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Effects of facial skin smoothness and blemishes on trait impressions

Jaeger, B.; Wagemans, F.M.A.; Evans, A.M.; van Beest, I.

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Bastian Jaeger, Fieke M. A. Wagemans, Anthony M. Evans, and Ilja van Beest

Tilburg University

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Author Note

Bastian Jaeger, Fieke M. A. Wagemans, Anthony M. Evans, and Ilja van Beest, Department of Social Psychology, Tilburg University, The Netherlands.

Correspondence concerning this article should be addressed to Bastian Jaeger, Department of Social Psychology, Tilburg University, P.O. Box 90153, 5000 LE Tilburg, The Netherlands. E-mail: b.jaeger@uvt.nl

Abstract

People make trait inferences based on facial appearance, and these inferences guide social approach and avoidance. Here, we investigate the effects of textural features on trait impressions from faces. In contrast to previous work, which exclusively manipulated skin smoothness, we manipulated smoothness and the presence of skin blemishes independently (Study 1) and orthogonally (Study 2). We hypothesized that people are particularly sensitive to skin blemishes because blemishes potentially indicate poor health and the presence of an infectious disease. We therefore predicted that the negative effect of blemished skin is stronger than the positive effect of smoothed skin. The results of both studies are in line with this reasoning. Across ratings of trustworthiness, competence, maturity, attractiveness, and health, the negative influence of skin blemishes was stronger and more consistent than the positive influence of skin smoothness (Study 1). Moreover, the presence of skin blemishes diminished the positive effect of skin smoothness on attractiveness ratings (Study 2). In sum, both facial skin blemishes and facial skin smoothness influence trait impression, but the negative effect of blemished skin is larger and more salient than the positive effect of smooth skin.

Keywords: face perception, skin texture, health, attractiveness, personality

The Effects of Facial Skin Smoothness and Blemishes on Trait Impressions

People spontaneously form trait impressions based on a person's facial appearance

(Todorov, Olivola, Dotsch, & Mende-Siedlecki, 2015). Faces are judged along three largely

independent dimensions (Sutherland et al., 2013, 2017): In line with related work on person and

group perception (Abele & Wojciszke, 2007; Fiske, Cuddy, Glick, & Xu, 2002), the first two

dimensions represent evaluations of a target's intentions, captured by judgments of

trustworthiness, honesty, or morality, and ability, captured by judgments of competence,

confidence, or dominance (Oosterhof & Todorov, 2008). The third dimension represents an

evaluation of a target's attractiveness (Sutherland et al., 2013). Together, these three dimensions

reflect the functional nature of face judgments. Judging a person's intention and ability

constitutes an appraisal of their threat potential and determines who is approached or avoided

(Oosterhof & Todorov, 2008). Likewise, judging attractiveness constitutes an appraisal of a

person's mate value and determines who is sought out as a sexual partner (Rhodes, Simmons, &

Peters, 2005). Spontaneous face judgments thus provide perceptual input that guides social

behavior. In line with this reasoning, judgments of trustworthiness, competence, and

attractiveness influence behavior in a wide variety of domains such as criminal sentencing

(Gunnell & Ceci, 2010; Wilson & Rule, 2015), voting (Berggren, Jordahl, & Poutvaara, 2010;

Todorov, Mandisodza, Goren, & Hall, 2005), personnel selection (Bóo, Rossi, & Urzúa, 2013;

Gomulya, Wong, Ormiston, & Boeker, 2016), and social exchange (van't Wout & Sanfey, 2008).

Given the pervasive influence of face judgments on social behavior, it is important to

understand which facial cues drive trait perceptions. So far, research has largely focused on the

structural (e.g., facial width-to-height ratio, Stirrat & Perrett, 2010) and dynamic (e.g., emotional

expressions, Sutherland, Young, & Rhodes, 2016) properties of faces. Relatively little is known

about the role of textural properties, or the specific textural properties that influence trait impressions. This is surprising, given that a person's facial skin texture can be a valid indicator of their health and personality (Jones, Kramer, & Ward, 2012).

Existing studies have examined the influence of skin smoothness on perceptions of health and attractiveness. For example, health ratings of skin patches cropped from a face are correlated with attractiveness ratings of the entire face, suggesting that skin surface features contribute to perceptions of attractiveness (Jones, Little, Burt, & Perrett, 2004). Fink and colleagues (2001) also showed that a statistical measure of skin homogeneity (indexed by the correlation between neighboring pixels in a facial photograph) is positively related to perceived attractiveness. Recently, Tsankova and Kappas (2016) examined the effects of skin smoothness on a wider set of trait impressions. They found that targets whose skin had been smoothed with computer software were seen as more trustworthy, competent, attractive, and healthy which led them to conclude that having smooth skin has a positive influence on trait impressions.[1] Here, we seek to extend their findings by proposing that facial blemishes, more so than smooth skin, play an important role in impression formation.

With their manipulation of facial smoothness, Tsankova and Kappas (2016) eliminated common variations in skin texture such as wrinkles, uneven pigmentation, large pores, or birth marks. However, this manipulation also resulted in the removal of facial skin blemishes, which were present on some individuals. It is thus unclear to what extent the influence of facial skin

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[1] Applying cosmetics, which includes the use of foundation to smooth the facial skin, has also been shown to increase perceived attractiveness, trustworthiness, likeability, and competence (Etcoff, Stock, Haley, Vickery, & House, 2011). However, the effect of cosmetics on a person's perceived attractiveness is small in comparison to between-person variation in attractiveness (Jones & Kramer, 2015, 2016).

texture on trait impressions is driven by the presence of facial blemishes as opposed to smooth skin per se. Prior work has shown that people are particularly sensitive to cues connoting poor health in order to prevent contact with sick individuals (Schaller & Duncan, 2007). Thus, people may be particularly sensitive to the presence of blemishes. This view predicts more negative trait impressions of individuals with facial blemishes.

Moreover, the effect of blemishes may be stronger and more salient than the effect of smoothness. To investigate this question, we disentangle the unique roles of skin smoothness and skin blemishes in impression formation. Avoiding sick individuals is crucial for survival (Park, Schaller, & Crandall, 2007) and people rely on facial cues to infer a person's health (Henderson, Holzleitner, Talamas, & Perrett, 2016; Matts, Fink, Grammer, & Burquest, 2007). In fact, prior work suggests that people can identify individuals with an experimentally induced sickness just on the basis of a facial photograph (Axelsson et al., 2018; Regenbogen et al., 2017). Since the cost of a false positive (engaging with a sick individual) substantially outweighs the cost of a false negative (avoiding a healthy individual), even cues that resemble the symptoms of an infectious disease can trigger avoidance (Nesse, 2005; see also Zebrowitz & Rhodes, 2004). For example, individuals with benign facial irregularities (e.g., a port wine stain) are treated as a potential source of contagion (Houston & Bull, 1994; Ryan, Oaten, Stevenson, & Case, 2012). Similarly, we posit that this heightened sensitivity to disease cues might lead people to attribute common facial skin blemishes to the presence of a harmful disease, rather than a more probable non-infectious condition (e.g., acne). Ultimately, this vigilance could lead to more negative impressions of individuals with facial skin blemishes.

Here, we provide a more nuanced test of the influence of facial skin texture on trait judgments by manipulating skin smoothness and blemishes independently (Study 1) and

orthogonally (Study 2). Both studies were pre-registered and all data and analysis scripts are available at the Open Science Framework (https://osf.io/6drqn/). We report how our sample sizes were determined, and all data exclusions, manipulations, and measures in the studies.

Study 1

In our first study we replicated earlier work by Tsankova and Kappas (2016) by comparing people's judgments of individuals with smooth facial skin against an unmanipulated baseline version. Crucially, we also compared judgments of individuals with facial skin blemishes to an unmanipulated baseline version. We hypothesized that the effect of facial skin texture on people's trait judgments is primarily due to more negative evaluations of blemished faces, rather than more positive evaluations of smooth faces. In addition to judgments of trustworthiness, competence, and attractiveness, we also assessed health judgments (in a pre-test) and maturity judgments of the faces. Tsankova and Kappas (2016) raised the possibility that more positive trustworthiness judgments of individuals with smoothed skin are driven by more positive judgments of other traits, such as maturity, which are related to trustworthiness. This argument contrasts previous findings showing that individuals with smooth skin are perceived to be younger (Tiddeman, Burt, & Perrett, 2001). Therefore, we tested whether smooth skin has a positive or negative effect on perceived maturity. Prior work has also shown that averaging (i.e., morphing) faces leads to a healthier and more attractive appearance and one proposed explanation for this effect is that averaging creates a smooth skin texture free of blemishes (Fink et al., 2001; Little & Hancock, 2002). We tested this explanation directly by comparing the independent effects of blemishes and smoothness on health and attractiveness judgments.

Methods

Participants. Our sample size was based on the number of students who participated in

the study within two weeks, with a minimum set at 150. This provided us with at least 25

independent judgments for each face (cf. Oosterhof & Todorov, 2008). We recruited 233 Tilburg

University students on campus. The study was administered on a tablet and participants who

completed the study were entered in a raffle for one of three vouchers for a local café. It was

ensured that participants completed the study in a quiet environment without any distractions. In

line with our pre-registered exclusion criteria, we excluded six participants (2.58%) who always

gave the same rating, ten participants (4.29%) who indicated that they had noticed our

manipulation of facial skin texture, and fourteen participants (6.01%) who indicated that they

had seen the unmanipulated faces in a previous experiment. This resulted in a final sample of

203 participants (58.1% female; $M_{age} = 22.16$, $SD_{age} = 4.66$).

Materials. Similar to Tsankova and Kappas (2016), we used photos from the Radboud

Faces Database (Langner et al., 2010). We selected ten male and ten female individuals with a

frontal gaze and a neutral facial expression. In contrast to Tsankova and Kappas (2016), no

individuals with skin blemishes were included. Targets' average estimated age ranged from 20 to

30 years ($M_{age} = 23.81$, $SD_{age} = 3.67$) and we ensured that there were no gender differences in

age, $t(13.25) = 0.92$, $p = .38$.[2] Drawing on Langner and colleagues' (2010) validation study of

the face database, we also ensured that there were no gender differences in perceived

attractiveness of the individuals, $t(15.46) = 0.42$, $p = .68$.

Targets' average estimated age ranged from 22 to 43 years ($M_{age} = 29.78$, $SD_{age} = 5.34$).

All individuals were White, displayed a neutral facial expression, and were photographed from

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[2] Age data was missing for one male and three female targets.

the front. We ensured that there were no significant gender differences in estimated age, $t(25.7) =$ 1.16, $p = .26$, or attractiveness, $t(20.7) = 0.58$, $p = .57$, in our sample of targets.

The images were cropped to an oval shape measuring 500×600 pixels and three different versions of each face were created (for a total of 60 stimuli): an unmanipulated baseline version, a smoothed version, and a blemished version (see Figure 1). The images were manipulated using the GNU Image Manipulation Program (GIMP) 2.8.22 (Free Software Foundation, Inc.). For the smoothed version, we first created a duplicate layer of the face image and applied a Gaussian blur filter (level 10) to the bottom layer. We then removed the target areas of the top layer so that the smoothed bottom layer became visible. This ensured that only the relevant skin areas of the face would appear smoothed. For the blemished version, we first downloaded images of individuals with acne from the internet. We cropped the blemished areas from the faces to create different patches of blemished skin. These patches were then added to our target faces to mimic the presence of mild acne. Different numbers and combinations of acne patches were applied and their rotation, transparence, and contrast were varied to ensure that the manipulated faces looked realistic. As can be seen from the sample stimuli shown in Figure 1, the manipulations were subtle and meant to reflect common variations in skin texture.
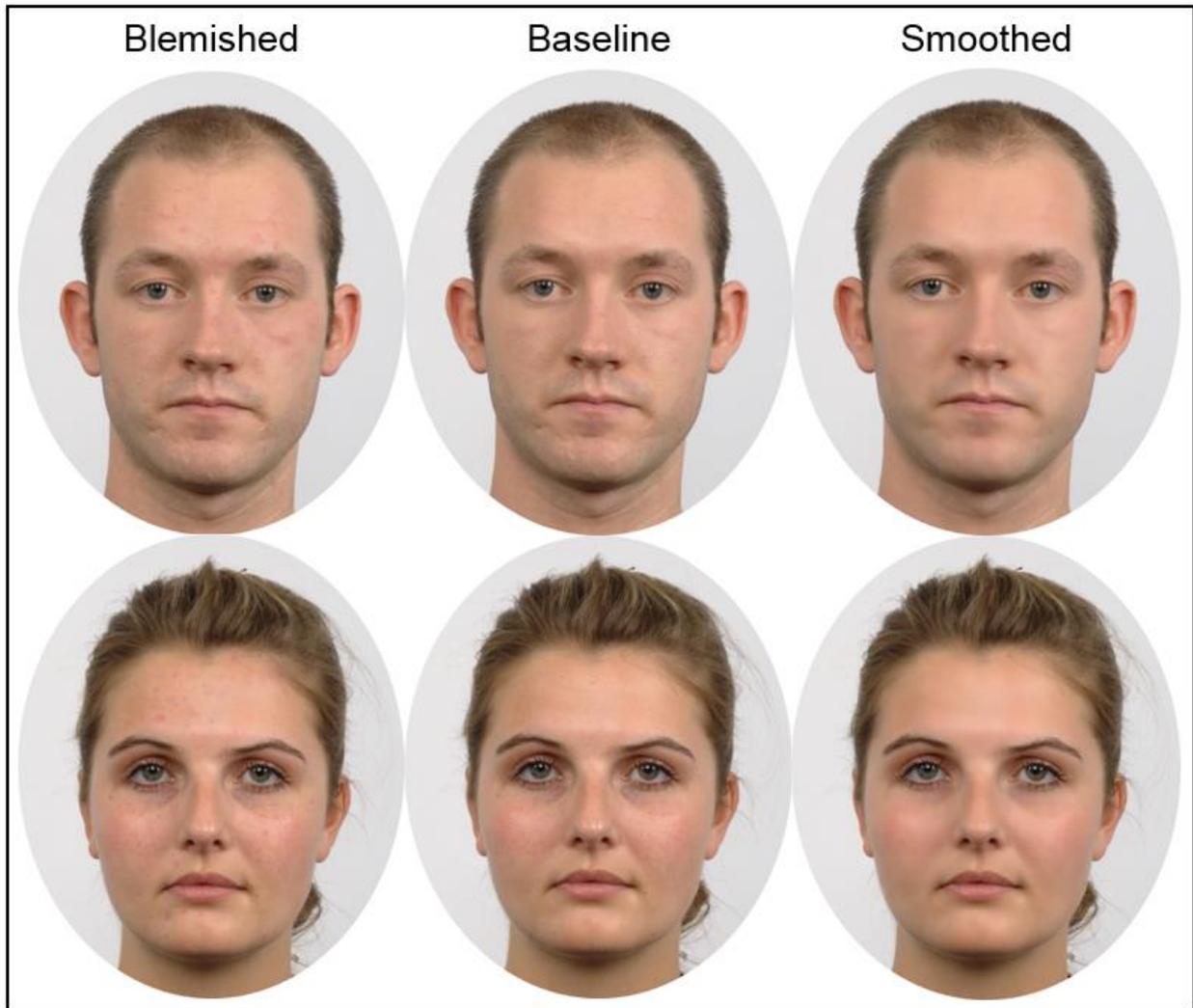
Figure 1. Exemplary stimuli for a male and a female face. The blemished version is displayed on the left, the baseline version in the middle, and the smooth version on the right.

Pre-test of face stimuli. We conducted a pre-test to check whether our manipulation of the faces was strong enough to influence participants' health judgments, but not too strong, so that they would be suspicious of our manipulation. We recruited 61 MTurk workers (45.9% female; $M_{age} = 35.20$, $SD_{age} = 12.77$) to rate the perceived health of the faces in exchange for 50 cents. Participants were randomly allocated to one of three different stimulus sets. After providing written informed consent, they rated the health of 20 faces (six or seven blemished, baseline, and smoothed faces) on a scale from 1 (*not healthy at all*) to 9 (*extremely healthy*).

Specifically, participants were shown one face at a time and asked how healthy they think the

person in the photo is. Importantly, they only saw one version of each individual. In other words,

each of the 20 faces was rated by all participants but which of the three versions of the face was

shown varied between sets. We calculated the intraclass correlation coefficient (ICC) as a

measure of inter-rater consistency. Participants showed significant consensus in their health

ratings ($ICC_{mean} = .259$, all ps < .001).

We estimated a linear mixed-effects regression model with random intercepts per

participant and face to test for the effects of skin smoothness and blemishes on health ratings.

We found a negative effect of blemished skin on health ratings, $b = -0.842$, $SE = 0.086$, $t(1138.5)$

$= 9.75$, $p < .001$, 95% CI [-1.017, -0.663], and a positive effect of smoothed skin, $b = 0.530$, $SE =$

0.086, $t(1139.5) = 6.13$, $p < .001$, 95% CI [0.342, 0.698]. We also found a significant difference

in the magnitude of the two effects, $z = 2.55$, $p = .011$, showing that the effect of blemished skin

on health ratings was significantly stronger than the effect of smoothed skin. Thus, our

manipulation of the faces was successful. For the main study, we selected 18 faces (nine male

and nine female) in order to have an equal number of faces within each skin condition (six

blemished faces, six baseline faces, and six smoothed faces). We omitted two faces (one male

and one female) that showed little to no differences in perceived health across the three skin

conditions.

Procedure and design. Three stimulus sets were created. Each set contained all 18 faces,

but which version of the face was included differed between sets. Each set contained six

baseline, six smoothed, and six blemished faces and every participant only rated one set.

Participants were randomly allocated to one of two conditions that determined which traits they

were going to rate. In one condition they first rated the faces on trustworthiness and then on

maturity and in the other condition, they first rated the faces on competence and then on

attractiveness. Thus, all participants were assigned to a 2 (trait condition:

trustworthiness/maturity vs. competence/attractiveness) × 3 (facial skin: blemished vs. baseline

vs. smoothed) design, with trait condition as a between-subject factor and facial skin as a within-

subject factor.

After providing written informed consent, participants were shown one face at a time in a

random order and were asked to rate the face on the relevant trait on a scale from 1 (*not* [trait] *at*

all) to 9 (*extremely* [trait]). Participants showed significant consensus in their trait ratings

(trustworthiness: ICC_{mean} = .094, all ps < .001; competence: ICC_{mean} = .148, all ps < .001;

maturity: ICC_{mean} = .212, all ps < .001; attractiveness: ICC_{mean} = .298, all ps < .001).

Results

To test whether the facial skin manipulation affected trait ratings, we estimated separate

linear mixed-effects regression models for each trait. We used dummy variables to compare the

blemished and smooth versions with the baseline version of each face. In all models, we included

participants and faces as random effects to account for variation in ratings across participants

(i.e., differences in average ratings between participants) and across stimuli (i.e., differences in

average ratings between faces).[3] We predicted that the blemished faces would be rated as less

trustworthy, competent, mature, and attractive compared to the baseline faces. We predicted no

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[3] In our preregistration, we indicated to run omnibus ANOVAs with follow-up paired *t*-tests. However, we realized

that these analyses ignore the multilevel structure of our data and are therefore less suited to estimate the effect of

our skin manipulation. The planned analyses revealed the same pattern of results with one exception. The difference

in trustworthiness ratings of blemished faces and baseline faces was no longer significant after correcting for

multiple comparisons, $t(17) = 2.26$, $p = .037$.

difference in ratings for the smoothed faces compared to the baseline faces. We also conducted *z*-tests to compare the magnitude of the effect of blemished skin to the magnitude of the effect of smoothed skin. We used the *lme4* package (Bates, Mächler, Bolker, & Walker, 2015) in R (R Core Team, 2017) to estimate mixed-effects regression models and the *lmerTest* package (Kuznetsova, Brockhoff, & Christensen, 2016) to obtain *p*-values.

Trustworthiness. First, we regressed participants' trustworthiness ratings of the faces on facial skin condition. There was a negative effect of blemished skin on trustworthiness ratings, *b* = -0.191, *SE* = 0.071, *t*(1700.1) = 2.69, *p* = .007, 95% CI [-0.339, -0.050], and a positive, but only marginally significant effect of smoothed skin, *b* = 0.122, *SE* = 0.071, *t*(1700.1) = 1.71, *p* = .087, 95% CI [-0.018, 0.262]. In line with our hypotheses, we found that, when compared to the baseline faces, the blemished faces were perceived as less trustworthy, but we found no clear evidence that the smoothed faces were perceived as more trustworthy (see Figure 2). A *z*-test comparing the strength of both effects revealed no significant difference, *z* = 0.69, *p* = .49.

Competence. Next, we regressed participants' competence ratings of the faces on facial skin condition. There was a negative effect of blemished skin on competence ratings, *b* = -0.370, *SE* = 0.068, *t*(1715.2) = 5.44, *p* < .001, 95% CI [-0.503, -0.236], but no effect of smoothed skin, *b* = 0.089, *SE* = 0.068, *t*(1715.2) = 1.31, *p* = .19, 95% CI [-0.044, 0.222]. As predicted, we found that, when compared to the baseline faces, the blemished faces were perceived as less competent, but the smoothed faces were not perceived as more competent (see Figure 2). We also found a significant difference between the effect of blemished skin and the effect of smoothed skin, *z* = 2.92, *p* = .004, showing that the effect of blemished skin on competence ratings was significantly stronger than the effect of smoothed skin.

Maturity. Next, we regressed participants' maturity ratings of the faces on facial skin condition. Results showed a negative effect of blemished skin on maturity ratings, $b = -0.473$, $SE = 0.070$, $t(1689.9) = 6.80$, $p < .001$, 95% CI [-0.609, -0.338], and a negative effect of smoothed skin, $b = -0.421$, $SE = 0.070$, $t(1689.9) = 6.05$, $p < .001$, 95% CI [-0.558, -0.287]. Thus, we found that, when compared to the baseline faces, both the blemished faces and the smoothed faces were perceived as less mature (see Figure 2). We found no significant difference between the effect of blemished skin and the effect of smooth skin, $z = 0.53$, $p = .59$.

Attractiveness. Finally, we regressed participants' attractiveness ratings of the faces on facial skin condition. Results showed a negative effect of blemished skin on attractiveness ratings, $b = -0.758$, $SE = 0.070$, $t(1715.1) = 10.86$, $p < .001$, 95% CI [-0.895, -0.621], and a positive effect of smoothed skin, $b = 0.295$, $SE = 0.070$, $t(1715.1) = 4.23$, $p < .001$, 95% CI [0.159, 0.432]. As predicted, we found that the blemished faces were perceived as less attractive and the smoothed faces were perceived as more attractive when compared to the baseline faces (see Figure 2). We found a significant difference between the effect of blemished skin and the effect of smoothed skin, $z = 4.68$, $p < .001$, showing that the effect of blemished skin on attractiveness ratings was significantly stronger than the effect of smoothed skin.
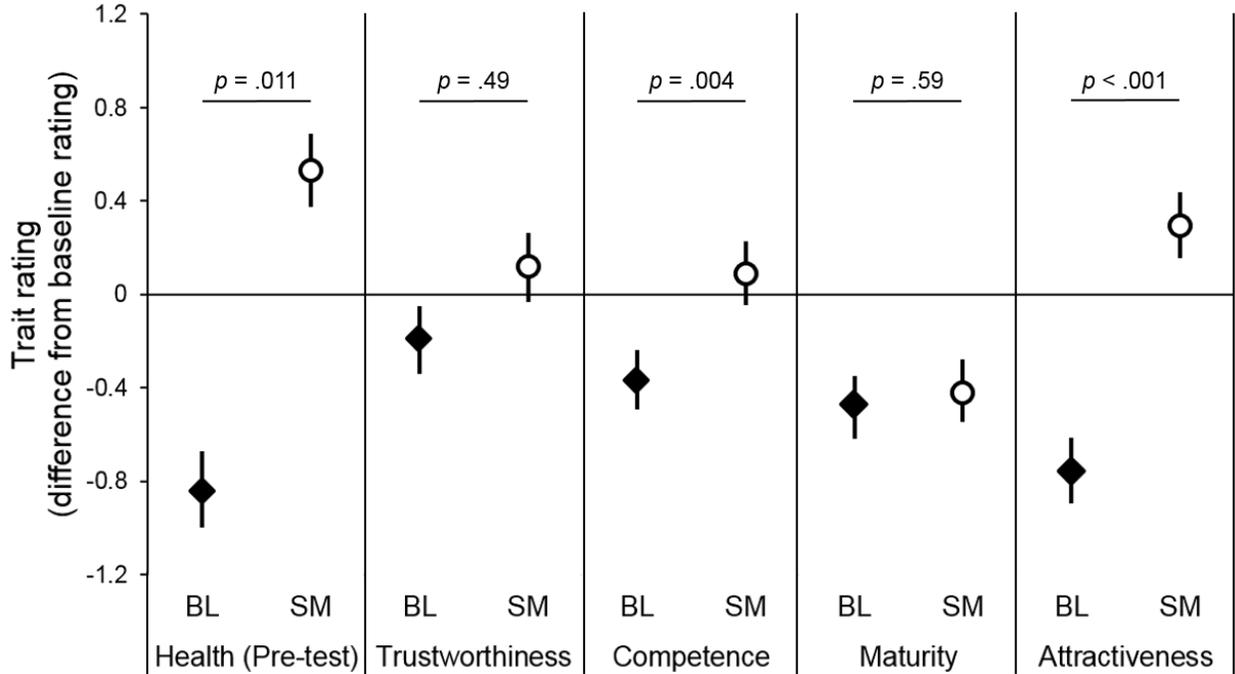
Figure 2. The graph shows the difference in ratings of the blemished (BL) faces (black

diamonds) and of the smoothed (SM) faces (white dots) when compared to ratings of the

baseline faces for each trait. Positive deviations from zero (i.e., the rating of the baseline faces)

denote more positive ratings whereas negative deviations denote more negative ratings. Error

bars reflect 95% confidence intervals and *p*-values were derived from a *z*-test comparing the

magnitude of the two effects.

The influence of target gender. We also examined the influence of target gender (the

gender of the person displayed in the image) on trait ratings by regressing participants' ratings on

facial skin, target gender (coded -1 for male and 1 for female), and the interaction between facial

skin and target gender separately for each trait.

For trustworthiness ratings, we still found a negative effect of blemished skin, b = -0.192,

SE = 0.071, $t(1698.0)$ = 2.69, p = .007, 95% CI [-0.331, -0.052], and a positive, but marginally

significant effect of smoothed skin, b = 0.122, SE = 0.071, $t(1698.0)$ = 1.71, p = .087, 95% CI [-

0.018, 0.262]. We found no effect of target gender on trustworthiness ratings, b = 0.058, SE =

0.104, $t(22.5) = 0.56$, $p = .58$, 95% CI [-0.145, 0.260]. Results did not show an interaction effect between target gender and blemished skin, $b = -0.078$, $SE = 0.071$, $t(1698.0) = 1.10$, $p = .27$, 95% CI [-0.062, 0.218], or target gender and smoothed skin, $b = 0.003$, $SE = 0.071$, $t(1698.0) = 0.04$, $p = .97$, 95% CI [-0.137, 0.142].

For competence ratings, we still found a negative effect of blemished skin, $b = -0.370$, $SE = 0.068$, $t(1713.2) = 5.44$, $p < .001$, 95% CI [-0.503, -0.237], but no effect of smoothed skin, $b = 0.089$, $SE = 0.068$, $t(1713.2) = 1.31$, $p = .19$, 95% CI [-0.044, 0.222]. We found no effect of target gender on competence ratings, $b = -0.071$, $SE = 0.121$, $t(20.0) = 0.59$, $p = .56$, 95% CI [-0.307, 0.165]. Results did not show an interaction effect between target gender and blemished skin, $b = 0.068$, $SE = 0.068$, $t(1713.2) = 1.00$, $p = .32$, 95% CI [-0.065, 0.201], or target gender and smoothed skin, $b = 0.050$, $SE = 0.068$, $t(1713.2) = 0.73$, $p = .46$, 95% CI [-0.083, 0.183].

For maturity ratings, we still found a negative effect of blemished skin, $b = -0.472$, $SE = 0.070$, $t(1698.8) = 6.80$, $p < .001$, 95% CI [-0.610, -0.337], and a negative effect of smoothed skin, $b = 0.421$, $SE = 0.070$, $t(1698.8) = 6.05$, $p < .001$, 95% CI [-0.557, -0.285]. We found no effect of target gender on maturity ratings, $b = 0.010$, $SE = 0.291$, $t(16) = 0.03$, $p = .97$, 95% CI [-0.581, 0.561]. Results did not show an interaction effect between target gender and blemished skin, $b = 0.062$, $SE = 0.070$, $t(1696.8) = 0.91$, $p = .36$, 95% CI [-0.073, 0.200], or target gender and smoothed skin, $b = 0.036$, $SE = 0.070$, $t(1696.8) = 0.52$, $p = .60$, 95% CI [-0.173, 0.100].

For attractiveness ratings, we still found a negative effect of blemished skin, $b = -0.758$, $SE = 0.070$, $t(1713.1) = 10.87$, $p < .001$, 95% CI [-0.894, -0.621], and a positive effect of smoothed skin, $b = 0.296$, $SE = 0.070$, $t(1715.1) = 4.23$, $p < .001$, 95% CI [-0.159, 0.432]. We found no effect of target gender on attractiveness ratings, $b = 0.029$, $SE = 0.156$, $t(18.4) = 0.19$, $p = .85$, 95% CI [-0.276, 0.335] and no interaction effect between target gender and blemished

skin, $b = 0.018$, $SE = 0.070$, $t(1713.1) = 0.26$, $p = .80$, 95% CI [-0.119, 0.155]. However, we did find a significant interaction between target gender and smooth skin, $b = 0.172$, $SE = 0.070$, $t(1713.1) = 2.47$, $p = .014$, 95% CI [0.036, 0.309]. Smooth skin was associated with higher attractiveness ratings for women, $b = 0.468$, $SE = 0.091$, $t(1806.1) = 5.14$, $p < .001$, 95% CI [0.289, 0.646], but not for men, $b = 0.123$, $SE = 0.098$, $t(806.1) = 1.25$, $p = .21$, 95% CI [-0.069, 0.316].

Accounting for random variation in the effect of blemishes. When creating the blemished versions of the faces, we used different combinations of blemishes for each face in order to create realistic stimuli. Since the amount and severity of blemishes consequently differed between faces, we would expect variation in the magnitude of the effect of blemishes on participants' trait ratings between faces. We therefore ran additional mixed-effects regression models that included random slopes for the effect of facial skin for each target to test the robustness of our results. Comparing models with and without random slopes showed that including random slopes significantly increased model fit for ratings of attractiveness, $\chi(5) = 28.85$, $p < .001$. However, the effects of blemished skin and smoothed skin on attractiveness ratings remained virtually unchanged. Including random slopes did not increase model fit for ratings of trustworthiness, $\chi(5) = 0.17$, $p = .99$, competence, $\chi(5) = 2.65$, $p = .75$, or maturity, $\chi(5) = 3.17$, $p = .67$.

Discussion

In Study 1, we investigated the independent effects of facial skin smoothness and facial skin blemishes on trait judgments. Results showed that faces with skin blemishes were seen as less trustworthy, competent, mature, attractive, and healthy compared to the unmanipulated version of the faces. Results for the smoothed faces were less clear-cut: The positive effect of

smoothed skin on trait ratings was only marginally significant for trustworthiness ratings and not

significant for competence ratings. Smoothed skin was related to higher perceived attractiveness

and health. However, the positive effect of smoothed skin on attractiveness held only for female,

but not for male targets. More importantly, and in line with our hypothesis that blemishes are a

more salient cue than smoothness, we found that the negative effect of blemishes on trait ratings

was stronger than the positive effect of smoothness for impressions of attractiveness, health, and

competence (but not trustworthiness).

Finally, Tsankova and Kappas (2016) raised the possibility that any positive effect of skin

smoothness on trait impressions might be due to higher perceived maturity. This argument stands

in contrasts with other work showing that smooth skin is associated with youthfulness

(Sutherland et al., 2013; Tiddeman, Burt, & Perrett, 2001). In support with the latter reasoning,

we found that smoothed faces were seen as less mature than the unmanipulated baseline faces. In

sum, our results suggest that people form more negative trait impressions of individuals with

facial skin blemishes. Moreover, the negative influence of blemishes on impressions was

stronger and more consistent across different traits than the positive influence of skin

smoothness.

Study 2

We have argued that due to a heightened sensitivity for cues indicating poor health,

people's trait impressions are more strongly affected by the presence of skin blemishes than by

smooth skin. A specific prediction that follows from this hypothesis is that impressions should be

influenced more strongly by blemishes than by smooth skin. The results of Study 1 clearly

supported this prediction. Another plausible prediction is that the positive effect of smoothness

should vary as a function of whether or not blemishes are present. If blemished skin is a more

salient cue in the process of impression formation, then we would expect a smaller influence of skin smoothness in the presence (vs. absence) of blemishes.

We tested this predicted interaction by orthogonally manipulating the two skin properties in a 2 (unsmoothed vs. smoothed skin) × 2 (unblemished vs. blemished skin) design. We focused on judgments of attractiveness as we found effects for both smoothness and blemishes on this trait in the previous study. In line with our previous findings, we predicted that compared to the unmanipulated baseline faces, the smoothed faces would be perceived as more attractive, the blemished faces would be perceived as less attractive, and that the effect of blemishes would be stronger than the effect of smoothness. Crucially, we predicted that the positive effect of smoothness would be weaker when skin blemishes were also present. We further predicted that skin blemishes would lead to lower attractiveness ratings for both unmanipulated and smoothed faces.

Next to testing for a potential interaction between smoothness and blemishes, the current study included several notable improvements. We tested our hypotheses using a new and larger set of images drawn from the Chicago Faces Database (Ma, Correll, & Wittenbrink, 2015) with targets that were on average older. Skin unevenness increases with age (Fink, Grammer, & Matts, 2006) and smoothing might therefore have a stronger effect for older individuals. Thus, using this new set of older targets not only allowed us to test if our findings from Study 1 generalize to a different image set, it also provided a stronger test of our hypothesis that blemishes have a stronger effect than smoothness.

Methods

Participants. We aimed for a minimum sample of 160 participants, which would provide 40 independent judgments for each face. This sample size is in line with previous studies that

manipulated facial appearance and followed a similar experimental design (Rudert, Reutner, Greifeneder, & Walker, 2017). We recruited 204 MTurk workers. The median completion time was 5.5 minutes and participants were paid $1. In line with our pre-registered exclusion criteria, we excluded 35 participants (17.16%) who indicated having seen one or more face stimuli in a previous study (and who could have thus been aware of our manipulation) and 4 participants (1.96%) who explicitly stated that the images looked 'artificially generated' or 'digitally altered'. This resulted in a final sample of 164 participants (64.4% female; $M_{age} = 35.12$, $SD_{age} = 10.50$).

Materials. We selected fourteen male and fourteen female individuals from the Chicago Face Database (Ma et al., 2015). The accompanying dataset contains age and attractiveness ratings for all target. Each image was shown to 20-131 ($M = 43.74$) participants who rated targets on different dimension (for more details, see Ma et al., 2015). Targets' average estimated age ranged from 22 to 43 years ($M_{age} = 29.78$, $SD_{age} = 5.34$). All individuals were White, displayed a neutral facial expression, and were photographed from the front. We ensured that there were no significant gender differences in estimated age, $t(25.7) = 1.16$, $p = .26$, or attractiveness, $t(20.7) = 0.58$, $p = .57$, in our sample of targets. The images were cropped to an oval shape measuring 480 $\times$ 600 pixels. Four different versions of each face were created using the same image manipulation technique as in Study 1 (for a total of 112 stimuli): an unmanipulated baseline version, a smoothed version, a blemished version, and a smoothed-blemished version (see Figure 3). For the smoothed-blemished version, we used each target's smoothed version and added the same pattern of skin blemishes that was used to create the blemished version.

Figure 3. Exemplary stimuli for a female face. The unmanipulated baseline version is displayed on the top-left, the smoothed version on the bottom-left, the blemished version on the top-right, and the smoothed-blemished version on the bottom-right.

Procedure and design. Four stimulus sets were created. Each set contained all faces, but which version of the face was included differed between sets. Each set contained seven faces per facial skin condition. As a high number of individuals with skin blemishes might raise suspicion among participants, we also included twelve additional unmanipulated faces that acted as filler items. Participants only rated one set. Thus, all participants were assigned to a 2 (skin

smoothness: unsmoothed vs. smoothed) × 2 (skin blemishes: unblemished vs. blemished) design,

with skin smoothness and skin blemishes as within-subject factors. After providing written

informed consent, participants were shown one face at a time in a random order and were asked

to rate the target's attractiveness on a scale from 1 (*not attractive at all*) to 9 (*extremely*

attractive). Participants showed significant consensus in their attractiveness ratings (ICC_{mean} =

.373, all *p*s < .001).

Results

We again estimated linear mixed-effects regression models with participants and faces as

random effects. Our first goal was to test if the findings from Study 1 replicated with a different

set of targets. Regressing attractiveness ratings on skin smoothness (0 = unsmoothed, 1 =

smoothed) and skin blemishes (0 = unblemished, 1 = blemished) showed a negative effect of

blemished skin, *b* = -0.450, *SE* = 0.039, *t*(4372.0) = 11.68, *p* < .001, 95% CI [-0.528, -0.371],

and a positive effect of smoothed skin, *b* = 0.260, *SE* = 0.039, *t*(4372.0) = 6.77, *p* < .001 , 95%

CI [0.193, 0.340]. When compared to the baseline faces, the blemished faces were perceived as

less attractive and the smoothed faces were perceived as more attractive. We found a significant

difference between the effect of blemished skin and the effect of smoothed skin, *z* = 3.49, *p* <

.001, showing that the effect of blemished skin on attractiveness ratings was significantly

stronger than the effect of smoothed skin. Thus, we successfully replicated our findings from

Study 1.

Next, we tested our main prediction of an interaction effect between skin smoothness and

skin blemishes. Regressing attractiveness ratings on smoothness, blemishes, and their interaction

revealed a negative effect of blemished skin, *b* = -0.373, *SE* = 0.054, *t*(4371.0) = 6.84, *p* < .001,

95% CI [-0.469, -0.267], a positive effect of smoothed skin, *b* = 0.338, *SE* = 0.054, *t*(4371.0) =

6.21, $p < .001$, 95% CI [0.237, 0.437], and a significant interaction effect, $b = -0.155$, $SE = 0.077$, $t(4371.0) = 2.01$, $p = .044$, 95% CI [-0.318, -0.008] (see Figure 4). As predicted, smoothed skin had a smaller effect on attractiveness ratings for blemished faces, $b = 0.183$, $SE = 0.051$, $t(2093.2) = 3.55$, $p < .001$, 95% CI [0.082, 0.283], as opposed to unblemished faces, $b = 0.344$, $SE = 0.056$, $t(2093.8) = 6.18$, $p < .001$, 95% CI [0.230, 0.464]. These results show that the positive effect of smoothed skin on perceived attractiveness was reduced by 46.80% when targets displayed skin blemishes at the same time. The presence of blemishes led to lower perceived attractiveness for both unsmoothed faces, $b = -0.370$, $SE = 0.054$, $t(2092.6) = 6.83$, $p < .001$, 95% CI [-0.480, -0.265], and smoothed faces, $b = -0.530$, $SE = 0.055$, $t(2092.6) = 9.64$, $p < .001$, 95% CI [-0.643, -0.421].[4]

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[4] None of the results were influenced by adding target gender as a predictor or by including random slopes for the effect of blemished and smoothed skin to account for variation in effects across images. Target gender had no effect on attractiveness ratings and we found no significant interaction between target gender, skin smoothness, and skin blemishes.
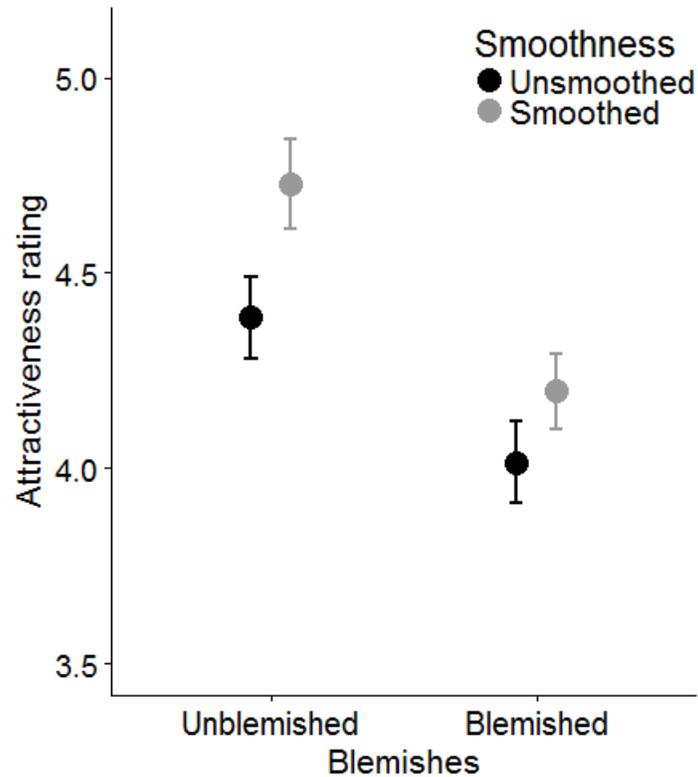
Figure 4. Attractiveness ratings as a function of skin blemishes and skin smoothness. Mean

values represent the predicted attractiveness scores. Error bars denote standard errors.

Discussion

Study 2 shed more light on the mutual influence of skin smoothness and blemishes on

perceptions of attractiveness. We found that skin smoothness positively influenced attractiveness

ratings, but that this effect was substantially smaller when targets also displayed skin blemishes.

Blemishes negatively influenced perceived attractiveness for individuals with unmanipulated and

smoothed skin. This pattern of results is in line with our argument that blemishes are a more

salient cue in impression formation than skin smoothness. Using a larger and on average older

sample of targets, we were also able to replicate the findings of our previous study. While both

smoothing and adding blemishes influenced perceptions of attractiveness (for both male and

female targets), the negative effect of blemished skin was again significantly stronger than the positive effect of smoothed skin.

General Discussion

We investigated the influence of facial skin texture on impression formation by comparing trait judgments of individuals with facial skin blemishes and smooth skin against an unmanipulated version. Building on prior studies showing that people are particularly sensitive to cues connoting poor health (Zebrowitz & Rhodes, 2004), we predicted that the negative influence of facial skin blemishes would be stronger than the positive influence of smoothed skin. Results from our pre-test confirmed that facial skin texture influenced perceptions of health. Individuals with blemished skin were seen as less healthy whereas individuals with smoothed skin were seen as healthier compared to individuals with unmanipulated skin. In line with our prediction, the negative effect of blemished skin on health judgments was significantly stronger than the positive effect of smoothed skin. Study 1 showed that, compared to an unmanipulated baseline version, individuals with skin blemishes were perceived as less trustworthy, less competent, and less attractive. While individuals with smooth skin were not perceived as significantly more trustworthy or competent compared to the baseline version, we did find that they were perceived as more attractive. However, the negative effect of blemished skin on attractiveness ratings was again significantly stronger than the positive effect of smoothed skin. This pattern was replicated in Study 2 with a new set of faces. Moreover, our second study showed that while smoothed skin had a positive impact on perceived attractiveness, this effect was reduced by almost half when individuals also displayed skin blemishes. In sum, our results demonstrate the salient role of skin blemishes in the formation of trait judgments from facial features.

The present findings are consistent with the functional view of trait impressions from faces. Perceived trustworthiness and competence represent evaluations of an individual's threat potential (Oosterhof & Todorov, 2008). In a similar vein, perceived attractiveness is a proxy for an individual's mate value and determines who is sought out as a sexual partner (Rhodes et al., 2005). In other words, trait impressions from faces are proxies for underlying approach-avoidance tendencies. Negative judgments of individuals with skin blemishes may thus reflect the avoidance response triggered by the detection of a potential disease threat.

Our interpretation of the results converges with previous findings showing that even benign physical irregularities (e.g., a port wine stain) can trigger avoidance (Houston & Bull, 1994; Ryan, Oaten, Stevenson, & Case, 2012). This can be explained by people's sensitivity to cues connoting poor health and the potential presence of an infectious disease (Schaller et al., 2015). Given the high cost of engaging with sick individuals, even cues that resemble symptoms of an infectious disease can trigger an avoidant response aimed at shielding the individual from contracting the disease. We add to this literature by demonstrating that people's sensitivity to disease cues not only guides behavioral responses towards individuals (e.g., by increasing physical proximity; Houston & Bull, 1994), but also influences social perception (see also, van Leeuwen & Petersen, 2017). In addition, we show that this response is not only triggered by relatively rare facial irregularities such as a port wine stain, but also by subtle skin blemishes that can result from common skin conditions.

Our findings support the notion that an individual's perceived health is an important determinant of attractiveness perceptions (Jones et al., 2004). Low perceived health may not only indicate the presence of a disease, but also a weak immune system, which are both undesirable characteristics for potential mates (Rhodes et al., 2007; Zebrowitz & Rhodes, 2004). We find that

individuals with skin blemishes are not only seen as less healthy, but also as less attractive. Across our three sets of faces in our pre-test and Study 1, we find large correlations between perceived health and perceived attractiveness ($\bar{r}$ = .67). In fact, even though trustworthiness, competence, and attractiveness represent core dimensions of trait impressions from faces and are assumed to be relatively independent (Sutherland et al., 2013), we found large correlations between them (rs = .60 - .81). Therefore, it is unclear whether there is a direct effect of facial skin blemishes on each trait, or whether blemishes primarily influence one trait (e.g., health) which, in turn, influences perceptions of other traits (e.g., attractiveness). Our theoretical framework would predict that more negative trait impressions of individuals with skin blemishes are driven by the motivation to avoid potentially sick individuals. Future studies could test this prediction by investigating whether perceived health mediates the influence of blemishes on perceived trustworthiness, competence, and attractiveness. Prior work has already shown that perceptions of health account for a substantial part of the association between facial redness and attractiveness judgments (Pazda, Thorstenson, Elliot, & Perrett, 2016; Thorstenson, Pazda, Elliot, & Perrett, 2017).

People's sensitivity to cues of poor health likely extends beyond the relative influence of blemished and smooth skin. For example, the previously mentioned work on facial redness also showed that the effect of decreased redness was stronger than the effect of increased redness (Pazda et al., 2016; Thorstenson et al., 2017). Relatedly, Park and colleagues (2012) found that individuals high on pathogen disgust perceive relatively unattractive people as even more unattractive than individuals low on pathogen disgust. However, pathogen disgust was unrelated to attractiveness ratings of relatively attractive people, suggesting that concerns about pathogens selectively influence reactions to seemingly unfit or unhealthy individuals. Building on these

findings, we would suggest that other facial cues of health should follow the same pattern, with features indicating poor health exerting a stronger influence than features indicating good health. In addition, the influence of cues to poor health might be moderated by individual differences in pathogen concern (Duncan, Schaller, & Park, 2009).

While we were able to demonstrate our main findings in two image sets that differed in nationality and age and that included both male and female targets, more research is needed to explore the generalizability of our results. First, skin unevenness due to wrinkles or irregular pigmentation increases with age (Fink et al., 2006) and the effect of skin smoothing, which erases these irregularities, might vary as a consequence. In our second study, we used images of targets that were on average older and that had a wider age range than targets in our first study. Comparing the effect of smoothed skin on attractiveness ratings of targets between Study 1 (20 to 30 years old; $M_{age} = 23.81$, $SD_{age} = 3.67$) and Study 2 (22 to 43 years old; $M_{age} = 29.78$, $SD_{age} = 5.34$) showed no significant difference (Study 1: $b = 0.295$, $SE = 0.070$; Study 2: $b = 0.260$, $SE = 0.039$; $z = 0.44$, $p = .66$). However, our studies differed on many other aspects and a more direct test of the influence of skin smoothness across the entire age range is needed to address this question.

Second, both studies reported here featured Caucasian targets that were rated by participants from Western societies (the Netherlands and the United States). Given recent evidence for cultural differences in impression formation (Han et al., 2017; Sutherland et al., 2017), our findings should be replicated using more diverse sets of targets and raters.

Third, future research should also consider different aspects of facial skin texture. As we have stated before, smooth skin demonstrates the absence of several possible irregularities such as blemishes, wrinkles, uneven pigmentation, large pores, or birth marks. Here, we focused on

the role of blemishes due to people's sensitivity to cues connoting the potential presence of an infectious disease. It remains to be tested whether other skin properties similarly influence trait impressions. Relatedly, it could be argued that adding blemishes not only influenced skin texture, but also skin color. Even though blemishes were only present on some parts of the face, the overall facial redness of the blemished faces was higher compared to the unmanipulated baseline faces. However, facial redness has been linked to more positive judgments of health and attractiveness (Pazda et al., 2016; Thorstenson et al., 2017), whereas we found more negative judgments of blemished faces. Thus, even though changes in facial redness might have contributed to the observed effects, these changes cannot explain why blemished faces were perceived more negatively. Ultimately, larger samples of faces that represent the entire spectrum of variation on different facial cues need to be evaluated on multiple trait dimensions in order to understand the influence of different face properties on trait perceptions. Furthermore, statistical approaches such as mediation analysis (Pazda et al., 2016; Thorstenson et al., 2017) or network analysis (Costantini et al., 2015) can aid in disentangling the interrelationships between different traits.

To conclude, the current research demonstrates that the presence of skin blemishes affects trait impressions from faces. Perceptions of trustworthiness, competence, and attractiveness reflect approach-avoidance tendencies and guide who is sought out as a sexual or social partner. Negative judgments of individuals with blemished skin might thus serve the function of preventing contact with potentially unhealthy individuals.

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