and not wearing cosmetics. In Study 1 participants gave attractiveness ratings of these images to confirm experimentally that makeup makes the faces look more attractive, as found previously. These attractiveness ratings then served as the dependent variable in all the subsequent mediation analyses. In Studies 2 through 6, participants viewed these images and rated the symmetry (Study 2), averageness (Study 3), femininity (Study 4), age (Study 5), and health (Study 6) of the faces. This allowed us to determine whether makeup affects each of these factors of beauty. For each factor we also conducted a simple mediation analysis with makeup (yes/no) as the independent variable, attractiveness as the dependent variable, and the factor of interest as the mediator variable. This allowed us to test whether each factor individually mediates the effect of makeup on attractiveness. Finally, we conducted a parallel multiple mediator analysis to determine whether all five of the factors together fully mediate the effect of makeup on attractiveness. This also allowed us to investigate the relative importance of the factors in mediating the effect of makeup on attractiveness.

General Method

Stimuli

In selecting stimuli, we were guided by concerns about power and validity. First, we wanted stimulus images of the faces with and without makeup to be as precisely matched as possible for all variables other than makeup. This required the use of controlled

image sets collected with the purpose of comparing faces with and without makeup. The application of makeup and the control of extraneous variables across the before and after images makes this kind of image set more time-consuming and expensive to produce than other sets of face images. Because of this, studies investigating makeup have used small samples of target images compared with other studies of face perception. In the studies cited above showing that makeup makes faces appear more attractive, the mean number of target faces was only 21. Here we used two sets of images, with 44 and 32 targets, for a total of 76 target faces.

The two sets of target images had different ages and different types of cosmetic application, which allowed us to probe the generalizability of the effects of makeup. The first set of targets, which we label Set One (see Figure 1, Panel A) comprised 44 White female university students (age = 18–27 years; $M = 21.18$, $SD = 1.94$) who self-applied their own cosmetics from a provided range of best-selling cosmetics, which included foundations, lipsticks, brow pencils, eyeshadows, mascaras, eyeliners, and blushers. Targets were instructed to apply cosmetics as if they were going on a “night out” (A. L. Jones & Kramer, 2015; A. L. Jones et al., 2015; A. L. Jones et al., 2014). Targets were photographed using a Nikon D3000 SLR camera from a distance of ~ 1 m, against a white background in a windowless room. Overhead lights and a Nikon SS-400 flash angled 45° toward the ceiling were used for illumination. Targets were photographed with a neutral expression, with their hair tied back from their face, and jewelry removed. In the initial exposure, targets removed all traces of facial cosmetics before being photographed. They were later photographed again after self-applying cosmetics. Between photographs, all camera settings were held constant. The targets were each paid (£6) for their participation and gave consent for their likeness to be shown in psychological studies.

The second set of targets (see Figure 1, Panel B) comprised 32 White women in four age bands (20 years [eight women between 18 and 22 years old], 30 years [eight women between 28 and 33 years old], 40 years [eight women between 38 and 42 years old], 50 years [eight women between 48 and 52 years old], M age = 32.50, $SD = 11.14$), who had cosmetics applied by a professional makeup artist who was instructed to apply makeup to make the

women more beautiful (A. L. Jones et al., 2018; Russell et al., 2019). Targets were photographed using a Canon EOS-1 Ds MII camera. Diffuse lighting in front of the face and a pair of direct flashes placed at 45° on either side of the face were used for illumination. As before, targets maintained a neutral expression and removed jewelry, and were photographed before and after the makeup application by a professional makeup artist. Camera settings were held constant between photographs. The targets were paid (€40) for their participation (as part of a range of other activities) and gave consent for their likeness to be used in psychological studies.

Procedures

For Studies 1 through 6, participants were tested in-person at Gettysburg College and were given partial course credit toward an introductory psychology class for their participation. Ethical approval was received from the Gettysburg College Institutional Review Board and each participant provided written informed consent. We report all measures, manipulations, and exclusions in these studies. Participants were instructed that they would be viewing two blocks of faces (i.e., “Set One” and “Set Two”) for which they would have to give ratings (order was randomized within each block). Before beginning the ratings, participants viewed a short display of all the faces in order to give them a sense of the range of faces they would be rating.

Studies in face perception often present the same facial identities to observers with a manipulation within one session, which increases the risk of carry-over effects. Here, participants viewed every identity, but only once per identity in a randomly allocated cosmetics condition (either no makeup or with makeup), and separate observers judged different traits. As such, the effect of cosmetics is more carefully isolated within a session, and carry-over effects are avoided entirely.

Analyses

For Studies 1 through 6, we calculated an average rating for each image across all participants in order to conduct by-item analyses. This resulted in two scores per face, one for each

Figure 1
Averaged Composite Images of the Stimuli Used



Note. The morphed average of the stimulus images used without makeup (left images) and with makeup (right images) for Set One (Panel A) and Set Two (Panel B). We present morphed images to avoid representing recognizable individuals. Because they are morphed composite images, the skin looks equally smooth in the with makeup and without makeup images. In the actual stimulus images, the skin typically looks more even in the with makeup condition. See the online article for the color version of this figure.

cosmetics condition. We analyzed the effect of makeup on each perceived trait using the item (target identity) as the unit of analysis. Given that the two image sets differed in terms of cosmetics application, target age, and several other factors, we first sought to determine whether the effect of makeup differed across the two sets. If the effect did differ, we analyzed the two sets separately, but if the effect did not differ, we analyzed the two sets together. Toward this end, in each study we first ran a two-way mixed analysis of variance (ANOVA) with image set as a between-item factor and makeup as a within-item factor. If there was a significant interaction between target set and makeup, we analyzed the effect of makeup using a within-item ANOVA with makeup as the only factor, separately for each of the two sets. If there was not a significant interaction between target set and makeup, we performed a within-item ANOVA with makeup as the only factor, including all the faces from both target sets in the same analysis. To foreshadow the results, the effect of makeup differed between the two sets for judgments of age and health, but not for the other judgments. Thus, we combined the two image sets to analyze the effect of makeup on every trait except for perceived age and perceived health.

Using the item as the unit of analysis, power is affected by the number of items rather than the number of participants. a priori power analyses using G*Power Version 3.1.9.2 found that sample sizes of 197, 33, or 15 items would be required to reach power ($1 - \beta$) of .80 for small, medium, or large effect sizes ($\eta^2 = .01, .06, \text{ or } .14$, respectively). This indicates that our sample size of 76 items (or of 44 and 32 items for the separate face sets) is adequately powered for large or medium effect sizes, but not for small effect sizes. Sensitivity power analyses were conducted for all hypothesis tests, excluding mediation analyses, and in all cases the observed effect sizes exceeded the required effect size computed by the sensitivity power analysis, as reported in the following text. For items and participants, sample size was determined before any data analysis.

For Studies 2 through 6, we also conducted simple mediation analyses using the SPSS plugin MEMORE (Montoya & Hayes, 2017). MEMORE implements ordinary least squares regression in a path-analytic framework for designs with repeated measurements of both the mediator and dependent variables. For each study, makeup (yes/no) was the independent variable and perceived attractiveness (ratings collected in Study 1) was the dependent variable. The variable of interest for the given study was entered as the mediating variable. We generated 95% confidence intervals (CIs) from 10,000 bootstrap samples. To aid readers who are unfamiliar with the use of mediation analysis for repeated measures, we describe the meaning of the individual components of the mediation analysis in study 2 (in subsequent studies we simply report the results).

Study 1: Attractiveness

Participants and Task

Sixty-six Gettysburg College students (41 women; M age = 19.14, $SD = 1.02$) participated in the study. Participants were asked “How attractive is this face?” on a scale ranging from 1 (*least attractive*) and 7 (*most attractive*).

Results

The effect of makeup on attractiveness did not interact with image set, $F(1, 74) = 2.02, p = .159, \eta_p^2 = .03$, so we report results with the two image sets combined. Rated attractiveness as a function of makeup condition is shown in Figure 2. Makeup significantly increased the perception of attractiveness, $F(1, 75) = 122.29, p < .001, \eta_p^2 = .62$ (without $M = 2.91, SE = .08$; with $M = 3.54, SE = .09$). The analysis had 80% power to detect an effect size of $\eta = .011$ (correlation between attractiveness ratings with and without makeup = .795).

Discussion

As expected, makeup increased facial attractiveness, confirming previous findings. Although it is clearly established that cosmetics increase attractiveness, how cosmetics increase attractiveness remains less clear. To better understand the mechanisms through which cosmetics influence attractiveness, in the next set of studies we examined whether cosmetics affect known factors of beauty. Specifically, we investigated the effect of makeup on perceived symmetry (Study 2), averageness (Study 3), femininity (Study 4), age (Study 5), and health (Study 6).

Study 2: Symmetry

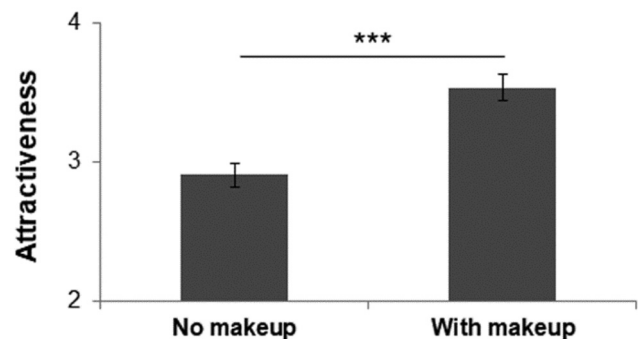
Participants and Task

Fifty-eight Gettysburg College students (35 women; M age = 19.19, $SD = 1.27$) participated in the study. Participants were asked to rate “How symmetrical is this person’s face?” on a scale ranging from 1 (*very asymmetrical*) and 7 (*very symmetrical*).

Results

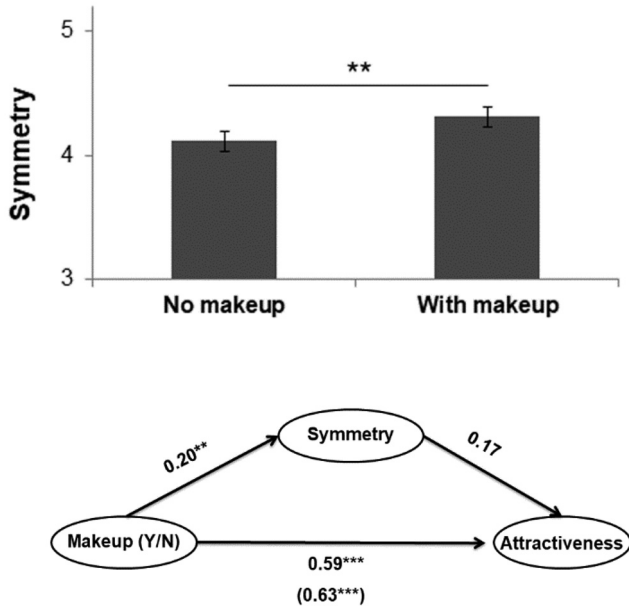
The effect of makeup on perceived symmetry did not interact with image set, $F(1, 74) = 1.04, p = .311, \eta_p^2 = .01$, so we report results with the two image sets combined. Rated symmetry as a function of makeup condition is shown in the top panel of Figure 3. The faces appeared significantly more symmetrical with makeup, $F(1, 75) = 9.16, p = .003, \eta_p^2 = .11$ (without $M = 4.11, SE = .08$,

Figure 2
Mean Attractiveness Ratings



Note. Error bars show ± 1 standard error. Asterisks indicate significant effects at $p < .001$.

Figure 3
Mean Perceived Symmetry Ratings and Mediation Model for Symmetry



Note. Error bars show ± 1 standard error. Total effects are shown in parentheses. Asterisks indicate significant effects at ** $p < .01$ and *** $p < .001$.

with $M = 4.31$, $SE = .08$). The analysis had 80% power to detect an effect size of $\eta = .017$ (correlation between symmetry ratings with and without makeup = .677).

Mediation analysis is shown in the bottom panel of Figure 3. The total effect of makeup on attractiveness was significant ($c = .63$, 95% CI [.51, .74], $p < .001$), meaning that the faces were rated, on average .63 points higher on attractiveness when wearing makeup than not. The total effect is determined by the attractiveness ratings of Study 1 and is identical in Studies 2 through 6. The a path (effect of the independent variable on the potential mediator) is the measurement of the effect of makeup on perceived symmetry as described earlier. This effect was significant ($a = .20$, 95% CI [.07, .33], $p = .003$). The b path (effect of the mediator on the dependent variable, holding the independent variable constant) was not significant ($b = .17$, 95% CI [−.03, .37], $p = .099$). The indirect effect is the product of the a and b paths, and measures how much of the effect of the independent variable on the dependent variable is due to the mediator variable. The indirect effect of makeup on attractiveness via perceived symmetry was not significant ($ab = .03$, 95% CI [−.01, .10]). The direct effect of makeup on attractiveness (controlling for the influence of the mediator variable) was significant ($c' = .59$, 95% CI [.47, .71], $p < .001$), indicating that makeup still accounts for variance in perceived attractiveness when perceived symmetry is controlled.

Discussion

Faces were perceived as more symmetrical with makeup than without makeup. This effect is contrary to the finding of no significant difference in asymmetry between faces with and without

makeup (Killian et al., 2018). This difference may be due to our use of a perceptual rather than a physical measurement of facial symmetry. However, this effect of makeup on perceived symmetry did not mediate the effect of makeup on attractiveness, as evidenced by the nonsignificant indirect effect. The nonsignificant b path—indicating no significant effect of perceived symmetry on perceived attractiveness, when controlling for makeup—is consistent with the meta-analytic finding that symmetry is only a weak predictor of attractiveness (Rhodes, 2006). Whereas makeup did increase the appearance of symmetry, the increased appearance of symmetry did not affect perceived attractiveness.

Study 3: Averageness

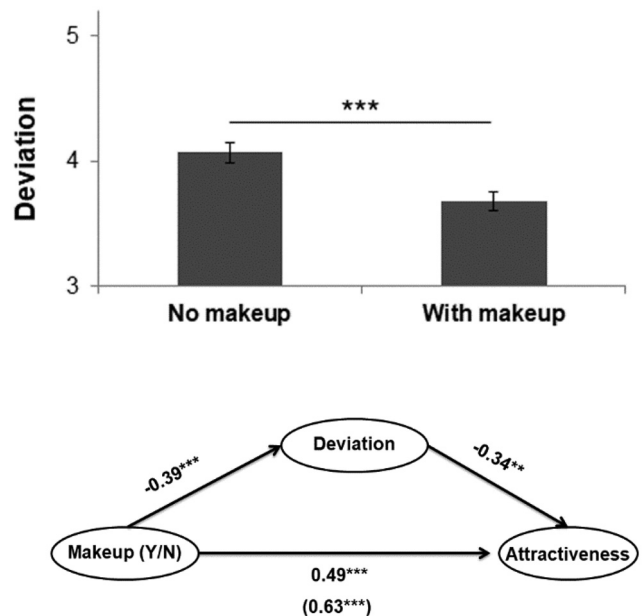
Participants and Task

Fifty-two Gettysburg College students (26 women; M age = 18.65, $SD = .86$) participated in the study. Participants were asked to rate “How much does this face deviate from other women’s faces that you know?” on a scale ranging from 1 (*very typical*) and 7 (*very atypical*).

Results

The effect of makeup on deviation did not interact with image set, $F(1, 74) = .03$, $p = .873$, $\eta_p^2 < .001$, so we report results with the two image sets combined. Rated deviation as a function of makeup condition is shown in the top panel of Figure 4. Targets were assigned lower deviation scores (i.e., appeared more average) with cosmetics, $F(1, 75) = 38.96$, $p < .001$, $\eta_p^2 = .34$ (without $M =$

Figure 4
Mean Perceived Deviation Ratings and Mediation Model for Deviation



Note. Error bars show ± 1 standard error. Total effects are shown in parentheses. Asterisks indicate significant effects at ** $p < .01$ and *** $p < .001$.

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4.07, $SE = .08$, with $M = 3.68$, $SE = .07$). The analysis had 80% power to detect an effect size of $\eta = .018$ (correlation between averageness ratings with and without makeup = .658).

Mediation analyses are shown in the bottom panels of Figure 4. The a path was significant ($a = -.39$, 95% CI [.22, .54], $p < .001$), as was the b path ($b = -.34$, 95% CI [.14, .54], $p = .001$). The indirect effect was significant ($ab = .13$, 95% CI [.03, .24]), as was the direct effect ($c' = .49$, 95% CI [.36, .63], $p < .001$).

Discussion

Cosmetics decreased the perceived deviation of faces from the average, in other words it made the faces appear more average. It is likely that makeup made faces appear more average by enhancing facial traits that are more average in female faces. For example, by conferring a more even skin tone as well as aspects of coloration that are more typical of female faces, such as skin color (Nestor & Tarr, 2008) and facial contrast (A. L. Jones et al., 2015; Russell, 2009). Perceived deviation (i.e., averageness) also significantly mediated the effect of makeup on attractiveness.

Study 4: Femininity

Participants and Task

Fifty-nine Gettysburg College students (36 women; M age = 18.66, $SD = .96$) participated in the study. Participants were asked to rate "How feminine is this face?" on a scale ranging from 1 (*not at all feminine*) and 7 (*very feminine*).

Results

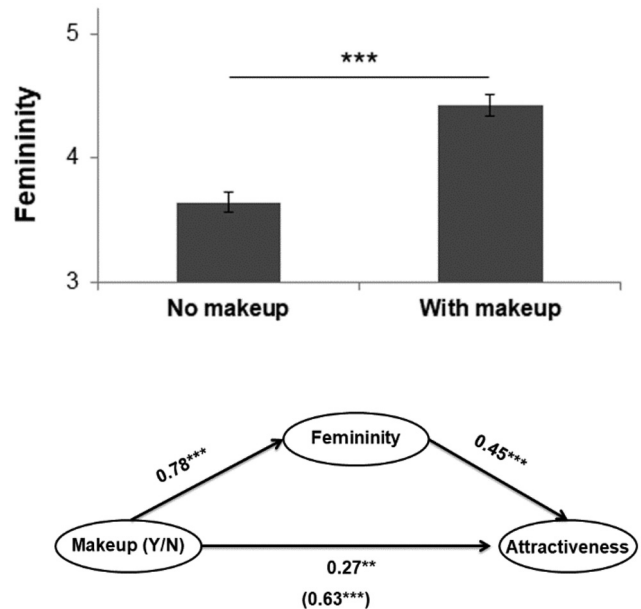
The effect of makeup on perceived femininity did not interact with image set, $F(1, 74) = .001$, $p = .981$, $\eta_p^2 < .001$, so we report results with the two image sets combined. Rated femininity as a function of makeup condition is shown in the top panel of Figure 5. Makeup increased the perception of femininity, $F(1, 75) = 207.17$, $p < .001$, $\eta_p^2 = .73$ (without $M = 3.64$, $SE = .08$, with $M = 4.42$, $SE = .08$). The analysis had 80% power to detect an effect size of $\eta = .011$ (correlation between femininity ratings with and without makeup = .787).

Mediation analyses are shown in the bottom panels of Figure 5. The a path was significant ($a = .78$, 95% CI [.67, .89], $p < .001$), as was the b path ($b = .45$, 95% CI [.23, .67], $p < .001$). The indirect effect was significant ($ab = .35$, 95% CI [.19, .54]), as was the direct effect ($c' = .27$, 95% CI [.07, .47], $p = .008$).

Discussion

Makeup increased perceived femininity. This finding is consistent with previous research showing a positive link between cosmetics and perceived femininity (Cox & Glick, 1986; Graham & Jouhar, 1981). It is likely that cosmetics increase femininity through their influence on sexually dimorphic traits such as facial contrast (A. L. Jones et al., 2015; Russell, 2009) and facial feature size (A. L. Jones et al., 2018; Matsushita et al., 2015; Morikawa et al., 2015). Further, perceived femininity also significantly mediated the effect of makeup on attractiveness.

Figure 5
Mean Perceived Femininity Ratings and Mediation Model for Femininity



Note. Error bars show ± 1 standard error. Total effects are shown in parentheses. Asterisks indicate significant effects at ** $p < .01$ and *** $p < .001$.

Study 5: Age

Participants and Task

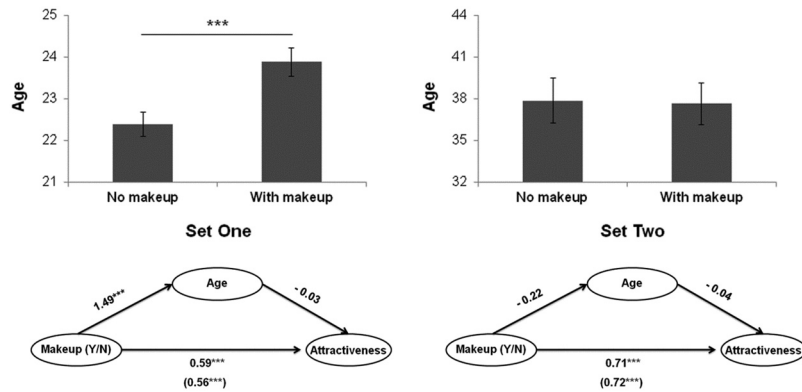
Fifty-seven Gettysburg College students (40 women; M age = 18.39, $SD = .70$) participated in the study. Participants were asked to rate "How old does this person look?" on a scale ranging from 0 to 70 years of age. This response scale differed from those of the other studies, which used seven-point Likert scale trait ratings.

Results

There was a significant interaction between makeup and image set on perceived age, $F(1, 74) = 15.80$, $p < .001$, $\eta_p^2 = .18$. Because of this, we did not combine Set One and Set Two in subsequent analyses. Perceived age as a function of makeup condition is shown in the top panels of Figure 6. Targets in Set One appeared significantly older with cosmetics, $F(1, 43) = 52.81$, $p < .001$, $\eta_p^2 = .55$ (without $M = 22.39$, $SE = .29$, with $M = 23.88$, $SE = .35$). The analysis had 80% power to detect an effect size of $\eta = .010$ (correlation between age ratings with and without makeup = .810). On the other hand, the age judgments of Set Two targets were not affected by cosmetics, $F(1, 31) = .27$, $p = .608$, $\eta_p^2 = .01$ (without $M = 37.87$, $SE = 1.63$, with $M = 37.65$, $SE = 1.49$). The analysis had 80% power to detect an effect size of $\eta = .002$ (correlation between age ratings with and without makeup = .968).

Mediation analyses are shown in the bottom panels of Figure 6. The total effect of makeup on attractiveness was significant in both Set One ($c = .56$, 95% CI [.41, .71], $p < .001$) and Set Two ($c = .72$, 95% CI [.55, .89], $p < .001$). The a path was significant

Figure 6
Mean Perceived Age Ratings and Mediation Models for Age



Note. Error bars show ± 1 standard error. Total effects are shown in parentheses. Asterisks indicate significant effects at *** $p < .001$.

in Set One ($a = 1.49$, 95% CI [1.08, 1.90], $p < .001$) but not in Set Two ($a = -.22$, 95% CI [-1.07, .64], $p = .608$). The b path was not significant in either Set One ($b = -.03$, 95% CI [-.15, .10], $p = .676$) or Set Two ($b = -.04$, 95% CI [-.12, .03], $p = .265$). The indirect effect was not significant in either Set One ($ab = -.04$, 95% CI [-.18, .10]) or Set Two ($ab = .01$, 95% CI [-.03, .06]). The direct effect was significant in both Set One ($c' = .59$, 95% CI [-.36, .83], $p < .001$) and Set Two ($c' = .71$, 95% CI [.54, .88], $p < .001$).

Discussion

The results from Set One, where the average age of the women was 21, replicate the finding that women in their 20s appear older when wearing makeup (Russell et al., 2019). The results from Set Two, where the average age of the women was 33, are also consistent with the finding that women in their 30s look no different in age with or without makeup (Russell et al., 2019). Both sets of results support the notion that the effect of cosmetics on age perceptions depends on the age of the wearer. However, the nonsignificant b coefficient in both sets was surprising as age has been found to predict attractiveness in several studies (Ebner, 2008; Henss, 1991; Korthase & Trenholme, 1982; Kwart et al., 2012; Lennon, 1988). This may be due to the restricted age range in Set One, which had a narrow age range of targets. However, this cannot explain the result with Set Two, whose targets had a much wider age range. With both Set One and Set Two the results do not support the idea that perceived age mediates the effect of makeup on attractiveness.

Study 6: Health

Participants and Task

Fifty-five Gettysburg College students (32 women; M age = 19.15, $SD = 1.19$) participated in the study. Participants were asked to rate “How healthy is this person’s face?” on a scale ranging from 1 (*very unhealthy*) to 7 (*very healthy*).

Results

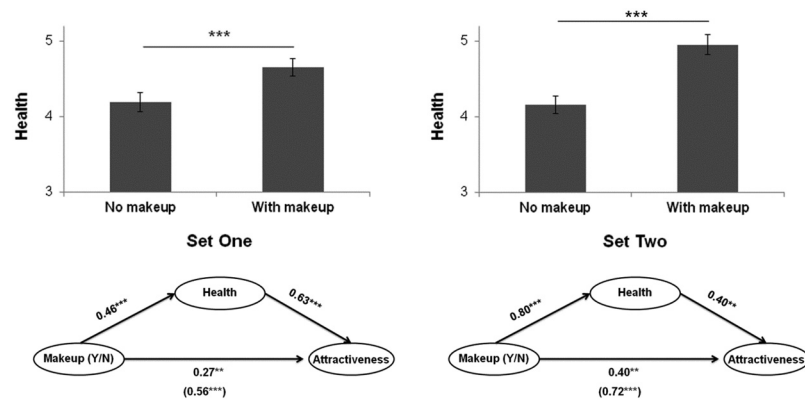
There was a significant interaction between makeup and image set on perceived health, $F(1, 74) = 6.31$, $p = .01$, $\eta_p^2 = .08$. Because of this, we did not combine Set One and Set Two in subsequent analyses. Perceived health as a function of makeup condition is shown in the top panels of Figure 7. Targets in Set One appeared significantly healthier with cosmetics, $F(1, 43) = 35.92$, $p < .001$, $\eta_p^2 = .46$ (without $M = 4.19$, $SE = .13$, with $M = 4.66$, $SE = .12$). The analysis had 80% power to detect an effect size of $\eta = .011$ (correlation between health ratings with and without makeup = .800). Additionally, Set Two targets also appeared healthier when wearing cosmetics, $F(1, 31) = 47.35$, $p < .001$, $\eta_p^2 = .60$ (without $M = 4.16$, $SE = .11$, with $M = 4.95$, $SE = .13$). The analysis had 80% power to detect an effect size of $\eta = .022$ (correlation between health ratings with and without makeup = .567).

Mediation analyses are shown in the bottom panels of Figure 7. The total effect of makeup on attractiveness was significant ($c = .63$, 95% CI [.51, .74], $p < .001$). The total effect of makeup on attractiveness was significant in both Set One ($c = .56$, 95% CI [.41, .71], $p < .001$) and Set Two ($c = .72$, 95% CI [.55, .89], $p < .001$). The a path was significant in both Set One ($a = .46$, 95% CI [.31, .62], $p < .001$), and Set Two ($a = .80$, 95% CI [.56, 1.03], $p < .001$). The b path was significant in both Set One ($b = .63$, 95% CI [.39, .87], $p < .001$) and Set Two ($b = .40$, 95% CI [.16, .63], $p = .002$). The indirect effect was significant in both Set One ($ab = .29$, 95% CI [.13, .46]) and Set Two ($ab = .32$, 95% CI [.15, .47]). The direct effect was significant in both Set One ($c' = .27$, 95% CI [.10, .43], $p = .002$) and Set Two ($c' = .40$, 95% CI [.16, .64], $p = .002$).

Discussion

Perceived health was increased by cosmetics in both sets. Facial contrast likely contributed to this effect, as it is related to perceived health (Russell et al., 2016) and is increased by cosmetics (A. L. Jones et al., 2015). Cosmetics also homogenize skin texture (Batres et al., 2019), which is related to perceived health (Fink et al., 2006), and affect other aspects of facial color relevant to perceived health (A. L. Jones et al., 2016). The effect of makeup on perceived health was a bit larger in Set Two than in Set One,

Figure 7
Mean Perceived Health Ratings and Mediation Models for Health



Note. Error bars show ± 1 standard error. Total effects are shown in parentheses. Asterisks indicate significant effects at $** p < .01$ and $*** p < .001$.

we suspect due to the targets of Set Two being older. There was clear evidence with both face sets that perceived health mediated the effect of makeup on perceived attractiveness.

Multiple Mediation Analysis of Studies 1 Through 6

In Studies 2 through 6 we sought to determine experimentally whether makeup affects each of the five factors of beauty. We also conducted simple mediation models to measure the significance and effect size of each of these factors individually as mediators of the effect of makeup on attractiveness. In this final analysis we sought to measure the significance of all five factors together as mediators of the effect of makeup on attractiveness, and to measure their effect sizes to explore whether certain factors are especially important. Toward this end, we used the data from the previous studies to conduct a parallel multiple mediator model using the MEMORE plugin for SPSS (Montoya & Hayes, 2017). This analysis examines the indirect effect of each mediator while controlling for the indirect effects of the other mediators. The size of the indirect effects can be compared with each other, providing insight into which mediators have the strongest influence on the dependent variable. Additionally, the analysis allows for a combined measurement of all the indirect effects—the total indirect effect.

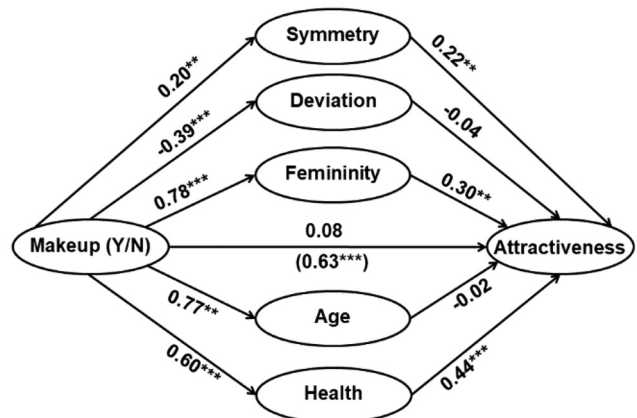
As in the simple mediation analyses, makeup (yes/no) was the independent variable and perceived attractiveness (Study 1) was the dependent variable. Five parallel mediators were analyzed, using the ratings of the factors collected in Studies 2 through 6 (symmetry, averageness (measured as deviation), femininity, age, and health). Although the effect of makeup on two of the factors (age and health) differed by image set—the mediation by those factors did not differ by image set—there was no mediation by age in either set, and there was mediation by health in both sets. For this reason, we combined Set One and Set Two and conducted a single analysis with all the faces. Ninety-five percent confidence intervals were generated from 10,000 bootstrap samples.

Results

The parallel multiple mediator model appears in Figure 8. The total effect of makeup on attractiveness was significant ($c = .63$, 95% CI

[.51, .74], $p < .001$). The a paths were significant for all of the mediators, including perceived symmetry ($a = .20$, 95% CI [.07, .33], $p = .003$), deviation (i.e., “averageness”; $a = -.39$, 95% CI [-.51, -.26], $p < .001$), femininity ($a = .78$, 95% CI [.67, .89], $p < .001$), age ($a = .77$, 95% CI [.31, 1.23], $p = .001$), and health ($a = .60$, 95% CI [.47, .74], $p < .001$). The b paths were significant for perceived symmetry ($b = .22$, 95% CI [.06, .37], $p = .007$), perceived femininity ($b = .30$, 95% CI [.09, .50], $p = .005$), and for perceived health ($b = .44$, 95% CI [.28, .59], $p < .001$), but were not significant for perceived deviation (i.e., averageness; $b = -.04$, 95% CI [-.15, .22], $p = .706$) or perceived age ($b = -.02$, 95% CI [-.03, .07], $p = .520$). The indirect effects were significant for perceived symmetry ($ab = .04$, 95% CI [.01, .10]), perceived femininity ($ab = .23$, 95% CI [.09, .37]) and perceived health ($ab = .26$, 95% CI [.16, .38]), but not for perceived deviation (i.e., averageness; $ab = .01$, 95% CI [-.07, .10]), or perceived age ($ab = -.01$, 95% CI [-.06, .02]).

Figure 8
Parallel Multiple Mediation Model With Perceived Symmetry, Deviation, Femininity, Age, and Health as Mediator Variables



Note. Total effect is shown in parentheses. Note that perceived age was rated on a different scale than the other mediators. Asterisks indicate significant effects at $** p < .01$ and $*** p < .001$.

Pairwise contrasts of each indirect effect allowed us to determine whether any of the indirect effects were larger than the others. These contrasts are shown in Table 1. The indirect effects of perceived femininity and perceived health did not differ from one another but were larger than the indirect effects involving the other mediators. In addition, the indirect effect of perceived symmetry was larger than that of perceived age. The total indirect effect, which accounts for all the specific indirect effects, was significant ($ab = .54$, 95% CI [.36, .73]), but the direct effect was not significant ($c' = .08$, 95% CI [-.10, .27], $p = .366$).

Discussion

The parallel multiple mediator analysis showed that the five factors of beauty together fully mediated the effect of makeup on attractiveness. The total indirect effect was significant, but the direct effect was not significant. This finding is consistent with the claim that makeup increases attractiveness through its effects on these factors of beauty. We also investigated the relative strength of the different mediators. The only specific indirect effects that were significant were those mediated by symmetry, femininity, and health. However, symmetry had a very small contribution to the total indirect effect, much smaller than femininity or health. Together, femininity and health accounted for nearly all the total indirect effect of makeup on attractiveness. The pairwise contrasts found that the indirect effects of femininity and health did not differ from each other but were significantly greater than the indirect effects of each of the other three mediator variables. Overall, the multiple mediation analysis is consistent with the claim that makeup makes faces look more attractive because it makes them appear more feminine and healthier.

General Discussion

We proposed that makeup makes faces appear more attractive because it alters visual factors of beauty including perceived symmetry, averageness, femininity, age, and health. We used two large, high-quality stimulus sets to test three aspects of the proposal—that makeup increases these factors of beauty, that there is significant mediation of the effect of makeup on attractiveness by these factors individually, and that there is significant mediation of the effect of makeup on attractiveness by these factors collectively. The results

of our studies supported all three aspects of the proposal. Further, we found evidence that perceived femininity and health accounted for almost all the mediation. These findings are consistent with the proposal that makeup makes faces look more attractive by manipulating perceived health and femininity.

In Studies 2 through 6, we experimentally tested whether makeup affects the perception of symmetry (Study 2), averageness (Study 3), femininity (Study 4), age (Study 5), and health (Study 6), by asking participants to rate faces with and without makeup on these traits. Makeup had significant, positive effects on perceived symmetry, averageness, femininity, and health. The effect of makeup on perceived age was mixed, with the effect of makeup on perceived age being significant and positive for Set One (all young adults) but not significant for Set Two (a mix of young and middle-aged adults). This replicates previous work showing that makeup has opposite effects on the perceived age of young and middle-aged/older faces (Russell et al., 2019). Overall, the results of these experiments were consistent with the proposal that makeup modifies factors that underlie the perception of beauty.

In Studies 2 through 6, we conducted simple mediation models to test the extent to which each of the factors of beauty mediates the effect of makeup on attractiveness. Neither symmetry nor age significantly mediated the effect of makeup on attractiveness. The lack of mediation by symmetry may be a result of the relatively small effect of symmetry on attractiveness judgments (Rhodes, 2006). It is less clear why there was not mediation by age. It will be necessary to investigate this relationship in the future with more middle-aged and older faces to determine whether age plays a larger role in the effectiveness of makeup for women of those age ranges. Also, all the perceptual judgments here used Likert scale ratings, except for the perceived age judgments in which participants guessed the age of the target face. It is possible that our results would differ if we used a rating scale for perceived age (e.g., a Likert scale rating of “youthfulness”). The other factors, perceived averageness, femininity, and health all significantly mediated the effect of makeup on attractiveness.

Finally, we used a parallel multiple mediator model to test the prediction that the five factors tested in Studies 2 through 6 collectively mediate the effect of makeup on attractiveness. The total effect was significant, showing an effect of makeup on attractiveness. However, the direct effect was not significant, indicating that when the five factors were held constant, the presence or absence of makeup on the face did not account for variance in attractiveness. This indicates that the five factors fully mediated the effect of makeup on attractiveness. The role of perceived health and perceived femininity was particularly strong, accounting for nearly all the effect of makeup on attractiveness. In other words, makeup made the faces more attractive primarily because it made them look more feminine and healthier. This is consistent with the idea that makeup works by modifying the appearance of femininity and health.

These results are consistent with findings that makeup modifies specific visual features that are related to perceived femininity and health, including facial contrast, facial feature size, lip color, skin color, and skin evenness. Facial contrast refers to the luminance and color contrast between the facial features (specifically the eyebrows, eyes, and lips) and the surrounding skin (Russell, 2009). Makeup increases facial contrast (Etcoff et al., 2011; A. L. Jones et al., 2015; Russell, 2009), which is naturally higher in female faces (A. L. Jones et al., 2015; Russell, 2009; Russell et al., 2017),

Table 1
Pairwise Contrasts of Indirect Effects in the Parallel Multiple Mediation Analysis

Pairwise contrast	Effect	SE	Lower CI	Upper CI
Symmetry vs. Health	-.22	.06	-.33	-.10
Symmetry vs. Deviation	.03	.06	-.07	.15
Symmetry vs. Femininity	-.19	.08	-.34	-.03
Symmetry vs. Age	.06	.03	.00	.14
Health vs. Deviation	.25	.08	.10	.40
Health vs. Femininity	.03	.09	-.14	.21
Health vs. Age	.28	.06	.17	.39
Deviation vs. Femininity	-.22	.09	-.39	-.04
Deviation vs. Age	.03	.04	-.05	.12
Femininity vs. Age	.25	.08	.09	.40

Note. Significant contrasts appear in bold. Lower CI and Upper CI refer to the lower and upper bounds of the 95% confidence interval.

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in younger faces (Porcheron et al., 2013, 2017; Russell et al., 2017), and is positively associated with perceived health (Russell et al., 2016). Makeup also increases the apparent size of the eyes (Matsushita et al., 2015; Morikawa et al., 2015) and eyebrows, and can make the nose appear smaller (A. L. Jones et al., 2018). The size of the eyes and lips are proportionately larger in females than males (Bruce & Young, 1998) while the nose is smaller (Burriss et al., 2007; Koehler et al., 2004). Lip color, which is commonly modified by lipstick, is associated with perceived femininity (Stephen & McKeegan, 2010) and is capable of modifying the apparent color of the face (Kobayashi et al., 2017), which is associated with perceived femininity/masculinity (Nestor & Tarr, 2008) and to perceived health (Stephen et al., 2009). Makeup also makes the skin appear more even or homogeneous (Batres et al., 2019). Skin homogeneity is associated with perceived age and health (Fink et al., 2001, 2006). Thus, there is ample evidence that makeup can modify the appearance of factors of attractiveness, particularly perceived femininity and health, but also age.

Our approach toward investigating the mechanisms underlying the efficacy of makeup is borrowed from the facial attractiveness literature. Within this literature, socialization has been rejected as the sole explanation for beauty preferences because of evidence for some universal, cross-cultural agreement in facial preferences (Langlois et al., 2000; Rhodes, 2006). However, there is reason to believe that socialization may play a more important role in preferences for adornment than in preferences for unadorned faces. Even considering only typical, “received cosmetics” (Russell, 2010), there is ample geographic and temporal variation in makeup preferences (Corson, 1972; G. Jones, 2010; Peiss, 1998) that would be difficult to explain in terms of natural or sexual selection. There is also recent evidence suggesting that there is greater agreement on visual preferences for naturally occurring objects and scenes than for artifacts of human culture (Vessel et al., 2018). For example, Vessel et al., found greater agreement on preferences for images of natural landscapes than for images of exterior architecture. Adornment and self-decoration are artifacts of human culture, and thus it may be the case that there is less agreement on preferences for practices of facial adornment, decoration, and beautification than there is for the beauty of unadorned faces. Thus, we do not claim to rule out socialization as a factor in explaining how makeup works. Indeed, socialization may partly underlie the ability of makeup to modify the factors of attractiveness investigated here.

It is important to note that mediation analysis itself cannot demonstrate the causal direction between the mediator variables and the dependent variable (attractiveness) with the current data. While there is ample experimental evidence that these mediator variables have a causal effect on attractiveness (as described in the introductory Factors of Beauty section), there is also longstanding evidence of attractiveness “halo effects,” showing that attractive people are believed to have more socially desirable personality traits (Dion et al., 1972). Thus, it is conceivable that makeup makes faces appear more attractive through some other causal route, and the increased attractiveness then causes the faces to appear to be healthier, younger, and so forth. The mediation analyses we present here are incapable of distinguishing between these possibilities because the mediator variables and the dependent variable are all measured rather than manipulated. Because of this we must conclude that our results are consistent with, but do not

decisively demonstrate, the idea that makeup works because it modifies underlying factors of beauty.

An important limitation of these findings comes from our use of only White European target faces, and of participants from the same university in the same country. Though controlling these variables may have enhanced the internal validity of the findings, it also diminishes their generalizability. It will be important for future work exploring these questions to employ target faces from a broader range of racial and ethnic backgrounds, and participants from a wider range of cultural backgrounds.

In conclusion, we found evidence that makeup modifies five factors of beauty, to varying degrees. Three of these factors individually mediated the effect of makeup on attractiveness, in simple mediation models. When all five factors were entered as mediators in a parallel multiple mediator model, they fully mediated the effect of makeup on facial attractiveness. Perceived femininity and health accounted for nearly all the mediation. These results are consistent with the notion that makeup works because it modifies underlying factors of beauty, particularly perceived health and femininity. This indicates that makeup use is based on perceptual as well as cultural factors and suggests the possibility that this may be true for other practices of adornment, decoration, and beautification.

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