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Signals of personality and health: The contributions of facial shape, skin texture and viewing angle

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Abstract

To what extent does information in a person's face predict their likely behaviour? There is increasing evidence for association between relatively neutral, static facial appearance and personality traits. By using composite images rendered from 3D scans of women scoring high and low on health and personality dimensions, we aimed to examine the separate contributions of facial shape, skin texture and viewing angle to the detection of these traits, whilst controlling for crucial posture variables. After controlling for such cues, participants were able to identify Agreeableness, Neuroticism and Physical Health. For personality traits, we found a reliable laterality bias, in that the right side of the face afforded higher accuracy than the left. The separate contributions of shape and texture cues varied with the traits being judged. Our findings are consistent with signalling theories suggesting multiple channels to convey multiple messages.

Keywords: faces, personality, laterality, three-dimensional, health

The notion that our character can be read from our face has been widespread throughout history, with examples littered throughout plays and novels. These concepts of folk physiognomy are often discouraged, centred around the belief that such judgements are inaccurate and unfair. However, recent work suggests these perceptions can be surprisingly accurate. A class of "controllable" cues (Mazur, 2005) such as posture, clothing, and facial expressions (e.g. smiling) are easily detectable and largely under volitional control, and can convey accurate, readily available information about the sender (Naumann, Vazire, Rentfrow & Gosling, 2009). More surprisingly, judgements are also accurate from very brief exposures to 'thin slices' of nonverbal behaviour. For example, people are accurately able to predict the quality of an individuals interpersonal relationships from these small exposures (Ambady & Rosenthal, 1992).

There is growing evidence for another class of "constant" cues, which are not under dynamic control (Mazur, 2005), but can still allow accurate perception of personality. In fact, the static, non-expressive face can be all that is needed for accurate personality judgements of many types to be made, including dominance (Mueller & Mazur, 1997), aggression (Carré, McCormick & Mondloch, 2009), sociosexuality (Boothroyd, Jones, Burt, DeBruine & Perrett, 2008), trustworthiness (Stirrat & Perrett, 2010), political affiliation (Rule & Ambady, 2010) and sexual orientation (Freeman, Johnson, Ambady & Rule, 2010).

Personality research identifies the factors that best characterise how stable biases in behaviour differ between individuals. Five-factor (or "Big Five") models of personality have proven to be robust and reliable descriptions of these individual differences (Goldberg, 1993). It is therefore highly interesting that many of the Big Five traits can be accurately perceived from the static non-expressive face, both in photographs of individuals (Penton-Voak, Pound, Little & Perrett, 2006), and in composite images of people with similar personalities (Kramer & Ward, 2010; Little & Perrett, 2007). Composites created from individuals who score low or high on Big Five traits are often identified accurately, especially in female faces (Kramer & Ward, 2010; Little &

Perrett, 2007; Penton-Voak et al., 2006), for the traits of Extraversion, Neuroticism, and Agreeableness. Male faces are more difficult to read, with Little and Perrett (2007) demonstrating accurate identification of only Extraversion. A very important point is that accurate identification does not appear to result from perceptions of attractiveness. Specifically, Kramer and Ward (2010) had participants discriminate between high and low composites for different traits and rate the attractiveness of the different composites. They rejected the possibility that raters were assigning socially desirable traits (e.g., high Agreeableness) to the more attractive face. In fact, accuracy for individual raters was not predicted by their ratings of facial attractiveness.

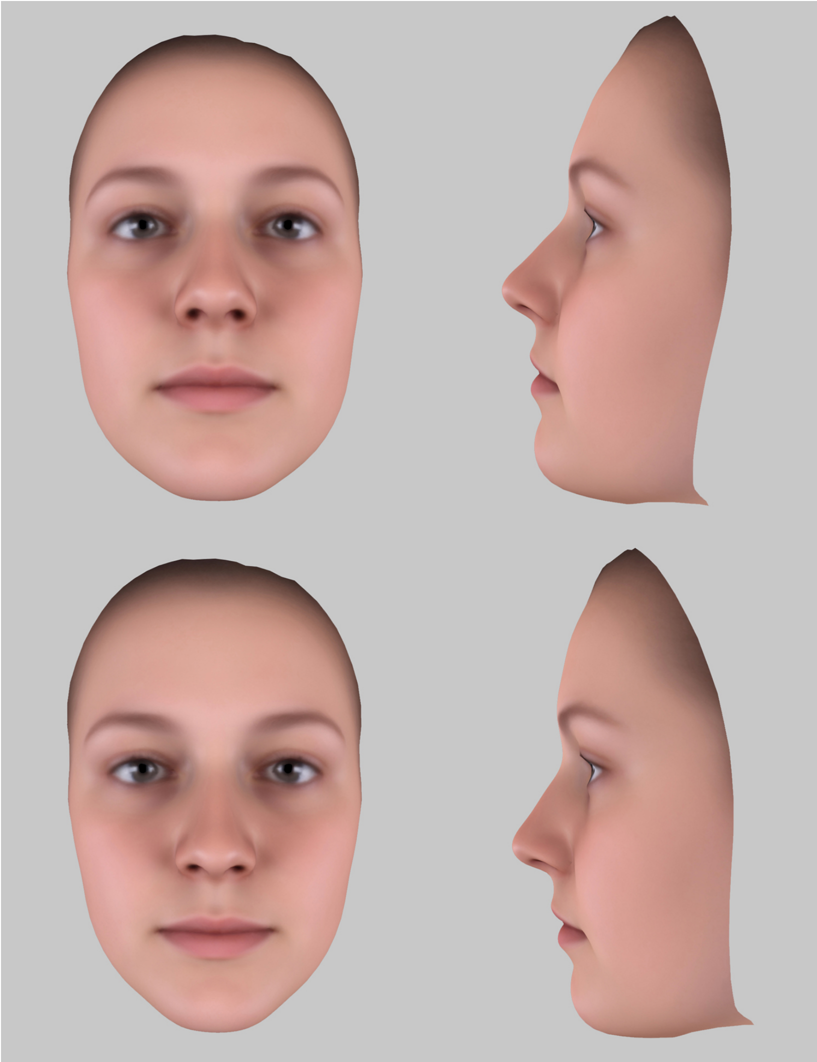
Results with composite images are especially interesting, as accurate personality identification from composites indicates that people with similar personalities share a similar facial appearance. Consider that Agreeableness could be identified from an individual face, but any individual face expressed Agreeableness in an idiosyncratic manner. If a composite image were then made from people of high Agreeableness, the signal for the trait would be lost, being proportionally reduced for every face in the composite. Conversely, if high Agreeableness were reflected in similar facial properties across individuals, a composite of those individuals would express those shared properties and “agreeable” appearance.

The findings with composites therefore suggest that people with similar personalities can share similar facial appearances, and further, that naive observers can accurate identify associations between appearance and personality. However, these findings do not address some key issues. A possible alternative explanation of previous findings is that the signal for personality is not in the face, but in the posture of the head - that is, slight deviations of the head from a straight-ahead, upright position. Head posture alone can signal a wide array of information. Mignault and Chaudhuri (2003) demonstrated strong influences of just slight head tilt on perceptions of many traits from a face with a neutral expression. For example, faces which were bowed were more likely to be perceived as experiencing sadness, feeling inferior, and being submissive (Tiedens & Fragale, 2003). Those with heads raised are perceived as being more dominant (Otta, Lira, Delevati, Cesar & Pires, 1994). All of these effects are apparent after inflections of just 5° in either direction, and the effect is compounded with a larger postural difference.

Experimenters attempt to control for posture when taking photographs, and ask participants to look directly ahead at the camera, so that large deviations from the standard position would be avoided. However, subtle differences in the angle of the head outside the picture plane could have important effects. For example, if those low in Agreeableness posed for a neutral photograph with their chins raised slightly more than others who are high in Agreeableness, then the posture would validly signal personality, but not the facial features themselves. In this example, the 2D projection of the different postures (chin raised or lowered) would produce artefactual differences within the facial image, such as the apparent size of the chin and height of the eye-line. This is illustrated in Figure 1. Furthermore, if these differences are consistent across individuals, posture will have effects even in composite images in spite of any subsequent manipulations (e.g. cropping) such as in the hypothetical Agreeableness example above.

Figure 1. An example of how minor changes in head tilt affect face perceptions. The left column shows the different 2D projections that result when the same face model is tilted according to the right column.The top tier images display a postural tilt of -5°, whereas the lower two images have been manipulated by $+5^{\circ}$.

Fundamentally, making facial composites of individuals in order to capture their shared facial traits assumes that the posture of the head in all photographs is identical outside the picture plane, which it surely is not. Personality in facial photos might be accurately identified by observers, not by subtle facial shape or facial surface features, but by differences systematically related to personality, in the way the head is held for the photograph.



Addressing this possibility is therefore important, but not necessarily simple. In theory, one approach might be to give participants a bite-bar or head clamp, in order to fix position and angle of the head to a known value before taking the photograph. An approach like this would increase the uniformity of head posture, but at a cost of increasing muscular tension in the face, obscuring important regions of the face, and creating a highly unnatural context for a simple photograph.

The approach we take here is to use 3D facial scanning. In this process, a 3D model of the head is captured, in our case through the use of simultaneous images taken by multiple cameras at known positions. The resulting 3D models can then be rotated to arbitrary angles relative to their position at the time of their original capture. Rather than simply assuming that posture of the head is identical in all photos, the 3D models can be brought into a common alignment that minimises any postural differences.

The 3D-scan creates a model of the geometry of the face separate from its surface texture. The shape of the face is based on the underlying skeleton, muscle, adipose, and skin layers; while texture refers to surface features like colour of the skin and lips, and features of the eyebrows. (An analogous separation of 2D shape and surface is possible with traditional photograph composites.) We can readily use this separation of information sources to investigate whether shape and surface offer redundant or distinctive information about personality from the face.

We do not know of any investigations looking at the contributions of facial shape and surface to personality identification, however, some studies have shown differing perceptions of attractiveness when these features are manipulated. Said and Todorov (2011), using mathematical modelling, have demonstrated differing influences of facial shape and surface features on attractiveness. Using the results from a principal components analysis, faces can be made more or less attractive by altering the position of the face along these dimensions. Interestingly, male faces can become more attractive by having their shape feminised, but their skin texture is optimally attractive when more masculinised (i.e., darker and with more facial hair). For females, optimum attractiveness is unidirectional toward the more feminine attributes. Conversely, Little and Hancock (2002) found separate contributions of shape and texture to attractiveness, in that males with smoother skin textures (i.e., more feminine) were rated as more attractive, along with those who possessed the average masculine face shape.

Additionally, recent studies have demonstrated that facial colour influences perceptions of health. Carotenoid colouring is associated with higher intakes of dietary vegetables and fruit, and is perceived as attractive and healthy by a wide sample of populations (Stephen & McKeegan, 2010). Additionally, increasing facial redness (Stephen, Law-Smith, Stirrat & Perrett, 2009) increases attractiveness (Stephen, Coetzee, Law-Smith & Perrett, 2009). It may be that personality perceptions can be influenced by skin texture also.

The control of stimulus orientation that is possible with the use of three-dimensional stimuli has another advantage: We can readily manipulate the viewing angle of the presented stimulus. A body of research has found laterality effects in perceptions from the face. Generally, the left side of the face is rated as more expressive (Nicholls,Wolfgang, Clode & Lindell, 2002), and actually expresses emotions more intensely (Sackeim, Gur & Saucy, 1978). Despite this, Butler et al. (2005) found that participants gaze at the right side of an actor's face first, and for longer. It is this same side that influences perceptions of attractiveness, sex and age (Burt & Perrett, 1997). Because there seem to be systematic (or directional) asymmetries within the face, it may be that personality information is also lateralised. In the one study involving laterality and personality identification, Kramer and Ward (2011) used hemiface stimuli to argue that accuracy for personality traits was greater from the right side of the actor's face than the left. However, hemiface stimuli are at best an unusual view of the face. Although precise positioning of a real face to specific angles is difficult to achieve, we can create naturalistic views of 3D face models to desired viewing angles.

The possibility that information in the face allows accurate decoding of personality is intriguing and suggests new avenues for visuo-social cognition. To summarise our aims, the present study examines whether the information for accurate identification is in the face or posture. We take advantage of the versatility of stereophotogrammetry to explore the possibilities of separate contributions of facial shape and texture, and of different information in the left and right sides of the face, as demonstrated with hemifaces (Kramer & Ward, 2011).

Method

Stimuli

Personality assessment and photographic capture. A group of 242 Bangor students (151 females, age *M* =21.33*, SD* =3.76) were recruited for stimulus creation. Participants indicated ethnicity based on the UK 2011 Census form question. Each participant completed the Big Five Inventory 44 (BFI-44; John & Srivastava, 1999) in order to obtain measures of personality. They also completed the 12-Item Short Form Survey (SF-12; Ware, Kosinski & Keller, 1996) to measure physical health. The SF-12 can be considered to be a measure of health in daily living, rather than a multidimensional construct (Eberst, 1984). Finally, facial images of each participant were captured in collaboration with Di3D (Dimensional Imaging Ltd, UK), using their FCS-100 system. This consisted of four 10 mega-pixel cameras placed around a calibration board, allowing for the simultaneous capture of four images from different locations of known separation. These high-resolution images were then merged using Di3D passive stereophotogrammetry software, which combined the images to produce high-resolution texture maps and 3D models of the participant. All participants were photographed with a neutral expression, at a fixed distance to the camera, and with their hair pulled back from the face as much as possible, with cosmetics and jewellery removed . Females who reported their ethnicity as white, with neutral expressions (N = 92, age M = 21.1, SD = 3.29) were used.

Three-dimensional scan standardisation and landmarks. Due to the individual nature of facial structure, each scan differed in its number of vertices. In order to create averages, each scan had to have its number of vertices standardised, accomplished by conforming each 3D model to a high resolution template containing 4,735 vertices. This was achieved using the Di3Dtransfer tool with a series of 48 landmarks which were manually identified on the individual 3D model and the template to increase the accuracy of the transfer (Figure 2). The landmarks were partly based upon the landmarks used in JPsychomorph (Tiddeman, Burt & Perrett, 2001), a 2D morphing software. Other points were based upon prominent and easily identifiable features of the face, for example, the eyebrow ridges, or tip of the nose. Landmarks such as the widest points on the nose could be reliably found by moving the scan through principal planes and land-marking the point that broke the planar surface first. Due to the reflective texture of the human eye, the camera flash caused it to appear concave. Many landmarks were added around the eyes in order to reduce this effect when the composites were created. Using the Di3Danalyse tool, all resulting meshes had an alignment error under 0.5 mm of the original scan, meaning all vertices of the fitted meshes were identical to the original scan within 0.5mm. This process ensured that each face was oriented to best fit the standardised template. So for example, the original model for a participant tilting their head slightly down and left would be fit to the standard template facing directly forwards, mitigating subtle postural differences between participants. Once the morphometry of the original scan was standardised to the vertices of the template, a surface map was created using the Di3D software, mapping pixel values in the camera images to vertices in the standardised model. An important point is that the process creates a separate 3D model and surface texture for each participant, allowing us to separate these cues.

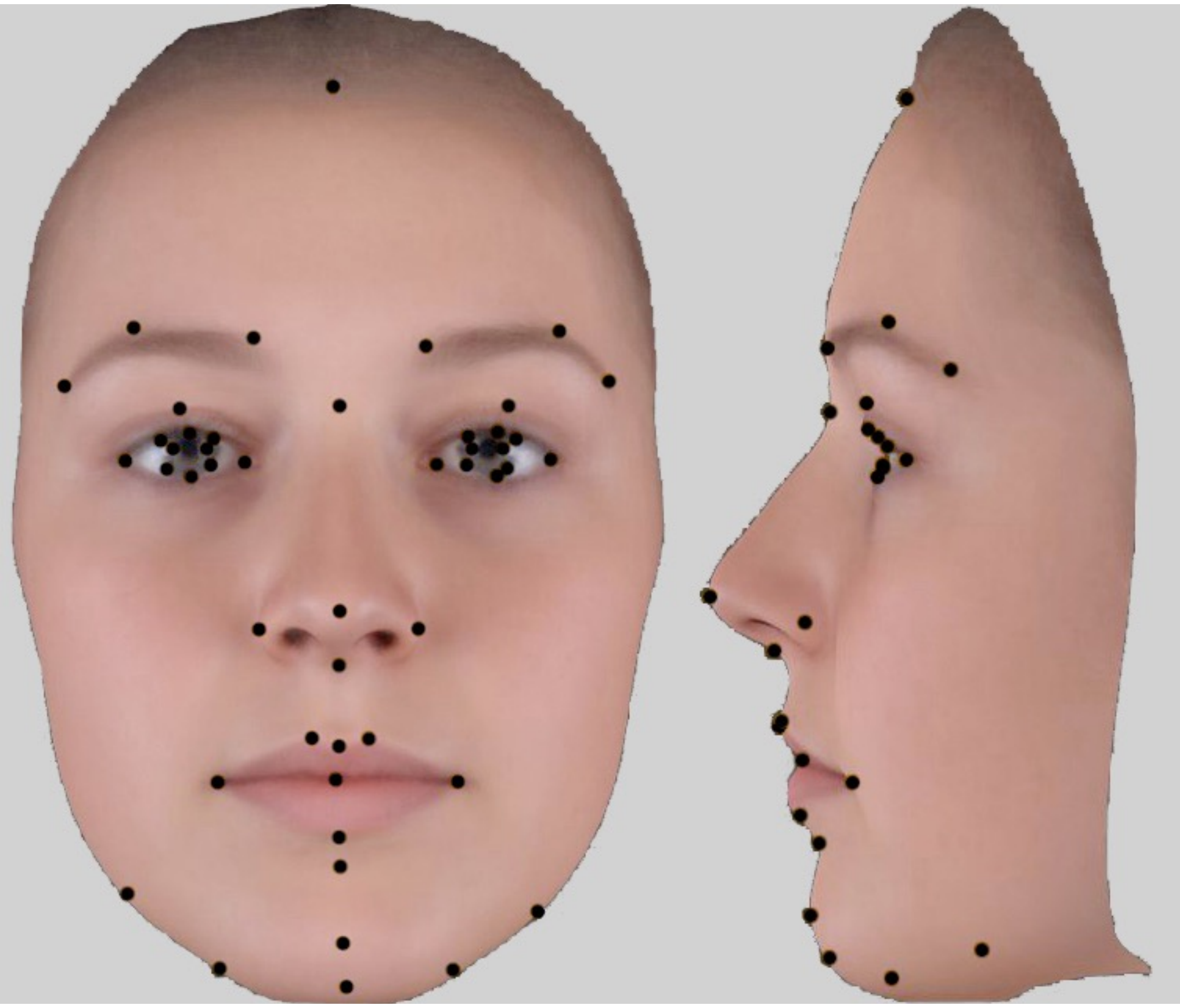


Figure 2. A composite female face displaying the set of 42 landmarks used.

Composite Stimuli Creation. Composite 3D images were created for each trait by taking the standardised models of the 15 highest and lowest female scorers for each trait. The high and low composites were created by separately averaging the standardised models for each group using Morphanalyser (Tiddeman, Duffy & Rabey, 2000) software. Composites were created by looping through the standardised vertices of each face within the group, and calculating the average position of each vertex. The resulting 3D objects were then further manipulated in Cheetah3D (3D3 Solutions, Vancouver, Canada) to produce renders in three views (see Figure 3) with standardised artificial lighting and viewing angle. Faces were turned 45° to the left along the Heading (H) axis, so that their right side was displayed to the viewer (Right View), and then rendered to create a 2D stimulus image (Figure 3). Conversely, they were turned 45º to the right along the H axis, displaying their left side (Left View) to the viewer, where they were rendered. Composite models were also rendered from the front, with zero rotation on the Heading-Pitch-Bank (HPB) axes. The field of view was set to 60°, with a perspective projection. The approximate camera distance from the face was 150% of the face height. The camera was placed at 0° along the X axis, -0.05° along the Y axis and 1.5° along the Z axis within the camera settings. For every render, their orientation along the P and B axis were kept at 0°, ensuring their posture was identical.

Figure 3. Example stimuli. The facial composite for high Agreeableness demonstrating the Left, Front and Right views respectively.

Shape Alone and Texture Alone Models. As described earlier, the process of stimulus production creates separable 3D object models and surface textures. In order to assess the separate contributions of skin texture and facial structure to trait perception, an average female face was produced using Morphanalyser (Tiddeman, Duffy & Rabey, 2000) from all 92 individual face models. The textures of the high and low trait composites were then each applied to the average facial shape. This yielded 24 face models that differed in surface texture but shared the same averaged 3D shape. We refer to these as our “Texture Alone” models, not because texture was presented without shape, but because only texture differed between the high and low composites. In an analogous way, we created our “Shape Alone” models. In this case, we applied the average texture to the 3D shape of the high and low trait composites. These 24 models therefore shared a common texture but unique shape. In this way, the contributions of structure and texture could be controlled and assessed separately (O’Toole, Price, Vetter, Bartlett & Blanz, 1999), as well as compared to the “Combined” models, which reflect both the shape and the texture information for high and low trait composites.

Participants

Forty-four participants (25 females, age $M = 24.30$, $SD = 5.79$) from Bangor University took part in the study for a payment of £6 and course credits.

Design

Three factors defined the experimental design and stimulus presentation: View (Left, Front, Right) x Information Source (Combined, Shape Alone, Texture Alone) x Trait (Agreeableness, Conscientiousness, Extraversion, Neuroticism , Openness and Physical Health). All factors were varied within participants. Trials were blocked by View, and the order of blocks was counterbalanced across participants.

Procedure

On each trial, high and low trait composites were presented on the left and right of the screen (approximate image size of 18 x 21 centimetres, 550 x 600 pixels, with a viewing distance of approximately 50 cm but not fixed). The experimental factors of View, Information Source, and Trait were held constant for each pair. Participants were asked to judge which face better suited a discrimination statement (e.g., “more talkative”) appearing above the faces, and to indicate their response with an unspeeded mouse click. For personality traits, the discriminatory statements were adapted from the BFI-44 (John & Srivastava, 1999). For physical health, the eight questions contributing the most weight to the physical health score from the SF-12 (Ware, Kosinski, & Keller, 1996) were used. Discrimination statements were adapted so that of the eight statements for each trait, the correct responses for four of the statements reflected high social desirability (indicating high levels of Agreeableness, Conscientiousness, Extraversion, Openness, and Health; and low levels of Neuroticism; e.g. ‘more interested in others’ feelings’) while the other four were low in social desirability (e.g. ‘more cold and aloof’). When the statement was high in social desirability, two of the trials had the correct answer on the left of the screen and two had the correct answer on the right. The same counterbalancing was true for the trials with low social desirability statements. Each of the eight discrimination statements for a trait, along with its corresponding pair of high and low trait composites, appeared once within a block for a total of 432 trials.

Results

There were three main findings. Firstly, while mitigating any postural effects, we largely replicated previous findings demonstrating accurate trait perceptions from the face (Kramer & Ward, 2010; Little & Perrett, 2007). That is to say, for many traits, people with similar personalities share a similar facial appearance. Secondly, we found that information allowing accurate personality identification is largely lateralised to the right side of the face. Thirdly, we found significant and separate contributions of facial structure and skin texture for many cases of accurate trait identification.

The focus of the study was to determine the effects of view, texture and shape on the accuracy of individual trait identification. Our plan for analysis was therefore to consider the effects of View and Information Source separately for each trait. We consider the significant findings for each trait below; however, means and variance measures for all conditions are provided in Table I.

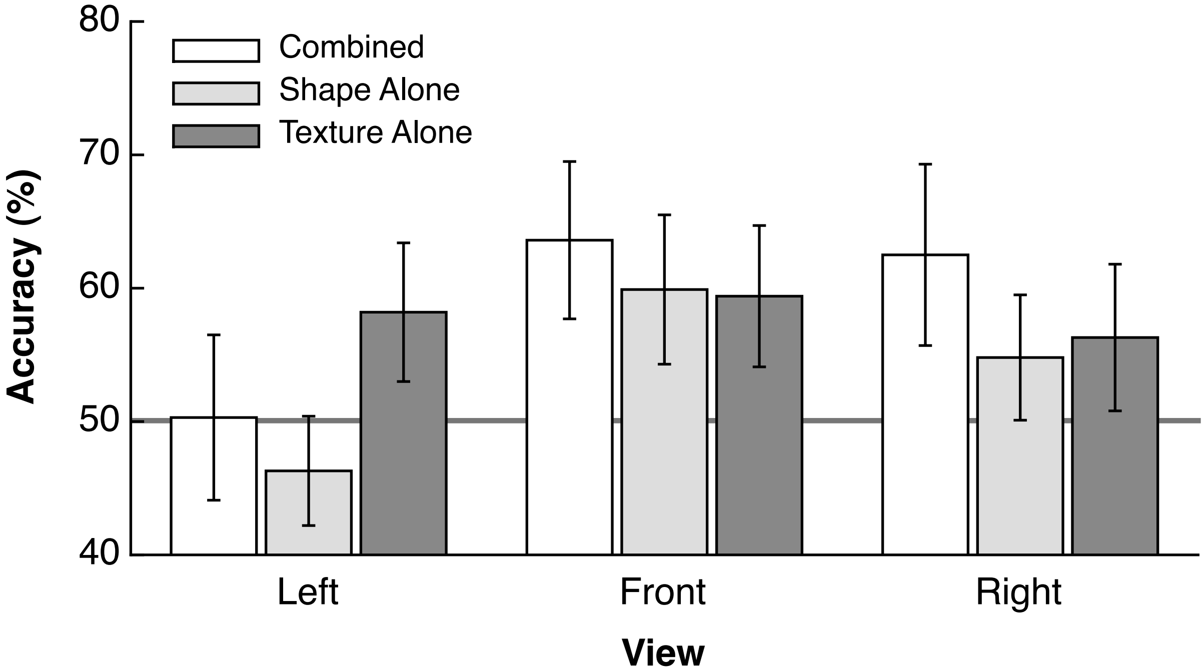
Individual Trait Accuracy

Agreeableness. We first consider which of the conditions produced above chance performance for Agreeableness, illustrated in Figure 4. For the Front and Right views, all conditions were significantly above chance, all *ps* $< .003$. However, within the Right View, the Shape Alone condition was just significant, $t(43) = 2.06$, $p = .045$, as was the Texture Alone $t(43) = 2.31$, $p = .026$. In the Left View, only the Texture Alone condition was above chance, $t(43) = 3.17$, $p = .003$.

A 3 (View: Front, Left, Right) x 3 (Information Source: Combined, Shape Alone, Texture Alone) ANOVA revealed a main effect of View, $F(2, 86) = 8.50$, $p < .001$, and a View x Information Source interaction, $F(4, 172) = 3.30$, $p = .012$. Inspection of Figure 3 strongly suggests this is driven by the chance performance of most conditions in the Left View. Indeed, the mean accuracy for the Left View was $M = .52$, while for the Right View it was $M = .58$, and for the Front View it was $M = .61$.

Figure 4. Accuracy on two-alternative forced choice discrimination of Agreeableness. Error bars represent a 95% confidence interval, and conditions with error bars crossing the 50% line are not significantly different from chance.

Conscientiousness. No significant main effects or interactions were found, all *p*s $> .05$. Accuracy for this trait is typically around chance levels in other studies involving full face composites (Kramer & Ward, 2010; Little & Perrett, 2007).



Extraversion. Only two conditions were significantly different from chance (Figure 5). The Texture Alone condition was significantly accurate with both the Front View, $t(43) = 2.79$, p = .008, and Right View, $t(43) = 4.05$, p < .001.

A 3 x 3 ANOVA revealed a significant main effect of View, $F(2, 86) = 4.28$, $p = .017$, with the Left being less accurate, $M = .49$, than the Right, $M = .55$, or Front Views, $M = .54$. There was a main effect of Information Source, $F(2, 86) = 5.50$, $p = .006$, and, as Figure 5 demonstrates, this was driven by Texture Alone conditions, suggesting that texture may play a role in the perception of Extraversion. Although previous studies with composite images have found high levels of accuracy for identifying Extraversion (Little & Perrett, 2007; Kramer & Ward, 2010), performance was little different from chance with our posture-controlled stimuli.

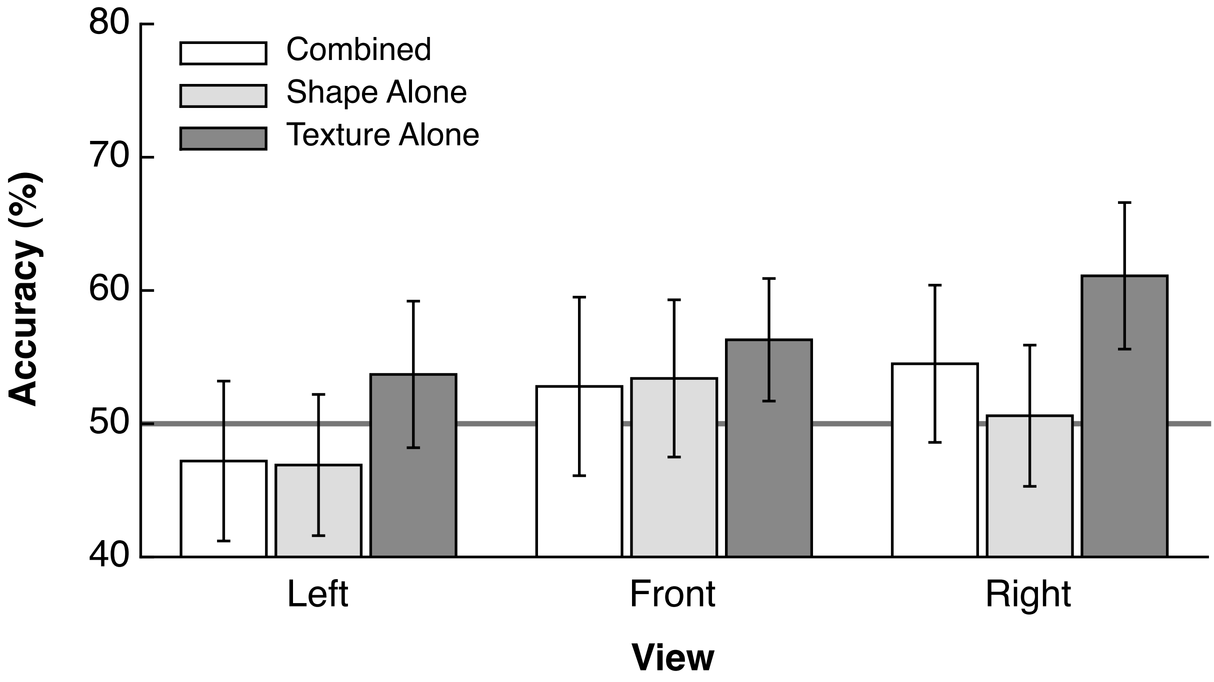
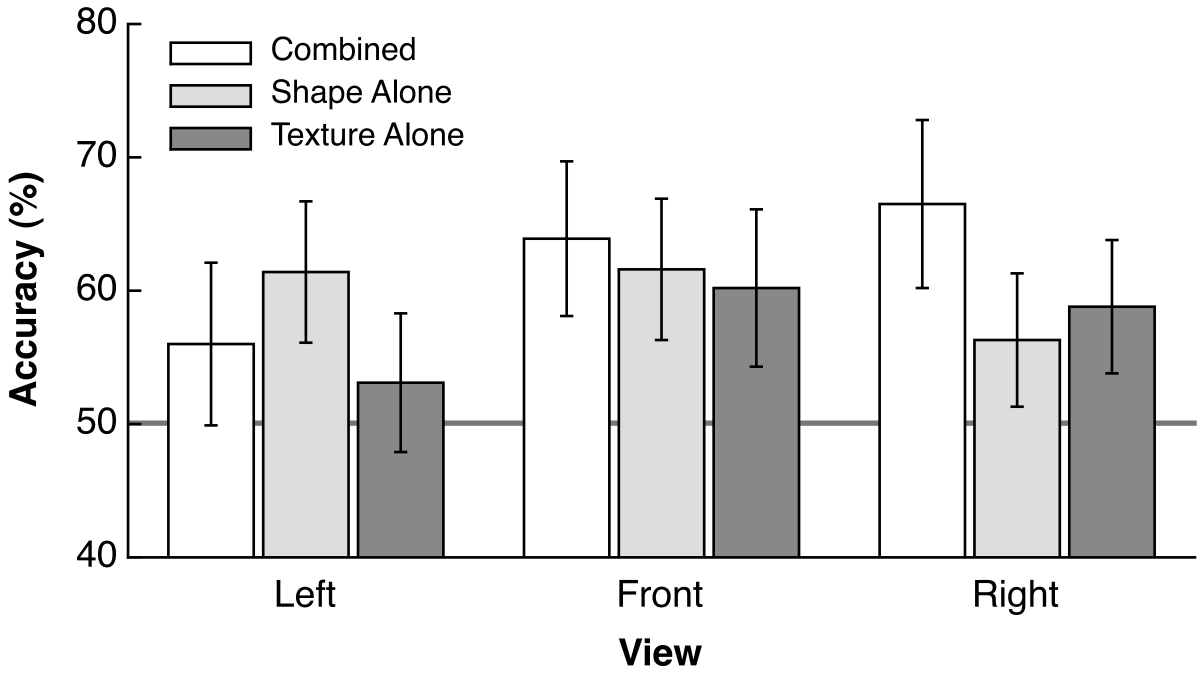


Figure 5. Accuracy on Extraversion. See Figure 4 for details.

Neuroticism. Results for Neuroticism are shown in Figure 6. For the Front and Right Views, all conditions were significantly above chance, all *p*s < .015. In the Left View, only Shape Alone was significant, $t(43) = 4.32$, $p < .0001$, with the Combined condition just failing to reach significance, $t(43) = 1.97$, $p = .055$.

A 3 x 3 ANOVA demonstrated a significant main effect of View, $F(2, 86) = 3.55$, $p = .033$, demonstrating a difference in accuracy across Views, with lower accuracy in the Left View, $M = .57$, compared to the Right and Front Views, $M = .61$, and $M = .62$, respectively. A significant interaction between View x Information Source, $F(4, 172) = 3.38$, $p = .011$, was also present. Figure 6 suggests this interaction was mostly driven by the chance performance of most factors in the Left View.

Figure 6. Accuracy on Neuroticism. See Figure 4 for details.



Openness. No main effects or interactions were found, all *p*s > .05. Accuracy was never significantly different from chance, all *p*s > .05. Other studies show similar accuracy for this trait (Kramer & Ward, 2010).

Physical Health. Results for Physical Health are given in Figure 7. Physical Health was accurately detected across all Views and Information Sources, all *p*s < .05. In the Right View, however, the Shape Alone condition failed to reach significance, $t(43) = 1.18$, $p = .25$.

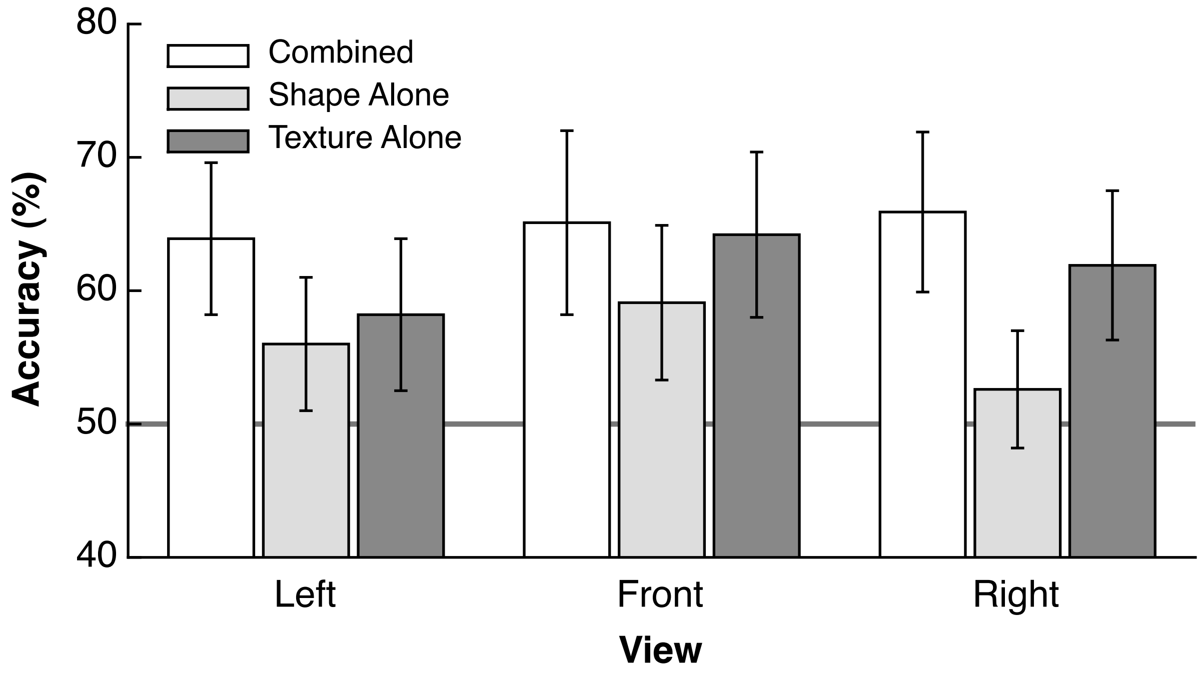
A 3 x 3 ANOVA demonstrated a significant main effect of Information Source, $F(2, 86) = 6.51$, $p = .002$, showing a difference in accuracy across Information Sources. Accuracy on Shape Alone ($M = .56$) was less than Texture Alone ($M = .62$) and the Combined condition ($M = .63$).

Figure 7. Accuracy on Physical Health. See Figure 4 for details.

Finally, across all the traits tested, we found no main effect or interactions involving sex of the observer, suggesting men and women showed equivalent accuracy when judging faces.

Discussion

Previous studies have claimed to find accurate detection of personality traits and health from neutral, static facial images (Kramer & Ward, 2010; Little & Perrett, 2007; Penton-Voak et al.,



2006). Here, we have eliminated potential postural cues to convincingly demonstrate that the face does accurately signal some personality traits, as well as health. We have identified differences between the two sides of the face in the expression of traits, and demonstrated that facial shape and skin texture make different contributions to the expression of different traits. We now take a broader perspective, looking for regularities across the different traits and viewing conditions.

First, how do our results compare to previous studies? Previous studies have been limited to the subset of conditions defined by our Front View and Combined Information stimuli (Kramer & Ward, 2010; Little & Perrett, 2007). Our results with controlled postures in the Front/Combined conditions are qualitatively similar to those obtained by Kramer and Ward (2010): accurate identification of Agreeableness, Neuroticism, and Physical Health; and chance performance on Conscientiousness and Openness. The exception appears to be Extraversion. Although Extraversion was identified at high levels of accuracy in both Little and Perrett (2007; their high extravert composite was rated as .53 units higher on average than their low extravert composite on a 7 point Likert scale for perceived extraversion), and Kramer and Ward (2010; mean accuracy of 87.5%, using a two alternative forced choice as utilised here), this trait was largely at chance levels with our posture-controlled stimuli (Figure 5). We suggest that posture is an important cue to Extraversion in facial photos. Systematic variation in posture will necessarily produce changes in the projection of 2D shape, but would be expected to have relatively less impact on global texture variables such as colour (although it could impact features such as the apparent arch of the eyebrow). With the sources of any postural cue eliminated in our stimuli, judgements of Extraversion from shape alone were no different from chance, leaving only a small cue to Extraversion remaining in texture. The differing patterns of accuracy we find from shape and texture are therefore consistent with the possibility that previous demonstrations of accurate Extraversion identification may be due to posture.

Although Extraversion appears to be signalled largely from posture rather than from the face, as a whole our results confirm that the face can reliably signal personality and health information. Across the studies by Little and Perrett (2007), Kramer and Ward (2010), and the present study, we have independent samples, using different but related measures of personality, and very different methods of image capture and stimulus construction, which all demonstrate that cues to Agreeableness and Neuroticism are present in the face.

For the personality traits which could be accurately identified (Agreeableness and Neuroticism), accuracy for the left side of the face was significantly less than for the front and right Views. Even with Extraversion, the small cue from facial texture appeared to be larger on the right than the left. What might be the cause of such differences? Previous research has shown the left side of the face is rated as more emotionally expressive than the right, even from turns of the head as small as 15°, and especially in female faces (Nicholls, et al., 2002). Additionally, Wylie and Goodale (1988) demonstrated greater musculature displacement of the left side of the face during spontaneous smiles when compared to the right. Indeed, it seems the bias towards expressiveness in the left side of the face is innate: people asked to express as much emotion as possible for a family photograph consistently display their left side more prominently (Nicholls, Clode, Wood & Wood, 1999). Additionally, research involving non-human primates has found similar directional asymmetries, with the left side more expressive (Fernández-Carriba, Loeches, Morcillo & Hopkins, 2002). If the left side of the face therefore carries more dynamic information about current mood and mental state, then the right side may correspondingly carry more stable trait signals. Consistent with this possibility, people look at, and gaze longer, at the right side of the face when forming initial impressions of sex, age and attractiveness (Burt & Perrett, 1997; Butler et al., 2005).

At this point, we think it is unlikely that the laterality effects we found resulted from hemispheric asymmetries in the observers. Although a frequent finding is that the right hemisphere demonstrates some degree of specialisation or fluency for faces as compared to the left hemisphere (Ashwin, Wheelwright & Baron-Cohen, 2005; Kanwisher, McDermott & Chun, 1997; LeGrand, Mondloch, Maurer & Brent, 2003), this does not account well for our results. First, hemispheric differences in face processing are commonly found under conditions of brief exposure and controlled fixation, which maximise the impact of a lateralised stimulus on one cerebral hemisphere (McCarthy, Puce, Gore & Allison, 1997), rather than the unlimited, free viewing conditions used here. Second, from the observer's perspective, in the Left View, important facial features like the eyes, eyebrows, lips, and chin all appear on the left side of the stimulus object (see Figure 3). If, as seems unlikely under our viewing conditions, visual information did impact on one hemisphere more than another, then facial features would have been more directly engaged by the right hemisphere on Left View faces than Right. That is, an account based on right-hemisphere specialisation for faces in the observers would predict better performance in the Left than Right view conditions. Finally, recent work on hemifaces (Kramer & Ward, 2011) identified no differences in perceptions concerning normal or mirrored faces. This suggests that the signalling content of the faces is important, and is not explained in the way in which the observer processes them (Burt & Perrett, 1997). Currently, our results with viewing angle therefore suggest there are directional asymmetries in the face, such that information about a variety of personality traits are more reliably expressed on the right side.

In contrast to these results with personality, Physical Health was accurately identified without evidence for any lateralisation, as accuracy was comparable across all viewing angles, especially in the Combined condition. Additionally, the accuracy of physical health was greater from texture than from facial shape. Since colour is present in both the Texture Alone and Combined condition, it supports previous research on the value of colour signals for health perception (Stephen et al., 2009). However, an important extension of the present study is demonstrating that surface features of the face go beyond simply giving an impression of health, but actually allow accurate identification of true levels of health in daily living.

Finally, the more informative information source (shape or texture) depended on the trait being identified. For Agreeableness, Extraversion, and Physical Health, texture was the better cue; while for Neuroticism, shape was more reliable. As expected, accuracy was highest in the Combined condition, which provided both shape and texture cues. Although we did see instances in which a single cue was numerically superior to the combined cue (e.g., Extraversion), we did not find any strong evidence of conflicting cues, in which the Combined condition was significantly less accurate than a single cue alone. These results are therefore consistent with a trait signalling system utilising multiple channels to communicate multiple messages about the signal sender. These messages are correlated with the sender's condition and can be assembled by the receiver to gain an overall more accurate impression of the sender (Zuk, Ligon & Thornhill, 1992). Not only do we find different personality traits signalled through different channels in the present research, but shape and texture have been shown elsewhere to communicate different kinds of messages. For example, previous work has demonstrated colour in the texture of a face leads to perceptions of health through blood perfusion (Stephen et al., 2009). Additionally, increases of skin luminance increase attractiveness and perceptions of sex (Russell, 2009), while increases in lip colour also influence attractiveness and femininity (Stephen & McKeegan, 2010). Whilst colour is a signal of health in the face, texture also contains a variety of other information, such as eyebrow shape and position, which interplay with shape information and convey signals of dominance and masculinity (Gangestad & Thornhill, 2003). Indeed, aspects of colour such as the attractiveness of red lips rely on shape for their boost in attractiveness: full lips are universally more attractive than thin lips (Bisson & Grobbelaar, 2004). Shape in itself signals a great deal of information through adiposity (Coetzee, Perrett & Stephen, 2009), which indicates health, while high width-to-height ratios are robust predictors of aggressiveness (Carré et al., 2009). Considering there are multiple sources of information, an implication is that individuals will need to attend to different areas and features of the face, based on the nature of the personality assessment.

Even a “neutral” photograph is the result of a social interaction, and nonverbal signals including head posture are apparently used during this interaction to signal some aspects of personality. In addition to this kind of “controllable” posture cue, our results confirm that facial features alone can also signal personality. Such correlations between facial appearance and personality seem likely to be important targets for social cognition and perception systems.

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Appendix I

Table 1. Means for all conditions.

Trait	View	Information Source	M	SD
Agreeableness	Left	Combined	0.5	0.2
		Shape Alone	0.46	0.14
		Texture Alone	0.58	0.17
	Front	Combined	0.64	0.2
		Shape Alone	0.6	0.19
		Texture Alone	0.59	0.17
	Right	Combined	0.63	0.22
		Shape Alone	0.55	0.16
		Texture Alone	0.56	0.18
Conscientiousness	Left	Combined	0.52	0.16
		Shape Alone	0.51	0.16
		Texture Alone	0.51	0.17
	Front	Combined	0.53	0.22
		Shape Alone	0.48	0.18
		Texture Alone	0.52	0.15
	Right	Combined	0.45	0.18
		Shape Alone	0.45	0.18
		Texture Alone	0.51	0.17
Extraversion	Left	Combined	0.47	0.2
		Shape Alone	0.47	0.17
		Texture Alone	0.54	0.18
	Front	Combined	0.53	0.22
		Shape Alone	0.53	0.19
		Texture Alone	0.56	0.15
	Right	Combined	0.55	0.19
		Shape Alone	0.51	0.17
		Texture Alone	0.61	0.18
Neuroticism	Left	Combined	0.56	0.2
		Shape Alone	0.61	0.17
		Texture Alone	0.53	0.17
	Front	Combined	0.64	0.19
		Shape Alone	0.62	0.18
		Texture Alone	0.6	0.19
	Right	Combined	0.66	0.21
		Shape Alone	0.56	0.16
		Texture Alone	0.59	0.17
Openness	Left	Combined	0.5	0.18
		Shape Alone	0.47	0.17
		Texture Alone	0.51	0.18
	Front	Combined	0.52	0.21
		Shape Alone	0.49	0.16
		Texture Alone	0.51	0.18
	Right	Combined	0.5	0.24
		Shape Alone	0.51	0.19
		Texture Alone	0.52	0.16
Physical Health	Left	Combined	0.64	0.19
		Shape Alone	0.56	0.16
		Texture Alone	0.58	0.19
	Front	Combined	0.65	0.23
		Shape Alone	0.59	0.19
		Texture Alone	0.64	0.2
	Right	Combined	0.66	0.2
		Shape Alone	0.53	0.14
		Texture Alone	0.62	0.19