Cognitive Processing (2022) 23:79–90
https://doi.org/10.1007/s10339-021-01061-2

RESEARCH ARTICLE

Implicit evidence on the dissociation of identity and emotion recognition

Marcello Passarelli[1] · Michele Masini[2] · Carlo Chiorri[3] · Alessandro Nurcis[3] · Roberta Daini[4] · Fabrizio Bracco[3]

Received: 19 May 2021 / Accepted: 7 September 2021 / Published online: 7 October 2021

Abstract
Recognition of identity and of emotional facial expressions of individuals are both based on processing of the human face. While most studies show these abilities to be dissociated, some others find evidence of a connection. One possible explanation for these contradictory results comes from neurological evidence, which points to identity recognition being mostly based on holistic processing, while emotion recognition seems to be based on both an explicit, fine-grained process, and an implicit, mostly-holistic one. Our main hypothesis, that would explain the contradictory findings, is that holistic implicit emotion recognition, specifically, would be related to identity recognition, while explicit emotion recognition would be a process separate to identity recognition. To test this hypothesis, we employed an experimental paradigm in which spatial frequencies of visual stimuli are manipulated so that automatic, holistic-based, implicit emotion recognition influences perceived friendliness of unfamiliar faces. We predicted the effect to be related to identity recognition ability, since they both require holistic face processing. After a successful replication study, we employed the paradigm with 140 participants, measuring also identity recognition ability and explicit emotion recognition ability. Results showed that the effect is not moderated by these two variables ($p = .807$ and .373, respectively), suggesting that the independence of identity and emotion recognition holds even when considering, specifically, implicit emotion recognition.

Keywords Face processing · Identity recognition · Emotion recognition · Holistic processing · Implicit recognition

Introduction

Faces convey a lot of information. Among the most essential and easily accessible pieces of information are identity and emotions. We can quickly recognize the identity of people from their face, even in unfavorable conditions (Maurer et al. 2007). Similarly, we can recognize the emotional facial expressions of individuals with remarkable accuracy (D'Argembeau and Van der Linden 2007). However, these abilities are not present to the same degree in all individuals: variability is commonly observed in both identity (Bowles et al. 2009) and emotion (Hall 1978; Schlegel et al. 2014; Passarelli et al. 2018) recognition from faces, with some individuals being considerably more skilled than others (Russell et al. 2009).

Despite being both based on the processing of people's faces, the ability to recognize identity and the ability to recognize emotions seem to be at least in part dissociated (Bruce and Young 1986). The strongest case for the dissociation of identity and emotion recognition is based on the existence of specific deficits that impair one ability and not the other (Etcoff 1984; Young et al. 1993; Bentin et al. 2007). Prosopagnosia is a deficit in face identity recognition that can follow a cerebral lesion (Bodamer 1947) or be present from birth in the absence of brain injury (McConachie 1976), and in which emotion recognition seems to

Handling editor: Bruno Laeng (University of Oslo); Reviewers: Tetsuto Minami (Toyohashi University of Technology) and a second researcher who prefers to remain anonymous.

✉ Marcello Passarelli
passarelli@itd.cnr.it

1 ITD - Consiglio Nazionale delle Ricerche, Via de Marini 6, 16149 Genova, Italy

2 V.I.E. (Valorizzazione Innovazione Empowerment), Viale Brigata Bisagno 12/4, 16129 Genova, Italy

3 Dipartimento di Scienze della Formazione, Università degli Studi di Genova, Corso Andrea Podestà 2, 16139 Genova, Italy

4 Dipartimento di Psicologia, Università degli Studi di Milano-Bicocca, Piazza dell'Ateneo Nuovo, 1, 20126 Milano, Italy

be usually preserved (Duchaine et al. 2003). Meanwhile, specific impairments in emotion recognition with preserved identity recognition can be observed following a cerebral lesion (Adolphs et al. 1995), but are also observed in a wide range of psychiatric disorders such as schizophrenia (Comparelli et al. 2013), bipolar disorder (Surguladze et al. 2005), and autism specter disorders (Baron-Cohen et al. 1999).

Experiments on identity and emotion recognition provided further evidence on the dissociation of the two processes, as identity familiarity does not facilitate recognition of emotions (Young et al. 1986; Campbell et al. 1996). Lastly, and most crucially, identity and emotion recognition processes seem to be associated with distinct cerebral activation patterns (George et al. 1993; Narumoto et al. 2001; Winston et al. 2004). Identity recognition seems to mainly involve an area—the fusiform face area—in the occipitotemporal cortex (Grill-Spector et al. 2006; Downing et al. 2006). Emotion recognition, instead, seems to involve two separate neural pathways (Paradiso 1998): a "low road" comprising a set of subcortical nuclei that includes the amygdala and that may perform coarse, implicit emotional processing (Krolak-Salmon et al. 2004), and a "high road," involving the occipital and temporal lobes, as well as the thalamus, that seems to perform fine-grained emotional processing (Haxby et al. 2000). Focal lesions to the amygdala seem to affect the "low road" of emotion recognition (Laeng et al. 2010).

Grounding on all this evidence, some authors (Bruce and Young 1986; Haxby et al. 2000) modeled the processes of identity and emotion recognition as completely separate. However, some experimental results point to some kind of connection between these processes. Specifically, amygdala—involved in implicit emotion recognition—seems to be more active when the face is familiar versus unfamiliar (Schwartz et al. 2003; Leibenluft et al. 2004; Gobbini and Haxby 2006). Furthermore, some experimental studies do report reciprocal influence between identity and emotion recognition (Braun et al. 1994; Schweinberger and Soukup 1998; Baudouin et al. 2000; Lander and Metcalfe 2007).

As a result, the picture is ambiguous: there seem to be compelling evidence for the separation of identity and emotion recognition, but some studies revealed some kind of connection between them, albeit weak (other examples include Duchaine et al. 2006; Minnebusch et al. 2007; Daini et al. 2014). A possible explanation of these contrasting results is offered when considering how faces are perceived for identity and emotion recognition.

Holistic and analytic processing of faces

There is evidence that identity recognition is based, at least in part, on holistic recognition of the whole face (Farah et al. 1998; Rossion et al. 2011; Richler et al. 2011; Tanaka and Simonyi 2016). The very existence of the composite effect points in this direction (Turati et al. 2010; Young et al. 2013). The holistic representation of faces seems to be linked with activation in the middle fusiform gyrus and the inferior occipital gyrus (Schiltz and Rossion 2006), and seems to rely on processing of low spatial frequencies, which convey the coarse information regarding a stimulus (Goffaux and Rossion 2006). Individuals with identity recognition deficits seem to have a specific impairment in building a holistic face representation (Bukach et al. 2006; Ramon et al. 2010; DeGutis et al. 2014). Additionally, low identity recognition ability seems to be associated with more interference due to local information in a Navon test (Behrmann and Avidan 2005; Bentin et al. 2007), lower strength of the composite effect (Palermo et al. 2011a,b; Avidan et al. 2011), difficulty in holistic processing of non-face stimuli (Bentin et al. 2007; Tanzer et al. 2013), and face exploration strategy more focused on details (Schwarzer et al. 2007). All these phenomena point out to the possibility that normal identity recognition ability requires holistic processing of the face.

Regarding emotion recognition, evidence for both holistic and analytical processes comes from experimental paradigms manipulating image spatial frequencies. At a neural level, high and low spatial frequencies are initially processed separately (Flevaris et al. 2014; Gauthier et al. 2005). Removing low spatial frequencies from an image results in a stimulus that, while still providing fine-grained information, seems to be harder to process holistically (Hughes et al. 1990); on the other hand, removing high spatial frequencies results in an image harder to analyze locally (Wenger and Townsend 2000). Emotion recognition seems to be based on both low and high spatial frequencies (Kätsyri et al. 2008; Laeng et al. 2010; Aguado et al. 2010; Meaux and Vuilleumier 2016), but the amygdala is considerably more sensitive to low spatial frequencies (Vuilleumier et al. 2003), suggesting that the "low road" is more based on holistic perception (Meaux and Vuilleumier 2016). This is supported by evidence for the existence of an inversion effect for low spatial frequency emotion recognition (Prete et al. 2015a).

Therefore, holistic perception of the face is related to both identity recognition and the "low road" of emotion recognition, while the "high road" of emotion recognition seems to be more based on analytic processing of the face. It is possible to hypothesize that contradictory results about the relationship between identity and emotion recognition described above are due to identity recognition being related only to the "low road" of emotion recognition. Were this hypothesis to be supported, the association between identity and emotion recognition would be more noticeable when emotion recognition has to be carried out using the "low road" specifically. Were this to be confirmed, it would have important implications for our understanding of face processing.

Fig. 1 On the top left, low-spatial frequencies image of an actress with an angry expression; on the bottom left, a high-spatial frequency image of the same actress with a neutral expression. On the right, the hybrid image that combines the two. Viewing distance from the image and size of the picture can make some spatial frequencies more visible; from far away, the low spatial frequencies should be consciously visible in the hybrid image

The invisible expression effect

In order to test whether identity recognition ability is associated with implicit emotion recognition, we needed to employ an experimental paradigm in which emotion recognition could only be carried out using the implicit, mostly-holistic 'low road'. One such paradigm is described by Laeng et al. (2010) in a series of studies on impression formation. In their studies, Laeng et al. showed that emotional expressions encoded in low spatial frequencies can influence perceived friendliness of unfamiliar faces. Although the authors gave no name to the effect, for convenience, we will refer to it as the Invisible Expression effect, from the title of their paper.

The Invisible Expression effect was evidenced using 'hybrid' stimuli that superimpose the high spatial frequencies (7–128 cycles/image) of an image and the low spatial frequencies (< 6 cycles/image) of another (hybrid stimuli have been described in Oliva and Schyns 1997; Oliva et al. 2006). In Laeng et al.'s series of images (2010), high spatial frequencies encoded the frontal picture of an actor with a neutral expression. Low spatial frequencies encoded a frontal picture of the same actor with either a neutral or emotional expression, according to the experimental condition. The emotional expression encoded by the low spatial frequencies was not consciously perceived by participants (Prete et al. 2018), and the result was a 'hybrid' picture in which the actor was perceived by participants to have a neutral expression (see Fig. 1 for an example). However, when asked to rate on a 5-point scale the friendliness of the unfamiliar faces shown in hybrid images, participants rated angry hybrid images as less friendly, on average, than purely neutral images; purely neutral images were also rated as less friendly, on average, than happy hybrid images.

If our general hypothesis were to be supported, identity recognition ability would be related to the strength of the Invisible Expression effect. This is because we hypothesize that, since holistic processing of the face is the basis of both identity recognition and implicit emotion recognition, individuals with a tendency toward processing faces analytically would not be influenced by the expressions embedded in the hybrid stimuli. Therefore, our experimental hypothesis (1) is that identity recognition ability moderates the Invisible Expression effect (i.e., the relationship between the expression encoded in the low spatial frequencies of the hybrid images and the friendliness rating).

Explicit emotion recognition seems to be mostly related to the "high road" of emotion recognition, and the Invisible Expression effect is related to the "low road" (implicit) one. Were these processes to be connected, we would observe that individuals with low deliberate emotion recognition ability would struggle to also process the 'hidden' emotional stimuli, and would therefore not be influenced by them in the friendliness judgement task. On the other hand, were these processes to be entirely separate, deliberate ('high road') emotion recognition would not influence at all implicit ('low road') emotion recognition, and would therefore also have no influence on the IEE effect. Since we expect these two processes to be separate, our hypothesis (2) is that deliberate emotion recognition does *not* moderate the Invisible Expression effect.

Our hypothesis (3) is that the general tendency for local/global processing of non-face stimuli will moderate the Invisible Expression effect. We expect that individuals with a general tendency for global processing would rely more on the "low road" for emotion recognition and will show an enhanced Invisible Expression effect.

Study 1 (Stimuli selection and replication)

The first study aimed to guide the selection of stimuli to include in Study 2. Since Study 2 was to include several measures with a relatively long administration time, the

Invisible Expression effect had to be measured with relatively few stimuli. Therefore, the results of Study 1 were used to select twenty images of gender-balanced actors to be included in Study 2, with the aim to include the actors for which the Invisible Expression effect was stronger. Some images (e.g., actors that failed to be convincing in their portrayal of an angry expression), in fact, can be expected to show a weaker (or absent) Invisible Expression effect due to low stimulus quality.

The study also represents a replication of the Invisible Expression effect on the Italian population (although this effect was already successfully replicated on Italian samples; see for example Prete et al. 2015a,b). Material preparation followed Laeng et al.'s (2010) procedure. Only three of the experimental conditions considered by Laeng et al. were included in the replication study—namely, the "neutral"/control condition, the happy hybrid image condition, and the angry hybrid image condition. The happy and angry hybrid conditions were the ones expected to maximize the Invisible Expression effect, since in the original study these two conditions had the highest average difference in perceived friendliness.

Methods

Participants

In order to determine the adequate number of participants, we used the procedure described in Judd et al. (2017) and Westfall et al. (2014) and implemented in their website (https://jakewestfall.shinyapps.io/two_factor_power/). We used the default settings (specifically, the expected effect size at $d = 0.50$, which indicates a moderate effect), setting the number of stimuli to 210 and the expected power to 0.80. The resulting minimum number of participants was 16. Assuming that data from some participants could not be taken into account due to excess of missing data, failures in the device administering the stimuli, or withdraw from the study, we recruited 20 participants (13 women, 7 men, age 25.9 ± 6.35 years, range 20–45) through convenience sampling. Participation was voluntary, and participants received no compensation.

Materials and procedure

The experimental stimuli were created by manipulating images of 70 actors (35 females) obtained from the Karolinska Directed Emotional Faces (Goeleven et al. 2008). Images of the frontal neutral, angry, and happy expressions of the 70 actors were converted to grayscale, resized to 250×250 pixels, and normalized for brightness and contrast. The three images for each actor were aligned using the center of the eyes as a reference point.

Following Laeng et al.'s (2010) procedure, low spatial frequency images were created by using a low-pass filter and retaining only spatial frequencies of 1–6 cycles/image. High spatial frequency images retained only spatial frequency of 7–128 cycles/image. Subsequently, low- and high-passed images were combined to create three types of stimuli:

> "Neutral" images, in which both low and high spatial frequencies encoded the neutral expression of an actor, effectively re-composing the original neutral image.
> "Happy" hybrid images, in which the low spatial frequencies encoded the happy expression of an actor, and the high spatial frequencies encoded the neutral expression of the same actor.
> "Angry" hybrid images, in which the low spatial frequencies encoded the angry expression of an actor, and the high spatial frequencies encoded the neutral expression of the same actor.

Each participant was presented with images of every actor, for a total of 210 stimuli. For each trial, the participant was shown the stimulus and was asked to rate how friendly the actor looked, from 1 (very hostile) to 5 (very friendly). Participants had no time limit for answering, and they could not change responses. The order of stimuli presentation was pseudo-randomized, so that the same actor would never been shown twice in a row. Stimuli were shown on a 15.6″ screen, and participants were required to use a chin rest that ensured their viewing distance from the screen was about 40 cms(so that the size of the images on the screen would correspond to 6° of visual angle).

The test was built using Psychopy v1.83.01 (Peirce 2007, 2008). After they rated all images, participants were asked whether or not they noticed something unusual about the stimuli, and if so, whether they could identify the type of manipulation we performed.

Results

In order to take into account non-independence of observations, data were analyzed using a linear mixed model. The dependent variable of the model was the friendliness rating, and the single fixed effect was the experimental condition (neutral, hybrid angry, hybrid happy). Random intercepts were included for each participant. Both random intercepts and random slopes were included for each actor. The random slopes for the actors were included in order to guide the selection of the actors' images to include in Study 2.

The Invisible Expression effect was successfully replicated ($F(2, 38.18) = 16.24$, $p < 0.001$, *partial* $\eta^2 = 0.007$). Marginal means were 2.85 [2.68, 3.02] for the hybrid angry condition, 2.91 [2.73, 3.09] for the neutral/control condition, and 3.06 [2.87, 3.25] for the hybrid happy condition. The difference was statistically significant between all conditions (Hybrid Angry—Neutral = − 0.06 [− 0.11, − 0.01], $t(153.40) = 2.42$, $p = 0.016$, *Cohen's* $d = 0.39$; Neutral—Hybrid Happy = − 0.15 [− 0.23, − 0.08], $t(23.40) = 4.26$, $p < 0.001$, *Cohen's* $d = 1.80$; Hybrid Angry—Hybrid Happy = − 0.22 [− 0.29, − 0.14], $t(24.80) = 5.70$, $p < 0.001$, *Cohen's* $d = 2.29$, using Satterthwaite's (1946) approximation for degrees of freedom and Benjamini and Hochberg's (1995) correction for multiple comparisons). No participants reported noticing image manipulation.

The effect—while small—was induced reliably, with little variation between stimuli used (the random slope variances for the actors considered were 0.001 for the hybrid angry vs. neutral expression conditions, 0.006 for the neutral vs. hybrid happy conditions, and 0.01 for the hybrid angry vs hybrid happy conditions, compared to effect estimates, respectively, of − 0.06, 0.15, and 0.22). The actors chosen for inclusion in Study 2 were the twenty for which the difference between the Hybrid angry and the Hybrid happy condition was higher, i.e., those that on average induced a stronger effect.

Detailed results about the random effects estimated for each actor are reported in the supplementary materials.

Study 2 (Main study)

Methods

Participants

We used the results of Study 1 as part of the input to GLIMMPSE (https://glimmpse.samplesizeshop.org/#/) to get an estimate of an appropriate sample size of a balanced cross-classified linear mixed model that included a repeated measures predictor and three covariates. We estimated that we could reach a power of 0.802 with about 140 participants. The study therefore included 140 participants (108 women, 32 men, age 27.02 ± 10.95 years, range 19–76), recruited through convenience sampling. Of these, 11 were excluded from analysis since they presented a critical performance (under the tenth percentile of their age range) to three or more of the subtests of the Leuven Perceptual Organization Screening Test (L-POST; see below). The final sample included 129 individuals (98 females, age 26.80 ± 10.55 years, range 19–76). Given the negligible loss of participants and the difficulty of recruiting further participants, we decided not to replace the excluded cases. Participation was voluntary and participants received no compensation. No participant took part to both Study 1 and Study 2.

Materials

Leuven Perceptual Organization Screening Test (L-POST). The L-POST (Torfs et al. 2014; Vancleef et al. 2015; available online at http://gestaltrevision.be/tests/lpost_consent.php) is a computerized test for detecting deficit in visual perceptual organization, divided in 15 subtests. The test has a Cronbach's α of 0.76 and a test–retest reliability of 0.77 (Vancleef et al. 2015). Performance to 10 of the L-POST subtests (Shape ratio discrimination, Dot lattices, RFP Fragmented outline, RFP contour integration, RFP texture surfaces, Kinetic object segmentation, Dot counting, Figure ground segmentation, Recognition of objects in isolation, Recognition of objects in a scene) was used as an exclusion criterion so as to ensure that the sample did not include individuals with visuo-perceptual organization deficits. The 5 remaining L-POST subtests specifically focus on local/global perception and were therefore not considered as part of the exclusion criterion.

Cambridge Face Memory Test (CFMT). The CFMT (Duchaine and Nakayama 2006, available online at: http://www.bbk.ac.uk/psychology/psychologyexperiments/experiments/facememorytest/) is a maximal performance test for measuring identity recognition ability. It includes 75 trials. The participant is shown six novel faces to memorize. Subsequently, for each trial, the participant is shown three faces (which may be in a different pose, under different lighting, and/or with added Gaussian noise) and has to select which of the three was one of the memorized faces. There is no time limit, and no possibility to change answers. All faces are shown in grayscale, with covered hair and without details that may ease identification. Identity recognition ability is measured as the proportion of correct responses (range 0–100%; 33% corresponds to chance). Cronbach's α estimates for the CFMT range 0.83–0.90 (McKone et al. 2011).

Facial Expression Recognition Test (FERT). The FERT (Passarelli et al. 2018) is a maximal performance test for measuring ability at recognizing emotions from facial expressions. The FERT includes 36 trials in which the participant is shown an emotional portrayal on the part of a professional actor, together with a neutral picture of the same actor for reference. The participant has to identify the portrayed emotion, choosing from a list of six basic emotions (anger, disgust, fear, happiness, sadness, surprise). There is no time limit, and responses cannot be changed. Emotion recognition ability is modeled using a 2-parameters logistic model (see Passarelli et al. 2018, for the scoring procedure). Test score reliability is 0.92.

Group Embedded Figure Test (GEFT). The Group Embedded Figure Test (Witkin et al. 2002) is a measure of field independence, here used as a proxy for tendency toward local or global processing (De-Wit and Wagemans 2013). The test includes 25 items, in which the participant is shown a complex figure in which they have to find and trace a specific simple figure. Scoring considers the number of correct responses to the second and third test sections (range 0–18). Higher scores correspond to a stronger tendency toward local processing. Estimates of test–retest reliability for the GEFT range 0.78–0.92 (Kepner and Neimark 1984).

Invisible Expression effect. The Invisible Expression effect was measured using a computerized test with the same structure as the one used in Study 1. However, only the 20 actors selected on the basis of the results of Study 1 were included, for a total of 60 trials.[1]

Procedure

The study was presented to participants as a research on the relationship between identity and emotion recognition. After giving informed consent, participants were assigned an anonymous code. The order of measures was randomized for each participant. Stimuli for measuring the Invisible Expression effect were shown on a 15.6'' screen, and participants used a chin rest at about 40 cm from the screen (so that the size of the images on the screen would correspond to 6° of visual angle). Total administration time was 60–70'. The experimental protocol was reviewed and approved by [removed for blind review].

Results

Score range for the CFMT was [50%, 99%] (mean 79.98 ± 10.83), indicating that performance went from below the cut-off for developmental prosopagnosia to nearly perfect performance. Scores for the FERT has less variability than expected, with a range of [−1.82, 1.29], an average of −0.21, and a standard deviation of 0.64 (the normative standard deviation is 1), possibly due to homogeneity of the sample compared to the normative one. Scores for the GEFT spanned the whole theoretical range [0, 18] (mean 11.66 ± 4.66).

Due to non-independence between observations, data were analyzed using a linear mixed model. The dependent variable was the friendliness judgement given by participants in each trial for the Invisible Expression effect. The experimental condition (neutral, hybrid angry, hybrid happy) was included as a trial-level fixed effect. Participants scores at the CFMT, FERT, and GEFT were included as participant-level moderators of the fixed effect. The model included random intercepts for the participants and for the actors included in the Invisible Expression effect measure, and a random slope for the effect of experimental condition for the participants.

The correlation between CFMT and FERT scores was 0.16 ($p = 0.067$); the correlation between CFMT and GEFT scores was 0.21 ($p = 0.018$); the correlation between FERT and GEFT scores was 0.11 ($p = 0.218$).

The Invisible Expression effect was replicated ($F(2, 195.66) = 3.80$, $p = 0.024$, *partial* $\eta^2 = 0.038$). Marginal means were 2.74 [2.54, 2.94] for the hybrid angry condition, 2.91 [2.71, 3.11] for the neutral/control condition, and 3.19 [2.99, 3.40] for the hybrid happy condition. The difference was statistically significant between all conditions (Hybrid Angry—Neutral = −0.17 [−0.21, −0.13], $t(811.80) = 8.12$, $p < 0.001$, *Cohen's* $d = 0.10$; Neutral—Hybrid Happy = −0.28 [−0.33, −0.23], $t(152.70) = 11.53$, $p < 0.001$, *Cohen's* $d = 0.29$; Hybrid Angry—Hybrid Happy = −0.45 [−0.51, −0.40], $t(124.40) = 17.07$, $p < 0.001$, *Cohen's* $d = 0.49$, using Satterthwaite's (1946) approximation for degrees of freedom and Benjamini and Hochberg's (1995) correction for multiple comparisons).

No moderation of the Invisible Expression effect was significant (CFMT: $F(2, 195.66) = 0.13$, $p = 0.877$, *partial* $\eta^2 < 0.001$; FERT: $F(2, 195.66) = 0.57$, $p = 0.569$, *partial* $\eta^2 < 0.001$; GEFT: $F(2, 195.66) = 0.16$, $p = 0.851$, *partial* $\eta^2 < 0.001$).

Moderating effects estimated by the model are shown in Figs. 2 (CFMT), 3 (FERT), and 4 (GEFT). From visual inspection, there is no trend in favor experimental hypotheses (1) and (3). Hypothesis (2), of not observing moderation of FERT score on the Invisible Expression effect, is confirmed (Fig. 3).

Discussion

In Study 1 we sought to replicate the Invisible Expression effect described by Laeng et al. (2010). Participants were presented with hybrid stimuli of faces, in which high spatial frequencies encode the picture of a face with a neutral expression and low spatial frequencies encode a picture of the same actor with a neutral or emotional (happy or angry) expression. Participants were asked to rate the friendliness of the actors portrayed. The expression encoded in the low spatial frequencies, while not consciously perceived, influenced this judgement. Hybrid happy faces were judged, on average, more friendly than neutral (control) faces, which were in turn judged as more friendly than hybrid angry faces.

In Study 2, we tested some hypotheses pertaining to identity and emotion recognition. Our main hypothesis (1) was of a moderating effect of identity recognition ability, measured by the CFMT, on the Invisible Expression effect. This hypothesis was based on the reasoning that identity

[1] Actors' gender was balanced. As an exploratory analysis, we checked whether actor gender was associated with perceived friendliness, and we found no significant results. As this was not the focus of the study, we did not include this variable in the models.

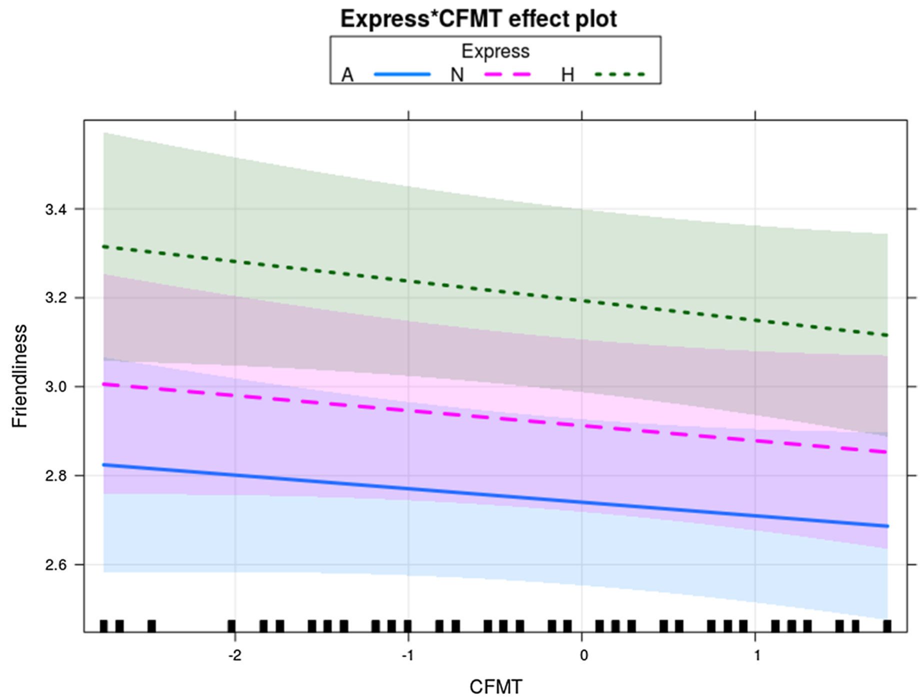

Fig. 2 Moderating effect of Cambridge Face Memory Test (CFMT) on the Invisible Expression effect. Test score is on the x axis, and friendliness rating on the y axis. The three lines correspond to the marginal means for the three experimental conditions (black, continuous = neutral (N); red, dashed = hybrid angry (A); green, dotted = hybrid happy (H)). Shaded areas represent 95% confidence intervals. Parallel lines indicate absence of moderation

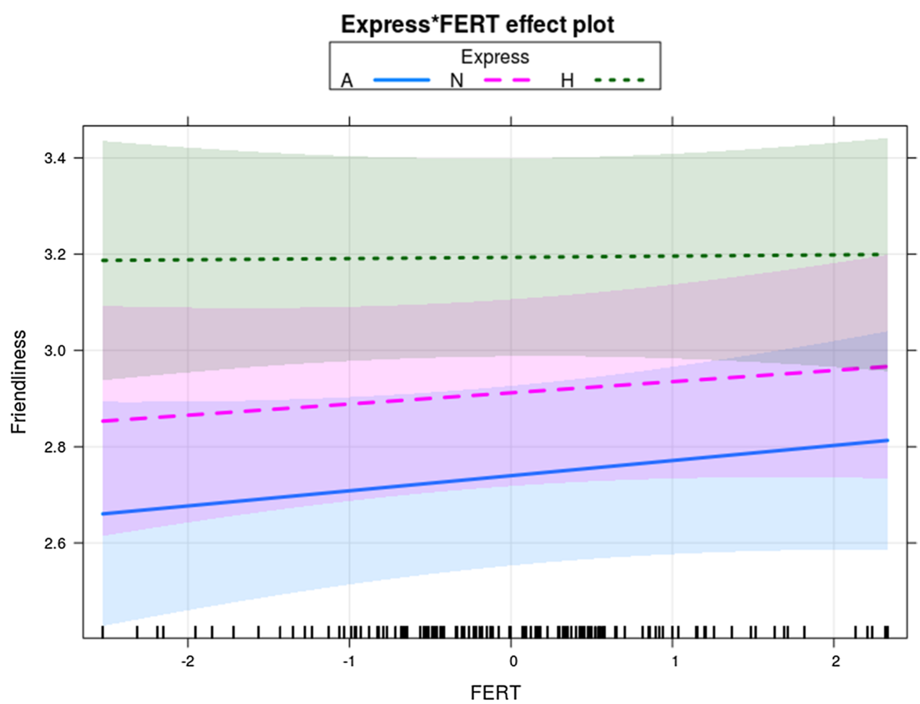

Fig. 3 Moderating effect of the Facial Expression Recognition Test (FERT) on the Invisible Expression effect. Test score is on the x axis, and friendliness rating on the y axis. The three lines correspond to the marginal means for the three experimental conditions (black, continuous = neutral (N); red, dashed = hybrid angry (A); green, dotted = hybrid happy (H)). Shaded areas represent 95% confidence intervals. Parallel lines indicate absence of moderation

and implicit emotion recognition could be related since they both rely, in part, on holistic representation of faces (Vuilleumier et al. 2003; Bentin et al. 2007; Avidan et al. 2011; Palermo et al. 2011a). However, our results did not support this hypothesis: the Invisible Expression effect seems to of equal size (i.e., weak but reliably induced) in all individuals, regardless of their identity recognition ability. This result favors the model for which identity and emotion recognition are two distinct and unrelated abilities (Haxby et al. 2000) even when considering, specifically, implicit emotion recognition.

Our hypothesis (2) was that there would be no moderation of deliberate emotion recognition ability, measured by the FERT, on the Invisible Expression effect. This is because

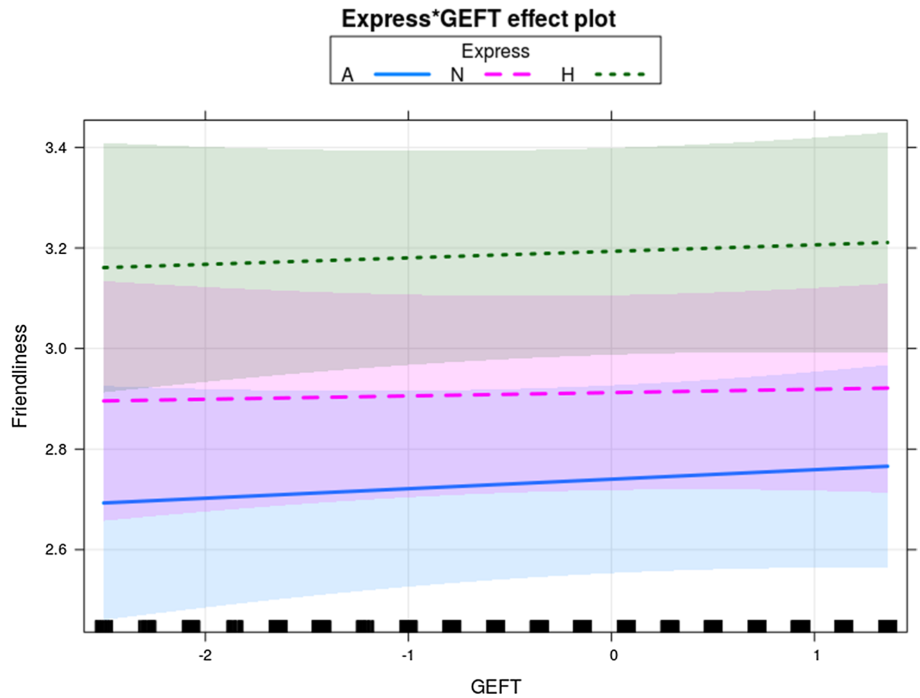

Fig. 4 Moderating effect of the Group Embedded Figure Test (GEFT) on the Invisible Expression effect. Test score is on the x axis, and friendliness rating on the y axis. The three lines correspond to the marginal means for the three experimental conditions (black, continuous = neutral (N); red, dashed = hybrid angry (A); green, dotted = hybrid happy (H)). Shaded areas represent 95% confidence intervals. Parallel lines indicate absence of moderation

we expected explicit and implicit emotion recognition to be mostly separate processes. The results align with our expectations, as we found no evidence that implicit processing of facial expressions, involving the amygdala and based on mostly holistic processing, would be related to the ability of consciously recognizing and naming emotions. Further studies—possibly using a Bayesian framework, which is more suited for providing evidence of absence of an effect—are needed to confirm this finding.

Lastly, our hypothesis (3) was to observe a moderation of the general tendency toward global/local processing, measured by the GEFT, on the Invisible Expression effect. Again, the Invisible Expression effect seems equally induced across the range of GEFT scores. This result suggests that holistic processing of facial expressions is performed also by individuals that rely on analytic processing when analyzing geometric shapes.

Additionally, we observed a weak (< 0.30) and non-significant correlation between identity recognition ability, measured using the CFMT, and emotion recognition ability in everyday conditions, measured using the FERT. This result supports the model that posits dissociation between identity and deliberate emotion recognition in ecological situations (i.e., using unfiltered stimuli; Haxby et al. 2000).

Limitations

The study presents several important limitations, mostly due to concerns about administration time. Most of the measures we used in Study 2 were maximal performance tests, and the number of measures had to be kept low so as to not tire participants excessively. However, using a single measure for both identity recognition ability and tendency toward local/global processing is a critical aspect of the study. Typically, studies on identity recognition ability employ multiple measures in order to better assess it (e.g., Daini et al. 2014). The same is true for tendency toward local/global processing, which can be measured using wildly different tasks (e.g., De-Wit and Wagemans 2013). Our choice to limit the number of measures was based on a trade-off in which we decided to favor the comfort and performance of our participants, but our understanding of the phenomena we investigated would benefit from a replication of the study that used alternative (or additional) measures for the same constructs.

A second limitation of the study is its focus on the normal ability range for identity and emotion recognition. Only three participants (2.3%) were below the CFMT cut-off for prosopagnosia for the Italian population (Albonico et al. 2017), as would be expected from random sampling. Therefore, study findings cannot be generalized to individuals with severe deficits in identity recognition. It is possible that only those individuals—rather than individuals on the low end of the normal ability range—lack an Invisible Expression effect.

Future work

Future work should focus on overcoming the limitations of the present study, and in particular in checking whether or not the results will be replicated when using alternative measures. Additionally, testing the hypothesis in a sample including a non-negligible proportion of individual with developmental prosopagnosia may lend further evidence for the dissociation of emotion and identity recognition.

Lastly, the present study tested a hypothesis that could have explained why, despite a general model of dissociation between identity and emotion recognition, some studies report a connection between these abilities. Since our hypothesis was not supported, this association remains unexplained and the conditions in which identity and emotion recognition influence each other are still to be understood.

Conclusions

The present paper started from the acknowledgment that in scientific literature there is lack of consensus on whether or not identity and emotion recognition are completely dissociated processes. While experimental and clinical evidence seems to be more in favor of their dissociation, some experimental paradigms do show reciprocal influence between identity and emotion recognition. We hypothesized that this influence could be explained by ability in generating a holistic representation of faces, which would impact identity recognition, but would only impact one out of two efficient strategies for emotion recognition (i.e., implicit emotion recognition, which is more based on global rather than local processing). We therefore used an experimental paradigm that requires emotion recognition to be performed using only the implicit mode, hypothesizing that this specific task would show an association between identity and emotion recognition that is masked in paradigms that allow deliberate, local processing for emotion recognition.

Our hypothesis was not supported, and our results have shown no evidence of association of identity and emotion recognition even when emotion recognition is implicit. While the effect could be present and detectable with a larger sample size or a different experimental paradigm, the lack of significant results in the present study lends further support to the model of dissociation between identity and emotion recognition.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s10339-021-01061-2.

Funding No funding was received for this study.

Availability of data and material Data are available upon request to the authors.

Code availability R codes are included in the supplemental materials.

Declarations

Ethics approval The study received ethical approval from the Ethics Committee of [removed for blind review].

Consent to participate All participants provided informed consent prior to the participation to the study.

Consent for publication All participants provided consent for the publication of anonymized data and results.

Conflicts of interest Not applicable.

References

Adolphs R, Tranel D, Damasio H, Damasio A (1995) Fear and the human amygdala. J Neurosci 15:5879–5891. https://doi.org/10.1523/JNEUROSCI.15-09-05879.1995

Aguado L, Serrano-Pedraza I, Rodríguez S, Román FJ (2010) Effects of spatial frequency content on classification of face gender and expression. Span J Psychol 13:525–537. https://doi.org/10.1017/S1138741600002225

Albonico A, Malaspina M, Daini R (2017) Italian normative data and validation of two neuropsychological tests of face recognition: Benton Facial Recognition Test and Cambridge Face Memory Test. Neurol Sci 38:1637–1643. https://doi.org/10.1007/s10072-017-3030-6

Avidan G, Tanzer M, Behrmann M (2011) Impaired holistic processing in congenital prosopagnosia. Neuropsychologia 49:2541–2552. https://doi.org/10.1016/j.neuropsychologia.2011.05.002

Baron-Cohen S, Ring HA, Wheelwright S et al (1999) Social intelligence in the normal and autistic brain: an fMRI study. Eur J Neurosci 11:1891–1898. https://doi.org/10.1046/j.1460-9568.1999.00621.x

Baudouin J-Y, Gilibert D, Sansone S, Tiberghien G (2000) When the smile is a cue to familiarity. Memory 8:285–292. https://doi.org/10.1080/09658210050117717

Behrmann M, Avidan G (2005) Congenital prosopagnosia: face-blind from birth. Trends Cogn Sci 9:180–187. https://doi.org/10.1016/j.tics.2005.02.011

Benjamini Y, Hochberg Y (1995) Controlling the false discovery rate: a practical and powerful approach to multiple testing. J R Stat Soc Ser B 57:289–300. https://doi.org/10.1111/j.2517-6161.1995.tb02031.x

Bentin S, Degutis JM, D'Esposito M, Robertson LC (2007) Too many trees to see the forest: performance, event-related potential, and functional magnetic resonance imaging manifestations of

integrative congenital prosopagnosia. J Cogn Neurosci 19:132–146. https://doi.org/10.1162/jocn.2007.19.1.132
Bodamer J (1947) Die Prosop-Agnosie. Arch Für Psychiatr Und Nervenkrankheiten Ver Mit Zeitschrift Für Die Gesamte Neurol Und Psychiatr 179:6–53. https://doi.org/10.1007/BF00352849
Bowles DC, McKone E, Dawel A et al (2009) Diagnosing prosopagnosia: effects of ageing, sex, and participant–stimulus ethnic match on the Cambridge Face Memory Test and Cambridge Face Perception Test. Cogn Neuropsychol 26:423–455. https://doi.org/10.1080/02643290903343149
Braun CMJ, Denault C, Cohen H, Rouleau I (1994) Discrimination of facial identity and facial affect by temporal and frontal lobectomy patients. Brain Cogn 24:198–212. https://doi.org/10.1006/brcg.1994.1011
Bruce V, Young A (1986) Understanding face recognition. Br J Psychol 77:305–327. https://doi.org/10.1111/j.2044-8295.1986.tb02199.x
Bukach CM, Bub DN, Gauthier I, Tarr MJ (2006) Perceptual expertise effects are not all or none: spatially limited perceptual expertise for faces in a case of prosopagnosia. J Cogn Neurosci 18:48–63. https://doi.org/10.1162/089892906775250094
Campbell R, Brooks B, de Haan E, Roberts T (1996) Dissociating face processing skills: decisions about lip read speech, expression, and identity. Q J Exp Psychol Sect A 49:295–314. https://doi.org/10.1080/713755619
Comparelli A, Corigliano V, De Carolis A et al (2013) Emotion recognition impairment is present early and is stable throughout the course of schizophrenia. Schizophr Res 143:65–69. https://doi.org/10.1016/j.schres.2012.11.005
D'Argembeau A, Van der Linden M (2007) Facial expressions of emotion influence memory for facial identity in an automatic way. Emotion 7:507–515. https://doi.org/10.1037/1528-3542.7.3.507
Daini R, Comparetti CM, Ricciardelli P (2014) Behavioral dissociation between emotional and non-emotional facial expressions in congenital prosopagnosia. Front Hum Neurosci 8:1–11. https://doi.org/10.3389/fnhum.2014.00974
DeGutis JM, Chiu C, Grosso ME, Cohan S (2014) Face processing improvements in prosopagnosia: successes and failures over the last 50 years. Front Hum Neurosci. https://doi.org/10.3389/fnhum.2014.00561
De-Wit L, Wagemans J (2013) Individual differences in local and global perceptual organization. In: Oxford handbook of perceptual organization, pp 713–735
Downing PE, Chan AWY, Peelen MV et al (2006) Domain specificity in visual cortex. Cereb Cortex 16:1453–1461. https://doi.org/10.1093/cercor/bhj086
Duchaine BC, Nakayama K (2006) The Cambridge Face Memory Test: results for neurologically intact individuals and an investigation of its validity using inverted face stimuli and prosopagnosic participants. Neuropsychologia 44:576–585. https://doi.org/10.1016/j.neuropsychologia.2005.07.001
Duchaine BC, Parker H, Nakayama K (2003) Normal recognition of emotion in a prosopagnosic. Perception 32:827–838. https://doi.org/10.1068/p5067
Duchaine BC, Yovel G, Butterworth EJ, Nakayama K (2006) Prosopagnosia as an impairment to face-specific mechanisms: elimination of the alternative hypotheses in a developmental case. Cogn Neuropsychol 23:714–747. https://doi.org/10.1080/02643290500441296
Etcoff NL (1984) Selective attention to facial identity and facial emotion. Neuropsychologia 22:281–295. https://doi.org/10.1016/0028-3932(84)90075-7
Farah MJ, Wilson KD, Drain M, Tanaka JN (1998) What is "special" about face perception? Psychol Rev 105:482–498. https://doi.org/10.1037/0033-295X.105.3.482
Flevaris AV, Martínez A, Hillyard SA (2014) Attending to global versus local stimulus features modulates neural processing of low versus high spatial frequencies: An analysis with event-related brain potentials. Front Psychol. https://doi.org/10.3389/fpsyg.2014.00277
Gauthier I, Curby KM, Skudlarski P, Epstein RA (2005) Individual differences in FFA activity suggest independent processing at different spatial scales. Cogn Affect Behav Neurosci 5:222–234. https://doi.org/10.3758/CABN.5.2.222
George MS, Ketter TA, Gill DS et al (1993) Brain regions involved in recognizing facial emotion or identity: an oxygen-15 PET study. J Neuropsychiatry Clin Neurosci 5:384–394. https://doi.org/10.1176/jnp.5.4.384
Gobbini MI, Haxby JV (2006) Neural response to the visual familiarity of faces. Brain Res Bull 71:76–82. https://doi.org/10.1016/j.brainresbull.2006.08.003
Goeleven E, De Raedt R, Leyman L, Verschuere B (2008) The Karolinska Directed Emotional Faces: a validation study. Cogn Emot 22:1094–1118. https://doi.org/10.1080/02699930701626582
Goffaux V, Rossion B (2006) Faces are "spatial"–holistic face perception is supported by low spatial frequencies. J Exp Psychol Hum Percept Perform 32:1023–1039. https://doi.org/10.1037/0096-1523.32.4.1023
Grill-Spector K, Sayres R, Ress D (2006) High-resolution imaging reveals highly selective nonface clusters in the fusiform face area. Nat Neurosci 9:1177–1185. https://doi.org/10.1038/nn1745
Hall JA (1978) Gender effects in decoding nonverbal cues. Psychol Bull 85:845–857. https://doi.org/10.1037/0033-2909.85.4.845
Haxby JV, Hoffman EA, Gobbini MI (2000) The distributed human neural system for face perception. Trends Cogn Sci 4:223–233. https://doi.org/10.1016/S1364-6613(00)01482-0
Hughes HC, Fendrich R, Reuter-Lorenz PA (1990) Global versus local processing in the absence of low spatial frequencies. J Cogn Neurosci 2:272–282. https://doi.org/10.1162/jocn.1990.2.3.272
Judd CM, Westfall J, Kenny DA (2017) Experiments with more than one random factor: designs, analytic models, and statistical power. Annu Rev Psychol 68:601–625. https://doi.org/10.1146/annurev-psych-122414-033702
Kätsyri J, Saalasti S, Tiippana K et al (2008) Impaired recognition of facial emotions from low-spatial frequencies in Asperger syndrome. Neuropsychologia 46:1888–1897. https://doi.org/10.1016/j.neuropsychologia.2008.01.005
Kepner MD, Neimark ED (1984) Test–retest reliability and differential patterns of score change on the Group Embedded Figures Test. J Pers Soc Psychol 46:1405–1413. https://doi.org/10.1037/0022-3514.46.6.1405
Krolak-Salmon P, Hénaff M-A, Vighetto A et al (2004) Early amygdala reaction to fear spreading in occipital, temporal, and frontal cortex. Neuron 42:665–676. https://doi.org/10.1016/S0896-6273(04)00264-8
Laeng B, Profeti I, Sæther L (2010) Invisible expressions evoke core impressions. Emotion 10:573–586. https://doi.org/10.1037/a0018689
Lander K, Metcalfe S (2007) The influence of positive and negative facial expressions on face familiarity. Memory 15:63–69. https://doi.org/10.1080/09658210601108732
Leibenluft E, Gobbini MI, Harrison T, Haxby JV (2004) Mothers' neural activation in response to pictures of their children and other children. Biol Psychiatry 56:225–232. https://doi.org/10.1016/j.biopsych.2004.05.017
Maurer D, O'Craven KM, Le Grand R et al (2007) Neural correlates of processing facial identity based on features versus their spacing. Neuropsychologia 45:1438–1451. https://doi.org/10.1016/j.neuropsychologia.2006.11.016
McConachie HR (1976) Developmental prosopagnosia. A single case report. Cortex 12:76–82. https://doi.org/10.1016/S0010-9452(76)80033-0

McKone E, Hall A, Pidcock M et al (2011) Face ethnicity and measurement reliability affect face recognition performance in developmental prosopagnosia: evidence from the Cambridge Face Memory Test-Australian. Cogn Neuropsychol 28:109–146. https://doi.org/10.1080/02643294.2011.616880

Meaux E, Vuilleumier P (2016) Facing mixed emotions: analytic and holistic perception of facial emotion expressions engages separate brain networks. Neuroimage. https://doi.org/10.1016/j.neuroimage.2016.07.004

Minnebusch DA, Suchan B, Ramon M, Daum I (2007) Event-related potentials reflect heterogeneity of developmental prosopagnosia. Eur J Neurosci 25:2234–2247. https://doi.org/10.1111/j.1460-9568.2007.05451.x

Narumoto J, Okada T, Sadato N et al (2001) Attention to emotion modulates fMRI activity in human right superior temporal sulcus. Cogn Brain Res 12:225–231. https://doi.org/10.1016/S0926-6410(01)00053-2

Oliva A, Torralba A, Schyns PG (2006) Hybrid images. In: ACM SIGGRAPH 2006 Papers on - SIGGRAPH '06. ACM Press, New York, New York, USA, p 527

Oliva A, Schyns PG (1997) Coarse blobs or fine edges? Evidence that information diagnosticity changes the perception of complex visual stimuli. Cogn Psychol 34:72–107. https://doi.org/10.1006/cogp.1997.0667

Palermo R, Rivolta D, Wilson CE, Jeffery L (2011a) Adaptive face space coding in congenital prosopagnosia: typical figural aftereffects but abnormal identity aftereffects. Neuropsychologia 49:3801–3812. https://doi.org/10.1016/j.neuropsychologia.2011.09.039

Palermo R, Willis ML, Rivolta D et al (2011b) Impaired holistic coding of facial expression and facial identity in congenital prosopagnosia. Neuropsychologia 49:1226–1235. https://doi.org/10.1016/j.neuropsychologia.2011.02.021

Paradiso S (1998) The emotional brain: the mysterious underpinnings of emotional life. Am J Psychiatry 155:570–570. https://doi.org/10.1176/ajp.155.4.570

Passarelli M, Masini M, Bracco F et al (2018) Development and validation of the Facial Expression Recognition Test (FERT). Psychol Assess 30:1479–1490. https://doi.org/10.1037/pas0000595

Peirce JW (2007) PsychoPy—psychophysics software in Python. J Neurosci Methods 162:8–13. https://doi.org/10.1016/j.jneumeth.2006.11.017

Peirce JW (2008) Generating stimuli for neuroscience using PsychoPy. Front Neuroinform. https://doi.org/10.3389/neuro.11.010.2008

Prete G, Capotosto P, Zappasodi F et al (2015a) The cerebral correlates of subliminal emotions: an electroencephalographic study with emotional hybrid faces. Eur J Neurosci 42:2952–2962. https://doi.org/10.1111/ejn.13078

Prete G, D'Ascenzo S, Laeng B et al (2015b) Conscious and unconscious processing of facial expressions: evidence from two split-brain patients. J Neuropsychol 9:45–63. https://doi.org/10.1111/jnp.12034

Prete G, Laeng B, Tommasi L (2018) Modulating adaptation to emotional faces by spatial frequency filtering. Psychol Res. https://doi.org/10.1007/s00426-016-0830-x

Ramon M, Busigny T, Rossion B (2010) Impaired holistic processing of unfamiliar individual faces in acquired prosopagnosia. Neuropsychologia 48:933–944. https://doi.org/10.1016/j.neuropsychologia.2009.11.014

Richler JJ, Cheung OS, Gauthier I (2011) Holistic processing predicts face recognition. Psychol Sci 22:464–471. https://doi.org/10.1177/0956797611401753

Rossion B, Dricot L, Goebel R, Busigny T (2011) Holistic face categorization in higher order visual areas of the normal and prosopagnosic brain: toward a non-hierarchical view of face perception. Front Hum Neurosci. https://doi.org/10.3389/fnhum.2010.00225

Russell R, Duchaine B, Nakayama K (2009) Super-recognizers: people with extraordinary face recognition ability. Psychon Bull Rev 16:252–257. https://doi.org/10.3758/PBR.16.2.252

Satterthwaite FE (1946) An approximate distribution of estimates of variance components. Biom Bull 2:110. https://doi.org/10.2307/3002019

Schiltz C, Rossion B (2006) Faces are represented holistically in the human occipito-temporal cortex. Neuroimage 32:1385–1394. https://doi.org/10.1016/j.neuroimage.2006.05.037

Schlegel K, Grandjean D, Scherer KR (2014) Introducing the Geneva Emotion Recognition Test: an example of Rasch-based test development. Psychol Assess 26:666–672. https://doi.org/10.1037/a0035246

Schwartz CE, Wright CI, Shin LM et al (2003) Differential amygdalar response to novel versus newly familiar neutral faces: a functional MRI probe developed for studying inhibited temperament. Biol Psychiatry 53:854–862. https://doi.org/10.1016/S0006-3223(02)01906-6

Schwarzer G, Huber S, Grüter M et al (2007) Gaze behaviour in hereditary prosopagnosia. Psychol Res 71:583–590. https://doi.org/10.1007/s00426-006-0068-0

Schweinberger SR, Soukup GR (1998) Asymmetric relationships among perceptions of facial identity, emotion, and facial speech. J Exp Psychol Hum Percept Perform 24:1748–1765. https://doi.org/10.1037/0096-1523.24.6.1748

Surguladze SA, Brammer MJ, Keedwell P et al (2005) A differential pattern of neural response toward sad versus happy facial expressions in major depressive disorder. Biol Psychiatry 57:201–209. https://doi.org/10.1016/j.biopsych.2004.10.028

Tanaka JW, Simonyi D (2016) The "parts and wholes" of face recognition: a review of the literature. Q J Exp Psychol 69:1876–1889. https://doi.org/10.1080/17470218.2016.1146780

Tanzer M, Freud E, Ganel T, Avidan G (2013) General holistic impairment in congenital prosopagnosia: evidence from Garner's speeded-classification task. Cogn Neuropsychol 30:429–445. https://doi.org/10.1080/02643294.2013.873715

Torfs K, Vancleef K, Lafosse C et al (2014) The Leuven Perceptual Organization Screening Test (L-POST), an online test to assess mid-level visual perception. Behav Res Methods 46:472–487. https://doi.org/10.3758/s13428-013-0382-6

Turati C, Di Giorgio E, Bardi L, Simion F (2010) Holistic face processing in newborns, 3-month-old infants, and adults: evidence from the composite face effect. Child Dev 81:1894–1905. https://doi.org/10.1111/j.1467-8624.2010.01520.x

Vancleef K, Acke E, Torfs K et al (2015) Reliability and validity of the Leuven Perceptual Organization Screening Test (L-POST). J Neuropsychol 9:271–298. https://doi.org/10.1111/jnp.12050

Vuilleumier P, Armony JL, Driver J, Dolan RJ (2003) Distinct spatial frequency sensitivities for processing faces and emotional expressions. Nat Neurosci 6:624–631. https://doi.org/10.1038/nn1057

Wenger MJ, Townsend JT (2000) Spatial frequencies in short-term memory for faces: a test of three frequency-dependent hypotheses. Mem Cognit 28:125–142. https://doi.org/10.3758/BF03211581

Westfall J, Kenny DA, Judd CM (2014) Statistical power and optimal design in experiments in which samples of participants respond to samples of stimuli. J Exp Psychol Gen 143:2020–2045. https://doi.org/10.1037/xge0000014

Winston JS, Henson RNA, Fine-Goulden MR, Dolan RJ (2004) fMRI-adaptation reveals dissociable neural representations of identity and expression in face perception. J Neurophysiol 92:1830–1839. https://doi.org/10.1152/jn.00155.2004

Witkin H, Oltman P, Raskin E, Karp SA (2002) Group embedded figures test manual. Consulting Psychologists Press, Palo Alto, CA

Young AW, McWeeny KH, Hay DC, Ellis AW (1986) Matching familiar and unfamiliar faces on identity and expression. Psychol Res 48:63–68. https://doi.org/10.1007/BF00309318

Young AW, Newcombe F, de Haan EHF et al (1993) Face perception after brain injury. Brain 116:941–959. https://doi.org/10.1093/brain/116.4.941

Young AW, Hellawell D, Hay DC (2013) Configurational information in face perception. Perception 42:1166–1178. https://doi.org/10.1068/p160747n