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Research Paper

Your attention makes me smile: Direct gaze elicits affiliative facial expressions☆

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ABSTRACT

Facial electromyographic responses and skin conductance responses were measured to investigate whether, in a neutral laboratory environment, another individual's direct gaze elicits a positive or negative affective reaction in the observer. The results showed that greater zygomatic responses associated with positive affect were elicited by seeing another person with direct as compared to averted gaze. The zygomatic responses were greater in response to another person's direct gaze both when the participant's own gaze was directed towards the other and when the participant was not looking directly towards the other. Compatible with the zygomatic responses, the corrugator activity (associated with negative affect) was decreased below baseline more in response to another person's direct than averted gaze. Replicating previous research, the skin conductance responses were greater to another person's direct than averted gaze. The results provide evidence that, in a neutral context, another individual's direct gaze is an affiliative, positive signal.

1. Introduction

In both humans and non-human primates, eye contact can communicate messages with opposite meanings, such as friendliness or threat (Argyle & Cook, 1976; Gomez, 1996; Kleinke, 1986; Skuse, 2003; Yamagiwa, 1992). One's interpretation of the meaning of another's direct gaze depends on a great number of antecedent, concurrent, and anticipated contextual factors, and the outcome of this interpretation is likely to have a great influence on a perceiver's behavioral responses. In some circumstances, direct gaze is likely to become interpreted as a positive, affiliative signal, and it is responded to, for example, with a smile and by moving closer to the gazing person, whereas in other circumstances direct gaze may evoke negative feelings leading to indifferent or even hostile behavior. An interesting question is, however, what kind of a response is elicited by another's direct gaze in a situation which could be regarded as socially relatively neutral. Is another's direct gaze (eye contact) inherently positive or negative? Although real-life social encounters between two persons may never be completely devoid of social contextual factors, investigation of this issue is possible in a neutral laboratory environment where many of the real-life factors influencing these responses can be controlled and eliminated.

Considering that another individual's direct gaze is often an affiliative cue signaling the sender's motivational tendency of approach (Adams and Kleck, 2003, 2005), it seems likely that another's direct gaze would elicit compatible reactions in the observer. Moreover, as humans have a fundamental need for belonging (Baumeister & Leary, 1995) and as direct gaze indicates social inclusion (Wirth, Sacco, Hugenberg, & Williams, 2010), one would expect that direct gaze would be perceived as a positive social signal evoking positive affective reactions. Compatible with these considerations, previous research has shown, for example, that seeing another person with direct as compared to averted gaze elicits increased electroencephalographic, relative left-sided frontal alpha activity associated with positive affect and motivational approach tendency (Hietanen, Leppänen, Peltola, Linna-aho, & Ruuhiala, 2008; Pönkänen, Peltola, & Hietanen, 2011). Two recent studies employing the affective priming paradigm indicated that more positive affective reactions were automatically activated by perception of direct gaze compared to perception of closed eyes (Chen, Peltola, Ranta, & Hietanen, 2016; Chen, Helminen, & Hietanen, 2017), and a study relying on the implicit association paradigm showed a robust preference for faces looking towards as compared to faces looking away (Lawson, 2015). Most recently, a study employing the startle reflex methodology reported that the magnitudes of participants' eyeblink startle and cardiac reflexes elicited by high-intensity noise stimuli were

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modulated by simultaneously presented gaze direction stimuli (Chen, Peltola, Dunn, Pajunen, & Hietanen, 2017). Direct gaze attenuated the eyeblink startle and cardiac reflexes compared to those elicited in the context of a downward gaze. Thus, the defense reflexes were weaker when presented in the context of direct versus downward gaze suggesting that another's direct gaze, compared to downward gaze, automatically elicits more positive affective responses in the viewer. In addition, studies relying on self-evaluative rating measures have shown more positive ratings to direct than averted gaze when the measurements have been conducted in "neutral" laboratory-environments (Kuzmanovic et al., 2009; Mason, Tatkow, & Macrae, 2005), although in some studies the ratings of direct gaze, even though being positive, have been less positive than those of averted gaze (Hall, Coats, & LeBeau, 2005; Hietanen et al., 2008; Pönkänen, Alhoniemi, Leppänen, & Hietanen, 2011).

In the present study, our main aim was to investigate the nature of affective reactions to another person's direct gaze by measuring one's facial electromyographic (EMG) responses. Measuring of facial EMG responses has been a widely used method to investigate the valence of affective reactions (Cacioppo, Petty, Losch, & Kim, 1986; Tassinary & Cacioppo, 1992). As the facial EMG responses seem to be relatively automatic, evidenced by their short latency (i.e., 300–400 ms after stimulus onset; Dimberg & Thunberg, 1998) and by their occurrence even when the stimuli are rendered invisible by backward masking (Dimberg, Thunberg, & Elmehed, 2000), this method can be seen suitable to provide more direct and objective information about one's affective reactions than any of the methods used in the studies described above. Numerous studies have shown that affectively positive stimuli elicit increased EMG activity of the *Zygomaticus major* (the muscle that elevates the corners of the mouth) and decreased activity of the *Corrugator supercilii* (the muscle that knits the eyebrows), whereas affectively negative stimuli elicit increased activity of the *Corrugator supercilii* muscle (Cacioppo et al., 1986; Larsen, Norris, & Cacioppo, 2003). These EMG responses have been observed in reaction to other people's facial (Dimberg, 1990), vocal (Hietanen, Surakka, & Linnankoski, 1998) and bodily (Magnée, Stekelenburg, Kemner, & de Gelder, 2007) expressions of emotions as well as in reaction to affective pictures of complex scenes, clips of environmental sounds, and words (Larsen et al., 2003).

There are a few previous studies measuring participants' facial EMG responses to pictures of human faces or animated virtual characters looking towards the observer or not and expressing a facial emotion or a neutral face (Mojzisch et al., 2006; Rychlowska, Zinner, Musca, & Niedenthal, 2012; Schrammel, Pannasch, Graupner, Mojzisch, & Velichkovsky, 2009; Soussignan et al., 2013). While the results of most of these studies provided evidence that the facial reactions in response to the facial expressions were modulated by the expressor's gaze direction (Rychlowska et al., 2012; Schrammel et al., 2009; Soussignan et al., 2013), the studies showed no effect of gaze direction on the EMG responses when there was a neutral expression on the face. However, it is possible that this was due to the fact the stimuli were images presented on a computer monitor. Images of avatars or images of real people do not *look* back at the viewer, not even when the gaze is directed towards the viewer. In many previous experiments from our laboratory, gaze direction has been observed to influence psychophysiological responses (electroencephalographic and autonomic responses) when participants are seeing a live person, but not when they are seeing a picture of the same person on a computer monitor (Hietanen et al., 2008; Pönkänen, Alhoniemi et al., 2011; Pönkänen, Peltola et al., 2011). Therefore, in the present study too, we investigated the effect of another's gaze direction on facial EMG responses when the participants were facing a live person.

In everyday dyadic interactions, both interactors shift their gaze towards and away from each other. There are periods of time when neither of the partners looks towards the other partner's eyes, periods while one of them looks at another's eyes while the other is looking elsewhere, and periods when both look into each other's eyes, thus, making eye contact. In the present experiment, a secondary aim was to investigate the effects of another's gaze direction on a participant's reactions when the participant him-/herself is looking either at the other person or slightly away. Moreover, to simulate the everyday interaction, the participants could voluntarily choose whether to look at the other individual or not. Third, this feature of the experiment allowed us also to investigate if the facial EMG responses to direct gaze could depend on whether the eye contact was voluntary or forced. It has been suggested that processing of social information is influenced by the possibility for interaction (De Jaegher, Di Paolo, & Gallagher, 2010; Schilbach et al., 2006). Supposedly, an interaction resulting from an external (experimenter's) demand is not as rewarding as a voluntary interaction. To investigate the effect of free-choice vs. forced choice eye contact on facial EMG responses we also included in our experimental design a condition in which the participant and the model person were required to look at each other. We also measured sympathetic skin conductance responses (SCR) in order to measure, not only physiological responses related to affective valence, but also responses indexing physiological arousal (Critchley, 2002), another central component of the affective response (Plutchik, 1980). Previous studies have shown that SCRs are larger in response to seeing another's direct gaze than averted gaze or closed eyes (Helminen, Kaasinen, & Hietanen, 2011; Hietanen et al., 2008; Myllyneva & Hietanen, 2015; Nichols & Champness, 1971).

In sum, in the present study, we measured facial EMG activity from the *Zygomaticus major* muscle region (cheek) and from the *Corrugator supercilii* muscle region (brow) and autonomic arousal (skin conductance responses, SCR) from participants when they were presented with another live person through an electronic shutter. On a majority of trials, the participants were allowed to decide whether they looked at the other person or looked sideways (at a pre-determined fixation spot). The model persons also independently varied their gaze direction between direct and averted. In addition to these free-choice trials, there were a number of trials on which the participant and the model were instructed to look at each other (i.e., forced choice trials). We expected that eye contact with another person would result in greater zygomatic EMG activity and SCRs compared to looking at another person with averted gaze. Secondly, we hypothesized that another person's direct gaze would result in greater zygomatic EMG responses and SCRs compared to averted gaze also when the observer himself/herself is not looking directly towards the other person, but sees from the "corner of the eye" that the other is looking at him/her. This assumption was based on results from a previous study suggesting that increased psychophysiological responses to eye contact critically depend on the understanding of being watched by another (Myllyneva & Hietanen, 2015). Third, we expected that the zygomatic EMG responses and SCRs in response to eye contact would be greater if the eye contact results from participants' free choice compared to when it is externally controlled. We also measured participants' explicit affective feelings (affective valence and arousal) in response to different gazing conditions to compare the psychophysiological responses to these explicit evaluations.

2. Methods

2.1. Participants

The participants (N = 27) were 15 females and 12 males (age range = 22–27 years; mean age = 22.2, SD = 2.1) recruited from undergraduate psychology courses. Apart from one male, all participants were right-handed. All participants had normal or corrected-to-normal vision and they did not report of any neurological or psychiatric problems. All participants gave a written, informed consent, and received either course credits or a movie ticket for their participation. Ethical statement for the experiment was obtained from the Ethics Committee