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Should I Stay or Should I go: An Exploration of Spontaneous Postural Behaviours Following Threatening Emotion Perception

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Abstract:

Emotional facial expressions can indicate behavioral intentions to others. Observing a threatening emotional expression (e.g., angry face) could prompt avoidance. However, the literature reports mixed findings with emotional expressions such as anger or fear being associated with both approach and avoidance. In this study (N = 152 participants, 93.9% women, 4.7% men, 1.4% other, M_{age} = 19.57, SD_{age} = 3.25), we investigated how facial characteristics (i.e., gaze direction) and individual traits (i.e., Big Five and schizotypal personality traits) modulate behavioral responses to the perception of approaching emotional facial expressions (angry, fearful, sad, and neutral faces). We assessed motor responses using force plates to investigate spontaneous postural adjustments. Results show that angry and fearful faces elicit defensive responses characterized by backward body sway (i.e., avoidance). Although facial features further qualified those defensive reactions with averted gazes in fear stimuli eliciting a relative approach, we did not find conclusive evidence for the role of personality in these responses. Results are discussed in light of socio-functional and appraisal models of emotion perception. The present study underlines the relevance of studying postural sway to assess adaptive avoidance of threatening social stimulus.

keywords: Emotion Facial Expression, Body Sway, Personality, Schizotypal personality traits, Gaze direction

Emotional expressions, particularly facial expressions, play a pivotal role in non-verbal communication (Frijda, 1987; Keltner & Haidt, 1999; Van Kleef, 2009; Van Kleef et al., 2011). In line with the social functional account of emotions, emotional facial expressions can communicate a wide variety of messages to an observer (Keltner & Haidt, 1999; Niedenthal & Brauer, 2012). While both fearful and angry faces signal unpleasant situations, they are associated with distinct action tendencies: fearful expressions indicate that the perceived person feeling the emotion is motivated to flee, while angry expressions suggest that the perceived person feeling the emotion is motivated to aggress (Frijda, 1987; Lerner & Keltner, 2000). As such, an observer would feel threatened by an observed person displaying angry face, but not an observed person displaying fearful face. Because angry expressions are threatening, they will elicit adaptive avoidant motoric responses. However, subtle cues can alter the perceived meaning of the emotion. Among these, gaze direction plays a crucial role: direct gazes toward the observers would communicate an immediate threat, whereas an averted gaze on an angry face might not signal a similar threat. Similarly, whereas a fearful face does not signal a threat when gazing toward the observer, an averted fearful gaze might indicate the presence of a threat in the environment of an observer (see Sander et al., 2007). In addition, individuals may differ in their tendency to respond to similar social signals, depending on their personality traits. For instance, it was noted that avoidant reactions to angry faces were moderated by proneness to experience anger, with more aggressive participants approaching angry facial expressions (Veenstra et al., 2017).

Thus, our theoretical stance challenges over-simplistic claims by positing that spontaneous motoric response to mere exposure to emotional facial expression is a product of 1) evaluation of low-level cues modulating the signal associated with the expression such as gaze, and 2) personality traits that might influence the recognition of the social signal and the relevance of this signal for reacting. Integrating personality research and literature on emotion perception, this study aims to further understand how the perception of facial expressions can elicit adaptive motor responses. Moving beyond a stimulus-response model to understand how postural adjustments follow social threats could help refining neuroscientific and clinical models. To this aim, we used an ecological passive viewing task where participants merely watched facial expressions, while we monitored their postural avoidance (i.e., increased distance between perceived stimulus and self by leaning backward). Measures of Center of Pressure displacements on the antero-posterior axis (CoP-Y) have classically been used to successfully characterize approach and avoidance (For reviews, see Lelard et al., 2019; Monéger et al., 2025).

Approaching and Avoiding Emotional Facial Expressions

Several studies emphasized how negative stimuli and positive stimuli triggered defensive (avoidance) and appetitive (approach) responses respectively (Bradley et al., 1990, 2001; Elliot, 2006; Elliot & Covington, 2001). However, solely accounting for the valence of the observed faces fails to consistently account for approach/avoidant tendencies for emotional facial expressions such as sadness, fear, or anger (Hammer & Marsh, 2015; Kaltwasser et al., 2017; Krieglmeyer & Deutsch, 2013; Marsh et al., 2005; Paulus & Wentura, 2016; Seidel et al., 2010; Wilkowski & Meier, 2010). Despite being all negative emotions, these emotions differ in the extent they are threatening for the participant. Angry faces indicate a motivation to aggress and thus constitute a threat to the observer that should be motivated to avoid the threat as a result (or, depending on goals and personality traits, to aggressive approach responses; see Krieglmeyer & Deutsch, 2013; Veenstra et al., 2017). In contrast, sad and fearful expressions both indicate a lack of resources to cope with an unpleasant situation and thus do not directly threaten the observer (Hammer & Marsh, 2015; Kaltwasser et al., 2017). It can be predicted that avoidance, relative to an initial postural position, will occur only in the situation where an emotional facial expression will communicate a direct threat to the observer: *angry faces will elicit avoidance compared to the initial postural position* (**H1a**). In contrast, because they signal help requests, *fearful faces and sad faces will predict approach compared to the initial postural position* (Hammer & Marsh, 2015; Ikeda, 2023; Kaltwasser et al., 2017; but see Paulus & Wentura, 2016) (**H1b**, **H1c**).

Threatening faces and gaze direction

An angry face is threatening only to the extent that it might indicate that the target is angry at us. Conversely, a fearful face can suggest a threat if it indicates that something in the surroundings is threatening. As such, the threat communicated by an emotional facial expression is highly dependent on stimuli characteristics such as gaze direction (Sander et al., 2007). Consistent with appraisal theories of emotions, gaze directions have been identified as a critical factor in evaluating mental states of others (N'Diaye et al., 2009; Sander et al., 2007). Indeed, gaze direction plays an important role in communicating intentions (Macdonald & Tatler, 2013, 2018; Ozono et al., 2012). The shared signal hypothesis holds that approach-related emotions (anger because feeling angry is associated with an aggression motivation – which could trigger avoidance for an external observer – and joy because feeling happy is associated with an affiliation motivation) are detected faster and perceived as more intense, when combined with direct gazes, whereas avoidance-related emotions (fear because feeling afraid is associated with a retreat motivation and sadness because feeling sad is associated with an isolation motivation) are detected faster and perceived as more intense, when combined with averted gazes (Adams & Kleck, 2005; N'Diaye et al., 2009; Sander et al., 2007).

Gaze direction might also alter the appraisal of emotional faces (see Ellsworth & Scherer, 2003). Direct gazes enhance the detection of anger, as they indicate a direct threat;

and conversely averted gazes facilitate the detection of fear because it signals a threat in the environment (Sander et al., 2007). We can thus hypothesize that postural *avoidance relative to an initial postural position associated with angry faces will be increased by direct (vs averted) gazes* (**H2a**)*, main effects of fearful faces will be increased by averted (vs direct gazes)* (**H2b**)*,* and *main effects of sad faces will be increased by averted (vs direct gazes)* (**H2c**).

Threatening faces and Personality

In addition to facial features such as gaze direction, dispositional variables significantly moderate automatic avoidant and approach responses to threatening emotional faces (Hammer & Marsh, 2015; Heuer et al., 2007; Kaltwasser et al., 2017). According to the cybernetic model of the Big Five, personality traits are "probabilistic descriptions of relatively stable patterns of emotion, motivation, cognition, and behavior, in response to classes of stimuli that have been present in human cultures over evolutionary time" (DeYoung, 2015, p.3). The model focuses on the Big five traits that are hypothesized to serve regulatory functions: *openness to experience* is linked to curiosity and engagement with information, *conscientiousness* allows abstract and long-term goal pursuit, *agreeability* serves the facilitation of social cooperation, *extraversion* is related to reward sensitivity and social engagement, and *neuroticism* corresponds to threat sensitivity and avoidance. Whereas openness to experience and conscientiousness are less directly relevant in the context of social interactions, agreeability, extraversion, and neuroticism should directly influence responses to emotional facial expressions. For instance, Lebert et al. (2020) observed that extraversion and neuroticism scores were positively correlated with postural avoidance of both fearful and angry faces, suggesting that reward- and threat-sensitivity associated with extraversion and neuroticism respectively drive these postural reactions. Based on the findings of Lebert et al. (2020), it follows that, *because neuroticism is associated with sensitivity to threat, it will* *exacerbate postural avoidance relative to an initial postural position associated with angry faces and trigger avoidance relative to an initial postural position associated with fearful faces* (**H3a**), and *because extraversion is associated with sensitivity to reward, it will exacerbate postural avoidance relative to an initial position associated with angry faces and trigger avoidance relative to an initial position of fearful faces* (**H3b**).

Although agreeability did not appear to moderate Lebert et al. (2020) results, its function of facilitating social cooperation should result in a positive moderation of any main effect associated with perceiving emotional facial expressions. Thus, we can predict that, *because agreeability is associated with social facilitation, it will exacerbate any main postural reaction to emotional facial expressions* (**H3c**)

Conversely, other personality traits can negatively moderate the influence of emotional facial expressions on posture. Schizotypal Personality Traits (SPT) are associated with deficits in emotion recognition (Abbott & Green, 2013; Durtette et al., 2023; Morrison et al., 2013; for a recent meta-analysis, see Zouraraki et al., 2023). Importantly, it was noted that high scores in SPT were associated with a greater tendency to perceive averted gazes as directed toward the self (Wastler & Lenzenweger, 2018), consistent with observations of impaired gaze processing among individuals with schizophrenia (Chan et al., 2021; Hooker & Park, 2005; White et al., 2016). Hence, SPT is particularly relevant for studying the interaction between gaze perception and emotion recognition on approach and avoidant behaviors. These personality traits are often described as a non-clinical disposition that can be located on the schizophrenia spectrum (Claridge, 1997). As a non-clinical personality trait, it allows for the study of larger samples without the confounding variables associated with medical treatments and comorbidities (see Lenzenweger, 2015). It is associated with similar social cognition impairments as the ones reported in the clinical literature studying schizophrenia regarding both emotion perception (Besche-Richard et al., 2012; Gao et al., 2021; for a meta-analysis, see Kohler et al., 2010), and biased gaze perception (Chan et al., 2021; Hooker & Park, 2005).

Three dimensions of schizotypal personality traits have been described: a cognitive perceptive dimension (i.e., ideas of reference, magical thinking, and unusual perceptual experiences), a disorganization dimension (i.e., odd speech and behavior), and an interpersonal dimension (i.e., paranoid ideation, social anxiety, no close friends; Fonseca-Pedrero et al., 2018; Raine et al., 1994). This multi-dimensional model of SPT is well established and, because these dimensions reflect distinct psychological processes, they should be examined separately rather than collapsed into a global SPT score (Fonseca-Pedrero et al., 2018; Kemp et al., 2025; Raine et al., 1994). Although Abbott and Green (2013) noted a deficit in emotion identification that was specific to the interpersonal dimension of SPT, a more recent meta-analysis suggested that all dimensions of SPT could be associated with worsen facial emotional recognition (Zouraraki et al., 2023). However, investigating the behavioural consequences of SPT on emotion perception, and particularly with regard to subtle cues such as gaze direction, could reveal insights in emotional processing differences for each dimension of SPT. These findings would be especially important in light of the importance of social cognition in schizophrenia (for a review, see Green et al., 2015). As such, *SPT, being associated with a lower emotion identification accuracy, should reduce the influence of emotional facial expressions on postural control* (**H3d**).

To sum up, reacting to a threatening emotional facial expression requires identifying the social message behind the observed expression (that can be modulated through gaze direction, e.g., *This person is angry with me* vs *This person is angry with someone else*), and its relevance for individuals (that is determined by personality traits, e.g., neuroticism regulating threat-sensitivity). In addition to the moderation hypotheses regarding gaze direction and personality traits, we can also emit more complex general predictions regarding the interactions between personality traits, and gaze direction in threatening faces such as angry faces: Stronger avoidant responses should be observed for direct angry faces among individuals with high neuroticism, extraversion, or agreeability scores. In contrast, *SPT* will reduce postural responses associated with direct angry faces (**H4**).

Measuring Defensive Reactions to Emotional Expressions

A large part of the literature on avoidance relies on response time paradigms to assess avoidance. Approach-Avoidance tasks compare response times associated with approaching vs avoiding a class of stimuli using keyboard responses or joystick movements (for a meta-analysis, see Phaf et al., 2014). However, it was reported that results using these experimental tasks were highly dependent on instructions (Seibt et al., 2008; see also Van Dessel et al., 2015, 2020). In their study, Seibt et al. (2008) observed that participants were faster to remove their hand from a negative word when the instructions described the behavior as *moving their hand away from the stimulus* in comparison to when the same behavior was described as *pulling the negative toward them*.

Other protocols can be deployed to investigate defensive reactions to emotional facial expressions without necessarily relying on instructions. For instance, camera recordings of visible motoric movements (e.g., Mirabella et al., 2023), or functional neuroimaging of neural processes relating to threat processing (e.g., de Gelder et al., 2004; Pichon et al., 2008) can provide valuable insights into spontaneous defensive reactions in response to emotional stimuli. However, protection action tendencies can also manifest in subtle, spontaneous body movements. One promising way to capture these reactions is through force platforms. These platforms assess center of pressure (CoP) displacements—a precise marker of body sway and balance control. Because subtle spontaneous postural adjustments measurements are ecological, non-invasive, relatively cheap, but also implicit (non-conscious, indirect, and uncontrollable), they can offer unique insights into spontaneous defensive reactions.

Postural studies

Force plates use sensors integrated to a platform to compute the location of the CoP (i.e., the ground point where the total sum of vertical forces acts, see Quijoux et al., 2021). CoP computations can allow the study of postural control following two axes: the medio-lateral axis (CoP-X) or the antero-posterior axis (CoP-Y). Several kinematic parameters reflecting active movements can be extracted from the CoP, such as the velocity of the movement. These movement parameters can be used when combined with instruction-based paradigms to investigate events such as gait initiation (e.g., Gélat et al., 2011; Naugle et al., 2012). However, instruction-based paradigm, forcing participants into movement, may compromise ecological validity when studying spontaneous body movements. Average CoP-Y constitutes a valid measure of spontaneous (i.e., not instruction based) approach and avoidance (Eerland et al., 2012; Fawver et al., 2015; Hillman et al., 2004; Horslen & Carpenter, 2011; Kordts-Freudinger et al., 2017; Kosonogov et al., 2024; Lelard et al., 2017; Perakakis et al., 2012; for a meta-analysis, see Monéger et al., 2025). In contrast to other protocols, force plates can measure postural displacements that are 1) natural, 2) likely automatic, 3) not based on instructions.

Although neural reactions to emotional expressions are well studied in the literature (e.g., de Gelder et al., 2004; de Gelder et al., 2015; Van den Stock, 2011), only a few studies investigated the influence of emotional expressions on postural control using force plates (Lebert et al., 2020, 2021, 2024; Stins et al., 2011). Interestingly, a recent study conducted by Lebert et al. (2024) observed a significant effect of emotional facial expressions on CoP-Y such that individuals leaned more forward in response to neutral faces, and backward in response to angry faces. Sad and Fearful faces appeared to elicit a relative approach, consistent with the idea that they are not directly threatening to participants, but may communicate help requests and threat signaling respectively. However, other studies were less conclusive, with Stins et al. (2011) finding only an effect of emotional expressions on gait initiation response times and not on average CoP-Y parameters. Finally, in an earlier study, Lebert et al. (2021) failed to detect the hypothesised effects of emotional facial emotional expression on average CoP-Y displacements.

Current Study

We aim to explore how threatening (vs non-threatening) emotional faces can foster avoidance, as indexed by backward CoP-Y displacements, and how personality and stimuli features such as gaze direction influence this process. Angry faces communicate an intention of aggression and, therefore, constitute a threat for the observer. In contrast, sadness and fear, despite being negative emotions, do not communicate threatening intentions toward the observer. Nevertheless, the perception of a threat might be influenced by facial features such as gaze direction that can modify the message associated with the facial emotion, and individuals' personality that can modulate threat-sensitivity and general emotion perception. Our study aimed to provide a robust and highly-powered test of the elements fostering adaptive avoidance responses to threatening emotional facial expression. To do so, we used a valid, ecological, implicit, and non-invasive protocol: a passive viewing task of facial emotional expressions while standing on a force plate measuring body sway.

Methods

Transparency and Openness Statement

All data, materials and codes have been made publicly available via the Open Science Framework and can be accessed at https://osf.io/56n9u/. We report how we determined the sample size, all data exclusions, measures and manipulations in this study. This study was not pre-registered. Data was analyzed using R (R Core Team, 2020).

Material

Participants. Participants were 152 undergraduate students from the Université Paris Cité. The number of participants was limited by the available resources and feasibility of the study. However, with 150 participants, we have an 80% probability of detecting an effect size of $f^2 = 0.066$. Four participants were excluded from our sample because they reported excessive fatigue and/or vertigo resulting in incomplete data measures. Six participants were excluded because of technical issues (i.e., mislabeled recording, or unrecorded data). Following recent recommendations for handling outliers with multidimensional data (in this study, CoP displacements along the medio-lateral and CoP displacements along antero-posterior axes), we applied the Minimum Covariant Determinant with a breakdown point of 75% (MCD75; see Leys et al., 2019; Sunderland et al., 2019). As a result, 22 participants were excluded from our analyses[1]. The resulting sample consisted of 120 participants (114 women, 4 men, and 2 others; $M_{age} = 19.44$, $SD_{age} = 3.30$, see Supplementary Online Material (SOM) for additional sample characteristics, https://osf.io/n56h4). With this sample, we have an 80% chance of detecting a small to medium interaction effect size of $f^2 = 0.082$ (Cohen, 1988). To our knowledge, this is the highest statistical power recorded in studies using force plates to study avoidant motivation. Indeed, a recent meta-analysis estimated that the average sample size in this field, including the current article, is roughly 40 participants (Monéger et al., 2025).

Stimuli. Stimuli were taken from the Karolinska Directed Emotional Faces (KDEF, Lundqvist et al., 1998). We selected 8 identities (4 women and 4 men) expressing both neutral expressions, typical anger, typical fear, and typical sadness for a total of 32 unique emotional facial expressions. All stimuli represented faces directed toward the camera. In addition to the original pictures associated with a direct gaze, stimuli were modified using Photoshop® to change gaze direction. We created three gaze directions conditions: 1) the original direct gaze,

2) maximally averted gaze using photoshop, and 3) ambiguous gaze using photoshop (see Figure 1). Ambiguous gazes were selected in a pilot study including 121 undergraduate students and corresponded to gaze directions associated with mixed evaluations regarding their direction (approximately 50% of the participants evaluated the gaze as direct, and 50% evaluated the gaze as averted, see online material). Hence, the complete list of stimuli consisted in 4 (Emotion type) x 3 (Gaze direction) x 8 (identities) = 96 unique stimuli that were randomly displayed. There was as many gaze directions toward the left than gaze directions toward the right.

Figure 1.

Direct (left), ambiguous (centre) and Averted (right) gaze of a typical angry face from the KDEF (KDEF stimulus ID: BF01ANS).

Experimental Set-Up. We used a large white screen (102cm x 65cm) to display the stimuli. The force plate was located at a distance of 155cm from the screen. We used PsychoPy2 Builder (v2023.2.2; Peirce et al., 2019) to create and display the protocol. Experimental sessions took place in a quiet and dimly lit room. The experimenter was isolated from the participants by being placed behind a screen (see OSF webpage for a picture of the experimental set-up, https://osf.io/56n9u/).

Force Plates. We used an AMTI AccuSway+® force plate with a 100Hz sample rate to assess CoP displacements on the medio-lateral and antero-posterior directions**.** To synchronize data collection with the experimental task, we set up a custom trigger using a parallel port. We programmed the psychopy experiment so that each block started with a trigger sent to the force plate (see SOM for details on how to implement a similar trigger; see also online material for the programmed psychopy experiment).

Big Five. The big 5 personality traits were measured using the French 10-item version of the Big-5 Personality Inventory (Courtois et al., 2020). The scale measures each of the five personality traits using two items. We used a 5-points scale from "Completely disagree" (1) to "Completely agree" (5). Because each trait is measured using only two items, reliability for each trait was approximated using the Spearman-Brown Prophecy index (Eisinga et al., 2013). Items measuring Extraversion had a satisfying reliability, SB = .82. The neuroticism measure was associated with a somewhat low reliability, SB = .65. The agreeability dimension was associated with a poor reliability, SB = .069.

Schizotypal personality questionnaire. SPT were measured using the validated French Likert-format SPQ-Br (Ferchiou et al., 2017). In this scale, 5 items measure the cognitive-perceptive dimension of SPT (e.g., "*I am sometimes sure that other people can tell what I am thinking*", in our sample, $\alpha = 0.45$), 7 items measure the interpersonal dimension of SPT (e.g., "*I feel I have to be on my guard even with friends*", in our sample, $\alpha = 0.64$), and 10 items measure the disorganization dimension of SPT (e.g., "*Some people think that I am a very bizarre person*", in our sample, $\alpha = 0.72$).

Protocol

Participants were led in the experimental room where they completed the informed consent form before starting the experimental procedure. Before starting the tasks, they were asked to stand on a force platform with their feet hip-wide, hands along their trunk, and maintain a comfortable stance throughout the session. At the beginning of the session, the position of the participants was marked using color tape to ensure consistent position between blocks. The experimental procedure consisted in a short training block (12 trials) followed by four blocks of 24 trials (each block followed with a 1mn break). Each trial consisted in two phases: one passive viewing phase to measure postural adjustments (10s) and a Go/No Go decision task (1s). This Go-No-Go task was included in the protocol to 1) foster involvement of the participants in the task (i.e., avoid a completely passive state), and 2) assess compatibility effects corresponding to the difference between response times associated with stopping approaching threatening stimuli (i.e., Anger) and response times associated with stopping non-threatening stimuli (Neutral, Sadness, and Fear)[2]. Each trial began with a 2s blank screen followed by a 0.5s fixation cross in the center of the screen.

Passive Viewing. Faces from the KDEF expressing basic emotion (anger, fear, sadness and neutral) with digitally modified gaze directions (direct, ambiguous, averted), were randomly displayed on a large screen using a projector. Each stimulus could only be displayed once per session. To increase immersion in the situation, and because it can be evaluated as more threatening (Nuel et al., 2021), stimuli were displayed approaching the participant for a minimum duration of 10 seconds. The approaching speed was 0.5m/s. To simulate a realistic approach, stimuli were re-sized to the dimensions of an average face (approximately 18.5cm x 14cm, Zhuang et al., 2010). They started at a perceived 6m (face dimension of 1.34° x 1.77°) and stopped at a perceived 0.5m (face dimension of 14.94° x 20.96°) to 1m (face dimension of 8.01° x 10.57°). To simulate the approach of the stimulus, the displayed size of the stimulus was dynamically re-computed every frame to correspond to the apparent size of a real approaching face following trigonometric computation. Specifically, we computed the degree of angle associated with the stimulus for a distance from 600 cm to 50 cm and then used this array of degrees of angle to compute the displayed size of the stimulus.

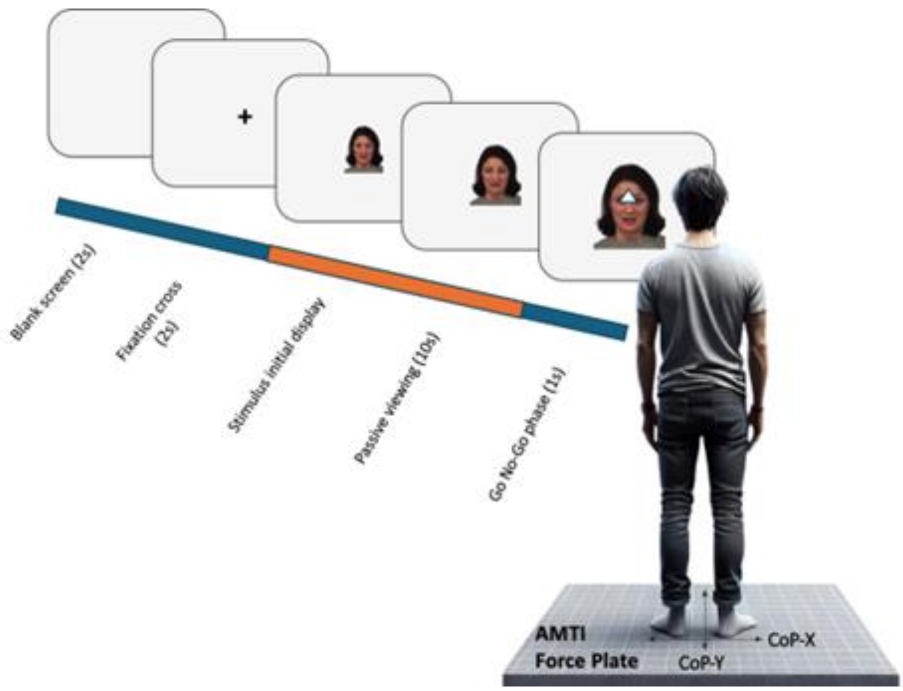
In the passive viewing phase, participants watched stimuli approaching for 10 seconds. During this phase, we measured the displacements of the center of pressure on the antero-posterior axis (CoP-Y in cm) to assess avoidance.

Go-No-Go task. After this passive viewing task, the Go-No-Go task started with a random shape (either a square or a triangle) appearing on the target stimulus. This prompted participants to either stop the approaching stimulus by pressing a trigger or let it continue its approach by not pressing the trigger. Pressing the trigger effectively resulted in the immobilization of the displayed stimulus. Half of the participants were instructed to stop the stimulus on the Square prompt (vs Triangle prompt) and the other half were instructed to stop the stimulus approach on the Triangle prompt (vs Square prompt). In the randomisation process, we added the following constraints: there were as many squares as triangles in each session, and each emotional facial expression was associated with the same number of squares and triangle. A typical trial example is provided in Figure 2.

Personality Assessment and Manipulation Check. Finally, after this experimental procedure, participants completed personality scales (BFI-10 and SPQ-Br) before completing an evaluation of the stimuli presented during the session. They had to indicate 1) the emotion expressed by the face (Anger, Sadness, Fear, or None of these responses) and where the face was gazing (on their left, straight at them, or on their right). Finally, participants were thanked and debriefed. The experimental protocol was reviewed and approved by a local ethic committee (Reference Number: 2023-031/CSP-2).

Figure 2.

Timeline of a trial (KDEF stimulis ID: BF01AFS).



Note: *Postural recording corresponds to the Passive viewing segment (10s)*

Statistical analyses. For our main postural analyses, mixed linear models using participant's level as a random variable were used to assess the effect of emotional facial expressions on avoidance reactions (Pinheiro & Bates, 2000). In order to evaluate the difference between each condition and the baseline (i.e., CoP-Y = 0), we forced the intercept of the model to be zero. As a result, each condition is tested against the baseline of CoP = 0 (i.e., postural position at the moment when the target stimulus appeared after the fixation cross, for a similar approach, see Gelman & Hill, 2006, p. 255). Because it is important to take into account time in postural analyses (see Lelard et al., 2019; Mouras & Lelard, 2018), CoP-Y was averaged into ten 1-second time bins, which were included as a covariate. This approach allowed us to control for general time-related effects on postural sway (e.g., relaxation over the course of the trial, or a progressive shift in leaning forward or backward), thereby isolating the variance in posture specifically explained by the target stimuli. As a result, each participant was associated with 10 (time-bins) x 4 (type of emotions: neutral, anger, fear, sadness) x 3 (gaze direction: direct, ambiguous, averted) = 120 CoP means. We used an auto-correlation component in the model to account for the longitudinal aspect of the data (i.e., time 1 predicts time 2 measurements and so on; Bates, 2005; Box et al., 2008). For all our analyses, we report 95% confidence intervals around the estimation of the slope in the mixed models, and 95% confidence intervals around the r statistics for Pearson's correlations. Additional analyses and materials are provided in the Supplementary Materials (see https://osf.io/56n9u/).

Results

Manipulation Check

Emotion Identification.

Our manipulation check indicated that most participants correctly identified the emotions in the post-experimental task ($M_{correct\ identification}$ = .93, *SD* = .12 – indicating that 93% of facial expressions were accurately categorized). As expected, a one sample t-test revealed that participants' evaluations of ambiguous gazes did not differ from randomness ($M_{ambiguous\ as\ direct}$ = .48, SD = .25), t(119) = 1.057, p = .29, 95%CI[.43, .52]. A mixed model predicting emotion identification, using Emotion type and Gaze direction as predictors (adjusted ICC = .23), indicated that Emotion type predicted Emotion identification, F(6, 1309) = 97.86, p < .001, but this effect was not qualified by Gaze direction, F(6, 1309) = 0.54, p = .77. This result contrasts with predictions from the Shared Signal Hypothesis, which anticipated greater identification of angry faces with direct versus averted gazes, and greater identification of sad and fearful faces with averted versus direct gazes. Full analyses of emotion perception are reported in the SOM (see https://osf.io/56n9u/).

We additionally replicated the influence of SPT on emotion recognition. As expected, global SPT scores negatively predicted correct general emotions identification (r = -.25, p = .007, 95%CI[-.41, -.069]). Similar correlations were observed for all dimensions of SPT (Perceptive cognitive, *r* = -.21, *p* = .023, *95%CI*[-.37, -.029]; Disorganisation, *r* = -.20, *p* = .028, *95%CI*[-.37, -.022]; and Interpersonal dimension, *r* = -.19, *p* = .036, *95%CI*[-.36, -

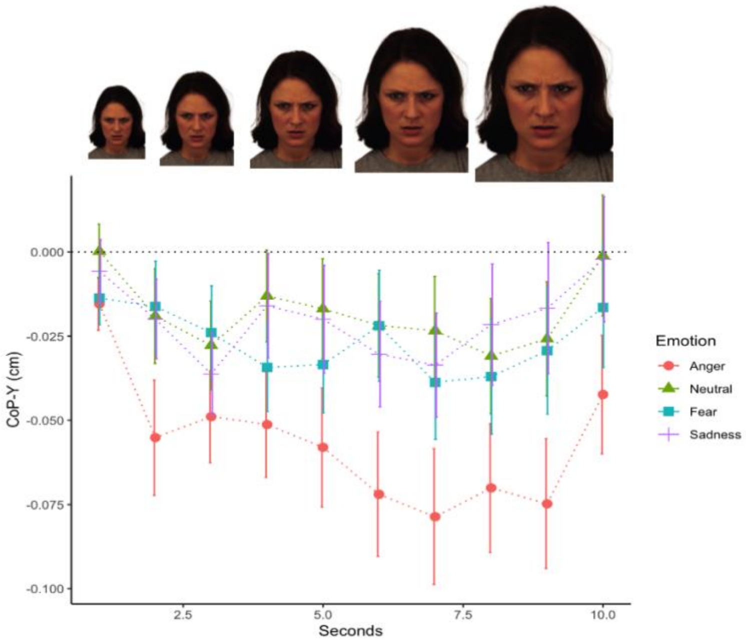
.012]). In contrast, neither Neuroticism, Agreeability, nor Extraversion predicted Emotion identification (*p*s > .05).

Main Hypotheses

We computed a longitudinal mixed model with CoP-Y as the dependent variable and Emotion type as the independent variable, incorporating time bin as a covariate and an auto-correlational component to account for temporal dependencies. The resulting longitudinal mixed models was associated with an *Inter-Class Correlation* (*ICC*) = .10, indicating that 10% of the variability in the data is accounted for by participants variability. An ANOVA of the model indicated a main effect of emotions, $F(1, 4676) = 9.26$, $p < .0001$. Whereas all conditions were associated with a relative avoidance (i.e., a negative CoP-Y), only Angry (M = -0.057, SD = 0.19, see **H1a**) and Fearful (M = -0.027, SD = 0.17, see **H1b**) faces elicited a significant backward movement throughout trials, $B = -0.047$, $t(4676) = -4.56$, $p < .0001$, *95%CI* [-0.067, -0.27], and $B = -0.034$, $t(4676) = -1.67$, $p = .09$, *95%CI* [-0.054, -0.014], respectively. In contrast, Neutral (M = -0.018, SD = 0.16) and Sad (M = -0.02, SD = 0.17, see **H1c**) faces failed to significantly influence CoP-Y displacements, $B = -0.017$, $t(4676) = -1.67$, $p < .0001$, *95%CI* [-0.037, 0.0029], and $B = -0.0069$, $t(4676) = -0.68$, $p = .5$, *95%CI* [-0.027, 0.013], respectively (see Figure 3)[3].

Figure 3.

CoP-Y displacements in comparison to baseline (black horizontal line) depending on emotional facial expression type (error bars correspond to standard errors). Displacements are shown over time as facial expressions approach (KDEF stimulus ID: *BF01ANS*).

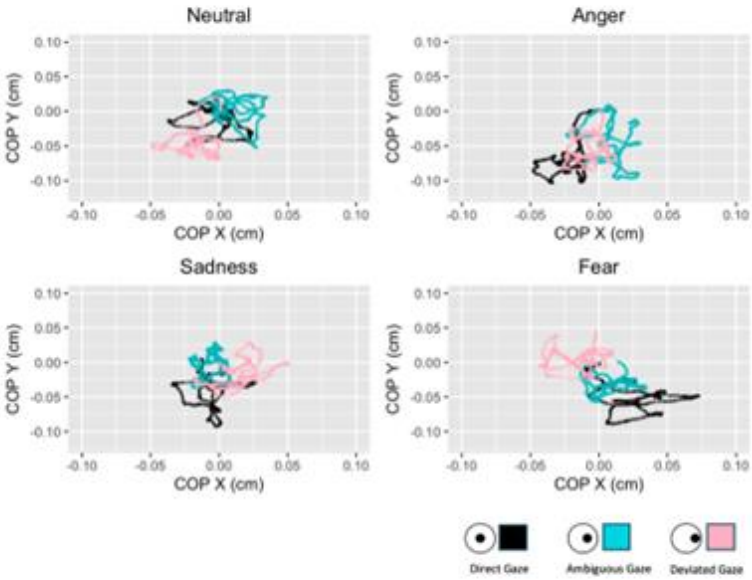


Note: Additional Figures can be found in the online shiny app, https://jeanmoneger.shinyapps.io/InPact_Study/, see also a static version at https://osf.io/ncmqk

Gaze effects. In order to study how gaze direction influenced avoidance (Hypothesis 2), we added gaze direction as a moderator of the model. An ANOVA of the model (ICC = .041) revealed that Gaze direction interacted with Emotion type, $F(12, 14268) = 2.93$, $p = .0005$ (see Figure 4).

Figure 4.

Average CoP displacements for each type of emotion depending on gaze direction of the stimulus.



Contrasts analysis of the interaction comparing CoP displacements in each condition to the initial baseline CoP position showed that fear was associated with a significant avoidance in the direct condition (M = -0.05, SD = 0.31), $B = -0.045$, $t(14268) = -3.34$, $p = .0009$, *95%CI* [-0.075, -0.019], a significant albeit smaller avoidance in the ambiguous condition (M = -0.033, SD = 0.27), $B = -0.035$, $t(14268) = -2.49$, $p = .013$, *95%CI*[-0.063, -0.0075], but a non-significant avoidance for averted gazes (M = 0.0037, SD = 0.28), $B = -0.0086$, $t(14268) = -0.61$, $p = .54$, *95%CI*[-0.036, 0.019]. This pattern of result is inconsistent with predictions derived from the shared signal hypothesis (see **H2b**).

In the neutral condition, direct gazes (M = -0.011, SD = 0.28) were not associated with avoidance, $B = 0.002$, $t(14268) = 0.15$, $p = .88$, *95%CI*[-0.026, 0.030], nor were ambiguous gazes associated with avoidance (M = 0.0031, SD = 0.29), $B = -0.012$, t(14268) = -0.87, p = .38. However, averted gazes (M = -0.046, SD = 0.27) led to significant avoidance, $B = -0.03$, $t(14268) = -2.14$, $p = .032$. Contrary to **H2a** regarding angry faces and **H2c** regarding sad faces, gaze did not appear to moderate the influence of other emotion types (all ps > .05).

Personality traits. Hypotheses **H3a**, **H3b**, **H3c** and **H3d** suggest that personality variables (SPT on the one hand, and relevant big five traits on the other hand) would moderate postural reactions to emotional facial faces. To this end, we investigated the role of SPT and its different dimensions, neuroticism, agreeability, and extroversion, in separate mixed models. With the exception of agreeability (*ICC* = .11) and the interpersonal facet of SPT (*ICC* = .11), respectively, $F(4, 4676) = 2.87$, $p = .022$, and $F(4, 4676) = 5.28$, $p = .0003$, no personality variable interacted with emotion types in independent ANOVA of the mixed models. Descriptively, agreeability predicted avoidance of sad and fearful faces, immobility for neutral faces, and approach of angry faces, although none of these contrasts reached significance (all *p*s > .05).

Regarding the interpersonal dimension of SPT, contrasts analyses revealed that only angry faces reactions were qualified by interpersonal SPT, $B = -0.026$, $t(4676) = -2.72$, $p = .0066$, *95%CI*[-0.045, -0.0073], such that the higher the interpersonal SPT score, the more avoidance displayed when facing angry faces. This is unexpected considering that SPT was expected to reduce any effect of emotional facial expression (see **H3d**).

Case analysis of anger. Finally, hypothesis **H4** considered the interaction between personality traits and gaze directions to predict avoidance of threatening faces. To account for this interaction, we focused on the threatening condition (i.e., Angry faces). Readers interested in further exploring these interactions can access the interactive Shiny App at https://jeanmoneger.shinyapps.io/InPact_Study/ or view a static PDF version at https://osf.io/56n9u/files/ncmqk. It can be expected that direct anger leads to avoidance, especially for high neuroticism scores. Neuroticism and gazes did interact in the Angry condition (*ICC* = .12), although this interaction was close to non-significance, $F(3, 3477) = 2.62$, $p = .049$. Probing the interaction revealed that the higher the neuroticism scores, the more avoidance in the direct gaze condition, although the effect failed to reach significance, $B = -0.031$, $t(3477) = -1.82$, $p = .068$, *95%CI*[-0.064, 0.0023]. All other slopes were not significant, nor close to significance (*p*s > .1).

We also expected SPT to reduce the effect of direct angry faces. General SPQ-Br score and gaze directions interacted, $F(3, 3477) = 2.75$, $p = .042$ ($ICC = .12$). Specifically, the higher the SPQ-Br score, the more avoidance of averted angry faces, although once again this slope failed to reach significance, $B = -0.029$, $t(3477) = -1.74$, $p = .082$, *95%CI*[-0.062, 0.0037]. Surprisingly, the disorganized (odd speech and odd behavior) dimension of SPT also predicted greater avoidance of angry faces, $F(3, 3477) = 4.15$, $p = .006$, such that disorganization predicted greater avoidance of averted angry faces, $B = -0.035$, $t(3477) = -2.11$, $p = .035$, *95%CI*[-0.068, -0.0024]. All other dimensions of SPT failed to qualify the effect of gaze on angry faces[4].

Discussion

We investigated the role of facial emotional expressions on posture. Specifically, we were interested in avoidant postural adjustments in the face of threatening expressions such as angry faces. We focused on facial features of the observed faces (i.e., gaze direction), as well as inter-individual dispositions (i.e., SPQ-Br and Big Five) to identify how threatening faces are processed according to contextual and personal variables. We relied on a posturometric paradigm using force plates to measure CoP displacements. Spontaneous body sway upon stimuli exposure is not instruction-based and constitutes an ecological measure of an automatic behavior. As such, it might be an ideal proxy for measuring approach and avoidance (Lelard et al., 2019). In table 1, we describe our main initial hypotheses and how our results supported or not each one.

Table 1. Hypotheses and results of the present study

	Formulation	**Rationale**	**Observation**
H1a	Angry faces will elicit avoidance compared to initial postural position.	Angry faces signal a motivation to aggress the observer.	Angry faces elicited avoidance.

H1b	Fearful faces will elicit approach compared to initial postural position.	Fearful faces signal a request for help.	Fearful faces elicited avoidance.
H1c	Sad faces will elicit approach compared to initial postural position.	Sad faces signal a request for help.	No main effect of sad faces.
H2a	Direct angry faces will exacerbate avoidance compared to initial postural position.	Direct gazes signal that the angry face directly targets the observer. Moreover, the shared signal hypothesis stating that direct angry faces should be perceived with more intensity (Adams & Kleck, 2005).	No moderation of gaze on avoidance of angry faces.
H2b	Averted fearful faces will exacerbate fearful faces' main effects.	Averted gazes signal a threat in the environment. Moreover, this hypothesis is derived from the shared signal hypothesis stating that averted fearful faces should be perceived with more intensity (Adams & Kleck, 2005).	Averted gazes reduced the main effect of fearful faces.
H2c	Averted sad faces will exacerbate sad faces' main effects.	This hypothesis is derived from the shared signal hypothesis stating that averted sad faces should be perceived with more intensity (Adams & Kleck, 2005).	No effect of gaze direction in sad faces.
H3a	Neuroticism will predict avoidance of angry and fearful faces.	Neuroticism is associated with increased threat-sensitivity, which was found to be associated with avoidance of angry and fearful emotional faces (Lebert et al., 2020) (Lebert et al., 2020).	No effect of neuroticism on avoidance of angry and fearful faces.
H3b	Extraversion will predict avoidance of angry and fearful faces.	Extraversion is associated with increased reward-sensitivity, which was found to be associated with avoidance of angry and fearful emotional faces (Lebert et al., 2020).	No effect of extraversion on avoidance of angry and fearful faces.
H3c	Agreeability will exacerbate any main effect of facial expression.	Agreeability is associated with social facilitation.	Agreeability predicted avoidance of sad and fearful faces, immobility for neutral faces, and approach of angry faces.
H3d	SPT will reduce any main effect of facial expression.	SPT are associated with impaired emotional facial expression recognition.	Interpersonal SPT score predicts increased avoidance of angry faces.
H4	Gaze directions and personality effects will interact to predict stronger motoric responses of angry faces.	H3a-H3d will be exacerbated by direct angry gazes.	Neuroticism predicts increased avoidance of direct angry faces; SPT scores predict greater avoidance of averted angry faces.

Consistent with our predictions that threatening faces elicit spontaneous avoidance, individuals exhibited avoidance when confronted to angry faces. Sad faces, in contrast to hypotheses from the literature, did not elicit a significant approach. This absence of effects might be due to our protocol: participants were watching *approaching* sad faces. It is possible that the social signal associated with an approaching sad face is different from the social signal associated with a receding or static sad face. This motion effect might have reduced the likelihood of responding accordingly to the perceived sad faces (see Nelson et al., 2013).

Unexpectedly, we also observed a similar avoidance for fearful faces. This latter finding is inconsistent with some accounts that fearful faces should elicit approach (e.g., Marsh et al., 2005). It is however consistent with Paulus and Wentura (2016) who observed a systematic avoidance of fearful faces. This finding indicates that fearful faces might be threatening. However, taking gaze direction into account revealed a more nuanced perspective on fearful expressions as threatening.

Gaze directions play an important role in communicating one's mental state (Macdonald & Tatler, 2013). Gaze direction can influence appraisal of the emotion by changing the message associated with the facial expression. Direct gazes for angry faces indicate direct threat to the observer, and averted gazes for fearful faces indicate the presence of a threat in the perceiver's environment (Sander et al., 2007). Fearful stimuli were associated with avoidance in the direct gaze condition, but not in the averted condition. As noted above, averted gazes in fearful faces indicate the presence of a threat in the environment. Thus, if individuals would avoid something, it would be the threat targeted by the stimulus gaze, located behind the participant. This would result in a relative approach. On the other hand, reactions to angry faces were not qualified by gaze direction, as avoidance was observed regardless of gaze direction. The absence of moderation of gazes with angry faces is surprising. It is possible that angry faces are threatening regardless of whether we perceive that the cause of the other's anger is us. For instance, a person walking in the streets may be more likely to move to another sidewalk when faced with an angry person - even if the situation clearly indicates that the angry person is upset with someone on the phone.

Of note, averted gazes also predicted avoidance of neutral faces. Consistent with the appraisal model of emotion perception (Sander et al., 2007), averted gazes in neutral faces might indicate social rejection (Wesselmann et al., 2012; Wirth et al., 2010). Avoidance of socially excluding targets could thus be expected.

Our findings that gaze direction influences reaction to facial emotional expressions are consistent with componential appraisal theories arguing that gaze is an essential element of facial emotional expression to inform others of one's current mental state (N'Diaye et al., 2009; Sander et al., 2007). Interestingly, gaze direction influenced behavioral responses despite any evidence of the effect of gaze directions on emotion identification in this study. Indeed, regarding emotion identification, although we replicated a medium-sized negative correlation between SPQ-Br scores and accuracy in emotion identification (Abbott & Green, 2013; Durtette et al., 2023; Morrison et al., 2013), we failed to replicate the shared signal hypothesis (Adams & Kleck, 2005). This might be due to our stimuli expressing typical emotions, which lead to a ceiling effect in the recognition of these facial expressions (i.e., 93% of the faces were accurately categorised in our study). We capitalized on clear expressions of emotions to influence participant's behaviors, and indeed, emotion recognition scores indicate that participants identified clearly emotions. However, because there was little room to incorrectly identify facial expressions, our effects all appear to be independent of any mechanism involving impaired emotion recognition (i.e., **H3d)**. Maybe more ambiguous expressions, such as the ones used in studies focusing on shared signal hypotheses (e.g., blended emotional expressions in Adams & Kleck, 2005), might have increased the importance of gaze in overt emotion identification.

Regarding personality traits, only the interpersonal dimension of SPT appeared to be significantly associated with increased avoidance of threatening faces. This result does not fit our initial hypothesis that, because of reduced accuracy in emotion identification, SPT should be associated with decreased postural reactions while watching facial emotional expressions. Rather, this association between interpersonal SPT and avoidance of threatening faces emphasizes the nature of interpersonal SPT, associated with greater distrust and social anxiety. As such, individuals displaying high interpersonal SPT displayed more sensitivity to threatening faces. Again, perhaps using more ambiguous facial expressions would have increased the probability of detecting our hypothesized effect, relying on emotion recognition as a main mechanism.

Other personality traits failed to clearly qualify postural reactions to threatening faces. This might indicate a general feature, possibly selected through evolution, of automatic avoidance of threats regardless of personality types, consistent with traditional evolutionary views positing an ancient neural pathway to fear reactions, shared by mammals and as such independent of personality traits and other high-level variables (e.g., Darwin, 1872; LeDoux, 1996). Nevertheless, delving into finer-grained predictions encompassing gaze directions of angry faces and personality, we observed interactions lending weak support to our predictions. Neuroticism increased avoidance of angry faces, but only for direct gazes. This finding gives credit to neuroticism being associated with heightened threat sensitivity and a greater motivation to avoid direct threats as predicted by the cybernetic model of the Big Five (DeYoung, 2015). Additionally, the interaction between general SPQ-Br scores and gaze direction can be interpreted through the lens of a reduced differentiation of averted gaze. Indeed, descriptively, it would appear that the higher the SPQ-Br score, the more avoidance of averted angry faces. It might be that gazes are more easily interpreted as directed toward the self among individuals associated with high SPT, which would tentatively support the idea that self-referential gaze processing bias observed in schizophrenia extend to schizotypy (see Chan et al., 2021; Wastler & Lenzenweger, 2018). As such, averted angry faces might not be distinguished from a direct angry face.

Limitations and Future directions

Several limitations must be emphasized in this work. First of all, we cannot assess the extent to which the observed outcomes are design-dependent. Specifically, to increase immersion and involvement in the study (see Nuel et al., 2019), we assessed reactions to approaching stimuli coupled with a go-no-go task. As noted, approaching stimuli are threatening by nature, regardless of their initial valence (Hsee et al., 2014; Nuel et al., 2021). Our study would show that this aversion to looming stimuli is actually conditioned to angry and fearful (vs neutral and sad) faces. Importantly, this possibility does not modify our main conclusions. Future studies could conceptually replicate the present finding while omitting or manipulating movement of the stimuli and presence of the go-no-go tasks to assess how dependent on the design these spontaneous reactions are.

The current study raised several questions that should be addressed in future studies. It was noted that trustworthiness was a strong predictor of approach (Radke et al., 2018; Slepian et al., 2017; Todorov, 2008). Trustworthy faces have been described as faces exhibiting signals of anger. To the extent that the strongest effect sizes in the current study relate to anger, it could be hypothesized that our findings are driven by evaluations of trustworthiness. Additionally, it would be interesting to question the emotional states of individuals to investigate how spontaneous reactions to emotional facial expressions are mediated by affective states (e.g., angry faces eliciting fear, in turn predicting avoidance).

Finally, the BFI-10 was associated with a poor reliability with regard to the Agreeability dimension. However, it must be emphasized that this poor reliability of the BFI-10 have been observed in other studies and considered normal by the original authors of the scale, as it reflects greater domain coverage of the sub-scales (see Balgiu, 2018; Carciofo et al., 2016; Rammstedt et al., 2023; for a discussion on reliability-validity trade-offs, see Clifton, 2020).

Conclusion

We investigated the role of gaze direction and personality in predicting avoidance of threatening emotional facial expressions using force plates. Participants confronted with expressions of anger and fear displayed significant avoidance. Although the effect associated with anger was independent of the gaze direction, gaze did moderate reaction to fearful and neutral faces. These findings are consistent with socio-functional accounts of emotions and can be integrated in an appraisal framework for explaining spontaneous reactions to social stimuli. Personality traits did not notably influence postural reactions to faces. However, further analyses restricted to angry faces provided suggestive evidence that accurate predictions could be made using a more nuanced framework integrating specific emotional expression's components such as gaze direction and personality variables. In particular, neurotic individuals displayed high sensitivity to threat by showing avoidance specific to angry faces with direct gazes. Altogether, these results highlight the importance of adopting higher-level analyses of avoidance, as emotional expressions alone may not elicit consistent reactions across studies. Subtle social cues, such as a simple gaze deviation, can shift perceived intentions and, depending on personality, evoke distinct motor responses.

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Footnotes:

1: Following Leys et al. (2011, 2014), we define outliers as data points that do not belong to the population distribution and are identified purely by their deviation from the main body of data. The proportion of outliers observed (~15%) aligns with what is typically reported for this type of measure (Sunderland et al., 2019). As these values are unlikely to represent the underlying population, and may result from both sampling and measurement noise, we chose not to interpret them.

2: Details on compatibility effects during the Go-No-Go task are available in a SOM (see https://osf.io/jy2rt/). Whereas there was no main effect of Emotion type on Response Times (RT) to stop stimuli, we observed a compatibility effect when contrasting RT to stop Angry (vs. Fearful, Sad, and Neutral faces), $F(1, 6894.6) = 8.55$, $p < .01$. No other contrast resulted in a compatibility effect, further emphasising that Angry faces are threatening in contrast to Fearful, Sad, and Neutral faces.

3: Following a reviewer's recommendation, we conducted an additional analysis on an independent sample (N = 147), rating a random subsample of our stimuli for emotional intensity and threat. Including these ratings as covariates did not change our conclusions, although the effects were slightly weakened. Model comparisons indicated that accounting for these factors did not significantly improve model fit. Full details of these analyses are available in the SOM (see https://osf.io/wesmu/).

4: Excluding men and others gender resulted in similar conclusions with the only exceptions that the General SPQ-Br scores and gaze direction only marginally interacted ($p = .056$) in the angry condition, and Neuroticism did not interact with gaze directions in the angry condition ($p = .25$). All other statistical decisions reported in the Results section remained unchanged when only considering women in the sample.

References

Abbott, G., & Green, M. J. (2013). Facial affect recognition and schizotypal personality characteristics. *Early Intervention in Psychiatry*, *7*(1), 58–63. https://doi.org/10.1111/j.1751-7893.2012.00346.x

Adams, R. B., & Kleck, R. E. (2005). Effects of direct and averted gaze on the perception of facially communicated emotion. *Emotion (Washington, D.C.)*, *5*(1), 3–11. https://doi.org/10.1037/1528-3542.5.1.3

Balgiu, B. A. (2018). The psychometric properties of the Big Five inventory-10 (BFI-10) including correlations with subjective and psychological well-being. *Global Journal of Psychology Research: New Trends and Issues*, *8*(2), 61-69.

Baez, S., Tangarife, M. A., Davila-Mejia, G., Trujillo-Güiza, M., & Forero, D. A. (2023). Performance in emotion recognition and theory of mind tasks in social anxiety and generalized anxiety disorders: A systematic review and meta-analysis. *Frontiers in Psychiatry*, *14*, 1192683.

Bates, D. M. (2005). Nonlinear Mixed Effects Models for Longitudinal Data. In *Encyclopedia of Biostatistics*. John Wiley & Sons, Ltd. https://doi.org/10.1002/0470011815.b2a12051

Besche-Richard, C., Bourrin-Tisseron, A., Olivier, M., Cuervo-Lombard, C.-V., & Limosin, F. (2012). Reconnaissance des expressions faciales émotionnelles et théorie de l’esprit dans la schizophrénie: La difficulté à identifier les états mentaux d’autrui serait-elle liée à un trouble de la reconnaissance des émotions faciales ? *L’Encéphale*, *38*(3), 241–247. https://doi.org/10.1016/j.encep.2011.04.006

Box, G. E. P., Jenkins, G. M., & Reinsel, G. C. (2008). Autocorrelation Function and Spectrum of Stationary Processes. In *Time Series Analysis* (pp. 21–46). John Wiley & Sons, Ltd. https://doi.org/10.1002/9781118619193.ch2

Bradley, M. M., Codispoti, M., Cuthbert, B. N., & Lang, P. J. (2001). Emotion and motivation I: defensive and appetitive reactions in picture processing. *Emotion*, *1*(3), 276–298. https://doi.org/10.1037/1528-3542.1.3.276

Bradley, M. M., Cuthbert, B. N., & Lang, P. J. (1990). Startle reflex modification: Emotion or attention? *Psychophysiology*, *27*(5), 513–522. https://doi.org/10.1111/j.1469-8986.1990.tb01966.x

Carciofo, R., Yang, J., Song, N., Du, F., & Zhang, K. (2016). Psychometric evaluation of Chinese-language 44-item and 10-item big five personality inventories, including correlations with chronotype, mindfulness and mind wandering. *PloS one*, *11*(2), e0149963.

Chan, S. K. W., Liu, T., Wong, A. O. Y., Wong, G. H. Y., Hsiao, J., Hui, C. L. M., Chang, W. C., Lee, E. H. M., & Chen, E. Y. H. (2021). Self-referential gaze perception of patients with schizophrenia and its relationship with symptomatology and cognitive functions. *Schizophrenia research*, *228*, 288–294. https://doi.org/10.1016/j.schres.2020.12.034

Claridge, G. E. (1997). *Schizotypy: Implications for illness and health*. Oxford University Press.

Clifton, J. D. (2020). Managing validity versus reliability trade-offs in scale-building decisions. *Psychological Methods*, *25*(3), 259.

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences* (2nd ed.). Routledge. https://doi.org/10.4324/9780203771587

Courtois, R., Petot, J.-M., Plaisant, O., Allibe, B., Lignier, B., Réveillère, C., Lecocq, G., & John, O. (2020). Validation française du Big Five Inventory à 10 items (BFI-10). *L'Encéphale*, *46*(6), 455–462. https://doi.org/10.1016/j.encep.2020.02.006

Darwin, C. 1872. The Expression of Emotions in Animals and Man. Murray.

Dapprich, A. L., Lange, W. G., von Borries, A. K. L., Volman, I., Figner, B., & Roelofs, K. (2021). The role of psychopathic traits, social anxiety and cortisol in social approach avoidance tendencies. *Psychoneuroendocrinology*, *128*, 105207.

de Gelder, B., de Borst, A. W., & Watson, R. (2015). The perception of emotion in body expressions. *Wiley Interdisciplinary Reviews: Cognitive Science*, *6*(2), 149-158.

de Gelder, B., Snyder, J., Greve, D., Gerard, G., & Hadjikhani, N. (2004). Fear fosters flight: a mechanism for fear contagion when perceiving emotion expressed by a whole body. *Proceedings of the National Academy of Sciences of the United States of America*, *101*(47), 16701–16706. https://doi.org/10.1073/pnas.0407042101

DeYoung, C. G. (2015). Cybernetic Big Five Theory. *Journal of Research in Personality*, *56*, 33–58. https://doi.org/10.1016/j.jrp.2014.07.004

Durtette, A., Schmid, F., Barrière, S., Obert, A., Lang, J., Raucher-Chéné, D., Gierski, F., Kaladjian, A., & Henry, A. (2023). Facial emotion recognition processes according to schizotypal personality traits: An eye-tracking study. *International Journal of Psychophysiology: Official Journal of the International Organization of Psychophysiology*, *190*, 60–68. https://doi.org/10.1016/j.ijpsycho.2023.06.006

Eerland, A., Guadalupe, T., Franken, I. H. A., & Zwaan, R. A. (2012). Posture as index for approach-avoidance behavior. *PLOS ONE*, *7*(2). https://doi.org/10.1371/journal.pone.0031291

Eisinga, R., Grotenhuis, M. t., & Pelzer, B. (2013). The reliability of a two-item scale: Pearson, Cronbach, or Spearman-Brown? *International Journal of Public Health, 58*(4), 637–642. https://doi.org/10.1007/s00038-012-0416-3

Elliot, A. J. (2006). The Hierarchical Model of Approach-Avoidance Motivation. *Motivation and Emotion*, *30*(2), 111–116. https://doi.org/10.1007/s11031-006-9028-7

Elliot, A. J., & Covington, M. V. (2001). Approach and Avoidance Motivation. *Educational Psychology Review*.

Ellsworth, P. C., & Scherer, K. R. (2003). Appraisal processes in emotion. In *Handbook of affective sciences* (pp. 572–595). Oxford University Press.

Fawver, B., Beatty, G. F., Naugle, K. M., Hass, C. J., & Janelle, C. M. (2015). Emotional State Impacts Center of Pressure Displacement Before Forward Gait Initiation. *Journal of Applied Biomechanics*, *31*(1), 35–40. https://doi.org/10.1123/JAB.2013-0306

Ferchiou, A., Todorov, L., Lajnef, M., Baudin, G., Pignon, B., Richard, J.-R., Leboyer, M., Szöke, A., & Schürhoff, F. (2017). Analyse de la structure factorielle de la version brève du questionnaire de personnalité schizotypique (SPQ-B) – format Likert – en population générale en France. *L'Encéphale*, *43*(6), 558–563. https://doi.org/10.1016/j.encep.2016.05.011

Fonseca-Pedrero, E., Debbané, M., Ortuño-Sierra, J., Chan, R. C. K., Cicero, D. C., Zhang, L. C., Brenner, C., Barkus, E., Linscott, R. J., Kwapil, T., Barrantes-Vidal, N., Cohen, A., Raine, A., Compton, M. T., Tone, E. B., Suhr, J., Muñiz, J., Fumero, A., Giakoumaki, S., Tsaousis, I., … Jablensky, A. (2018). The structure of schizotypal personality traits: a cross-national study. *Psychological medicine*, *48*(3), 451–462. https://doi.org/10.1017/S0033291717001829

Frijda, N. H. (1987). Emotion, cognitive structure, and action tendency. *Cognition and Emotion*, *1*(2), 115–143. https://doi.org/10.1080/02699938708408043

Gao, Z., Zhao, W., Liu, S., Liu, Z., Yang, C., & Xu, Y. (2021). Facial Emotion Recognition in Schizophrenia. *Frontiers in psychiatry*, *12*, 633717. https://doi.org/10.3389/fpsyt.2021.633717

Gélat, T., Coudrat, L., & Le Pellec, A. (2011). Gait initiation is affected during emotional conflict. *Neuroscience letters*, *497*(1), 64–67. https://doi.org/10.1016/j.neulet.2011.04.030

Gelman, A., & Hill, J. (2006). Multilevel linear models: the basics. In *Data Analysis Using Regression and Multilevel/Hierarchical Models* (pp. 251–278). chapter, Cambridge: Cambridge University Press.

Green, M. F., Horan, W. P., & Lee, J. (2015). Social cognition in schizophrenia. *Nature Reviews Neuroscience*, *16*(10), 620-631.

Hammer, J. L., & Marsh, A. A. (2015). Why do fearful facial expressions elicit behavioral approach? Evidence from a combined approach-avoidance implicit association test. *Emotion*, *15*(2), 223–231. https://doi.org/10.1037/emo0000054

Heuer, K., Rinck, M., & Becker, E. S. (2007). Avoidance of emotional facial expressions in social anxiety: The Approach–Avoidance Task. *Behaviour Research and Therapy*, *45*(12), 2990–3001. https://doi.org/10.1016/j.brat.2007.08.010

Hillman, C. H., Rosengren, K. S., & Smith, D. P. (2004). Emotion and motivated behavior: Postural adjustments to affective picture viewing. *Biological Psychology*, *66*(1), 51–62. https://doi.org/10.1016/j.biopsycho.2003.07.005

Hooker, C., & Park, S. (2005). You must be looking at me: The nature of gaze perception in schizophrenia patients. *Cognitive Neuropsychiatry, 10*(5), 327–345. https://doi.org/10.1080/13546800444000083

Horslen, B. C., & Carpenter, M. G. (2011). Arousal, valence and their relative effects on postural control. *Experimental Brain Research*, *215*(1), 27–34. https://doi.org/10.1007/s00221-011-2867-9

Hsee, C. K., Tu, Y., Lu, Z. Y., & Ruan, B. (2014). Approach aversion: Negative hedonic reactions toward approaching stimuli. *Journal of Personality and Social Psychology, 106*(5), 699–712. https://doi.org/10.1037/a0036332

Ikeda, S. (2024). Approach–Avoidance Responses to Affective Facial Expressions and Bodily Posture. *Japanese Psychological Research*, *66*(4), 454-461.

Kaltwasser, L., Moore, K., Weinreich, A., & Sommer, W. (2017). The influence of emotion type, social value orientation and processing focus on approach-avoidance tendencies to negative dynamic facial expressions. *Motivation and Emotion*, *41*(4), 532–544. APA PsycInfo. https://doi.org/10.1007/s11031-017-9624-8

Keltner, D., & Haidt, J. (1999). Social functions of emotions at four levels of analysis. *Cognition and Emotion*, *13*(5), 505–521.

Kohler, C. G., Walker, J. B., Martin, E. A., Healey, K. M., & Moberg, P. J. (2010). Facial emotion perception in schizophrenia: a meta-analytic review. *Schizophrenia bulletin*, *36*(5), 1009–1019. https://doi.org/10.1093/schbul/sbn192

Kordts-Freudinger, R., Oergel, K., & Wuennemann, M. (2017). Feel bad and keep steady: Emotional images and words and postural control during bipedal stance. *Journal of Nonverbal Behavior*, *41*(4), 305–324. psyh. https://doi.org/10.1007/s10919-017-0260-5

Kosonogov, V., Medvedeva, A., Komilova, F., & Volodina, M. (2024). Postural control in emotional states: An effect of biofeedback. *Gait & Posture*, *108*, 183–188. https://doi.org/10.1016/j.gaitpost.2023.12.004

Krieglmeyer, R., & Deutsch, R. (2013). Approach Does Not Equal Approach: Angry Facial Expressions Evoke Approach Only When It Serves Aggression. *Social Psychological and Personality Science*, *4*(5), 607–614. https://doi.org/10.1177/1948550612471060

Lebert, A., Chaby, L., Garnot, C., & Vergilino-Perez, D. (2020). The impact of emotional videos and emotional static faces on postural control through a personality trait approach. *Experimental Brain Research*, *238*(12), 2877-2886.

Lebert, A., Chaby, L., Guillin, A., Chekroun, S., & Vergilino-Perez, D. (2021). Are You “Gazing” at Me? How Others' Gaze Direction and Facial Expression Influence Gaze Perception and Postural Control. *Frontiers in Psychology*, *12*, 730953.

Lebert, A., Vergilino-Perez, D., & Chaby, L. (2024). Keeping distance or getting closer: How others' emotions shape approach-avoidance postural behaviors and preferred interpersonal distance. *PloS one*, *19*(2), e0298069. https://doi.org/10.1371/journal.pone.0298069

LeDoux, J. E. (1996). *The emotional brain: The mysterious underpinnings of emotional life.* Simon & Schuster.

Lelard, T., Godefroy, O., Ahmaidi, S., Krystkowiak, P., & Mouras, H. (2017). Mental Simulation of Painful Situations Has an Impact on Posture and Psychophysiological Parameters. *Frontiers in Psychology*, *8*. https://www.frontiersin.org/articles/10.3389/fpsyg.2017.02012

Lelard, T., Stins, J. F., & Mouras, H. (2019). Postural responses to emotional visual stimuli. *Neurophysiologie Clinique-Clinical Neurophysiology*, *49*(2), 109–114. https://doi.org/10.1016/j.neucli.2019.01.005

Lenzenweger, M. F. (2015). Thinking clearly about schizotypy: Hewing to the schizophrenia liability core, considering interesting tangents, and avoiding conceptual quicksand. *Schizophrenia Bulletin*, *41 Suppl 2*(Suppl 2), S483-491. https://doi.org/10.1093/schbul/sbu184

Lerner, J., & Keltner, D. (2000). Beyond valence: Toward a model of emotion-specific influences on judgement and choice. *Cognition and Emotion*, *14*, 473–493. https://doi.org/10.1080/026999300402763

Leys, C., Delacre, M., Mora, Y. L., Lakens, D., & Ley, C. (2019). How to Classify, Detect, and Manage Univariate and Multivariate Outliers, With Emphasis on Pre-Registration. *International Review of Social Psychology*, *32*(1), 5. https://doi.org/10.5334/irsp.289

Lundqvist, D., Flykt, A., & Öhman, A. (1998). The Karolinska Directed Emotional Faces – KDEF, CD ROM from Department of Clinical Neuroscience, Psychology section, Karolinska Institutet, ISBN 91-630-7164-9.

Macdonald, R. G., & Tatler, B. W. (2013). Do as eye say: Gaze cueing and language in a real-world social interaction. *Journal of Vision*, *13*(4), 6. https://doi.org/10.1167/13.4.6

Macdonald, R. G., & Tatler, B. W. (2018). Gaze in a real-world social interaction: A dual eye-tracking study. *Quarterly Journal of Experimental Psychology*, *71*(10), 2162–2173. https://doi.org/10.1177/1747021817739221

Marsh, A. A., Ambady, N., & Kleck, R. E. (2005). The Effects of Fear and Anger Facial Expressions on Approach- and Avoidance-Related Behaviors. *Emotion*, *5*(1), 119–124. https://doi.org/10.1037/1528-3542.5.1.119

Mirabella, G., Grassi, M., Mezzarobba, S., & Bernardis, P. (2023). Angry and happy expressions affect forward gait initiation only when task relevant. *Emotion, 23*(2), 387–399. https://doi.org/10.1037/emo0001112

Monéger, J., Chaby, L., Besche-Richard, C., & Vergilino-Perez, D. (2025). The Effects of Exposure to Pleasant and Unpleasant Stimuli on Body Posture: A Systematic Review and Meta-Analysis. *Psychophysiology*, *62*(8), e70126. https://doi.org/10.1111/psyp.70126

Morrison, S. C., Brown, L. A., & Cohen, A. S. (2013). A multidimensional assessment of social cognition in psychometrically defined schizotypy. *Psychiatry Research*, *210*(3), 1014–1019. https://doi.org/10.1016/j.psychres.2013.08.020

Mouras, H., & Lelard, T. (2018). Importance of temporal analyzes for the exploration of the posturographic correlates of emotional processing. *Frontiers in Behavioral Neuroscience*, *12*, 277.

Naugle, K. M., Hass, C. J., Bowers, D., & Janelle, C. M. (2012). Emotional state affects gait initiation in individuals with Parkinson's disease. *Cognitive, Affective & Behavioral Neuroscience, 12*(1), 207–219. https://doi.org/10.3758/s13415-011-0071-9

N'Diaye, K., Sander, D., & Vuilleumier, P. (2009). Self-relevance processing in the human amygdala: gaze direction, facial expression, and emotion intensity. *Emotion (Washington, D.C.)*, *9*(6), 798–806. https://doi.org/10.1037/a0017845

Nelson, A. J., Adams, R. B., Jr., Stevenson, M. T., Weisbuch, M., & Norton, M. I. (2013). Approach-avoidance movement influences the decoding of anger and fear expressions. *Social Cognition, 31*(6), 745–757. https://doi.org/10.1521/soco.2013.31.6.745

Niedenthal, P. M., & Brauer, M. (2012). Social functionality of human emotion. *Annual review of psychology*, *63*, 259–285. https://doi.org/10.1146/annurev.psych.121208.131605

Nuel, I., Fayant, M.-P., & Alexopoulos, T. (2019). "Science Manipulates the Things and Lives in Them": Reconsidering Approach-Avoidance Operationalization Through a Grounded Cognition Perspective. *Frontiers in Psychology*, *10*, 1418. https://doi.org/10.3389/fpsyg.2019.01418

Nuel, I., Fayant, M.-P., & Alexopoulos, T. (2021). Hold It Right There!: An Examination of the Approach-Aversion Effect in Virtual Reality. *Social Psychology*, *52*(3), 162–172. https://doi.org/10.1027/1864-9335/a000445

Ozono, H., Watabe, M., & Yoshikawa, S. (2012). Effects of facial expression and gaze direction on approach–avoidance behaviour. *Cognition and Emotion*, *26*(5), 943–949. https://doi.org/10.1080/02699931.2011.641807

Paulus, A., & Wentura, D. (2016). It depends: Approach and avoidance reactions to emotional expressions are influenced by the contrast emotions presented in the task. *Journal of Experimental Psychology: Human Perception and Performance*, *42*(2), 197–212. https://doi.org/10.1037/xhp0000130

Peirce, J., Gray, J. R., Simpson, S., MacAskill, M., Höchenberger, R., Sogo, H., Kastman, E., & Lindeløv, J. K. (2019). PsychoPy2: Experiments in behavior made easy. *Behavior research methods*, *51*(1), 195–203. https://doi.org/10.3758/s13428-018-01193-y

Perakakis, P. E., Idrissi, S., Vila, J., & Ivanov, P. Ch. (2012). Dynamical patterns of human postural responses to emotional stimuli. *Psychophysiology*, *49*(9), 1225–1229. https://doi.org/10.1111/j.1469-8986.2012.01392.x

Phaf, R. H., Mohr, S. E., Rotteveel, M., & Wicherts, J. M. (2014). Approach, avoidance, and affect: a meta-analysis of approach-avoidance tendencies in manual reaction time tasks. *Frontiers in psychology*, *5*, 378. https://doi.org/10.3389/fpsyg.2014.00378

Pichon, S., de Gelder, B., & Grezes, J. (2008). Emotional modulation of visual and motor areas by dynamic body expressions of anger. *Social neuroscience*, *3*(3-4), 199–212. https://doi.org/10.1080/17470910701394368

Pinheiro, J. C., & Bates, D. M. (2000). Fitting nonlinear mixed-effects models. *Mixed-effects models in S and S-PLUS*, 337-421.

Putman, P., Hermans, E., & van Honk, J. (2004). Emotional stroop performance for masked angry faces: it's BAS, not BIS. *Emotion*, *4*(3), 305.

Quijoux, F., Nicolaï, A., Chairi, I., Bargiotas, I., Ricard, D., Yelnik, A., Oudre, L., Bertin-Hugault, F., Vidal, P., Vayatis, N., Buffat, S., & Audiffren, J. (2021). A review of center of pressure (COP) variables to quantify standing balance in elderly people: Algorithms and open-access code. *Physiological Reports*, *9*(22), e15067. https://doi.org/10.14814/phy2.15067

Radke, S., Kalt, T., Wagels, L., & Derntl, B. (2018). Implicit and Explicit Motivational Tendencies to Faces Varying in Trustworthiness and Dominance in Men. *Frontiers in Behavioral Neuroscience*, *12*. https://doi.org/10.3389/fnbeh.2018.00008

Raine, A., Reynolds, C., Lencz, T., Scerbo, A., Triphon, N., & Kim, D. (1994). Cognitive-perceptual, interpersonal, and disorganized features of schizotypal personality. *Schizophrenia Bulletin*, *20*(1), 191–201. https://doi.org/10.1093/schbul/20.1.191

Rammstedt, B., Roemer, L., & Lechner, C. M. (2023). Consistency of the structural properties of the BFI-10 across 16 samples from eight large-scale surveys in Germany. *European Journal of Psychological Assessment*.

R Core Team. (2020). *R: A Language and Environment for Statistical Computing*. Vienna, Austria. Retrieved from https://www.R-project.org/

Sander, D., Grandjean, D., Kaiser, S., Wehrle, T., & Scherer, K. R. (2007). Interaction effects of perceived gaze direction and dynamic facial expression: Evidence for appraisal theories of emotion. *European Journal of Cognitive Psychology*, *19*(3), 470–480. https://doi.org/10.1080/09541440600757426

Seibt, B., Neumann, R., Nussinson Levy-Sadot, R., & Strack, F. (2008). Movement Direction or Change in Distance? Self and Object Related Approach-Avoidance Motions. *Journal of Experimental Social Psychology*, *44*, 713–720. https://doi.org/10.1016/j.jesp.2007.04.013

Seidel, E.-M., Habel, U., Kirschner, M., Gur, R. C., & Derntl, B. (2010). The impact of facial emotional expressions on behavioral tendencies in women and men. *Journal of*

Experimental Psychology: Human Perception and Performance, *36*(2), 500–507. https://doi.org/10.1037/a0018169

Slepian, M. L., Young, S. G., & Harmon-Jones, E. (2017). An approach-avoidance motivational model of trustworthiness judgments. *Motivation Science*, *3*(1), 91–97. https://doi.org/10.1037/mot0000046

Stins, J. F., Roelofs, K., Villan, J., Kooijman, K., Hagenaars, M. A., & Beek, P. J. (2011). Walk to me when I smile, step back when I'm angry: Emotional faces modulate whole-body approach–avoidance behaviors. *Experimental Brain Research*, *212*(4), 603–611. https://doi.org/10.1007/s00221-011-2767-z

Struijs, S. Y., Lamers, F., Vroling, M. S., Roelofs, K., Spinhoven, P., & Penninx, B. W. (2017). Approach and avoidance tendencies in depression and anxiety disorders. *Psychiatry research*, *256*, 475-481.

Sunderland, K. M., Beaton, D., Fraser, J., Kwan, D., McLaughlin, P. M., Montero-Odasso, M., Peltsch, A. J., Pieruccini-Faria, F., Sahlas, D. J., Swartz, R. H., ONDRI Investigators, Strother, S. C., & Binns, M. A. (2019). The utility of multivariate outlier detection techniques for data quality evaluation in large studies: an application within the ONDRI project. *BMC medical research methodology*, *19*(1), 102. https://doi.org/10.1186/s12874-019-0737-5

Todorov, A. (2008). Evaluating Faces on Trustworthiness. *Annals of the New York Academy of Sciences*, *1124*(1), 208–224. https://doi.org/10.1196/annals.1440.012

Van den Stock, J., de Jong, S. J., Hodiamont, P. P., & de Gelder, B. (2011). Perceiving emotions from bodily expressions and multisensory integration of emotion cues in schizophrenia. *Social Neuroscience*, *6*(5-6), 537-547.

Van Dessel, P., De Houwer, J., Gast, A., Roets, A., & Smith, C. T. (2020). On the effectiveness of approach-avoidance instructions and training for changing evaluations of social groups. *Journal of Personality and Social Psychology, 119*(2), e1–e14. https://doi.org/10.1037/pspa0000189

Van Dessel, P., De Houwer, J., Gast, A., & Tucker Smith, C. T. (2015). Instruction-Based Approach-Avoidance Effects: Changing Stimulus Evaluation via the Mere Instruction to Approach or Avoid Stimuli. *Experimental Psychology*, *62*(3), 161–169. https://doi.org/10.1027/1618-3169/a000282

Van Kleef, G. A. (2009). How Emotions Regulate Social Life: The Emotions as Social Information (EASI) Model. *Current Directions in Psychological Science*, *18*(3), 184–188. https://doi.org/10.1111/j.1467-8721.2009.01633.x

Van Kleef, G. A., Van Doorn, E. A., Heerdink, M. W., & Koning, L. F. (2011). Emotion is for influence. *European Review of Social Psychology*, *22*(1), 114–163. https://doi.org/10.1080/10463283.2011.627192

Veenstra, L., Schneider, I. K., Bushman, B. J., & Koole, S. L. (2017). Drawn to danger: trait anger predicts automatic approach behaviour to angry faces. *Cognition & emotion*, *31*(4), 765–771. https://doi.org/10.1080/02699931.2016.1150256

Wastler, H. M., & Lenzenweger, M. F. (2018). Cone of gaze in positive schizotypy: Relationship to referential thinking and social functioning. *Personality Disorders: Theory, Research, and Treatment*, *9*(4), 324–332. https://doi.org/10.1037/per0000258

Wesselmann, E. D., Cardoso, F. D., Slater, S., & Williams, K. D. (2012). To Be Looked at as Though Air: Civil Attention Matters. *Psychological Science*, *23*(2), 166–168. https://doi.org/10.1177/0956797611427921

White, T. P., Borgan, F., Ralley, O., & Shergill, S. S. (2016). You looking at me?: Interpreting social cues in schizophrenia. *Psychological medicine*, *46*(1), 149-160.

Wilkowski, B., & Meier, B. (2010). Bring It On: Angry Facial Expressions Potentiate Approach-Motivated Motor Behavior. *Journal of Personality and Social Psychology*, *98*, 201–210. https://doi.org/10.1037/a0017992

Wirth, J. H., Sacco, D. F., Hugenberg, K., & Williams, K. D. (2010). Eye Gaze as Relational Evaluation: Averted Eye Gaze Leads to Feelings of Ostracism and Relational Devaluation. *Personality and Social Psychology Bulletin*, *36*(7), 869–882. https://doi.org/10.1177/0146167210370032

Zhuang, Z., Landsittel, D., Benson, S., Roberge, R., & Shaffer, R. (2010). Facial anthropometric differences among gender, ethnicity, and age groups. *The Annals of occupational hygiene*, *54*(4), 391–402. https://doi.org/10.1093/annhyg/meq007

Zouraraki, C., Karamaouna, P., & Giakoumaki, S. G. (2023). Facial emotion recognition and schizotypal traits: A systematic review of behavioural studies. *Early Intervention in Psychiatry*, *17*(2), 121–140. https://doi.org/10.1111/eip.13328