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Temporal shifts in eye gaze and facial expressions independently contribute to the perceived attractiveness of unfamiliar faces

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**ABSTRACT**

We investigated whether attractiveness ratings of expressive faces would be affected by gaze shifts towards or away from the observer. In all experiments, effects of facial expression were found, with higher attractiveness ratings to positive over negative expressions, irrespective of effects of gaze-shifts. In the first experiment faces with gaze shifts away from the observer were preferred. However, when the dynamics of the gaze shift was disrupted, by adding an intermediate delay, the effect of direction of gaze shift disappeared. By manipulating the relative duration of each gaze direction during a gaze shift we found higher attractiveness ratings to faces with a longer duration of direct gaze, particularly in the initial exposure to a face. Our findings suggest that although the temporal dynamics of eye gaze and facial expressions influence the aesthetic evaluation of faces, these cues appear to act independently rather than in an integrated manner for social perception.

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Social interaction relies on the ability to rapidly determine the intention, the focus of attention, and the emotional state of others, often in the absence of verbal communication. In particular, at any one moment, complex information perceived from a face, especially the eye region, is encoded and processed in a fluid and instantaneous manner. Dynamic, non-verbal social cues such as expression and eye gaze can be detected and discriminated within fractions of a second with impressively high accuracy and acuity (Anstis, Mayhew, & Morley, 1969; Argyle & Cook, 1976; Cline, 1967; Gibson & Pick, 1963; Grossmann, Johnson, Farroni, & Csibra, 2007; Hall, Andrzejewski, Murphy, Mast, & Feinstein, 2008). These non-verbal cues communicating social interest are each known to influence the formation of first impressions, social judgements and preferences for different faces (Ambady & Rosenthal, 1993; Ewing, Rhodes, & Pellicano, 2010; Kleinke, 1986; Lau, 1982; Mason, Tatlow, & Macrae, 2005; Mueser, Grau, Sussman, & Rosen, 1984; Reis et al., 1990). However, very little is known about the interaction between information from the eyes connoting social attention, such as gaze shifts and direction, and other social information determined from expressions on our preferences for faces. In the following study, we investigated whether dynamic eye gaze information and facial expression directly influence each other or act as independent cues in modulating the attractiveness judgements of unfamiliar faces.

It is argued that the evaluation of facial attractiveness involves two criteria, namely aesthetic beauty and rewarding beauty, that are dissociated behaviourally and differentially represented in the brain (Aharon et al., 2001; O’Doherty et al., 2003; Senior, 2003). The former refers to the disinterested response associated with perceiving faces that are of high aesthetic value but of little, or no, social relevance to the observer. On the other hand, beautiful faces can be rewarding in that they entail the adaptive value as potential targets of further social interaction (e.g., mates).

Given that expressive and attentional cues from faces can communicate social interest and engagement with the observer very effectively, it is possible that these cues might also enhance the perceived attractiveness of the target face. For example, studies on face perception suggest the early development of sensitivity to the eye region, in that infants show a preference for looking at faces with a direct gaze (Farroni, Csibra, Simion, & Johnson, 2002; Farroni, Menon, Rigato, & Johnson, 2007). Moreover, other studies have implicated eye gaze as an...
important cue to the attentional state of another (as in joint attentional tasks, e.g., Frischen, Bayliss, & Tipper, 2007). This preference for eye gaze direction may, in turn, extend to the evaluation of facial attractiveness. Indeed, gaze direction has been found to influence attractiveness judgements in adults. For example, Ewing et al. (2010) used a forced-choice paradigm and reported that static images of faces with eye gaze directed at the observer were preferred over faces with averted gaze (and all faces conveying a neutral expression). However, they also found that when participants rated individual images of faces, attractiveness ratings were higher for faces with direct gaze compared to those with gaze averted to the left but, interestingly, not the right. The authors attributed the asymmetric results to the greater difficulty of discriminating the direction of gaze when it is averted to the right (see Calder, Jenkins, Cassel, & Clifford, 2008). The findings suggest that faces with direct rather than averted gaze, are perceived to be more attractive but only when the gaze direction can be detected unambiguously. Moreover, Ewing et al. (2010) ruled out a role for symmetry as the effect of gaze direction on both face preference and perceived attractiveness of faces was not found when the images of the faces were inverted.

A preference for faces with eye gaze directed at the observer was also reported using dynamic stimuli. For example, Mason et al. (2005) used highly stylized images of female faces, all presented with neutral expressions and either displaying gaze shifts away or towards the observer. They reported higher likeability ratings to faces when the direction of gaze shifted towards, rather than away from the observer. However, the effect of gaze shift towards the observer on the perceived attractiveness of the face was found only among male participants. The shift of gaze direction towards the observer acts as a salient cue for social engagement and is perceived as positive in general, as reflected in the higher likeability ratings in Mason’s et al. (2005) first experiment. Mason et al. argued, however, that the effect of gaze shift on perceived attractiveness is dissociable from likeability, possibly reflecting the different factors underpinning aesthetic and rewarding beauty, since a preference for a gaze shift towards the observer affects attractiveness ratings only when the social engagement is relevant to the observer, in this case male observers rating female faces.

There are a number of possible explanations as to why a face that directly gazes on an observer is perceived as more attractive than a face with an averted gaze. First, Reber, Schwarz, and Winkielman (2004) proposed the “processing fluency” hypothesis of aesthetic experience, which predicts that the more fluently a stimulus is processed by the perceptual system, the more positively it is evaluated. Extending this to the evaluation of facial attractiveness, some studies have reported evidence that direct gaze facilitates the perceptual processing of faces and this may, in turn, lead to a higher aesthetic evaluation of these faces. For example, in studies using a visual search task a target face is typically detected more rapidly if the eye gaze of the face is directed at the observer than if the gaze is averted, known as the “stare-in-the-crowd” effect (Senju, Hasegawa, & Tojo, 2005; von Grünau & Anston, 1995). Indeed, Senju and Hasegawa (2005) demonstrated that direct gaze in a face captures the allocation of spatial attention. They reported that the presence of a face in which the eyes are gazng directly at the observer hinders the detection of peripherally placed targets compared to a face with an averted gaze. Conversely, averted gaze is thought to induce a reflexive shift of attention away from the target face and initiate joint attention towards a third location of interest (Schuller & Rossion, 2001). Other evidence also supports the “processing fluency” effect of direct eye gaze. For example, face images with direct than averted gaze are associated with better person memory encoding (Mason, Hood, & Macrae, 2004; Smith, Hood, & Hector, 2006) and better discrimination of the invariant properties of the face such as its biological sex and identity (Macrae, Hood, Milne, Rowe, & Mason, 2002). Relatively, neuroimaging studies have found that viewing static images of faces shown with direct rather than averted gaze is associated with greater BOLD activation in the fusiform gyrus (George, Driver, & Dolan, 2001), a region known to be associated with face perception, and that faces with a gaze shift towards, rather than away from the observer elicit both an increase in activation in the right posterior superior temporal sulcus (pSTS, an area known to be involved in processing eye gaze information) and in its functional connectivity with the right fusiform gyrus (Ethofer, Gschwind, & Vuilleumier, 2011).
However, evidence in support of the “processing fluency” hypothesis has been inconsistent with regard to the role of eye gaze on facial attractiveness. First, the results of some studies suggest that direct gaze does not always enhance the perceptual processing of faces. For instance, Vuilleumier, George, Lister, Armony, and Driver (2005) reported that the ability to discriminate the sex of a face was better for faces with averted gaze. Moreover, Adams and Kleck (2003) found faster response times in identifying certain emotional expressions of faces with averted, rather than direct gaze. In reference to the “stare-in-the-crowd” effect (Senju et al., 2005), Cooper, Law, and Langton (2013) argued that the faster detection of faces with direct gaze among distracters in visual search tasks could be due to the failure to control for the similarity among the distractor items, and that a target face with a direct gaze is more likely to pop-out among more homogenous distracters. Second, it is unclear how attention to face images with direct gaze is enhanced relative to averted gaze, given that participants are typically required to pay attention to each face image during attractiveness rating experiments, prior to making judgements (Ewing et al., 2010; Mason et al., 2005).

An alternative proposal to the “fluency” hypothesis is that the effect of direct gaze on facial attractiveness lies in its social reward value to the observer. For example, when the eye gaze of another face is directed at oneself, it signals social interest and willingness to approach or engage in further interaction (Kleinke, 1986; Patterson, 1982). The findings of Kampe, Frith, Dolan, and Frith (2001) provide supporting neuroimaging evidence, in that viewing attractive faces with a direct gaze activated brain regions associated with the reward processing system, particularly the ventral striatum. Additionally, other studies have reported that viewing faces with direct and averted gaze differentially activated the approach-avoidance motivational circuitry in the brain (Hietanen, Leppänen, Peltola, Linna-aho, & Ruuhiala, 2008) even when the participant viewed a real person (Harmon-Jones, Lueck, Fearn, & Harmon-Jones, 2006). Moreover, Harmon-Jones et al. (2006) also reported larger skin conductance responses indicating physiological arousal during direct gaze. Arousal is associated with enhanced judgements of attractiveness regardless of arousal type (see review by Foster, Witcher, Campbell, & Green, 1998). Consequently, the arousal elicited by viewing faces with direct gaze might contribute to the higher perceived attractiveness of those faces.

Facial expression is an important social cue signaling the emotional state of another, and many studies have provided evidence supporting an association between positive expressions, (e.g., smile) and facial attractiveness (Golle, Mast, & Lobmaier, 2014; Lau, 1982; Mehu, Little, & Dunbar, 2008; Morrison, Morris, & Bard, 2013; Mueser et al., 1984; Otta, Abrosio, & Hoshino, 1996; Otta, Lira, Delevati, Cesar, & Pires, 1994; Reis et al., 1990; Tracy & Beall, 2011; Ueda, Kuraguchi, & Ashida, 2016). In particular, studies which compared the perceived attractiveness of smiling and neutral expressive faces found a preference for smiling faces, irrespective of whether the task involved ratings using a Likert scale or 2-alternative forced choice (Golle et al., 2014; Mehu et al., 2008; Otta et al., 1994, 1996; Reis et al., 1990). Moreover, O’Doherty et al. (2003) reported that viewing smiling faces was associated with greater activation in regions of the brain associated with reward-processing, particularly the orbitofrontal cortex (OFC). This finding suggests that, similar to the role of direct gaze, viewing faces with smiling expressions increases the reward value of faces thus enhancing their appeal. Furthermore, if a similar reward network in the brain is activated by both gaze direction and facial expression, this may mediate an interaction between these factors when evaluating faces.

Although the effects of eye gaze and facial expression on perceived attractiveness have been examined separately in the laboratory, our every-day social interactions are more likely to be based on a combined percept. For example, during naturalistic social interactions, the combination of both cues may be required to effectively interpret the intentions and emotional states of another. Accordingly, Adams and Kleck (2003, 2005) proposed the “shared signal” hypothesis which states that eye gaze and facial expression are processed in an integrated manner, particularly for the purpose of the target’s approach-avoidance disposition. For example, both direct gaze and positive expressions (but also anger) are both associated with an individual’s intention to approach the observer. Detection of both cues in this case is enhanced to allow the observer prepare an appropriate response. As such, the decoding efficiency of a particular combination of gaze direction and expression would be expected to increase when the two cues
are consistent in the approach-avoidance dimension compared to when they are not.

In support of their hypothesis, Adams and Kleck (2003) reported that happy and angry facial expressions were discriminated more accurately and rapidly when each was coupled with direct rather than averted gaze, whereas averted gaze facilitated the processing of fear and sad expressions. Both of these effects may be underpinned by an adaptive advantage to be alert to approach-avoidance related signals in order to efficiently respond. For instance, happy and angry expressions communicate an intention to positively engage or an imminent attack respectively, and evidence suggests that both of these expressions elicit an approach response (Carver & Harmon-Jones, 2009; Wilkowski & Meier, 2010). Such cues are, consequently, more relevant to the observer when coupled with direct eye gaze than when gaze is averted. Alternatively, fearful and sad expressions could signal a potential threat in the vicinity to be avoided, particularly when coupled with an averted gaze that suggests an attentional shift for the observer towards an external location.

The judgement of facial attractiveness also seems to be modulated by similar approach-avoidance mechanisms that are determined by an interaction between gaze direction and facial expressions. For example, Jones, DeBruine, Little, Conway, and Feinberg (2006) found that images of faces with direct gaze were judged to be more attractive when smiling than when shown with a neutral expression whereas faces with a neutral expression were preferred over faces with a smile when gaze was averted. Jones et al. (2006) also reported that gaze direction affected the perceived attractiveness of smiling faces only, and did not have an effect on how attractive a face appeared when the expression was neutral. In a later study, Conway, Jones, DeBruine, and Little (2008) reported a similar interaction between gaze direction and expression on facial attractiveness when participants judged faces conveying happy or disgusted expressions, especially for faces of the opposite sex. Taken together, the evidence suggests that facial attractiveness is modulated by facial cues such as eye gaze direction and emotional expressions that signal their social relevance to the observer (Conway et al., 2008; Jones et al., 2006; Mason et al., 2005).

Previous studies have mainly used static images of faces to investigate the effects of eye gaze and expression on perceived attractiveness. However, the nature of both eye gaze and expression information in a naturalistic setting is dynamic. In particular, a gaze shift can signal a change in attentional and intentional states, therefore conveying a more socially meaningful cue than a static gaze. It remains unclear, however, whether facial expressions can affect attractiveness judgements when the eye gaze shifts, or whether one source of social information dominates over the other. The following experiments were conducted to investigate the interactions between gaze shift and facial expression on the perceived attractiveness of unfamiliar faces. If gaze shift and expression act as integrated cues, we predicted that faces with a gaze shift towards, rather than away from the observer would be rated as more attractive only when the face was shown with a smiling rather than neutral expression. Previous studies used a range of expressions, from neutral to smiling, on attractiveness judgements. In order to investigate the role of expression, we also manipulated the intensity of the facial expression to test its effect on facial attractiveness when coupled with shifts in eye gaze.

**Experiment 1a**

The aim of the following experiment was to assess whether gaze shift and facial expression integrated to modulate attractiveness ratings or whether the two cues independently contributed to attractiveness. Based on Mason et al. (2005) we first predicted that faces in which the eye gaze shifted towards the observer would be rated as more attractive than gaze shifts away from the observer. Furthermore, if facial expression modulated perceived attractiveness, we predicted higher attractiveness ratings to faces with positive (smiling) expressions than those with neutral expressions and that an increase in the intensity of the expression (slight smile to full smile) would further enhance those ratings. On the other hand, if gaze shift and expression affected attractiveness ratings independently, then we predicted that the effects on attractiveness would be dominated by one of these cues (e.g., higher attractiveness to smiling faces irrespective of the direction of a gaze shift). We manipulated the intensity of facial
expressions by including neutral, slight smile and full smile (with a closed mouth). The “slight smile” was created by morphing between the neutral and smiling expressions of each individual face.

Methods

Participants
One hundred and eighty-four participants (75 females; mean age = 37.4, SD = 9.38 years) from the USA were recruited online through Amazon’s Mechanical Turk (Woods, Velasco, Levitan, Wan, & Spence, 2015). All were naïve to the purpose of the study and were awarded approximately €1.00 for participating in the experiment. The study (and all subsequent experiments) was approved by the Research Ethics Committee of the School of Psychology, Trinity College Dublin. Accordingly, all participants gave informed consent by proceeding with the experiment upon reading an introduction about the study.

Stimuli and apparatus
Face images of 34 faces were taken from the Chicago Face Database (Ma, Correll, & Wittenbrink, 2015a) in order to create our stimulus set. All images were of Caucasian, female faces, presented from a front facing viewpoint. None of the faces were famous and were, therefore, unfamiliar to the participants. For the purpose of our experiment, we used two different versions of each face identity from this original database: one showing a neutral and the other a happy expression. The happy expression consisted of a face with a full, close-mouthed smile (see Figure 1). To examine the effect of expression intensity on attractiveness ratings, we also included an intermediary expression of a smile. This expression was created for all face identities by morphing the neutral expression with the corresponding smiling expression for each facial identity to create a slight smile stimulus (see Figure 1). In total, three images of each of the 34 facial identities were obtained for our stimulus set, with each image conveying a neutral expression, a slight smile (averaged) or a closed-mouth smile.

The original face images, and images of the morphed expression, were edited using FaceGen software. First the original face images were uploaded onto the “FaceGen Modeller” and processed through its “PhotoFit” function. All hair information was removed and faces were presented from the neck up in each image. “FaceGen” allowed us to create images of the faces with different eye gaze directions (direct or averted left or right), for each of the three expressions of each face identity. The gaze direction

Figure 1. Example of the face stimuli used in Experiment 1a and 1b. The top row shows faces with direct eye gaze conveying (from left to right) an increase in expression intensity from a neutral expression, a slightly smiling expression (morphed between neutral and close-mouthed smile) to a full (close-mouthed) smiling expression. The bottom row shows the corresponding facial expressions with an averted eye gaze.
for averted gaze was either to the left or right (randomly assigned to each face image, and counterbalanced across all images) such that each face image was associated with one direction of an averted gaze. Each image was positioned in the centre of a black background and all were matched for contrast and luminance. The sizes were adjusted such that each image was approximately 400 × 400 pixels in dimension.

An example of a trial sequence is illustrated in Figure 2. We simulated a shift in gaze in each face by adapting the paradigm previously described by Mason et al. (2005). Specifically, gaze shift of the eyes was achieved by presenting two face images in rapid succession to simulate apparent motion of the eyes. The first face stimulus (S1) differed from the second face stimulus (S2) in gaze direction only, whilst maintaining the same expression. This manipulation resulted in one of two possible gaze shift directions (towards or away from observer) for each of the three facial expressions.

Participants completed the experiment using their own desktop computers via the online research platform Xperiment (http://www.xperiment.mobi; Woods et al., 2015). The resolutions of the screens used were recorded and ranged between 800 × 600 and 2560 × 1440 pixels.

**Design**

We adopted a within-subject design with two independent variables, namely the direction of gaze shift (away or towards the observer) and facial expression (neutral, slight smile and full smile). The dependent variable was the perceived attractiveness ratings provided to each of the faces. Each participant was presented with a total of 68 trials, with each of the 34 face images shown twice, once with a gaze shift towards the observer and the other away from the observer. Although each participant saw all facial expressions, each of the 34 faces were depicted showing one of the 3 facial expressions only. Thus facial expression was counterbalanced across facial identity for all participants in the experiment. This design was adopted to ensure that each face image was presented to each participant a minimum number of times to avoid the “mere exposure” effect (e.g., Peskin & Newell, 2004). All trials were presented in a random order across participants.

**Procedure**

Prior to the experiment, each participant completed a demographics questionnaire and was then provided with the instructions to the experiment. They were informed that images of female faces would be presented on the screen and their task was to rate the attractiveness of each face as soon as they were prompted.

A single practice trial was performed to allow the participants become familiar with the trial structure (as illustrated in Figure 2) and the nature of the response. The experiment could not proceed unless the participant indicated they understood what they were expected to do during the experiment and completed this initial practice trial. A trial began with the presentation of a white fixation cross, centred on a black background, which remained on screen for 500 ms, followed by a 30-ms blank screen. Then, in the centre of the screen, two face stimuli appeared in rapid succession for 1000 milliseconds each (i.e., a total of 2000 milliseconds). The end of a trial was marked by a response cue which indicated to the participant to provide an attractiveness rating of the face they had just viewed. A sliding scale was used to provide this rating, which ranged from very unattractive (0) to very attractive (100). The participant was instructed to make a response as quickly as possible.

![Figure 2](image-url) An illustration of the structure of a trial in Experiment 1a. Gaze shifts were simulated by presenting the face images in rapid succession. See text for more details.
and to utilize the whole scale. Participants moved the indicator along the scale, using a mouse press, to indicate their preferred rating of the attractiveness of the face stimulus they had just seen. The entire experiment took approximately ten minutes for each participant to complete.

**Results**

Participants’ mean attractiveness ratings to the faces for each of the gaze shifts and neutral, slight smile and full smile facial expressions were first calculated and are shown in Figure 3. Because of a concern that face images created using “FaceGen” software may alter their characteristics relative to the original photo images of the faces, we first compared the attractiveness ratings obtained in the present experiment (averaged across both directions of gaze shift) with those obtained from the corresponding facial identities reported in the Chicago Face Database (Ma, Correll, et al., 2015a, N = 34). A significant correlation (Pearson’s r = 0.863, p < 0.001) between the attractiveness ratings indicated that the edits made to the face images (using FaceGen) did not differentially affect their relative attractiveness. However, the ratings obtained in the current study (M = 38.8, SD = 10.3) were significantly lower than those normative ratings in the database (M = 48.2, SD = 12.4; mean difference = 9.33, SD = 6.27, t (33) = 8.67, p < 0.0001, Cohen’s d = 0.825).

Although we did not set out to compare ratings between male and female participants, we decided to conduct a preliminary data analysis on the basis of previous findings (Mason et al., 2005). This analysis failed to show evidence for an effect of the sex of the participant on ratings of attractiveness of the female face images [F (1, 182) = 2.32; p = 0.13, η²p = 0.013]. The ratings from male (M = 37.9, SD = 11.92) and female (M = 40.6, SD = 11.91) participants did not differ significantly and the sex of the participant was not taken into account in any of the subsequent analyses.

A 2 × 3 repeated-measures ANOVA was performed on the mean attractiveness ratings with direction of gaze shift (towards and away) and expression (neutral, slight smile, and full smile) as within-subject factors.

In this data analysis (and those of subsequent experiments), degrees of freedom were corrected using the Greenhouse-Geisser method whenever the assumption of sphericity was violated. Effect sizes were reported in terms of partial eta squared for the effects of each independent variable and their interaction(s); and Cohen’s d for mean differences respectively.

The results revealed a main effect of gaze shift [F (1, 183) = 5.30, p = 0.023, η²p = 0.028] with higher
attraction of expression indicated that faces with a slight smile (morphed) (M = 45.17, SD = 13.75) were rated as significantly more attractive than those conveying a neutral expression (M = 38.44, SD = 12.14; mean difference = 6.72, SD = 1.35, p < 0.0001, Cohen’s d = 0.706) or a full (close-mouthed) smile (M = 33.38, SD = 13.01; mean difference = 11.79, SD = 1.40, p < 0.0001, Cohen’s d = 1.17) (see Figure 3). Unexpectedly, attractiveness ratings were higher for faces conveying a neutral expression than those with a full smile (mean difference = 5.07, SD = 1.33, p < 0.0001, Cohen’s d = 0.739).

**Discussion**

In contrast to the findings reported by Mason et al. (2005), we found that when the eye gaze shifted away from the observer this was associated with higher attractiveness ratings for faces than when the gaze shifted towards the observer. While social attention, indicated by a gaze shift towards the observer, has been shown to enhance preferences for faces, our results suggest that this effect may be context-specific. For instance, in Mason et al.’s (2005) study, a gaze shift towards the observer rendered the female faces more attractive to the male participants only, with no effect on the ratings provided by the female participants (Mason et al., Experiment 2). Thus, as Mason et al. (2005) argued, eye gaze shifts may be highly dependent on the specific social relevance of the face to the observer. In the current study, the sex of the faces presented might not have been apparent due to the lack of hair even though the participants were briefed before the experiment that the faces they were going to view were female faces. We found no difference between the ratings provided by the male and female participants, therefore we do not have evidence suggesting that the faces varied in their social relevance across these groups. Nevertheless, we noticed that the ratings provided by the participants were generally low (less than 50%) suggesting that the effects of eye gaze found here may be specific to faces that are generally perceived as low in attractiveness.

An alternative possibility is that the results were based on the initial exposure of the face stimuli and the direction of the gaze first encountered, and not on any shift in gaze direction. For example, Willis and Todorov (2006) reported evidence suggesting that an initial exposure of 100 ms was sufficient for a specific trait (including attractiveness) to be inferred from an unfamiliar face, and that increasing the duration of the exposure to a face, from 500 to 1000 ms, did not further affect attractiveness judgments. It is plausible, therefore, that the results from our experiment reflected an impression formed upon initial exposure to the face in the first image, which was present for 1000 ms in each trial, rather than a preference for a gaze shift away from the observer. We tested this idea further in Experiment 1b.

Although we found a significant effect of facial expression on perceived attractiveness, with a preference for positive expression over neutral as previously reported (Golle et al., 2014; Mueser et al., 1984; Otta et al., 1994, 1996; O’Doherty et al., 2003; Reis et al., 1990; Ueda et al., 2016), our results were somewhat unexpected. Specifically, we did not replicate previous findings of higher facial attractiveness ratings with increasing intensity of a smiling expression (Golle et al., 2014; Ueda et al., 2016). Rather we found that participants found the average or morphed facial expression to be more attractive than either the original neutral or full smiling expression. There are a number of possible reasons for this result. First, a full but close-mouthed smile may not sufficiently convey a happy expression and, indeed, some participants reported that it appeared “unnatural”. Indeed, in a follow-up study in which 20 naïve participants were asked to identify the facial expression in single images of the faces used in this experiment, only 35% of the faces with closed smile were associated with a “happy” (or “content”) expression. Second, without a direct comparison between different expressions conveyed by the same faces (e.g., by adopting a 2-AFC design as in Golle et al., 2014), the expression of some faces may have been relatively difficult to perceive from an isolated image. To mitigate against these possibilities, we further investigated the effect of facial expression on perceived attractiveness in Experiment 2.
Experiment 1b

In Experiment 1a, it was unclear whether the benefit of a gaze shift away from, rather than towards, the observer on attractiveness judgements was due to the initial exposure to the face image or to the dynamic direction of the gaze. The aim of this experiment was, therefore, to disambiguate the effect of the order of the gaze direction (i.e., the direction of the initial gaze viewed) from the direction of the gaze shift itself (i.e., towards or away) relative to the observer. To that end, we introduced a 500-ms delay between the presentation of the first and second face images within each trial (i.e., S1 and S2) in order to disrupt the perception of a shift in gaze. Removing the shift in gaze should not change the results found in Experiment 1a (i.e., a preference for the “away” gaze shift) if those ratings were based on first impressions only. However, if the gaze shift itself was the basis of the findings, then a disruption to the shift would likely change the results.

Methods

Participants

Ninety-eight participants (59 females; mean age = 39.1, SD = 9.54 years) from the USA were recruited online through Amazon’s Mechanical Turk. All were naïve to the purpose of the study and were awarded approximately €1.00 for participating in the experiment. All gave informed consent by proceeding with the experiment as described in Experiment 1a.

Stimuli and apparatus

The face stimuli were the same as those used in Experiment 1a. Participants used their own desktop computers and screens to complete the experiment via Xperiment, as in Experiment 1a. The resolutions of the screens used were recorded and ranged between 800 × 600 and 2560 × 1440 pixels.

Design and procedure

The experimental design was mainly the same as that of Experiment 1a with the only exception that the factor of shift in gaze direction was described as the initial gaze direction viewed in the sequence of two images (i.e., direct gaze first vs. averted gaze first). The task for the participant was as described in Experiment 1a.

Results

The mean attractiveness ratings to each of the gaze direction and expressions are shown in Figure 4. As in Experiment 1a, the mean ratings made by female (40.46, SD = 11.81) and male (36.36, SD = 11.82) participants did not differ significantly [F (1, 96) = 2.82, p = 0.096, ηp² = 0.029] therefore the sex of the participant was not included in any subsequent analyses.

A 2 × 3 repeated-measures ANOVA was performed on participants’ average ratings with initial gaze (direct or averted gaze first) and facial expression (neutral, slight smile, and full smile) as within-subject factors. The order of presentation of the two gaze directions (i.e., mean ratings to direct gaze first = 39.03, SD = 12.11; averted gaze first = 38.62, SD = 11.91) did not have a significant effect on perceived attractiveness [F (1, 97) = 2.03, p = 0.158, ηp² = 0.02]. A significant main effect of expression [F (1.74, 168.48) = 72.3, p < 0.0001, ηp² = 0.427] was found. The interaction between expression and order of presentation failed to reach significance [F (2, 194) = 0.515, p = 0.598, ηp² = 0.005].

Post-hoc pairwise comparisons (with Bonferroni correction) replicated the findings from Experiment 1a, with higher attractiveness ratings associated with the slight smile expression (M = 45.23, SD = 14.38) compared to either the neutral (M = 37.53, SD = 12.63; mean difference = 7.71, SD = 1.93, p < 0.0001, Cohen’s d = 0.721) or full smile (M = 33.72, SD = 12.38; mean difference = 11.52, SD = 1.92, p < 0.0001, Cohen’s d = 0.999) expressions. Attractiveness ratings were lower for faces with a full smile than those with a neutral expression (mean difference = 3.81, SD = 1.79, p < 0.0001, Cohen’s d = 0.235).

Discussion

The results of this follow-up experiment suggest that the presentation order of two static images of the same face, in which either a direct or averted gaze was initially shown in the sequence of two images, did not affect the perceived attractiveness of the face. Therefore, the effect found in Experiment 1a for higher ratings to faces with an averted gaze shift was unlikely due to a preference for direct gaze during the initial exposure to the face stimulus (i.e., the initial face image in this gaze-shift condition was a direct gaze). It is unclear why a preference was
found for an averted gaze in Experiment 1a, although it may still be possible that the initial exposure had an effect, if the gaze shift was not attended to under the particular timing conditions of the stimuli (i.e., in both experiments, each of the two face images within a trial was shown for the same amount of time). Experiment 3 was designed to address this possibility by changing the relative timings of the exposure of each individual face image in the sequence.

The effect of facial expressions was consistent with that in Experiment 1a, with a preference for a slight smile (the morphed expression) over neutral or full smile expressions. Because of a concern that the closed smile was less discriminable as a positive expression than the morphed smile, the following experiment was designed to further investigate the role of facial expressions on the attractiveness judgements of faces.

**Experiment 2**

The finding from Experiment 1, that the effects of gaze shift and facial expression do not interact, suggests that these are possibly independent cues that act separately to modulate the perceived attractiveness of unfamiliar faces. In particular, the results of Experiment 1a suggest that the effect of gaze shift was consistent for all facial expressions and did not seem to vary with an increase in the perceived intensity of the facial expression. This is in contrast to findings from previous studies reporting interactions between expression and eye-gaze direction (e.g., Conway et al., 2008; Jones et al., 2006), although some included negative facial expressions.

While attractiveness judgements have been found to be enhanced by expressions of happiness, including different forms of smiles (Golle et al., 2014; Lau, 1982; Mehu et al., 2008; Mueser et al., 1984; Otta et al., 1994, 1996; Reis et al., 1990), fewer studies have examined the effect of negative facial expressions on perceived attractiveness. When negative expressions are included, these studies typically reported lower attractiveness ratings (Morrison et al., 2013; Tracy & Beall, 2011; Ueda et al., 2016). For example, Morrison et al. (2013) reported that attractiveness ratings to faces with an angry expression were lower than those with a neutral or happy expression. It was therefore expected that an angry

![Figure 4. Plot showing the mean perceived attractiveness ratings to faces shown in Experiment 1b. The results are shown for each facial expression with either direct gaze or averted gaze first. Error bars represent ±1 standard error of the mean.](image-url)
expression would negatively affect attractiveness ratings relative to a happy expression. Moreover, if expression and gaze-shift interact as cues for attractiveness, we expected that the relative benefit of a happy expression on ratings may be further enhanced by a gaze shift towards the observer.

Because of a concern that the positive expressions used in the previous studies may have been ambiguous, we replaced the closed-smile expression with a happy facial expression that depicted an open-mouth smile. An open-mouth smile is also more consistent with previous studies on perceived emotion in faces (e.g., Ekman et al., 1987; Young et al., 1997).

Methods

Participants
Ninety-nine participants (60 females; mean age = 28.71, SD = 7.22 years) were recruited online through the web-based participant recruitment platform “Proliﬁc.ac”. Participants were all native English speakers and were recruited from the U.S. (n = 14), U.K. (n = 82) and Ireland (n = 3). All were naïve to the purpose of the study and were awarded approximately €1.10 for participating in the experiment. All gave informed consent as described in Experiment 1a.

Stimuli and apparatus
The face stimuli were mainly based on the same identities as those used in Experiment 1a, except the face images now conveyed either a neutral, happy (open-mouthed smile) or angry expression (see Figure 5). An open-mouthed-smile version of two face identities from the Chicago Face Database did not exist, therefore images of two other facial identities replaced those from the original set (taken from the same database). The new images underwent the same editing processes as all other stimuli using FaceGen. 75% of these images were identiﬁed as having a happy or elated expression in the same follow-up study mentioned in Experiment 1a.

Participants completed the experiment using their own desktop PC via Proliﬁc.ac and the online experiment platform Gorilla (www.gorilla.sc). The resolutions of the monitors used by the participants were recorded and ranged between 1280 × 1024 and 2548 × 1282 pixels.

Design and procedure
The experimental design and procedure were identical to those described in Experiment 1a and b.

Results
Figure 6 shows the mean attractiveness ratings for each facial expression and gaze shift directions. As in the previous experiments, the mean ratings provided by female (35.61, SD = 12.37) and male (36.35, SD = 12.41) participants failed to reach statistical signiﬁcance [F (1, 97) = 0.085, p = 0.771, ηp2 = 0.001] and the sex of the participant was not included in any further analyses.

A 2 × 3 repeated-measures ANOVA was performed on participants’ attractiveness ratings with direction of gaze shift (towards or away) and facial expression (angry, neutral, or happy) as within-subject factors. A main effect of facial expression was found [F (1.671, 163.767) = 65.46, p < 0.001, ηp2 = 0.40]. The mean rating for faces with a gaze shift away from the observer (36.12, SD = 12.85) or towards the observer (35.84, SD = 12.62) were similar and the main effect of gaze

![Figure 5](image-url). An example of face images representing the facial expressions used as stimuli in Experiment 2 with (left-to-right) angry, neutral and happy (i.e., open-mouthed smile) expressions.
shift failed to reach significance \(F(1, 98) = 1.248, p = 0.267, \eta^2_p = 0.013\). There was no evidence for an interaction between gaze shift and expression \(F(2, 196) = 1.276, p = 0.281, \eta^2_p = 0.013\).

Post-hoc pairwise comparisons (with Bonferroni correction) on the main effect of expression indicated that faces with an angry expression \((M = 27.20, SD = 11.99)\) were rated as significantly less attractive than faces with a neutral \((M = 39.28, SD = 16.75; \text{mean difference} = 12.09, SD = 1.93, p < 0.0001, \text{Cohen’s } d = 0.958)\) or happy (i.e., open-mouthed smile; \(M = 41.23, SD = 14.33; \text{mean difference} = 14.03, SD = 2.13, p < 0.0001, \text{Cohen’s } d = 1.493)\) expression. Although the neutral expression was rated as slightly more attractive than the happy expression, the difference in ratings failed to reach statistical significance (mean difference = 1.94, SD = 2.28, \(p = 0.417, \text{Cohen’s } d = 0.141\)).

**Discussion**

The results of the current experiment further confirmed the effect of facial expression on perceived attractiveness. While an angry facial expression had a negative effect on attractiveness ratings compared to the neutral and happy expressions, the ratings for faces with neutral and happy expressions did not differ significantly. The failure to find a specific benefit from happy expressions on attractiveness ratings contradicts some previous reports that positive emotions enhance perceived attractiveness of faces (e.g., Golle et al., 2014; Lau, 1982; Mehu et al., 2008; Mueser et al., 1984; Otta et al., 1994, 1996; Reis et al., 1990). However, the current study differed from these studies with the inclusion of a negative facial expression. When negative expressions are considered, our results are consistent with those reported by Morrison et al. (2013) that angry facial expressions are rated as less attractive compared to those with happy or neutral expressions and, moreover, that neutral and happy expressions had a similar effect on perceived attractiveness.

With regard to gaze-shift, here we found no evidence that it affected perceived facial attractiveness, which is in contrast to the findings of Experiment 1a in which a main effect of gaze shift was reported by
consistent with Experiment 1b in which no effect was found. Given that the interaction between gaze shift and expression did not reach statistical significance, it is unlikely that the inclusion of the angry expression influenced the effect of gaze shift on attractiveness ratings in the present experiment. However, due to the inconsistent findings between Experiment 1a, 1b and the current experiment, we decided to further examine the role of the temporal aspects of the gaze shift in the formation of attractiveness judgements in the following experiment.

**Experiment 3**

In Experiment 1a, we found a preference for an averted gaze shift which contradicted our prediction based on findings by Mason et al. (2005). It is, however, known that the temporal dynamics of gaze also provides crucial information regarding its social meaning. In everyday situations, the eyes are in constant motion and individuals vary their gaze when interacting with others to signal intent: a quick glance at an individual could represent an acknowledgment of his/her presence, whilst prolonged eye gaze or frequent gaze shifts towards the observer could signify an exclusive allocation of attention to another, which could be perceived as social interest or intimacy. Indeed sensitivity to the temporal parameters of eye gaze seems to arise early in development, indicating their importance for social development. For example, Einav and Hood (2006) found that children as young as four years old could accurately and competently use both the gaze frequency (number of fixations on an image of an object) and duration (relative time spent fixating on one object image over another) to infer an actor’s preference for one of three images of objects. Moreover, the children were able to justify their answers by stating that the preferred picture was either gazed at for longer, or more often than the other images.

Although it remains unclear if temporal differences during gaze shifts have an impact on other social judgements, such as attractiveness, some studies have found evidence in support of an effect of gaze duration on likeability judgements (Georgescu et al., 2013; Kuzmanovic et al., 2009). For example, Kuzmanovic et al. (2009) reported that likeability ratings of faces of virtual characters increased as a function of the duration of their direct gaze (1, 2.5, or 4 s). Apart from the effect of direct gaze on attractiveness judgements (Conway et al., 2008; Ewing et al., 2010; Jones et al., 2006; Lawson, 2015), the duration of direct gaze is also likely to modulate these ratings. However, to the best of our knowledge, no studies have looked at the relationship between the temporal dynamics of perceived gaze and perceived attractiveness. As such, the following experiment was designed to test this relationship by manipulating the relative duration of each gaze direction during a gaze shift (i.e., the exposure ratio of direct to averted gaze). By doing so, we further attempted to disambiguate the effects of the order of the gaze direction during gaze shift from the shift itself on the results found in Experiment 1a. Hence, our second hypothesis was that perceived attractiveness of a target should increase with the relative duration of direct gaze during a gaze shift.

Similar to Experiments 1a and b, we also tested whether the intensity of positive facial expression increased with perceived attractiveness by including the “morphed” or slight smile expression as an intermediary expression, as described in Experiment 1a, and the happy (open-mouthed smiling) expression used in Experiment 2.

**Methods**

**Participants**

Ninety-three participants (53 female; mean age = 24.29 years, SD = 6.00) were recruited from the student population within Trinity College Dublin. They either received research credits or were paid €5.00 for their participation in the experiment. All were naïve to the purpose of the experiment. All participants provided informed, written consent in accordance with ethical approval.

**Stimuli and apparatus**

The happy facial expression stimuli were the same as those used in Experiment 2 whereas the neutral and slight smile expressions of the same individuals were as described in Experiment 1a and b. Pairs of face images were presented in succession to simulate movement of eye gaze, as described in Experiment 1a (see also Mason et al., 2005). The total duration of exposure to an individual face within each trial was 2 seconds, similar to Experiments 1a and 2.

The experiment was programmed using PsychoPy (Peirce, 2007) and run on an Alienware AURORA R4
desktop computer. The stimuli were presented on a 34 cm × 27.5 cm HP monitor with a resolution of 1280 × 800 pixels at 60 Hz. Each face image subtended a visual angle of approximately 10° × 10° from a viewing distance of 60 cm.

**Design and procedure**

We adopted a 3-way mixed design in which the relative duration of exposure of each face image in a sequence was a between-subject variable, whereas both the direction of the gaze shift (towards or averted) and the facial expression (neutral, slight or open smile) were within-subject variables. The relative duration condition was created by varying the duration of the first face stimulus (S1) relative to the second face stimulus (S2) in each gaze shift sequence as follows: 300 ms:1700 ms, and 1700 ms:300 ms, to a total (S1 + S2) exposure duration of 2000 ms. We also included a condition in which the timings were similar for both stimuli (i.e., 1000 ms:1000 ms) in order to ensure that any differences in the particular protocols across experiments were controlled (i.e., testing on-line versus in a laboratory) and to allow us compare the results directly with those found in Experiment 1a. Participants were randomly assigned to one of these three duration conditions.

The experiment took place in a darkened testing room within the Institute of Neuroscience, Trinity College Dublin. The experimental procedure and task was the same as described in Experiment 1a.

**Results**

Consistent with the previous experiments, initial comparisons of the ratings across male (37.00, SD = 12.25) and female (39.27, SD = 12.51) participants revealed no difference \(F(1, 87) = 0.774, p = 0.381, \eta^2_p = 0.009\) and this factor was not included in further analyses.

The mean ratings to faces across all conditions are shown in Figure 7. A 3-way mixed-model ANOVA was performed on participants’ attractiveness ratings with the direction of gaze shift (towards and away) and expression (neutral, slight smile and open-mouthed smile) as within-subject factors and S1:S2 gaze duration ratio (300:1700, 1000:1000 and 1700:300) as a between-subject factor. The mean attractiveness ratings for faces with gaze shift away from the observer (38.53, SD = 11.67) were similar to those for faces with gaze shift towards the observer (38.17, SD = 12.71) and no main effect of the direction of gaze shift \(F(2, 90) = 0.909, p = 0.343, \eta^2_p = 0.001\) was found. There was also no evidence for a main effect of gaze duration ratio\(^2\) \(F(2, 90) = 2.92, p = 0.059, \eta^2_p = 0.061\). A main effect of expression \(F(1.28, 115.60) = 5.93, p = 0.01, \eta^2_p = 0.062\) was revealed.

Post-hoc, pairwise comparisons (with Bonferroni correction) on the main effect of expression indicated that faces with an open smile \(M = 40.29, SD = 15.11\) were rated as significantly more attractive than those with a slight smile \(M = 36.43, SD = 12.44\), mean difference = 3.86, SD = 2.03, p = 0.001, Cohen’s
d = 0.367). Although attractiveness ratings were higher for the happy (open smile) than neutral expression (M = 38.32, SD = 13.08) this difference failed to reach significance (mean difference = 1.97, SD = 2.07, p = 0.541, Cohen’s d = 0.135). Attractiveness ratings for faces with the slight smile expression were significantly lower than those with a neutral expression (mean difference = 1.89, SD = 1.87, p = 0.034, Cohen’s d = 0.281). The effect of facial expression did not interact with the direction of gaze shift [F (2, 180) = 0.179, p = 0.836, $\eta^2_p = 0.002$] nor the S1:S2 exposure ratio [F (4, 180) = 0.43, p = 0.787, $\eta^2_p = 0.009$].

A significant interaction between the direction of the gaze shift and S1:S2 duration ratio was found [F (2, 90) = 3.13; p = 0.048, $\eta^2_p = 0.065$] as shown in Figure 8. Post hoc, pairwise comparisons with Bonferroni correction were conducted on the direction of gaze shift for each of the three S1:S2 duration ratio conditions. The results showed that for the 1700:300 condition, faces were rated as more attractive with a gaze shift away from the observer (M = 42.03, SD = 11.51) rather than towards the observer (M = 40.33, SD = 12.51, mean difference = 1.701, SD = 3.27, p = 0.016, Cohen’s d = 0.141). However, there were no differences in attractiveness ratings between the two gaze shift directions for either the 300:1700 or 1000:1000 conditions.4 The interaction between expression, direction of gaze shift, and S1:S2 duration ratio did not reach statistical significance [F (4, 180) = 1.26; p = 0.288, $\eta^2_p = 0.027$].

**Discussion**

Results from the current experiment suggested that neither the direction of gaze shift alone nor the S1:S2 duration ratio (i.e., the timing of gaze shift) alone had an effect on judgements of attractiveness. Instead, we found an interaction between these two factors. As suggested by the data plotted in Figure 8, we found no effect of eye gaze shift when each gaze direction was presented for the same duration of time (i.e., under the 1000:1000 condition). In contrast, a longer duration of a direct gaze seemed to be associated with an increase in attractiveness ratings. For example, the ratings in the 1700:300 “away gaze shift” were slightly higher than those to the “towards gaze shift”. However, only the pairwise comparison in the 1700:300 condition reached statistical significance.

![Figure 8](image-url)
The significant interaction between the gaze duration ratio and gaze shift, and the significantly higher ratings to faces shown in the “away gaze” condition when the initial gaze was a prolonged direct gaze, suggests that attractiveness ratings were affected by an initial exposure to a face, with higher ratings to faces with direct than averted gaze in this initial exposure. These results are consistent with findings from previous evidence suggesting a role for the initial exposure to faces (Willis & Todorov, 2006) as well and other studies in which positive ratings were increased when the duration of exposure to direct gaze increased (Georgescu et al., 2013; Kuzmanovic et al., 2009). Our result therefore suggests that the temporal dynamics of eye gaze, including gaze duration and the initial direction of the shift itself, affect attractiveness ratings in a combined manner.

On the other hand, our results suggest that eye gaze and other social cues do not integrate to influence facial attractiveness. This finding is contrary to what Jones et al. (2006) found, but consistent with the results of Experiments 1 (a & b) and 2 in which facial expression affected perceived attractiveness of unfamiliar faces, regardless of the direction of gaze shift. Moreover, the results of the present study did not provide evidence to suggest that an increase in the intensity of the smile leads to higher attractiveness ratings for unfamiliar faces: although attractiveness ratings for faces with the open-mouthed smile were higher than those with a slight smile expression, these ratings were only marginally (but not significantly) higher than those conveying a neutral expression. Furthermore, faces with a neutral expression were rated as more attractive than those with the slight smile expression. In Experiments 1a and 2, in contrast, the images of slight smiles were associated with higher attractiveness ratings than the more intense (i.e., closed-mouth) smiles. This change in ratings to slight smiles across experiments suggests that the overall context of the face stimulus set may have had some effect on the ratings. Also, it is worth noting that although one of the duration conditions in the current experiment, that is the duration condition of 1000:1000 ms, was similar to that tested in Experiment 1a, we failed to replicate the finding in Experiment 1a of a preference for an averted gaze shift. In Experiment 1a, however, the preference for a gaze-shift away from the observer may have been influenced by the facial expressions being generally perceived as more negative than positive (i.e., the closed-mouth smile was not unambiguously perceived as “happy”). We discuss the possible role of stimulus context in more detail in the following section. At the very least, our findings suggest that the direction of gaze shift, or the duration alone has an effect on perceived attractiveness that was not influenced by the expression of the face.

**General discussion**

The aim of our work was to investigate the role of socially-relevant cues, eye gaze and expression, on judgements of facial attractiveness and, in particular, whether such cues contribute in a combined or independent manner to the aesthetic evaluation of a face. Our data do not support the shared-signal hypothesis of gaze and expression on attractiveness. Instead the results of the studies reported here suggest that gaze shifts and facial expression act as independent cues in influencing attractiveness judgements. In particular, we found that across all experiments, the effect of gaze shift did not vary across facial expressions and the effect of expression was also independent of both the timing and the direction of the gaze shift.

This finding is seemingly in contrast to the findings of previous studies investigating the role of gaze direction on facial attractiveness. Specifically, Jones et al. (2006) found stronger preferences for attractiveness when faces were presented with direct gaze and a smile but not when they conveyed a neutral expression. In addition, they reported that attractiveness preferences were stronger when a neutral expression was coupled with an averted rather than a direct gaze. However, Ewing et al. (2010) reported higher attractiveness ratings to a direct gaze over an averted face, even in faces with a neutral expression.

Although it is unclear why these studies report different effects of eye gaze direction on faces with a neutral expression, one possibility is that different experimental or stimulus contexts may play a role. In particular, the effect of facial expression on attractiveness appears to be sensitive to variations in the choice of stimulus materials and experimental procedures across studies, leading to inconsistent results across and even within studies. For instance, Mueser et al. (1984) found that using either a two-alternative-forced-choice (2AFC) task or a rating task based on individual face images using the Likert scale, yielded
very different results although the same face images were used in both tasks. In the 2AFC task, faces with a sad expression were perceived as less attractive than faces with either a neutral or smiling expression, whilst no difference was found across expressions when ratings were provided to individual face images. Morrison et al. (2013) also reported no significant difference between neutral and happy expressions in attractiveness judgements, though both expressions were rated as more attractive than negative expressions such as sadness, fear, anger and disgust. The results of Experiment 2 reported here are consistent with Morrison et al.‘s (2013) findings, in that the angry expression was rated as less attractive than both the smiling and neutral expressions, although attractiveness ratings did not differ between the latter two expressions.

Previous studies have provided evidence for a role of stimulus context on face perception. For example, the influence of other, interleaving emotional stimuli on the perception of (unrelated) facial expressions is nicely demonstrated in the Kuleshov effect (see e.g., Calbi et al., 2017). Recent findings on facial attractiveness also support a role for the context of the stimulus set. For example, there is evidence in support of the “sequential dependence” effect, whereby a response provided to a current-trial is biased towards that of the preceding trial (Kondo, Takahashi, & Watanabe, 2012; Pegors, Mattar, Bryan, & Epstein, 2015; Taubert, Van der Burg, & Alais, 2016). Furthermore, unlike happy, sad and other emotional expressions, a neutral expression does not provide unambiguous information regarding another person’s emotional state or intentions. It may, therefore, be more susceptible to contextual conditions such as the presence of other emotional expressions in order for it to be appropriately discriminated and perceived as neutral, rather than a negative emotion. As such, in our experiment, pairing a neutral expression with a gaze shift either away or towards the observer may not represent either a congruent nor an incongruent gaze-expression combination relevant for a social response (Adams & Kleck, 2003, 2005).

A second reason for the inconsistencies across these studies may lie in the fact that the face stimuli used in the present studies maintained a static facial expression which was present for the entire two-second presentation of the target face, and therefore may have served as a more reliable signal compared to a gaze shift, and thus expression may have dominated the ratings response. This raises the possibility that for gaze and expression to interact, the two social cues may have to be equivalent in perceptual saliency (e.g., either both static or dynamic or both presented for similar temporal durations). Since dynamic cues are more reflective of social interactions in the real world, future research could help reveal the influence of the dynamic aspects of gaze shifts with changes in expressions in a more ethologically relevant display.

Although in Experiment 2 we found that a positive, relative to a negative, facial expression was associated with higher attractiveness ratings of a face, we did not find evidence for an increase in expression intensity affecting higher attractiveness judgements. Previous studies using both neuroimaging and behavioural measures (Golle et al., 2014; Mueser et al., 1984; O’Doherty et al., 2003; Ueda et al., 2016) provide supporting evidence that a smiling expression is associated with higher attractiveness ratings and enhanced activation in the medial orbitofrontal cortex (OFC), an area within the reward circuitry. Here, we found inconsistent effects with an increase in smiling: in Experiment 1a faces with a closed-mouth smile expression were rated as less attractive than those with either a slight smile or a neutral expression; in Experiment 2, faces with a happy (i.e., open-mouthed smile) expression were not rated as more or less attractive than those with a neutral expression; and lastly, in Experiment 3, faces with a happy (open-mouthed smile) were rated as more attractive than those with the slight smile. Notwithstanding the influence of stimulus context discussed above, different forms of smiles might carry socially different meanings. For example, a broad open-mouthed smile might be perceived to signify happiness, but a close-mouthed or a milder smile might be perceived as a polite, amused, or even nervous smile (Ambadar, Cohn, & Reed, 2009; Ekman & Friesen, 1982). In other words, while we initially assumed that by manipulating the intensity of smile we were varying the degree of positive emotion, the morphology of a smile may not represent a single continuum in terms of the perceived expression (see e.g., Calder, Young, Perrett, Etcoff, & Rowland, 1996). Although some insight was gained by asking naïve participants to identify the facial expressions used in Experiment 1a, nevertheless it remains unclear whether those categories would be maintained.
within the context of the experiment itself (as suggested by the change in ratings to neutral expressions across experiments). Therefore, we can only speculate that perceived attractiveness was enhanced when the expression represented an unambiguously happy and positive emotion (hence a clear social reward), as in the case of the open-mouthed smile in Experiment 2. Our data therefore provide supporting evidence for the role of positive facial expressions in enhancing perceived attractiveness. Furthermore, this finding is consistent with the “perceptual fluency” proposal that attractiveness ratings tend to be higher for stimuli that are relatively “easy” to perceive (e.g., Reber et al., 2004).

Our other main finding was that attractiveness ratings were unaffected by the direction of a gaze shift, which is contrary to the results reported by Mason et al. (2005). However, the effect of gaze-shift on ratings of attractiveness reported by Mason et al. (2005) did not appear to be robust in that it was dependent on the specific characteristics of the face images and the observer, namely that the images were of female faces and the raters were male. It should also be noted that the face images used in their study were of female models taken from fashion magazines, and therefore highly stylized to enhance their attractiveness and allure. It is therefore reasonable to suggest that male participants found viewing stylized faces as rewarding, especially when the gaze shifted towards the observer, with the consequence that male participants attended more to the features of those faces. In a similar vein, Jones et al. (2006) used images of composite faces as stimuli by averaging images from at least 15 female faces to create “attractive” and “unattractive” prototypes. Averageness is a well-known contributing factor to facial attractiveness (Langlois & Roggman, 1990; Rhodes & Tremewan, 1996; Rubenstein, Langlois, & Roggman, 2002; Valentine, Darling, & Donnelly, 2004) and, similar to the Mason et al. study, increased attractiveness may have enhanced participants’ attention to the faces (Li, Oksama, & Hyönä, 2016; Sui & Liu, 2009).

Indeed, Jones et al. reported higher attractiveness ratings overall (compared to the faces used in the current study) suggesting that their image manipulations were successful. Our results suggest it cannot be assumed that the use of less stylized, or original, images of faces would result in the same effect of eye gaze as previously reported.

Indeed, the role of attention in combining the effects of facial expression and eye gaze may have had an important influence on the present results. For example, it is possible that the distinct facial expressions used in Experiment 2 relative to Experiment 1 had the effect of drawing attention away from the eye region of the face towards other, more expressive, facial features such as the mouth region, thus limiting the role of gaze-shift on attractiveness in this context. Future studies based on eye movement recordings may help reveal the role of social intentions (i.e., male observers judging female faces) and experimental context (i.e., different facial expressions) on the nature of the facial features that are specifically attended. We expect that such studies would add further support to our argument that facial expression and gaze shift provide independent sources of information for judging facial attractiveness.

A potential limitation of the current study is the use of face images that were edited using computer-graphics (CG) software which may have resulted in the creation of “unnatural” looking faces. Our decision to use such images allowed us to standardize stimulus properties such as lighting and skin texture, as well as the fine control of gaze direction in order to achieve the animation of gaze shift. Furthermore, hair features such as hairstyle and hair length were not of interest in the current study but are known to affect attractiveness judgements (Bereczkei & Mesko, 2007; Saegusa, Intoy, & Shimojo, 2015). The original face images from the Chicago Face Database came with different hairstyles, hair colours and hair lengths. Hence, just like in many previous studies which investigated facial attractiveness using CG-edited faces, particularly FaceGen faces (Bird, Lauwereyns, & Crawford, 2012; Huang, Pan, Mo, & Ma, 2016; Jones et al., 2006; Ma, Xu, & Luo, 2015b; Potter & Corneille, 2008), hair information was systematically removed during the editing process of creating the stimuli to avoid confounding the ratings. This, however, might have lowered the overall attractiveness of the stimulus set. Previous studies have suggested that CG manipulations may affect face perception with such images reportedly perceived as “eerier” (MacDorman, Green, Ho, & Koch, 2009) and less trustworthy (Balas & Pacella, 2017). Although Crookes et al. (2015) argued that CG faces fail to tap into the full extent of face expertise required to identify faces they also suggested that such images could still be appropriate for other
aspects of face processing which do not involve identification. Indeed, a number of studies used “FaceGen” software to generate face images in order to investigate aspects of facial attractiveness and produced consistent and comparable results to those in studies where photographic images of real faces were used (Bird et al., 2012; Huang et al., 2016; Ma et al., 2015b; Potter & Cornille, 2008). For example, Balas, Tupa, and Pacella (2018) used the “Photofit” function within FaceGen to create images (as in the Experiments reported above) and compared social evaluations across the real and CG generated images of the same faces. They found that the social evaluation ratings given to both artificial and real faces were well-described by the two-factor model of “social face space” (see Oosterhof & Todorov, 2008) based on valence and dominance (Balas et al., 2018), implying that the general principles underlying social evaluations of real and CG faces are at least similar. Consistent with this finding, in Experiment 1a we reported a high correlation between the attractiveness ratings obtained to the CG-edited face images used in our experiments and the corresponding ratings to photographic images of the same faces obtained from the Chicago Face Database (see Experiment 1a). Taken together, these consistent findings suggest that observers do not adopt different criteria across different image formats when rating the same facial identity for attractiveness. However, we do recognize the overall lower ratings in the current study compared to the normative attractiveness ratings in the database and those in previous research might have been the result of using CG-edited faces with no hair. Further research will be required to address this limitation and to determine whether the effects found in the current study were specific to relatively unattractive, CG-edited faces.

Our main finding from Experiment 3 was that perceived attractiveness increased with the relative duration of direct gaze, regardless of facial expression. An image of a face, smiling or otherwise, was rated as more attractive when eye gaze was directed at the observer for a prolonged period of time. Put differently, it was both the initial exposure and the amount of perceived attention (in terms of duration) directed at the observer that influenced attractiveness judgements. This finding for a preference for a direct eye gaze is consistent with previous studies (e.g., Georgescu et al., 2013; Kuzmanovic et al., 2009). Prolonged eye gaze indicates social interest and engagement directed at the observer, and has been found to be rewarding (Kampe et al., 2001). A recent study by Heslinger, Carbon, and Hecht (2017) provided evidence suggesting that a prolonged duration of direct gaze (e.g., 10 second as opposed to a quick glance for 200 ms), not only increased the observer’s “sense of being watched”, but was also associated with a higher level of arousal. In accordance with the notion that facial attractiveness is associated (at least partly) with arousal, as well as the social reward perceived by the observer (Senior, 2003), face images with a relatively long duration of eye gaze directed at the observer should be rated as most attractive, which our data have confirmed. This effect, however, appeared to be dependent on the order of gaze direction during gaze shift such that direct, prolonged eye gaze benefits attractiveness only when this direct gaze is present in the initial exposure to the face.

In summary, we provide evidence consistent with previous findings that both facial expression and gaze information affect judgements of the attractiveness of faces. In particular, faces displaying a positive, rather than neutral or negative, emotional expression were associated with higher ratings of attractiveness as were faces that maintained a longer duration of eye contact with the observer. These results also provide new evidence to suggest that these cues appear to act independently of each other in the aesthetic evaluation of faces. Our findings add to growing evidence for a role of socially relevant cues on the evaluation of others, and provide further insight into the role of these cues on perceptual processes underpinning judgements of attractiveness in faces.

Notes

1. Note that here the “direct gaze first” and “averted gaze first” conditions were equivalent to the “gaze shift away” and “gaze shift towards” conditions respectively in Experiment 1a.
2. Mean attractiveness ratings to the 300:1700 condition = 39.12, SD = 12.46; the 1000:1000 condition = 34.04, SD = 12.37; and the 1700:300 condition = 41.24, SD = 12.1.
3. 300:1700 condition: mean rating for gaze shift away from observer = 39.1, SD = 21.4; mean rating for gaze towards the observer = 39.77, SD = 23.23; mean difference = 0.66, SD = 3.27, p = 0.341, Cohen’s d = 0.03.
4. 1000:1000 condition: mean rating for gaze shift away from observer = 34.44, SD = 17.78; mean rating for gaze
towards the observer = 34.4, SD = 19.34; mean difference = 0.038, SD = 2.72, p = 0.947, Cohen’s d = 0.0022.

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