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Social cognition in schizophrenia and healthy aging: Differences and similarities

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ABSTRACT

Social cognition is impaired in schizophrenia but it is not clear whether this is specific for the illness and whether emotion perception is selectively affected. To study this we examined the perception of emotional and non-emotional clues in facial expressions, a key social cognitive skill, in schizophrenia patients and old healthy individuals using young healthy individuals as reference. Tests of object recognition, visual orientation, psychomotor speed, and working memory were included to allow multivariate analysis taking into account other cognitive functions

Results: Schizophrenia patients showed impairments in recognition of identity and emotional facial clues compared to young and old healthy groups. Severity was similar to that for object recognition and visuospatial processing. Older and younger healthy groups did not differ from each other on these tests. Schizophrenia patients and old healthy individuals were similarly impaired in the ability to automatically learn new faces during the testing procedure (measured by the CSTFAC index) compared to young healthy individuals.

Conclusions: Social cognition is distinctly impaired in schizophrenia compared to healthy aging. Further study is needed to identify the mechanisms of automatic social cognitive learning impairment in schizophrenia patients and healthy aging individuals and determine whether similar neural systems are affected.

1. Introduction

Impairments in social cognition are prominent in schizophrenia, influence functional outcome and constitute an important target for treatment development (Green et al., 2012; Horan et al., 2012; Kurtz and Richardson, 2012; Statucka and Walder, 2013). Schizophrenia patients are poor in detecting and correctly identifying information contained in facial expressions when compared to healthy individuals but it is not clear whether this is specific for faces and whether emotional and non-emotional clues are equally affected.

The biological bases of social cognition are complex and only partially known. Face recognition is mediated by a distributed neural system consisting of multiple bilateral regions (Haxby et al., 1994; Li et al., 1993; Puce et al., 1995) with a core system in occipitotemporal regions of the extra-striate cortex, which provides visual analysis, and an extended system including temporo-limbic and parietal structures, which extracts meaning from faces (Haxby et al., 2002). Emotion processing involves interactions between multiple subcortical and cortical regions including the amygdala, basal ganglia, prefrontal cingulate and temporal cortical regions (Eimer and Holmes, 2007; Esslen et al., 2004; Palermo and Rhodes, 2007; Vuilleumier and Pourtois, 2007) and is organized in several networks (Kober et al., 2008).

Better understanding of how social cognition processes in schizophrenia differ from those in healthy individuals can advance investigation of their neural basis and help determine whether some constituent networks are selectively impaired. An established way of investigating illness specificity is to compare performance in populations with different pathologies or influenced by biological processes such as aging. In a recent study using this approach we compared schizophrenia and healthy aging groups and found that some executive functions showed similar severity of impairment in the two groups while other executive functions were more impaired in patients (Silver and Bilker, 2013). Examination of performance characteristics showed that the convergent outcome resulted from impairments at different stages of processing such that specific customized interventions would be needed to treat each condition.

In this study we investigated social cognition processes in schizophrenia and healthy aging. We compared the ability of schizophrenic and healthy old individuals to recognize facial identity and emotional clues using young healthy individuals as reference. In contrast to schizophrenia, the literature is unclear as to the effects of age on social

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cognition (Gao et al., 2009; Germine et al., 2011; Hildebrandt et al., 2011; Norton et al., 2009).

To enable analysis taking into account other cognitive processes we included tests of object recognition, visuospatial orientation, working memory and psychomotor speed.

We asked the following questions:

Is impairment in processing of facial identity and emotional clues different in patients?

Is impairment in processing of face stimuli different from non-facial stimuli in patients?

How does the impairment in schizophrenia compare with that in old healthy individuals?

2. Experimental materials and methods

2.1. Subjects

Participants included 75 (66 men, 9 women) individuals with schizophrenia, 60 (40 men, 20 women) elderly healthy and 77 (51 men, 26 women) young healthy individuals.

The patients were diagnosed with schizophrenia or in a few cases (N = 5) schizoaffective disorder, by consensus between treating and research clinicians who were all senior psychiatrists and who used clinical interviews, observations, and case notes to determine the DSM-IV diagnosis. These clinicians had shown good inter-rater agreement in past comparisons using rating scales. Clinical characteristics were: SANS total mean score = 49.41, SD = 22.39, SAPS total mean score = 24.23, SD = 20.67, age at first hospitalization mean = 28.48, SD = 10.39 years, illness duration mean = 9.64, SD 9.72 years, and number of hospitalizations mean = 3.45, SD = 5.43.

All received antipsychotics, 50% of second generation type (risperidone, clozapine, olanzapine, ziprasidone) and the rest first generation (perphenazine, haloperidol (mostly as decanoate), clopixol, pimozide). Their clinical condition was stable and drug doses were unchanged for at least 2 weeks prior to the study.

The elderly healthy group comprised individuals living in the community recruited for a study of healthy aging. Their selection was driven by the desire to study "pure" aging, free as far as possible from mild cognitive impairment (MCI) and early dementia or other brain pathologies. By selection, the elderly group included well-functioning fully independent individuals whose current general cognitive performance and historical educational achievements were on par or better than the control younger healthy group. Younger individuals were volunteers drawn from the same community or hospital staff. The selective process was reflected in the basic characteristics of the elderly group which were as good or better than the younger healthy volunteers. Thus the general performance (MMSE) mean score in the older group was 29.1 (SD 1.13, range 25–30, variance 1.28) and in the young group 29.14 (SD = 1.26, range 23–30, variance 1.58; p = .8430). Education duration in the old group had a mean = 14.72 (SD = 4.125, range 7–25, variance 17.12) and in the young mean = 11.94 (SD = 1.57, range 8–16, variance 2.46) years. The difference between groups was significant ($p < .001$) and reflected a greater proportion of individuals with one or more tertiary university degrees in the old group. Extensive questioning excluded individuals with medical problems, history of neurological disorders, drugs or alcohol abuse or medication that could significantly affect cognitive performance. The details of the healthy population are fully described in Silver et al. (2010) which also included some of the test data.

Mean ages in the study groups were: schizophrenia 37. 93 SD = 10.86 years, elderly healthy 72.28 SD = 6.76 years, and young healthy 37.39 SD = 10.74 years (vs. schizophrenia p = 0.20). Schizophrenia patients have significantly less education (mean 10.20, SD = 3.23 years) than the older ($p < 0.001$) but not younger (p = 0.07) healthy group.

2.2. Neuropsychological assessment

2.2.1. Facial emotion recognition

Facial emotion recognition was tested with the Penn Emotional Acuity Test (PEAT, Erwin et al., 1992). This presents 40 monochromatic pictures depicting happy, sad or neutral facial emotional expressions. The participant is asked to rate each picture on a seven point scale, whether the face presented was very happy, happy, mildly happy, neutral, mildly sad, sad, or very sad. The total number of true positive responses (i.e., response in the "happy" range for a happy face, in the "sad" range for a sad face and neutral for neutral faces) and the median RT for correct responses were the outcome measures.

2.2.2. Face identity recognition

Face identity recognition was tested with the Penn Face Memory Test (PFMT, Gur et al., 2001a, 2001b). This test consists of 20 target faces and 40 foils (20 for each test trial). Stimuli are black-and-white photographs of faces balanced for gender and age. All faces are of neutral emotional expression, as determined by 12 raters. In the learning phase, 20 stimulus faces are presented at a rate of 1/s. Recall is tested immediately after the learning phase (short delay) and after a long delay (approximately 20 min), during which time the subject performs unrelated tasks. The target faces are presented mixed with previously unseen (distractor) faces in a fixed pseudo-random sequence, and the participants are asked to indicate, in a forced-choice paradigm, whether or not they recognize the face. Different (previously unseen) distractor faces are used in the short and long delay conditions. The presentation of each picture is not limited in time and no feedback is given to the participant. The total correct score and median RT to correct response were the outcome measures.

2.2.3. Object recognition

Object recognition was assessed with the Visual Object Learning Test (VOLT, Glahn et al., 1997). It uses 20 Euclidean shapes as learning stimuli, which are presented over four learning trials, followed by immediate and long (approximately 20 min) delay test recall. Total correct score and median reaction time were the outcome measures.

2.2.4. Computerized Judgment of Line Orientation

Computerized Judgment of Line Orientation (JLO) (Benton et al., 1975; Gur et al., 2001a, 2001b) was used to assess visuospatial perception. This task is a computerized adaptation of the original paper-and-pencil task. Participants are shown two lines at an angle and are asked to indicate the corresponding lines on a simultaneously presented array. The difficulty is defined by the length of the stimulus lines. The number of correct responses was the outcome measure.

2.2.5. Psychomotor speed was tested with finger

Psychomotor speed was tested with Finger Tapping Test (Reitan and Davison, 1974), which examines the ability to make rapid repetitive movements. The test was modified, and the patients were asked to tap with the same index finger on two points set 30 cm apart as rapidly as possible. Each hand was tested separately. The outcome measure was the number of taps per minute with the dominant hand.

2.2.6. Mini Mental State Examination

Mini Mental State Examination (Folstein et al., 1975) was used to assess general cognitive function. Mean score in schizophrenia patients was 25.57 SD = 3.433 (vs healthy, young and old, $p < 0.001$).

2.3. Statistics

T-tests and analysis of variance (ANOVA) models were used to compare groups for continuous normal outcome variables. The values of the schizophrenia and older healthy groups were standardized using the means and SD of the younger healthy group.