Emotion Recognition of Facial Expressions Presented in Profile

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Abstract

Aim of the research. The literature on emotion recognition from facial expressions shows significant differences in recognition ability depending on the proposed stimulus. Indeed, affective information is not distributed uniformly in the face and recent studies showed the importance of the mouth and the eye regions for a correct recognition. However, previous studies used mainly facial expressions presented frontally and studies which used facial expressions in profile view used a between-subjects design or children faces as stimuli. The present research aims to investigate differences in emotion recognition between faces presented in frontal and in profile views by using a within subjects experimental design. Method. The sample comprised 132 Italian university students (88 female, M_{age} = 24.27 years, *SD* = 5.89). Face stimuli displayed both frontally and in profile were selected from the KDEF set. Two emotion-specific recognition accuracy scores, viz., frontal and in profile, were computed from the average of correct responses for each emotional expression. In addition, viewing times and response times (RT) were registered. Results.Frontally presented facial expressions of fear, anger, and sadness were significantly better recognized than facial expressions of the same emotions in profile while no differences were found in the recognition of the other emotions. Longer viewing times were also found when faces expressing fear and anger were presented in profile. In the present study, an impairment in recognition accuracy was observed only for those emotions which rely mostly on the eye regions.

Keywords

Emotion recognition; facial expressions; profile view; response times; emotional competence.

Introduction

Facial expressions are crucial regulators of social interaction and important signal of the nature of interpersonal relationships (Matsumoto & Hwang, 2011). Facial expressions of emotion have been extensively used as experimental stimuli in the study of emotional processes. Indeed, given that emotion recognition from facial expressions is a central skill for social functioning, standardized sets of photographs of real human emotional faces are often used for emotion recognition tasks in experimental contexts. Previous judgment studies demonstrated the universal recognition of facial expressions of emotion (Elfenbein & Ambady, 2002; Matsumoto, 2001). However, findings from emotion recognition research using different sets of pictures of posed facial expressions, such as the Pictures of Facial Affect (PFA; Ekman & Friesen, 1976) and the Karolinska Directed Emotional Faces (KDEF; Lundqvist, Flykt, & Öhman, 1998), showed that while happiness is recognized more accurately and faster than the other basic emotional expressions (e.g. Goeleven, De Raedt, Leyman, & Vershuere, 2008; Leppänen &

Hietanen, 2004) fear faces are identified less accurately and more slowly compared to the other facial expressions (Calvo & Lundqvist, 2008; Goeleven et al., 2008).

Such discrepancy may be explained by the fact that affective information is not distributed uniformly, so much so that the recognition of each emotion depends on a very specific area of the face. For example, it seems that happiness and disgust can be easily recognized by looking at the mouth region, anger and fear depends more on information in the eye region, whereas sadness and surprise may be similarly recognizable from both regions (Calvo & Marrero, 2009; Kohler, Turner, Stolar, Bilker, Brensinger, Gur et al., 2004; Leppänen & Hietanen, 2007; Smith, Cottrell, Gosselin, & Schyns, 2005).

Previous studies on facial emotion recognition focused on facial expressions presented at fixation and thus available to foveal vision only. Since in real-life settings faces often don’t appear in foveal vision but they initially appear in the visual periphery, in a recent study Calvo and colleagues (Calvo, Martin, & Nummenmaa, 2014) investigated facial expression recognition in peripheral versus central vision. Results showed no reduction of accuracy scores for happy faces in peripheral relative to central vision, while an impairment for the other expressions was found.

The study of emotion recognition from facial expressions presented outside the focus of overt attention is important because it involves the processing of social signals under impoverished perceptual conditions. Moreover, in real-life social settings faces not only appear initially in the visual periphery but faces often appear in profile with a significant loss of information regarding both the mouth and the eye regions. Since facial expressions of emotions are considered part of an evolved signal system that aids adaptation and survival, they should be reliably decoded at various angles, not just in frontal view. However, as previously indicated, the surface area of the face is less visible in profile views and wrinkle patterns produced by the movements of the facial musculature may be less apparent in profile than in frontal expressions. Previous studies that used emotional facial expressions in profile showed no main effect for facial perspective on accuracy scores for faces valence labelling (Kleck & Mendolia, 1990) but data were collected only on three judges, each responding to only one perspective of the face (frontal, full left, full right). In another study, Matsumoto and Hwang (2011) found that contempt, disgust, sadness, and surprise had slightly higher recognition accuracy rates in frontal views, while anger, fear, and happiness in profile views. However, also in this case view was a between-subjects factor. Finally, Skowronski and co-workers (Skowronski, Milner, Wagner, Crouch, & McCanne, 2014) found that the identification rates for children emotion expressions conveyed in 90-degree profile views (in comparison to full-face and 45-degree views) decreased for sad faces and angry faces in the unlimited time view condition.

Aim and hypothesis

In real-life social settings not only faces appear frontally but also in profile view, with a significant loss of information regarding both the mouth and the eye regions. Given the lack of previous studies on this topic, the present research aims to investigate differences in emotion recognition between faces presented in frontal and in profile views by using a within subjects experimental design. The stimuli were selected from the KDEF set (Lundqvist et al., 1998) which comprises pictures of human faces, displaying different emotional expressions and being photographed from five different angles. For the purposes of the current study, stimuli displayed both frontally and in profile, either full right or full left, were selected to investigate whether facial expressions presented in profile can be recognized as accurately as frontally presented facial expressions or if their recognition is impaired because of reduced signal clarity. Moreover, response times were also recorded and picture presentation times were left free to investigate differences between frontally and in profile presented pictures both in response and viewing times.

Method

Participants and procedure

The sample comprised 132 Italian university students (88 female, M_{age} = 24.27 years, SD = 5.89). The majority of the sample was registered on nursing (57.7%) and psychology (19.7%). Participants reported no history of neurologic or psychiatric illness and had normal or corrected-to-normal vision. Ethical approval for the study was obtained by the Ethical Committee of the University of Bologna. All participants gave written informed consent before taking part in the experiments. All procedures performed in our study were in accordance with the ethical standards of the Ethical Committee of the Department of Psychology (University of Bologna) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Subjects were invited to take part individually to the facial emotion recognition task. After written informed consent to participate in the study was obtained, instructions were explained. Participants were asked to look at each photograph and, when ready, to end the stimulus display via mouse-clicking. A slide comprising seven labels (anger, disgust, fear, sadness, happiness, surprise, or neutral) appeared thereafter, and participants were asked to select which of the words described the emotion being expressed. After the completion of the task, a warning slide was shown for 5 seconds with the instruction ‘‘Get ready to rate the next picture’’ immediately after this slide, a new stimulus was shown. This procedure was repeated for each picture. No time limits were provided. After explaining the task, and before the task begun, participants were asked to rate two probationary stimuli. On each trial the 56 pictures from a picture set were presented. The six sets were randomly assigned to participants. Stimuli were presented on a computer color monitor screen and responses were entered via mouse-clicking. Stimulus presentation and data collection were controlled by the E-Prime 2 experimental software (Schneider, Eschman, & Zuccolotto, 2002).

Two emotion-specific recognition accuracy scores, viz., frontal and in profile, were computed from the average of correct responses for each emotional expression. In addition, viewing time in millisecond were registered from stimulus onset to the end of the stimulus display, which was in turn determined by participant's mouse-click. Last, response times (RT) in millisecond were recorded from the end of the stimulus display to the choice of the emotional label. In both cases, an average of RT per emotional expression was calculated. As for recognition accuracy, frontal and in profile mean RTs were computed for each type of facial expression, for both viewing time and response.

Materials

Emotional facial stimuli were selected from the series A and B of the Karolinska Directed Emotional Faces database (Lundqvist et al., 1998). The KDEF database comprises color photographs of human faces displaying six emotions (anger, disgust, fear, sadness, happiness, surprise), and neutral expressions, with each face being photographed from different angles. For the purposes of the present study 56 face stimuli were selected (four per emotional expression); of these, 28 were displayed frontally and 28 in profile, either full right or full left. Stimuli were randomly organized into six different picture sets.

Statistical analysis

Repeated measures analyses of variance (ANOVAs) were conducted to check for differences in recognition accuracy, viewing time, and response times, among the seven emotional expressions. Greenhouse–Geisser adjustment to the degree of freedom was performed, when appropriate, and adjusted p values are reported. The pattern of errors (i.e., the participants' responses that did not correspond to the models' expressions) across emotional expression was also examined by means of a multivariate ANOVA. In this model, the verbal label chosen for each stimulus by participants was used as criterion variable, whereas emotional expression and position were used as predictors. In all cases, Bonferroni corrections ($p < .05$) for multiple contrasts were conducted to further examine differences among emotional expressions.

Results

Accuracy

Statistics for recognition accuracy are presented in Table 1. Results showed significant main effects of both Emotion and Position, and a significant interaction effect of Emotion × Position. Bonferroni post hoc tests showed that frontal facial expressions of fear ($p < .001$), anger ($p < .001$), and sadness ($p < .05$) were significantly better recognized than facial expressions of the same emotions in profile view. No statistically significant difference in recognition accuracy was found between profile and frontal facial expressions of surprise, disgust, happiness and neutrality (see Figure 1).

Table 1

Differences in Accuracy (in percentage of correct responses), Viewing Times and Response Times (millisecond) by type of expression and display position.

Emotion	**Anger**		**Disgust**		**Fear**		**Happiness**		**Neutral**	
	Frontal[a]	Lateral[b]	Frontal[d]	Lateral[e]	Frontal[g]	Lateral[h]	Frontal[j]	Lateral[k]	Frontal[m]	Lateral[n]
Accuracy	89.96 [b]	69.32 [a, e, t, h, k, n]	95.45 [a, g, p]	93.94 [b, h, q]	70.45 [h, j, m]	58.33 [b, e, g, k, n, q, t]	92.80 [g, q]	85.23 [b, h, q]	89.02 [h, s]	89.58 [b, h, q, t]
Viewing Times *										
M	2095.34[b]	3403.79[a]	2511.44	2572.99	2330.36[h]	3292.48[g]	2308.68	2220.01	2674.09	2610.43
SD	1037.46	2918.13	1996.31	2240.09	1446.29	2499.40	1725.95	1550.20	2223.36	1835.63
Response Times										
M	3148.99	3480.58	1624.67	1735.09	3407.93	3330.97	2302.73	2290.96	2711.23	2614.97
SD	2513.16	2967.19	881.49	943.62	2843.21	2512.92	1713.43	1652.47	2227.03	1824.41

Note. Mean scores with a superscript (horizontally) are significantly different.

* Global sample size for this variable was 130, as for two participants viewing time was not recorded.

Table 1 (continued)

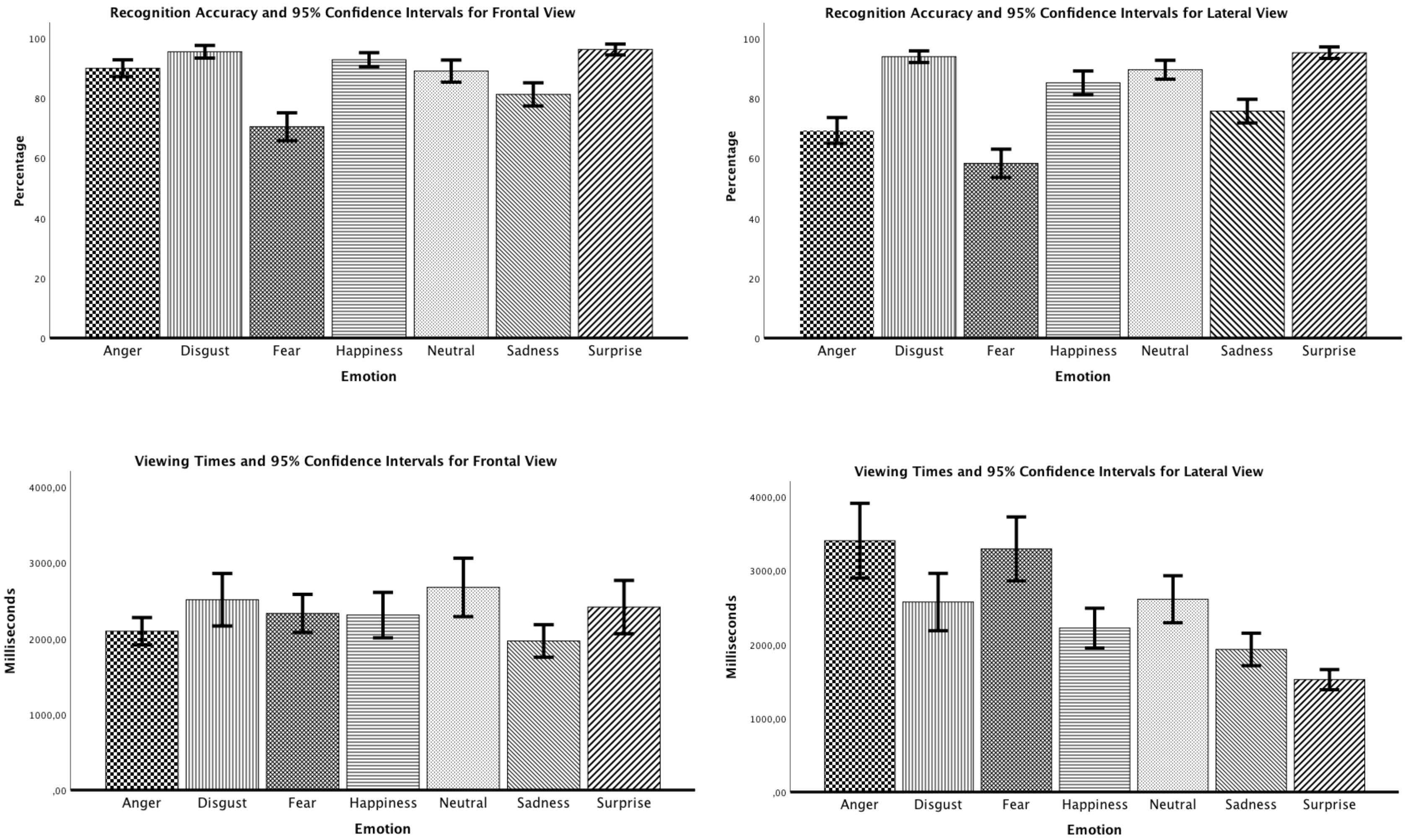
Emotion	**Sadness**		**Surprise**		**Main effect**	**Main effect**	**Interaction effect**
	Frontal[p]	Lateral[q]	Frontal[s]	Lateral[t]	Emotion	Position	Emotion × Position
Accuracy	81.25 [j, q]	75.76 [e, h, k, n, p, t]	96.21 [a, g, m, p]	95.27 [b, h, n, q]	F (6, 126) = 74.25, partial η^2 = .36, p < .001	F (1, 131) = 100.85, partial η^2 = .43, p < .001	F (6, 126) = 14.82, partial η^2 = .10, p < .001
Viewing Times *					F (6, 124) = 15.49, partial η^2 = .11, p < .001	F (1, 129) = 5.56, partial η^2 = .04, p < .05	F (6, 124) = 15.57, partial η^2 = .11, p < .001
M	1967.09	1931.11	2414.63[t]	1522.12[s]			
SD	1238.73	1267.03	2026.71	784.54			
Response Times					F (6, 126) = 32.29, partial η^2 = .19, p < .001	F (1, 131) = .04, partial η^2 = .00, p = n.s.	F (6, 126) = 1.17, partial η^2 = .00, p = n.s.
M	2962.72	2849.82	2403.99	2340.56			
SD	2075.44	2117.77	2013.18	1905.68			

Note. Mean scores with a superscript (horizontally) are significantly different.

* Global sample size for this variable was 130, as for two participants viewing time was not recorded.

Figure 1

Differences in mean scores for Accuracy and Viewing Times illustrating recognition accuracy and viewing times by display position, with Confidence Intervals for each emotion category.



Pattern of errors

Results showed significant main effect of Emotion only (*F* (6, 126) = 83.945, partial η^2 = .40, *p* < .001), while Position (*F* (1, 131) = 79.174, partial η^2 = .38, *p* = n.s.), and the interaction Emotion × Position (*F* (6, 126) = 14.298, partial η^2 = .10, *p* = n.s.) did not reach significance. Such results indicate that a correct label was used significantly more compared to an incorrect one for all types of emotional expressions (happy, *F* (6, 42) = 854.5; neutral, *F* (6, 42) = 221.4; fearful, *F* (6, 42) = 205.5; sad, *F* (6, 42) = 150.5; disgusted, *F* (6, 42) = 414.9; surprised, *F* (6, 42) = 368.8; angry, *F* (6, 42) = 299.4; all *p*s < .001). Bonferroni corrections (*p* < .05) for multiple contrasts were conducted to examine differences between the types of errors (see Table 2). Angry faces were misclassified most often as disgusted (*M* = 10.19%). Such pattern was moderated by display position, as revealed by a type of expression × position interaction (*F* (7, 36) = 5.17, *MSe* = 39.2, *p* < .001), with profile pictures being more likely to be labeled as disgusted (*M* = 17.88%) than frontal displayed stimuli (*M* = 2.5%). Fearful faces were misclassified most often as surprised (*M* = 19.13%). In this case, although multivariate analysis did not show significant differences (*p* > .05), univariate results revealed a significant type of expression × position interaction (*F* (1, 42) = 5.06, *MSe* = 45.71, *p* < .05), with profile fearful stimuli being more likely to be labeled as surprised (*M* = 23.27%) than frontal (*M* = 15%) stimuli.

No significant differences emerged between the various types of incorrect responses for surprised expressions, all having a very low rate (2% or less). Sad faces were misclassified most often as either neutral (*M* = 10.38%), disgusted (*M* = 5.58%) or fearful (*M* = 4.42%). Happy faces were misclassified most often as surprised (*M* = 4.99%), while neutral faces as sad (*M* = 6.35%).

Table 2

Confusion matrix with percentage of responses for each emotion, indicating the types of errors made by the participants.

Emotion	Anger	Disgust	Fear	Happiness	Neutral	Sadness	Surprise
Anger	79.64	10.19	.67	.18	3.07	3.94	2.31
Disgust	2.80	94.69	.50	.01	.10	1.10	.80
Fear	2.00	8.30	64.39	.18	1.00	5.00	19.13
Happiness	.20	.48	.48	89.01	3.88	.96	4.99
Neutral	1.50	.83	1.28	.68	89.30	6.35	.06
Sadness	.74	5.08	4.42	.08	10.38	78.50	.80
Surprise	.20	.48	2.42	.14	.82	.20	95.74

Notes. Data were computed by averaging the responses given to both frontal and lateral stimuli. Rows indicate the actual emotional stimuli viewed by participants, while columns refer to participants' answers in percentage.

Viewing times

Results from repeated measures ANOVA showed significant main effects of Emotion and Position, and a significant interaction Expression × Display Position (see Table 1 and Figure 1). Bonferroni post hoc tests showed that frontal expressions of fear and anger had significantly lower viewing times than expressions of the same emotions in profile ($p < .001$ for both comparisons). Viewing time for frontal surprise was instead higher than profile surprise ($p < .001$). No statistically significant difference in viewing times were found between profile and frontal expressions of disgust, happiness, neutrality, and sadness.

Response times

Repeated measures ANOVA of response times showed significant main effect of the variable Emotion, while no significant effects for both the variable Position and the interaction Emotion × Display Position were detected (see Table 1).

Discussion

The present study showed that frontal facial expressions of fear, anger, and sadness were significantly better recognized than facial expressions of the same emotions in profile view while no differences were found in the recognition of surprise, disgust, happiness and neutrality between frontally and in profile presented faces. Our results show that the recognition accuracy rate of facial expressions presented in profile remains high particularly in the case of surprise, disgust, happiness, and neutral stimuli. Nevertheless, a significant impairment in recognition performance was observed for fear, anger and sadness. Additionally, the less recognized emotion categories, namely anger and fear, had the longest viewing times only when displayed in profile. In fact, for frontal views they averaged the times of other emotion categories.

Previous studies that used emotional facial expressions in profile showed different results that may be due to the use of very different stimuli and research methods (Kleck et al., 1990; Matsumoto et al., 2011; Skowronski et al., 2014). For example, Kleck and Mendolia (1990) used as experimental stimuli only facial expressions of happiness and disgust elicited in a situation where young adults watched video segments intended to evoke either positive or negative affect. Moreover, judgments were made for intensity and affective quality of the facial expressions and data were collected only on three judges and each judge responded to only one perspective of the face. Matsumoto and Hwang (2011), stated that they found no differences in recognition accuracy as a function of view. Similarly to the study of Kleck and Mendolia (1990) observers judged only one of the four sets; thus, view was a between-subjects factor. The use of a between subjects design doesn’t allow to take into account individual differences in emotion recognition. Consistent with our findings, Skowronski and co-workers (2014) found that the identification rates for emotion expressions conveyed in 90-degree profile views (in comparison to full-face and 45-degree views) decreased for sad faces and angry faces in the unlimited time view condition. However, they used as experimental stimuli photographs from four male children and four female children and for each emotion and each view (frontal, 45 degree and 90 degree) two identical photos were presented.

Previous studies on face features, showed that the eyes and the mouth regions are the most diagnostic features for recognizing emotions (Gosselin & Schyns, 2001; Smith et al., 2005) and that emotional expressions could be grouped into “upper-face” and “lower-face” expressions (Wegrzyn, Vogt, Kireclioglu, Schneider, & Kissler, 2017). In particular, the disgusted and happy faces show significantly highest reliance on the mouth region, while the angry, fearful and sad faces show stronger reliance on the eyes (Wegrzyn et al., 2017). In a study by Eisenbarth and Alpers (2011) eye-tracking was used to monitor scanning behaviour of healthy participants while looking at different facial expressions. Across all emotional expressions, initial fixations were most frequently directed to either the eyes or the mouth. However, in sad and angry facial expressions, the eyes received more attention than the mouth while in happy facial expressions, participants fixated the mouth region for a longer time. For fearful and neutral facial expressions, both the eyes and mouth seem equally important.

In the present study, an impairment in recognition accuracy was observed only for those emotions which rely mostly on the eye regions. This may be due to the fact that when faces are presented in profile, either full left or full right, most of the information lost is related to eye region while less fine changes of the mouth can be still identified by the corner lip position. The facial expression of fear is mainly characterized by widened eyes and eyebrows slanted upward. Anger eyebrows are squeezed together to form a crease, and eyelids are tight and straight. Sad expressions usually display upwardly slanted eyebrows and a frown. When faces expressing fear, anger and sadness are presented in profile most of these information are lost while mouth changes are partially preserved.

The analysis of error patterns showed similar findings as previous studies. In the present study, fear faces are generally misclassified as surprise expressions while angry expressions are misclassified as disgust, consistently with previous finding showing that fear and surprise (Palermo & Coltheart, 2004) as well as anger and disgust (Pochedly, Widen, & Russell, 2012) are frequently confused. This may be due to the fact that these easily confused expressions can be described by a partly overlapping set of action units (Hager, Ekman, & Friesen, 2002) with lowered eyebrows in anger and disgust or the raised eyebrows and eye lids in fear and surprise (Matsumoto & Ekman, 2008), indicating a similarity of physical appearance (Wegrzyn et al., 2017).

Moreover, the present findings showed that fear faces in profile view are most often misclassified as surprise expressions than frontal ones. Such result might indicate that the mouth plays an important role in this confusion. Indeed, the mouth is usually open both in fear and surprise expressions. Similarly, lateral angry expressions are most often misclassified as disgust than frontal ones. This may be always due to the mouth position.

Longer viewing times were found when facial expressions of fear and anger are presented in profile than when they are presented frontally. This result may indicate that participants need more time to view and recognize fear and angry expressions when are presented in profile. At the same time, surprise stimuli seem to require shorter viewing times when viewed frontally rather than in profile. It is possible that profile surprise stimuli had a higher chance to be confused with profile fearful stimuli, thus requiring more time and attention for an accurate recognition. However, it is worth mentioning that our data showed no significant difference in accuracy scores between frontal and profile surprise stimuli; yet, surprise had the highest recognition rate overall. For such reasons this result requires further investigation. On the contrary, no significant interaction emotion by display position was found for response times. This may be due to the longer viewing times.

A clear limitation of the present study is that we use whole facial expressions as stimuli. Future studies should investigate the recognition of emotion from facial expressions presented in profile using a “masking” procedure to better evaluate the role of the mouth and the eye regions in the recognition ability. The most recent studies on emotion recognition used different kind of masking to investigate the role of different face regions in emotion recognition (Wegrzyn et al., 2017). Even if we used the whole face to investigate the emotion, the use of faces presented in profile could be considered a more ecological kind of masking face’s features and wrinkle patterns produced by the movements of the facial musculature. Another limitation of current results pertains the lack of a more in depth analysis of errors’ pattern (e.g., with an exploration of specific error probability), as it was beyond the purposes of the present study. However, we believe that this important topic can be better and further investigated by future studies on emotion recognition accuracy. Finally, further studies would benefit from the use of larger sample size more representative of the general adult population as this will improve the generalizability of present findings.

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Research involving human participants and ethical approval

All procedures performed in our study involving human participants were in accordance with the ethical standards of the Ethical Committee of the Department of Psychology

(University of Bologna) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from all individual participants included in the study.

Declaration of conflicting interests

The authors declare that there is no conflict of interest.

References

Calvo, MG., & Lundqvist, D. (2008). Facial expressions of emotion (KDEF): Identification under different display-duration conditions. *Behavior Research Methods*, 40 (1), 109–115.

Calvo, MG., & Marrero, H. (2009). Visual search of emotional faces: The role of affective content and featural distinctiveness. *Cognition and Emotion*, 23 (4), 782-806.

Calvo, MG., Martin, AF., & Nummenmaa, L. (2014). Facial expression recognition in peripheral versus central vision: role of the eyes and the mouth. *Psychological Research*, 78 (2), 180-195.

Eisenbarth, H., & Alpers, GW. (2011). Happy Mouth and Sad Eyes: Scanning Emotional Facial Expressions. *Emotion*, 11 (4), 860-865.

Ekman, P., & Friesen, WV. (1976). Measuring Facial Movement. *Journal of Nonverbal Behavior*, 1(1), 56-75.

Elfenbein, H. A., & Ambady, N. (2002). On the universality and cultural specificity of emotion recognition: A meta-analysis. *Psychological Bulletin*, 128, 205–235.

Goeleven, E., De Raedt, R., Leyman, L., & Vershuere, B. (2008). The Karolinska Directed Emotional Faces: A validation study. *Cognition and Emotion*, 22 (6), 1094–1118.

Gosselin, F., & Schyns, PG. (2001). Bubbles: a technique to reveal the use of information in recognition tasks. *Vision Research*, 41, 2261-2271.

Hager, JC., Ekman, P., & Friesen, WV. (2002). *Facial action coding system*. Salt Lake City, UT: A Human Face.

Kleck, RE., & Mendolia, M. (1990). Decoding of profile versus full-face expressions of affect. *Journal of Nonverbal Behavior*, 14, 35-49.

Kohler, CG., Turner, T., Stolar, NM., Bilker, WB., Brensinger, CM., Gur, RE. et al. (2004). Differences in facial expressions of four universal emotions. *Psychiatry Research*, 128, 235– 244.

Leppänen, JM., & Hietanen, JK. (2004) Positive facial expressions are recognized faster than negative facial expressions, but why? *Psychological Research*, 69 (1-2), 22-29.

Leppänen, JM., & Hietanen, JK. (2007). Is there more in a happy face than just a big smile? *Visual Cognition*, 15, 468-490.

Lundqvist, D., Flykt, A., & Öhman, A. (1998). The Karolinska directed emotional faces (KDEF) [CD- ROM]. Department of Clinical Neuroscience, Psychology section, Karolinska Institutet.

Matsumoto, D. (2001). Culture and emotion. In D. Matsumoto (Ed.), *The Handbook of Culture and Psychology* (pp. 171–194). New York, NY: Oxford University Press.

Matsumoto, D., & Ekman, P. (2008). Facial expression analysis. *Scholarpedia*, 3(5), 4237.

Matsumoto, D., & Hwang, HS. (2011). Judgments of Facial Expressions of Emotion in Profile. *Emotion*, 11 (5), 1223-1229.

Palermo, R., & Coltheart, M. (2004). Photographs of facial expression: Accuracy, response times, and ratings of intensity. *Behavior research methods, instruments, & computers*, 36 (4), 634-638.

Pochedly, JT., Widen, SC., & Russell, JA. (2012). What emotion does the "facial expression of disgust" express? *Emotion*, 12(6), 1315-1319.

Schneider, W., Eschman, A., & Zuccolotto, A. (2002). E-Prime user's guide [CD-ROM]. Pittsburgh, PA: Psychology Software Tools.

Skowronski, JJ., Milner, JS., Wagner, MF., Crouch, JL., & McCanne, TR. (2014). Pushing the boundaries of human expertise in face perception: Emotion expression identification and error as a function of presentation angle, presentation time, and emotion. *Journal of Experimental Social Psychology*, 50, 166-174.

Smith, ML., Cottrell, GW., Gosselin, F., & Schyns, PG. (2005). Transmitting and decoding facial expressions. *Psychological Science*, 16(3), 184-189.

Wegrzyn, M., Vogt, M., Kireclioglu, B., Schneider, J., & Kissler J. (2017). Mapping the emotional face. How individual face parts contribute to successful emotion recognition. *Plos One,* 12 (5), 1-15.