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# Pushing the boundaries of human expertise in face perception: Emotion expression identification and error as a function of presentation angle, presentation time, and emotion

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## HIGHLIGHTS

- Parents viewed child faces displaying various emotional expressions.
- Faces were viewed for different durations (unlimited, 600 ms, 100 ms).
- Different face views (full-face, 45° profile, 90° profile) were presented.
- Emotion identification accuracy was very poor when 90° faces were viewed for 100 ms.
- Faces displaying sadness and faces displaying anger were most often confused.

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## ABSTRACT

Past research results suggest that reliable identification of emotions conveyed by facial expressions can be made either when faces are: (1) briefly glimpsed, or (2) viewed in profile. Of interest was whether such effects would persist when perceivers encountered both manipulations, briefly (100 ms) viewing 90-degree profile faces. Our results show that expertise in emotion perception has limits: Identification accuracy of emotions conveyed by facial expressions was poor when 90-degree profile views of faces were presented for only 100 ms, especially for the emotions of sadness and anger. Our results also suggest that: (1) overall, observers can more accurately perceive happiness in faces than they could perceive negative emotions, and (2) in relatively easy viewing conditions, identification of faces displaying sadness and anger were most often confused, but when 90-degree profile faces were viewed for only 100 ms, sad faces and angry faces were most often misidentified as neutral faces.


## Introduction

Perceivers readily proceed from observations of actor behaviors to inferences about the actor's unobservable states and traits (McCarthy & Skowronski, 2011; Uleman, Saribay, & Gonzalez, 2008; Wells, Skowronski, Crawford, Scherer, & Carlston, 2011). One behavior that can be studied in light of this notion is an actor's facial expression. Research results (Aviezer, Hassin, Bentin, & Trope, 2008; Trope, 1986) suggest that perceivers first identify the meaning of a facial expression, then use that extracted meaning in the process of making an inference about the actor's internal emotion. The present article focuses on the identification stage of this process, and in particular, on the possible role that expertise in face processing plays there.

Humans are thought to be expert face processors (see Aviezer, Bentin, Dudarev, & Hassin, 2011; Curby & Gauthier, 2010). This expertise is revealed in multiple ways. For example: (1) face perception is very sensitive to subtle changes in spatial relations among face features (Bruce, Doyle, Dench, & Burton, 1991; Hosie, Ellis, & Haig, 1988; Kemp, McManus, & Pigott, 1990), and (2) adults can detect changes in facial feature configurations that approach the limits of normal visual acuity (Haig, 1984). Moreover, in their domain of expertise, experts have an enhanced ability to recognize familiar patterns, even under difficult processing conditions (De Groot & Gobet, 1996). This rule also applies to face perception. For example, perceivers readily identify facial expressions, even at brief presentation durations (e.g., 50 ms, Grimshaw, Bulman-Fleming, & Ngo, 2004; 100 ms, Prkachin, 2003; 125 ms, Martin, Slessor, Allen, Phillips, & Darling, 2012; 200 ms, Leppänen, Milders, Bell,

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Terriere, & Hietanen, 2004; 500 ms, Hess, Adams, & Kleck, 2009). Moreover, perceivers readily identify emotions conveyed by profile views of faces (Kleck & Mendolia, 1990; Matsumoto & Hwang, 2011).

The present article explores the limits of expertise in face perception by asking some participants to identify faces displaying emotions in difficult viewing conditions. We enhanced emotion identification task difficulty by combining two of the manipulations that are referred to in the paragraphs above: We presented faces conveying emotion expressions in one of three face orientations (frontal, 45°, and 90°), and we presented those faces for varying durations (100 ms, 600 ms, and unlimited). Key to our study is whether human expertise at face processing would prevent impairment in identification of emotions conveyed by facial expressions when those faces were **both** viewed in 90-degree profile and were viewed for only 100 ms. The absence of impairment evidence would confirm that perceiver expertise in the identification of emotions from facial expressions is impressive, and points to a high degree of perceiver fluency in the extraction of meaning from emotion-displaying faces. However, logic suggests that difficult viewing conditions should limit a perceiver's ability to identify emotions conveyed in facial expressions. Documentation of such impairments would help to determine the boundaries of the perceiver's ability to identify emotion expressions, and hence, would place limits on the extent to which perceivers can proceed from identification of emotion expressions to inferences about an actor's internal states (Aviezer et al., 2008; Trope, 1986).

The faces that we used conveyed one of five emotions (happy, angry, fearful, sad, and neutral). This manipulation allowed exploration of the possibility that a perceiver's ability to identify the emotion conveyed by a facial expression might depend on the emotion conveyed, especially in difficult viewing conditions. This issue is especially relevant given the existence of theoretical views that suggest that identification of the expressions conveyed by faces is not simply a matter of expertise, but also is affected by the relevance of an expression to a perceiver.

For example, some studies report that people are especially good at identifying facial expressions that convey happiness (the *happiness superiority effect*: Becker, Anderson, Mortensen, Neufeld, & Neel, 2011; Du & Martinez, 2011; Elfenbein & Ambady, 2002; Juth, Lundqvist, Karlsson, & Őhman, 2005; Langner et al., 2010; Mill, Allik, Realo, & Valk, 2009). Becker, Neel, Srinivasan, Neufeld, and Kumar (2012) speculated that this effect occurs because: (1) expressions of happiness signal approachability, possibilities of affiliation, and friendship; and (2) when happiness is viewed accurately, approaching happy targets may increase the likelihood of perceiver survival. Given these research results, we suspect that a happiness superiority effect would emerge in our data. Moreover, it was our expectation that, should such an effect emerge, it should be most likely to emerge under difficult face viewing conditions (i.e., face profiles viewed at 100 ms).

However, there is an opposing view: It might be to a perceiver's advantage to rapidly identify perceiver-directed anger in others so that the perceiver can take evasive action. This is the *threat–advantage hypothesis*. Indeed, in studies that use a target search methodology, as predicted by the hypothesis perceivers are especially good at locating faces that convey angry expressions (Fox & Damjanovic, 2006; Hahn, Carlson, Singer, & Gronlund, 2006; Hahn & Gronlund, 2007; Hansen & Hansen, 1988; Horstmann & Bauland, 2006; Őhman, Lundqvist, & Esteves, 2001; Pinkham, Griffin, Baron, Sasson, & Gur, 2010; Williams & Mattingley, 2006, but see Calvo & Nummenmaa, 2008; Calvo, Nummenmaa, & Avero, 2010; Horstmann, 2009; Purcell, Stewart, & Skov, 1996). Our study explores whether a similar effect may occur in the facility with which perceivers identify facial expressions.

There is one other issue addressed in our study. Our emotion recognition task presented perceivers with emotion-conveying faces accompanied by five response options (happy, angry, fearful, sad, and neutral). Thus, not only could we tally perceivers' emotion identification response accuracy rates, but we also could identify the nature of the mistakes that were made (e.g., misidentifying a neutral expression as a sad expression). Because behaviors can follow from emotion identifications, the nature of such errors might be critical. For example, imagine that on an isolated and dimly-lit train platform a perceiver sees a person huddled in a dimly lit corner. Because of the poor viewing conditions, the perceiver may catch only a brief glimpse of the person's face. Prior research results suggest that angry faces and sad faces are often confused (Grimshaw et al., 2004). In the context that we describe, such a mistake might be dangerous, causing the perceiver to approach the other with the intent to provide comfort. Instead, the perceiver might find an angry other who responds with rejection, or even worse, with violence or deadly force. Thus, it is important to understand the errors that perceivers make in emotion identification and the conditions under which they are especially likely to make them.

## Methods

### Participants

A convenience sample of 290 community parents (female $n = 197$) with normal or corrected-to-normal vision volunteered for the study. Participants were placed into one of three groups, which viewed faces either: (1) without a time limit, (2) for 600 ms, or (3) for 100 ms. Because our data were obtained from a non-student sample, in Table 1 we present demographic characteristics for the three groups. The results of both Chi-square tests and one-way ANOVAs yielded no significant between-group differences in these demographic characteristics.

### Measures

#### Personal data form

A personal data form solicited information about each participant's gender, age, ethnic background, education, marital status, and number of children.

#### Face photos

The pictures depicting emotions conveyed by faces in our study were taken from the Radboud Faces Database (RaFD, Langner et al., 2010). The RaFD contains color portrait images of 67 models (20 Caucasian male adults, 19 Caucasian female adults, 4 Caucasian

**Table 1**
Demographic characteristics of the 100 ms, 600 ms, and unlimited presentation duration groups.

| Demographic characteristic | Presentation duration ($N = 290$) | | |
|---|---|---|---|
| | 100 ms ($n = 56$) | 600 ms ($n = 182$) | Unlimited ($n = 52$) |
| Gender (%) | | | |
| Male | 28.6 | 33.0 | 32.7 |
| Female | 71.4 | 67.0 | 67.3 |
| Ethnic background (%) | | | |
| Caucasian | 50.0 | 34.1 | 44.2 |
| African American | 50.0 | 61.0 | 44.2 |
| Other | 0.0 | 4.9 | 11.6 |
| Age (years) | | | |
| *M* | 36.3 | 31.9 | 34.9 |
| *SD* | 12.4 | 9.4 | 12.4 |
| Education (years) | | | |
| *M* | 14.2 | 13.7 | 14.6 |
| *SD* | 2.2 | 2.5 | 2.9 |
| Marital status (%) | | | |
| Single/divorced | 42.9 | 63.7 | 61.5 |
| Married/cohabitating | 57.1 | 36.3 | 38.5 |
| Children (number) | | | |
| *M* | 2.0 | 2.2 | 2.1 |
| *SD* | 1.2 | 1.3 | 1.2 |