PSYCHOLOGY & NEUROSCIENCE

Psychology & Neuroscience, 2008, 1, 1, 21-26
DOI:10.3922/j.psns.2008.1.004

Facial information processing in schizophrenia

João Paulo Machado de Sousa and Jaime Eduardo Cecílio Hallak

Universidade de São Paulo, Ribeirão Preto, Brazil

Abstract

The processing of facial identity and emotion in schizophrenia and its relation with these patients' cognitive and social functioning has been extensively studied over the last 25 years. In this paper, the results of 32 studies indexed in the PubMed database and published between 2001 and 2005 are analyzed and synthesized. Following the description of the problem and presentation of current hypotheses, methodological aspects and findings concerning the processing of facial emotion and identity are discussed. The analysis shows that, despite the growing attention dedicated to the theme and the provision of more specific results, the question of dependence/independence between the two processes - emotion and identity recognition - and between these and the pervasive cognitive deficits found in schizophrenia remains unanswered. **Keywords:** schizophrenia, face, emotion, affect, identity.

Received 13 December 2007; received in revised form 27 February 2008; accepted 29 February 2008. Available online 20 May 2008.

Introduction

No other part of the human body is able to convey, from an immediate visual appraisal, so much essential information for survival and social functioning as the face. The facial features, which generate this information, may be divided in two groups: structural (the face's physical features) and dynamic (derived from the automatic or deliberate movement of the facial features).

These two groups may be better understood according to the type of information each transmits. Thus, structural features are those essentially responsible for the composition of an individual's facial identity. Besides identity, the structural features of the face still transmit information on the individual's gender and age, participating in the regulation of a broader social contact. The dynamic features of the face refer to the multiple possibilities of organization of the face's internal elements (eyes, mouth, eyebrows, etc.) as to create different facial expressions, indicators of the emotional context elicited by the environment.

The importance of the face in human interaction has drawn the attention of researchers for over a century. Darwin (1872) carried out a deep study on affect manifestations in humans and animals, suggesting that facial expressions represent innate and automatic behavioral patterns. According to this idea, it is reasonable to suppose that the human capacity to quickly and precisely decode facial expressions such as fear, for instance, has been selected throughout evolution due to its adaptive value.

Following Darwin's steps, other researchers found evidence that led them to propose that facial expressions are automatic representations derived from the individual's emotional experience. Hence, the informative value of such expressions is not their essential function, but a secondary effect of an internal and individual emotional experience (Izard & Malatesta, 1987; Ekman, 1997).

In contrast, Blair (2003) suggests that facial expressions of emotion mainly serve a communicational purpose, where the individual can transmit information on the emotional valence of objects and situations to observers of the same species. Therefore, the conditions for an emotional representation require not only an emotional event, but also a potential observer. Consistent with this, empirical evidence suggests that emotional expressions are not the automatic result of an internal emotional condition, but depend on the social context or even on the deliberate action of the person displaying the emotion.

Such a complex ability to decode important facial information in the environment, emotional or identity-related, will rely on the harmonic functioning of strategies learned throughout development and the neural systems underlying the processing of facial information.

Identity and emotion

Though apparently indistinct at first sight, evidence suggests that the processing of facial identity and facial affect relies on diverse and interconnected, systems. The model proposed by Bruce and Young (1986) suggests that facial affect is unimportant for face recognition. Instead, they propose that recognition relies on 'Facial Recognition Units' (FRU) that contain the basic structural

João Paulo Machado de Sousa and Jaime Eduardo Cecílio Hallak, Hospital das Clínicas da Faculdade de Medicina de Ribeirão Preto, Universidade de São Paulo, Ribeirão Preto, Brasil. Correspondence concerning this article should be addressed to João Paulo Machado de Sousa, Departamento de Psiquiatria, Neurologia e Psicologia Médica, Hospital das Clínicas, 3º andar, Av. Bandeirantes, 3.900 - Ribeirão Preto – São Paulo, Brazil. Phone: +55-16-3602-2853. E-mail: jpmpaulos@yahoo.com.br

codes for recognition. According to this model, whenever the observer encounters an emotional face, this face undergoes a normalization process during which the dynamic features are left aside. The normalized face is then submitted to an appreciation based on the FRUs to then be identified. In short, the model proposes the functional independence between the processing of identity and emotion.

Despite the coherence of that model, the question of dependence/independence between the processing of emotion and identity remains unanswered. In a study to investigate the effects of expression on recognition, Endo, Endo, Kirita and Maruyama (1992) designed a task using familiar and unfamiliar faces representing three emotions: happiness, sadness and neutral affect. The results showed that the time for face recognition was strongly affected by emotional affect, neutral faces being recognized faster than emotional faces.

Pathology and facial information processing

Despite the above proposition that the human ability to decode faces is innate and results from successful adaptation, that ability likely improves after birth, throughout the developmental process. Additionally facial decoding may be subject to the same risks of failure observed in other cognitive and neuropsychological functions. Part of the healthy development of facial information processing involves the capacity to modulate and respond properly to the environment's social requirements. Saarni (1984) observed that facial disappointment expressed by a young child who receives a poorer than expected gift is much more easily perceived than the same feeling expressed by an older child. Accordingly, one may infer that certain conditions may have a negative influence on the development and enhancement of this perceptive modality. Thus leaving open the possibility of erroneous interpretation of the social context or even to the inability of accomplishing any functional appraisal at all.

Probably the most well documented example of such dysfunctions (Damasio et al., 1982; De Renzi et al., 1990; Farah, 1991, in Posamentier & Abdi, 2003) is prosopagnosia (from the Greek prosopon, 'face' + agnosia, 'ignorance'). In that condition the individual is unable to identify familiar faces, resorting to other clues (voice, gestures, etc.) in order to recognize people. Despite such impairment, however, the capacity to interpret facial emotions may remain perfectly healthy in these individuals. Besides prosopagnosia, which refers more specifically to the dysfunction in face identification, several studies have also supplied evidence of impaired facial emotion recognition in psychiatric conditions such as depression, social phobia, panic disorder, and schizophrenia. Such impairment, in contrast with prosopagnosia whose circumscription is quite precise, may have varied presentations and is object of disagreement among researchers.

Faces and schizophrenia

The study of facial emotion processing in schizophrenia has faced a series of obstacles, such as the lack of standardized stimuli in the beginning, and the challenge of knowing exactly which cognitive processes were enrolled in each task's demands. These issues did not hinder research from expanding and providing important findings since the middle 1980s, when better focused and systematic studies started to appear. However, some crucial questions remain. Facial information decoding depends not only on the integrity of the perceptual system itself, but also on some cognitive functions such as memory and attention. Generally speaking, the schizophrenic patient presents important neurocognitive impairments, rendering the distinction between the effects of these and possible specific impairment in facial processing a difficult undertaking. Besides the question of 'global deficit vs. specific deficit', schizophrenia may be divided in subtypes, according to the group of prominent symptoms. The current research on facial processing in schizophrenia has been obliged to clearly define the patient group that is studied since the impairment in face perception seems to be subject to the disease's different presentations.

The objective of this review is to make a survey of the studies on processing of facial identity and emotion in schizophrenic patients published in the last 5 years, analyzing their methodological aspects and results, which point to answers for the questions posed above.

Method

Paper search and selection

The search was conducted on the Medline database using the keywords "schizophrenia", "affect", "identity", "face" and "facial", identifying a total of 97 papers, from which 32 were selected. Inclusion criteria were empirical studies published in the last five years in English, Portuguese or Spanish, involving the processing of facial identity and/or emotion in schizophrenia. The time range, set at five years, was determined in function of the publication of similar studies in 1994 (Phillips & David), 1997 (Mueser et al.) and 2002 (Edwards et al.).

Population

The 32 studies involved a total of 2641 participants, which were divided into three groups for this analysis: schizophrenia patients (SP), patients with other diagnoses (POD) and healthy controls (HC). The two groups of patients account for about half of the total, the remaining half being composed by HC.

Among the 2503 participants whose gender was noted (one of the studies did not specify the gender distribution of a group of 138 healthy controls), 59% (1,496) were male, and 41% (1,007) female. The distribution of gender by group was more uneven among SP, where there were almost two times more men than women (903 and 469, respectively). In the POD and HC groups, the differences were not as dramatic: 206 male and 180 female in the first; 387 male and 358 female in the second.

Regarding age, some studies provided means, while others informed the range, making it impossible to determine either a general mean or a global range. In the SP group, means varied between 17.6 (SD = 3.1) and 47.7 (SD = 7.1), and the range was 18-60. In the HC group, means varied between 21.7 (SD = 6.05) and 48.2 (SD = 9.6), while the age range was 18-45. Four studies had no control groups.

The POD group included 44 patients with affective disorders (1 study), 41 with depression (2 studies), 35 autistic patients (1 study) and 30 brain-lesioned patients (1 study). First-degree relatives of schizophrenic patients (134; 3 studies) and autistic patients (102; 1 study) were also included in this group since they were regarded as 'cases' in the studies they took part in. Given the small number of participants in each condition, specific information on gender and age are unimportant.

Tasks

A series of differences among the experimental designs adopted by each study was observed. Most authors adopted tasks specifically developed for their studies, despite the existence of consolidated tasks to evaluate facial information processing [e.g. Benton Facial Recognition Test (BFRT – Benton, Hamsher, Varney & Spreen, 1983), Kinney's Affect Matching Task (KAMT – Kinney, 1995)].

The different tasks used may be divided into four general categories, according to their requirements: 1) Emotion recognition: labeling of facial emotions using predefined categories or subjective judgment. 2) Emotion discrimination: response based on emotional face presented previously or simultaneously to a target stimulus. 3) Emotional intensity determination: response based on differences of emotional intensity represented in the stimulus.

Stimuli

The same diversity in the tasks chosen was observed in the stimuli that were used. The most used stimuli (9 studies) were, as expected, the series "Pictures of Facial Affect" by Ekman and Friesen (1976), followed by original or unidentified series (11 studies) of pre-existent tests like the BFRT or KAMT (4 studies), series by Matsumoto and Ekman (3 studies), series by Mazurski and Bond (2 studies), schematic faces (1 study), and series by Izard (1).

Results

Identity

The first main point is that research on facial information processing in schizophrenia focuses mainly on emotion recognition, with the processing of identity coming in second place. All the 32 studies investigated facial affect recognition, but only 50% also investigated non-emotional aspects, included in the category "identity." Among the 16 studies that investigated identity processing, seven (43.75%) found no differences between schizophrenics and healthy controls in this function. Schizophrenic patients with and without hearing impairment and healthy controls did not differ in BFRT performance (Kubota et al., 2003). The same procedure and results were found in a study by Scholten, Aleman, Montagne and Kahn (2005), comparing facial recognition abilities in male and female schizophrenics. Gur et al. (2002), using an age estimation paradigm, also failed to find differences between a group of patients and healthy controls.

Additionally, no differences were observed by Combs and Gouvier (2004) when comparing measures of attention and facial identity processing. Still among the studies that found no differences between patients and controls in identity processing, Schwartz, Marvel, Drapalski, Rosse and Deutsch (2002) observed that patients are as influenced as healthy controls by changes in facial configuration This finding supports the idea that schizophrenics have a contextual appraisal of the face, rather than a compartmented one.

Despite these negative results, a discretely higher proportion of studies investigating identity processing (56.25%) did find differences between patients and controls. Kucharska-Pietura, David, Masiak and Phillips (2005) state that schizophrenics are more impaired than controls in face recognition, and that such impairment correlates with illness' duration. Identity-related cognitive deficits were investigated by Bozikas, Kosmidis, Anezoulaki, Giannakou and Karavatos (2004), who verified memory and verbal fluency impairment in patients, and by Sachs, Steger-Wuchse, Kryspin-Exner, Gur and Katschnig (2004), who reported impairment in verbal memory, abstraction-flexibility and language processing.

Some studies suggest that facial recognition may be impaired due to restricted visual scanpath patterns (Loughland, Williams, & Gordon, 2002; Loughland, Williams, & Harris, 2004). In practice, schizophrenics do not 'see' the face as healthy people do, fixating more on peripheral and less important zones than on the facial features that transmit information about identity. Curiously, an attenuated form of these abnormal patterns was also observed in first-degree relatives of schizophrenic patients. The results of two other studies lie within an intermediate zone, indicating that schizophrenic patients have problems in the performance of affect matching tasks in different facial identities (Baudouin, Martin, Tiberghien, Verlut, & Franck, 2002; Martin, Baudouin, Tiberghien, & Franck, 2005). The proposed explanation is that these individuals' inability to disregard irrelevant information for the execution of the task is correlated with negative symptoms.

Emotion

All 32 studies investigated facial emotion processing in schizophrenia. Among those, five (15.6%) failed to find differences between patients and healthy controls: Holt et al. (2006) found no differences in emotional intensity judgments using a six-point Likert scale. Comparing patients with their first-degree relatives and healthy controls, Bölte and Poustka (2003), found similar performance in all three groups. Gur et al. (2002) reported no differences between patients and controls in an age estimation task involving emotional faces. Schwartz et al. (2002) investigated the

effect of configurational changes in emotion recognition and concluded that changes in face position or combination of different faces do not influence the process. Lastly, Baudouin at al. (2002) propose that variations in emotional expressions do not affect the recognition of facial identity.

In spite of these negative results, most of the studies (84.4%) found differences in the processing of facial emotion in schizophrenics. With the development of the research in the field, the results of these studies may be analyzed separately, according to their specificity.

Schizophrenia, cognition and social functioning

A study involving samples of schizophrenic patients with single and multiple episodes found that the recognition of facial emotion correlates with social and cognitive functioning in schizophrenia (Addington, Saeedi, & Addington, 2006). Additionally, other studies showed that men and women are differentially impaired in social contact, with males being the most affected (Hooker & Park, 2002; Scholten et al., 2005). This difference between genders, also observed in healthy people, remains unchanged in schizophrenia.

Results show that the impairment in emotion recognition may be related to cognitive deficits in different domains such as verbal memory, language processing and attention (Combs & Gouvier, 2004; Bozikas et al., 2004; Sachs et al., 2004). Martin et al. (2005), although not indicating specific cognitive deficits, suggest that schizophrenics again have difficulties disregarding irrelevant facial information for the execution of certain tasks. In this study, patients had problems matching photographs of the same emotion represented by distinct facial identities.

Social functioning problems resulting from dysfunctional emotional perception in schizophrenia may still be linked to the visual scanpath patterns observed in these patients. According to two studies by Loughland et al. (2002, 2004), schizophrenics show restricted visual scanpaths which lead to deficits mainly, but not exclusively, in the recognition of neutral and happy faces. An attenuated version of such a pattern is also be observed in these patients' first-degree relatives.

Affect processing and symptomatology

As proposed in the introduction, the research on facial information processing in schizophrenia has evolved, supplying more specific results related to different aspects of the schizophrenia. Evidence shows that patients with chronic schizophrenia have greater impairment in affect recognition than those in the beginning of the illness, which in turn are more impaired compared to healthy people (Kucharska-Pietura et al., 2005). Hearing impaired schizophrenics showed greater deficits compared to patients with normal hearing (Kubota et al., 2003) while disorganized and paranoid patients proved more impaired than residual patients (Weniger, Lange, Ruther, & Irle, 2004). Lastly, patients with blunted affect showed greater speed-accuracy decomposition (faster responses – probably linked to difficulty in sustaining concentration in the task – resulting in more judgment mistakes) in one study (Gur et al., 2006), but decreased response speed in another (Suslow, Roestel, & Arolt, 2003).

Some studies also pointed to deficits for specific emotions. For example, patients with higher psychopathy scores are more impaired in the recognition of sadness (Fullam & Dolan, 2006), schizophrenics in remission have greater difficulties recognizing sadness and anger, but not other emotions (Bediou et al., 2005), patients with blunted affect and anhedonia show increased sensitivity for negative emotions (Suslow, Droste, Roestel, & Arolt, 2005), and paranoid patients present abnormal amplitudes during the visualization of neutral faces in ERP studies (Herrmann, Reif, Jabs, Jacob, & Fallgatter, 2006).

Intervention

One of the studies (Wolwer et al., 2005) submitted two groups of patients to distinct training programs (one aimed at the remediation of cognitive deficits: CRT – Cognitive Remediation Training, and another specifically at emotion recognition: TAR – Training of Affect Recognition). After verifying that schizophrenics were impaired in the recognition of facial emotions, The TAR group displayed significant improvement in the recognition of facial emotions, approaching the performance of the control group.

Discussion

According to our analyses, we found that research on facial information processing has been evolving, providing specific results related to different aspects of the schizophrenic disorder. The study on facial information perception is divided in two wide domains: 1) processing of identity and 2) processing of emotion. The analyses indicate that there is substantially greater interest in the research related to emotional information, possibly motivated by the search for deeper comprehension of the mechanisms which lead to the precarious social adaptation of the schizophrenic patient.

Besides impaired social functioning, cognitive deficits in different domains are observed in schizophrenia, such as attention, memory and language processing. The observation of these impairments has led researchers to question whether the deficits in the processing of emotion and identity are specific phenomenon or the result of global cognitive impairment. The results of the studies we analyzed do not allow for the elaboration of a definitive answer, since they offer evidence pointing in diverse directions. In spite of this, there seems to be a solid correlation between memory impairment and identity processing, and between impaired attention and language and emotion processing. Further research dedicated to comprehensive cognitive assessment in conjunction with face processing tasks, might help establish the basis of this interaction.

Another question, derived from the one above, is whether identity and emotion processing is differentially impaired in schizophrenia. Almost a third of the studies

which investigated both these domains found no differences between schizophrenics and healthy controls regarding identity processing, but found patients impaired in emotion recognition. The remaining two thirds found impairment in both domains. This numerical difference, however, is not enough to confirm the hypothesis of a global deficit in face perception, since there are important differences in the study designs.

The major troublesome factor for a global analysis of the results from the different studies is the plethora of tasks and stimuli used. The use of standardized tasks would facilitate the comparison of results, but is hindered by the virtual impossibility of developing a small number of instruments adequate for the investigation of quite different aspects of the same problem.

Since no doubts seem to be left regarding the correlation between schizophrenia and facial processing deficits, the current area of most interest is the investigation of differences among the different patient subgroups. The most robust evidence in this direction indicates that patients with negative symptoms are more impaired than those without these symptoms. This more pronounced impairment is be true both for the processing of identity and emotion as well and, even more specifically, for the perception of negative valence emotions. Besides that, paranoid schizophrenics seem to show increased sensitivity for negative facial stimuli and neutral faces, tending to overestimate the intensity of negative emotions and attribute emotional content where there is none. It is possible that these factors take part in the genesis of hallucinations and delusions in this group of patients. Lastly, some results indicate that all these deficits outlined above, both identity and emotion-related, general or specific, could stem from abnormal patterns of visual face exploration. The visual fixation in unimportant regions of the face and the inability to disregard unrelated contextual information (such as the extraction of the emotional meaning of a face regardless of its identity, for example) provide strong evidence in this direction.

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