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Familiarity and face emotion recognition in patients with schizophrenia

Guillermo Lahera[a,*], Sara Herrera[a], Cristina Fernández[b], Marta Bardón[a], Victoria de los Ángeles[a], Alberto Fernández-Liria[a]

[a]*Department of Psychiatry, Príncipe de Asturias University Hospital, University of Alcalá, Madrid, Spain*
[b]*Integrated Substance Abuse Center Sur Usera, Madrid, Spain*

Abstract

Objective: To assess the emotion recognition in familiar and unknown faces in a sample of schizophrenic patients and healthy controls.
Methods: Face emotion recognition of 18 outpatients diagnosed with schizophrenia (DSM-IVTR) and 18 healthy volunteers was assessed with two Emotion Recognition Tasks using familiar faces and unknown faces. Each subject was accompanied by 4 familiar people (parents, siblings or friends), which were photographed by expressing the 6 Ekman's basic emotions. Face emotion recognition in familiar faces was assessed with this *ad hoc* instrument. In each case, the patient scored (from 1 to 10) the subjective familiarity and affective valence corresponding to each person.
Results: Patients with schizophrenia not only showed a deficit in the recognition of emotions on unknown faces ($p = .01$), but they also showed an even more pronounced deficit on familiar faces ($p = .001$). Controls had a similar success rate in the unknown faces task (mean: 18 +/− 2.2) and the familiar face task (mean: 17.4 +/− 3). However, patients had a significantly lower score in the familiar faces task (mean: 13.2 +/− 3.8) than in the unknown faces task (mean: 16 +/− 2.4; $p < .05$). In both tests, the highest number of errors was with emotions of anger and fear. Subjectively, the patient group showed a lower level of familiarity and emotional valence to their respective relatives ($p < .01$).
Conclusions: The sense of familiarity may be a factor involved in the face emotion recognition and it may be disturbed in schizophrenia.

1. Introduction

Patients with schizophrenia have a deficit in the recognition and discrimination of facial emotion [1–7], especially fear and anger [8]. A recent meta-analysis of this observed impairment revealed a large overall effect size ($d = 0.91$), irrespective of task type and moderated by task, illness-related and demographic factors [9–13]. This deficit appears in the early stages of the illness [14], is more pronounced in schizophrenia than in bipolar disorder [15] and remains stable across the distinct phases of the illness [12–14]. It has remained unclear whether this deficit represents an alteration that is specific to schizophrenia (the *nuclear* alteration in emotion processing described by Bleuler in 1911 [16]) or whether it is part of an unspecific and general cognitive deficit [17–20].

The deficit in emotion recognition has been related to several variables, such as the severity of negative [12,21] or positive symptoms [22], the duration of the illness [11] and alterations in other cognitive domains, especially in tasks with high mnemonic and attentional demands [12,17,22]. Recently, this deficit has been postulated to be a possible cognitive endophenotype because of its attenuated presence in subjects with a high risk of psychosis [23] and in unaffected first-degree relatives [24–26]. Regarding the implications of this deficit, a meta-analysis of 25 articles showed a significant relationship between emotion perception and functional outcomes in individuals with schizophrenia, with effect sizes in the medium range [27].

However, some lines of investigation have suggested that there are two separate and possibly independent cognitive processes: decisions based on the memories mediated by familiarity and those based on the neutral recollection of experiences [28–31]. *Familiarity* consists of the implicit memory of past affective experiences, and it seems to

* Corresponding author. Department of Psychiatry, Príncipe de Asturias University Hospital, Carretera Alcalá-Meco s/n 28805 Alcalá de Henares, University of Alcalá, Madrid, Spain. Tel.: +34 916780606; fax: +34 918816264.
E-mail address: guillermo.lahera@uah.es (G. Lahera).

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"release" rapid neurocognitive processes that are triggered by certain signals. *Familiarity r*eflects the memory of a subjective experience, which gives rise to the sensation that something has happened without the need to recover an episodic or specific semantic memory [31–33]. Various studies have shown that familiarity follows a specific neurobiological pathway, which has been evaluated using evoked potentials [34–36] and functional magnetic resonance images [37]. Faces of loved ones elicit larger autonomic (skin conductance and heart rate), electromyographic (zygomatic activity), and Event-Related Potential responses than all other faces [38,39]. Evidence also exists suggesting that familiar and unfamiliar faces are represented in the brain in different ways. This differential processing in the recognition of familiar faces has been associated, for example, with a minor influence of context and expression and with a major influence of facial movements [40].

Some studies have shown an anomalous processing of the contextual information on familiarity and recollection processes in schizophrenia [41]. Recently, Martin et al. [42] reported that patients with schizophrenia have an apparent reduced capacity to recall the details of known faces. In line with the possibility of a substantial alteration in familiarity in schizophrenia, some studies show an altered pattern of subjective and physiological responses to emotional stimuli [43,44]. Caharel et al. [45] demonstrated that patients with schizophrenia have characteristic amplitude of evoked potentials, which is different than that of controls with respect to the level of familiarity and emotion expression. This finding is consistent with the nature of the negative symptoms associated with the illness (apathy, abulia, anhedonia and social withdrawal) in that the emotional activation in response to the environmental stimuli and the sense of familiarity are reduced.

The effect of familiarity and its interaction with emotion recognition has been explored in healthy subjects [46,47]. The results indicated that there is an effect of familiarity on the accuracy of emotion recognition. The more familiar one is with a stimulus, in this case a person's face, the more likely one is to identify the emotion accurately. In this line, close friends were more accurate than casual acquaintances in decoding one other's subdued expressions of sadness, anger, and happiness [48]. However, patients with schizophrenia often show social misunderstanding and misinterpretations – that lead to delusional ideas – especially in the familiar context. Many reference and persecutory ideas involve feelings of suspiciousness and patients often attribute negative intentions to their close relatives and these attributions significantly impact their social and familiar behavior [49,50]. Our initial hypothesis was that patients with schizophrenia would show an aberrant salience of social and affective cues and, therefore, an altered sense of familiarity towards their own relatives. Secondly, we hypothesized that this altered familiarity may worsen the face emotion recognition in patients with schizophrenia. So, the main objective of this study was to evaluate the capacity for facial emotion recognition on familiar and unknown faces, in a sample of schizophrenic patients and healthy controls.

2. Methods

2.1. Participants

The sample was composed of: a) an experimental group of 18 out-patients diagnosed with schizophrenia (any type, according to the DSM-IV-TR criteria [51]) and a mean length of illness of 14.6 (SD = 9.9) years; mean age was 41.44 years (SD = 12) and 33.3% were female; b) a control group of 18 healthy volunteers (mean age = 44.5, SD = 15.4; 57.9% female). The sociodemographic characteristics of the sample are shown in Table 1.

The diagnosis was made by a psychiatrist or clinical psychologist after completing the Structured Clinical Interview for the DSM-IV (SCID) [52]; thirteen cases of paranoid-type schizophrenia, four cases of residual-type schizophrenia and one case of undifferentiated-type schizophrenia were found. The patients were further evaluated using the Positive and Negative Syndrome Scale (PANSS) scale of clinical symptomatology. All patients were stable outpatients at the time of testing. Patients with axis I psychiatric comorbidities, a history of cranioencephalic trauma, a neurological disease, visual defects or any medical condition that affected cognitive performance were excluded. The control group was made up of 18 volunteers who were matched in sociodemographic characteristics to the experimental group. Individuals with a history of axis I or II psychiatric disorders or with any type of neurological disease that could affect their cognitive performance were excluded. The ethics committee of the Principe de Asturias University Hospital approved the protocol, and all of the participating subjects gave their written informed consent.

For the evaluation, each subject (18 cases and 18 controls) was accompanied by four familiar individuals, such that a

Table 1
Sociodemographic characteristics of the sample.

	Controls (n = 18)	Patients (n = 18)	t-Test or χ^2 *p*
Age	44.5 (15.4)	41.44 (12)	
% Women	55.6	33.3	
% Studies level			n.s.
High School Graduate	31.6	55.6	
Bachelor's Degree	52.6	38.9	
Graduate	15.8	5.6	
% Marital status			n.s.
Single	47.4	88.9	
Married	36.8	11.1	
Divorced	5.3	0	
Widowed	10.5	0	
% Life together			.01
Family of origin	36.8	83.3	
Own family	42.1	11.1	
Alone	21.1	5.6	

total of 144 close individuals were captured to create the required stimulus material for the study. From the four familiar individuals who accompanied the patients, at least two were immediate family members (58% parents, 45% siblings and 4% spouses). The rest of the individuals were either other relatives or therapists with whom the patients had regular meetings. In each case, the patient scored (from 1 to 10) the subjective familiarity and affective valence corresponding to each person.

2.2. Variables and instruments

The capacity to recognize emotion expressions was evaluated in both groups using two recognition tasks:

- Unknown faces task: This task was based on the recognition of the facial emotion battery by Ekman and Friesen [53]. The photographs were scanned and presented in PowerPoint format and appeared as 8 × 10 cm slides. Each photo was presented next to a legend with the names of the six fundamental emotions (happiness, sadness, surprise, disgust, anger and fear). The participant was instructed to determine which of the six possible emotions was being expressed by the person in the photo. The battery consisted of 24 slides (four of each emotion) and six initial slides were shown at the beginning of the task for practice that were excluded of the analysis. All the slides were shown one by one without a time limit and the order of appearance was randomized to each participant. Trials are scored from 0 to 24, with higher scores indicating better performance.
- Familiar faces task: The task consisted of 24 photographs that were taken with a digital camera, converted to pcx format, standardized in terms of light and contrast with Adobe Photoshop TM software and organized into a PowerPoint presentation equivalent to that used in the Unknown faces task. The photographs corresponded to the six basic emotions expressed by four individuals known to the participant. The instructions were the same as those given in the unknown faces task, all the slides were shown one by one without a time limit and the order of appearance was randomized to each participant. Trials are also scored from 0 to 24, with higher scores indicating better performance.

2.3. Procedure

The evaluation of the recognition of emotions was carried out individually for each participant. The participants were asked to bring four relatives or acquaintances so that a test with photographs of familiar faces could be prepared. The accompanying individuals were instructed to express each emotion in the most natural way possible prior to being photographed through evocation of emotions (for ex. “Try to remember something that provokes disgust”). Next, the participants were asked to score on a scale from 1 to 10 the level of *subjective familiarity* or the grade of connection that they had with each of the accompanying people, with 1 being the lowest score (unfamiliar, alien) and 10 being the highest (close familiar). Moreover, the participants were asked to score the *affective valence* or type of relationship they had with each accompanying person using a second scale from 1 to 10, with 1 being the lowest score (negative relationship) and 10 being the highest (good relationship). Finally, each participant first completed the unknown faces task, followed by the familiar faces task.

2.4. Analysis of the data

For each group separately, we verified normality of distribution for the demographic variables and measures on the two Emotion Recognition Tasks with familiar/unknown faces. For the demographic variables we compared qualitative variables using a χ^2 test and quantitative variables using t-test. To investigate the overall differences between groups in unknown faces task and familiar faces task a multiway repeated measures ANOVA was carried out. When a significant interaction effect was found we conducted Bonferroni post hoc analysis. In the presence of a significant overall test, post hoc comparisons were performed by using the Wilcoxon matched signed-ranks test. We explored potential relations among face emotion recognition, affective valence and subjective familiarity ratings using non-parametric correlation analyses, and Mann–Whitney U test to compare familiarity and recognition of specific emotions between groups. The statistical analyses were carried out using the programs SPSS 15.0. The level of statistical significance was established at a value of $\alpha = 5\%$ using bilateral testing.

3. Results

First, a descriptive analysis of the sample was performed. As indicated in Table 1, both groups had similar sociodemographic characteristics, and no significant differences ($p < .05$) were found except in the case of “living-together situation” ($\chi^2 = 8.29$; $p = .01$). In the patient group, the mean PANS score was 105.83 (SD = 17.023) and the mean value for the duration of the illness was 14.6 years (SD = 9.9).

Second, a mixed ANOVA 2 × 2 was carried out with the type of Emotion Recognition Task as within-group factor (unknown faces vs. familiar faces) and Group as between-group factor (patients vs. controls). There was a significant main effect of Emotion Recognition Task ($F(1) = 15.35$, $p < .001$, $\eta^2 = .31$). All participants recognized emotions better in unknown faces ($M = 16.97$) than familiar faces ($M = 15.31$), ($p < .001$). In addition, there was a significant main effect of Group ($F(1) = 15.35$, $p < .001$, $\eta^2 = .31$,), reflecting that in general, patients recognized a lower number of emotions ($M = 14.56$), in comparison with control group ($M = 17.72$).

Table 2
Bivariate correlations between score in the familiar faces task, subjective familiarity and affective valence, in patients and controls.

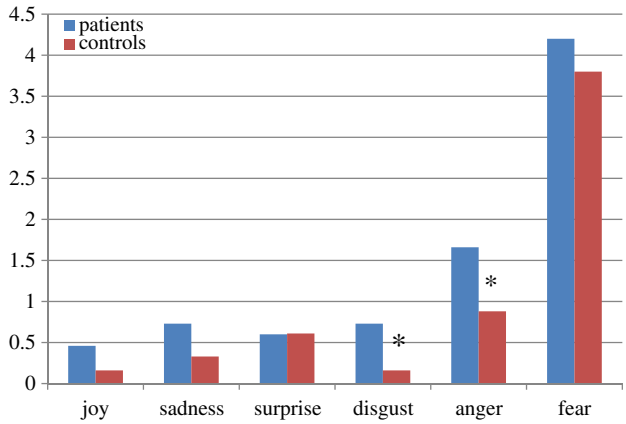
	Score Familiar Faces Task	Subjective Familiarity	Affective Valence
Patients			
Score in familiar faces task	1		
Subjective Familiarity	.293	1	
Affective Valence	.144	.486	1
Controls			
Score in familiar faces task	1		
Subjective Familiarity	.193	1	
Affective Valence	.539*	.669**	1

* $p < .05$; ** $p < .01$.

Besides, an interaction effect between Task and Group was found (F (1) = 6.82, $p < .05$, $\eta^2 = .17$). This interaction showed that, in unknown faces task, patients recognized less emotions than control group (F (1) = 7.15, $p = .011$, $\eta^2 = .17$) and less emotions in familiar faces task (F (1) = 14.18, $p = .001$, $\eta^2 = .29$), this difference between groups being higher than in unknown faces task. The effect size of this interaction was moderate (d = 0.59).

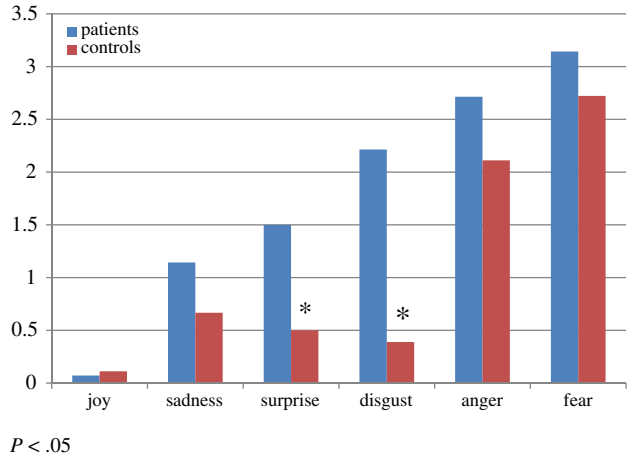
Controls had a similar success rate in the unknown faces task (mean: 18; SD: 2.2) and in the familiar faces task (mean: 17.4; SD: 3) (Wilcoxon matched signed-ranks test; T = −1,039; p = .299). Patients with schizophrenia had a significantly lower score in the familiar faces task (mean: 13.2; SD: 3.8) than in the unknown faces task (mean: 16; SD: 2.4) (T = −3,134; p = .002).

Third, to measure the effect of *familiarity* in emotion recognition, an index was calculated by subtracting the proportion of correct responses on the unknown faces task from the proportion of correct responses on the familiar faces task (IF = familiar correct/24 − unknown correct/24). A positive value reflects the facilitating effect of *familiarity*; the emotions on familiar faces are more easily recognized than those on non-familiar faces in the unknown faces task. The analyses showed that among patients, the IF was significantly lower than in the control group (U = 89; $p = .02$).



* $P < .05$

Graphic 1. Frequency of type of errors in the unknown faces task. * $p < .05$.



$P < .05$

Graphic 2. Frequency of type of errors in the familiar faces task. $p < .05$.

The patient group assigned lower degree of subjective familiarity (M = 7.4; SD = 1.3) and affective valence (M = 7.2; SD = 1.4) for their respective relatives than did the control group (M = 8.5; SD = 1.2 and M = 9; SD = .9, respectively) (U = 79, $p < .05$; U = 33, $p < .01$). Next, a Spearman correlation analysis was carried out between the subjective familiarity and emotional valence scores that the participants assigned to their respective relatives and the success rate in the familiar faces task. There were correlations between the subjective familiarity and emotional valence scores (Spearman .669; p = .003) and between success rate in familiar faces task and emotional valence (Spearman .539; p = .026) only in the control group. In the group of patients there was a statistical trend for the correlation between emotional valence and subjective familiarity (Spearman .486; p = .056; Table 2).

Moreover, the frequencies of the type of errors committed in each group in the unknown faces task (Graphic 1) and the familiar faces task (Graphic 2) were analyzed. On the one hand, in both tasks, the greatest number of errors occurred in the recognition of *anger* and *fear*, and this trend was observed in both the patient group and in the control group. Additionally, statistically significant between-groups differences were found. Specifically, in the unknown faces task, the patient group committed more errors in the recognition of *anger* (U = 77; $p = .03$) and *disgust* (U = 88.5; $p = .04$) than the control group, while in the familiar faces task, the patient group committed more errors in the recognition of *surprise* (U = 69; $p = .02$) and *disgust* (U = 35.5; $p = .00$) than the control group.

4. Discussion

A number of studies have reported a decreased capacity to recognize face emotion in patients with schizophrenia compared with healthy subjects, using instruments with

photographs of unknown actors such as the Emotion Recognition Task [6,7,9]. We have investigated if this impairment is also shown on familiar faces. We found that patients with schizophrenia not only have a deficit in the recognition of emotions on unknown faces, but they also have an even more pronounced deficit on familiar faces. Controls scored nearly equally on familiar and unknown faces, but patients scored significantly lower on familiar faces. When asked to subjectively assign a degree of subjective familiarity and affective valence to their respective relatives, patients showed lower familiarity and affective valence scores compared with the control group. Within the group of relatives, affective valence (or how patients scored the degree of relationship they had with each accompanying person — very negative, 0, to very positive, 10) seems to correlate with emotion recognition but degree of familiarity did not. Thus, results confirmed our two main hypotheses: patients with schizophrenia showed an altered sense of familiarity towards their own relatives, and this altered familiarity negatively affected the face emotion recognition.

This study represents an attempt to explore patient's face emotion recognition in personally familiar compared to unfamiliar individuals. Given that patients with schizophrenia are exposed to the emotional signals of personally familiar individuals to a much larger extent than strangers in their daily life, it represents a new and perhaps ecologically more valid approach to examining emotion-processing in schizophrenia. Our results are consistent with studies that indicated that familiarity may influence people's emotion-processing and that identity and emotion-processing may interact [54–56]. Interestingly, a study with healthy children also showed less correctness at recognizing emotions in familiar individuals compared to strangers. Authors concluded that personal familiarity may exert a distracting effect and that more salient emotional cues may distract away from identity recognition [56]. Patients with schizophrenia typically show an aberrant salience secondary to the dysregulation of dopamine transmission, leading to a mistaken interpretation of neutral or irrelevant stimuli as a source of reward or punishment [57]. One possible explanation of our findings is that exposition to familiar faces may display an aberrant salience that negatively interferes with the correct emotion recognition.

As in previous studies [reviewed in 2,8], the greatest number of errors, both with the familiar and unknown faces, was committed in the recognition of *anger* and *fear* in both the patient group and the control group. However, some emotions were poorly recognized by the patients on the faces of their own relatives, namely surprise and disgust.

The results from this study partially agree with those from previous studies. Although Caharel et al. [45] focused their study on the neurophysiological analysis of evoked potentials during facial processing, they found that the patient group was also less exact in the familiarity task. The authors related this fact to a generalized defect in facial processing, which was observed in both the sensory (P1) and perceptual (N170) stages. Interestingly, Platek & Gallup [58] showed that schizotypy traits are related to alterations in the recognition of one's own face, a process that involves the right hemisphere and is potentially related to the theory of mind [59]. The patients analyzed in our study were less able to recognize the emotions expressed on familiar faces (with whom they share genes, traits or previous experiences and who therefore contain elements of self-recognition) than those on alien faces. On the other hand, several authors have hypothesized that an aberrant response of the amygdala to emotional stimuli, together with a reduced prefrontal interconnectivity, could lead to affective flattening and the deficit in emotion recognition [60]. Given the assumption that viewing the faces of one's own relatives can activate a greater emotional response than viewing alien faces, our results agree with an excessive or aberrant activation of the amygdala, which would complicate the correct recognition of the expressed emotion. This overwhelming and imprecise reaction to emotional stimuli can lead to a sense of strangeness, mental saturation or finally, avoidance in the form of negative symptomatology.

Another explanation of this lower performance in the recognition of emotion on familiar faces within the group with schizophrenia would be that the relatives of schizophrenic patients may imitate gestures in a less effective way. A poor ability to mimic expressions in addition to a poor recognition of the expressed emotion has been described in schizophrenia [61–63]. Other studies [64,65] have shown a reduced capacity for emotional contagiousness, such as that observed with laughter, yawning or basic emotions of happiness or sadness. Healy et al. [66] measured the facial expressivity of schizophrenic patients using the Facial Action Coding System and found a significant reduction in this capacity compared with healthy subjects. This deficit could feed back to the patients' own deficit in social cognition, or it could adversely affect intra-familiar communication. This difficulty in the expression and perception of emotions could be a therapeutic target for interventions aimed at modulating expressed emotion in a familiar environment.

Apart from the small sample size, there are other limitations of the study that require cautious interpretation of the results. First, the expression of emotions by the relatives of the subjects was carried out through provocation and imitation. To verify these results, future studies are needed in which the recognition of genuine or spontaneous emotions expressed by the schizophrenic patients' relatives is measured. The expressive capacity of the relatives of both groups (patients and controls) can be assumed to be inferior to that of the actors who comprised the Emotion Recognition Task, but *a priori*, the expressive capacity of individuals in each group should be considered equal within the groups. Second, the 18 patients involved in the study were receiving antipsychotic medication during the time of testing. A recent review [67] has systematically studied the effect of pharmacological treatment on the recognition of facial affect without reaching any clear conclusions. It seems that neither

typical nor atypical antipsychotic medications can directly improve emotion recognition, which is in agreement with a previous study [68]; however, these medications have not been found to negatively affect emotion recognition. Finally, several of the faces familiar to the patients pertained to the therapeutic environment (nurses, psychiatrists or psychologists with whom the patient was historically linked). Conceivably, the emotional mechanisms involved in the therapeutic relationship are different from those within a family or a friendship.

The negative impact of familiarity on face emotion recognition represents an area of research with important clinical implications. Familiar environment of patients with schizophrenia often show affective attitudes and behaviors toward patients characterized by critical comments, hostility, and emotional over involvement [69]. The patient's misunderstanding of these emotional stimuli may lead to a positive feed-back of poor communication and disruption. It is known that family interventions in schizophrenia may reduce the number of relapse events and hospitalizations [70] and there has been recent interest in interventions aimed at improving social cognition and, specifically, face emotion recognition [71–73]. Taking into account the anomalous emotional processing of the familiar faces could help to modify and improve these preventive and therapeutic strategies.

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