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Effects of *Training of Affect Recognition* on the recognition and visual exploration of emotional faces in schizophrenia

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ABSTRACT

Background: Schizophrenia patients have impairments in facial affect recognition and display scanpath abnormalities during the visual exploration of faces. These abnormalities are characterized by fewer fixations on salient feature areas and longer fixation durations. The present study investigated whether social–cognitive remediation not only improves performance in facial affect recognition but also normalizes patients' gaze behavior while looking at faces.
Methods: Within a 2 × 2-design (group × time), 16 schizophrenia patients and 16 healthy controls performed a facial affect recognition task with concomitant infrared oculography at baseline (T0) and after six weeks (T1). Between the measurements, patients completed the Training of Affect Recognition (TAR) program. The influence of the training on facial affect recognition (percent of correct answers) and gaze behavior (number and mean duration of fixations into salient or non-salient facial areas) was assessed.
Results: In line with former studies, at baseline patients showed poorer facial affect recognition than controls and aberrant scanpaths, and after TAR facial affect recognition was improved. Concomitant with improvements in performance, the number of fixations in feature areas ('mouth') increased while fixations in non-feature areas ('white space') decreased. However, the change in fixation behavior did not correlate with the improvement in performance.
Conclusions: After TAR, patients pay more attention to facial areas that contain information about a displayed emotion. Although this may contribute to the improved performance, the lack of a statistical correlation implies that this factor is not sufficient to explain the underlying mechanism of the treatment effect.

1. Introduction

Impairments in facial affect recognition are one of the most often replicated neuropsychological findings in schizophrenia (Trémeau, 2006; Morris et al., 2009; Kohler et al., 2010) and have been identified as a significant factor contributing to poor social and community functioning (Lee et al., 2004; Couture et al., 2006; Pinkham et al., 2008). Deficits in facial affect recognition occur in first and multi-episode schizophrenia (Edwards et al., 2001; Addington et al., 2006) and are already present in individuals at clinical high risk for psychosis (Addington et al., 2008; Amminger et al., 2012a, 2012b; Wölwer et al., 2012) and in healthy relatives of schizophrenia patients (Kee et al., 2004; Bediou et al., 2007; Eack et al., 2010). For this reason, an involvement of impaired facial affect recognition as a vulnerability factor (Bediou et al., 2007) or putative endophenotype (Gur et al., 2007) in the etiopathogenesis of schizophrenia is discussed.

A better understanding of the underlying neurocognitive abnormalities is necessary in order to generate adequate treatment strategies or improve already existing approaches that focus on impaired facial affect recognition (Wölwer et al., 2010). The analysis of visual scanpaths (patterns of eye movements and foveal fixations) provides an objective, real-time behavioral correlate of neurocognitive strategies that individuals employ while viewing face stimuli (Manor et al., 1999; Williams et al., 1999). In general, people scan the salient regions of a face (i.e. eyes, nose, and mouth) in an inverted triangular pattern (Groner et al., 1984). Patients diagnosed with schizophrenia and other psychotic disorders show abnormalities in the visual exploration of faces (and other stimuli) characterized by fewer fixations of longer average durations and a tendency to avoid salient facial features (Streit et al., 1997; Williams et al., 1999; Loughland et al., 2002b; Green et al., 2003; Bestelmeyer et al., 2006; Benson et al., 2007; Lee et al., 2010), for review see Toh et al. (2011). Because of the stability of these atypical scanpaths in schizophrenia patients, their role as a potential trait marker was already discussed by several authors (Loughland et al., 2002a, 2004; Marsh and Williams, 2006; Beedie et al., 2011).

Despite the apparent relationship between scanpath abnormalities on the one hand and deficits in facial affect recognition on the other, whether and how these characteristics relate to each other remains

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unresolved, since only a few studies have investigated both in the same paradigm (Rosse et al., 1998; Schwartz et al., 1999; Loughland et al., 2004; Campbell et al., 2010). One way of investigating the relationship between divergent gaze patterns and impaired facial affect recognition in schizophrenia is to enhance performance with social–cognitive remediation programs that specifically target the correct decoding of facial emotions (Penn and Combs, 2000; Silver and Oakes, 2001; Frommann et al., 2003) and to assess concomitant changes in the visual exploration of facial stimuli. This approach would also help to uncover the mechanisms of change of such interventions.

In a study by Russell et al. (2008), after patients had been successfully trained with the computer-based Micro-Expression Training Tool (METT) they showed an overall increase in visual attention towards facial feature areas (i.e. eyes, nose, and mouth), i.e. improvements in facial affect recognition were associated with an increase in the number of fixations and the time spent viewing these feature areas. Nevertheless, correlations between accuracy and gaze parameters were only significant before the training, not afterwards. Since these were the first findings on the influence of a targeted social–cognitive remediation program on the visual exploration of faces in schizophrenia patients, the present study aimed to add evidence to this field by using a different kind of training program that is based on more implicit strategies rather than the explicit attention shaping processes applied in the METT. We investigated the impact of the six-week Training of Affect Recognition (TAR) (Frommann et al., 2003) on gaze behavior in schizophrenia patients by means of concurrent measurements of performance and visual exploration before (baseline T0) and after (T1) the training. A non-treated healthy control group was assessed twice within six weeks as well. We expected significant interactions between the factors 'group' and 'time' regarding (1) the performance in facial affect recognition and (2) the number and average duration of fixations in non-salient 'white space' and facial feature areas.

Table 1
Demographic and cognitive variables for patients and controls.

Demography	Patients Mean (SD)	Controls Mean (SD)	*T* (*p*)
Age	36.69 (11.67)	33.69 (8.82)	−.82 (.42)
Gender	4 females 12 males	3 females 13 males	.18 (.50)
Education (years)	11.69 (1.58)	13.25 (.78)	**3.55 (<.01)**
IQ	103.88 (11.97)	119.33 (11.93)	**3.6 (<.01)**

Cognition	T0 Patients Mean (SD)	T0 Controls Mean (SD)	T1 Patients Mean (SD)	T1 Controls Mean (SD)	Group *F* (*p*)	Time *F* (*p*)	G × T *F* (*p*)
Verbal memory	36.63 (13.33)	53.31 (8.05)	36.50 (14.66)	55.06 (7.89)	**21.24 (<.01)**	.41 (.53)	.55 (.47)
Digit sequencing	17.25 (3.59)	24.13 (3.9)	18.19 (4.68)	24.19 (3.43)	**24.03 (<.01)**	1.25 (.27)	.96 (.34)
Token motor task	54.93 (13.33)	73.79 (11.78)	57.20 (16.28)	73.25 (13.85)	**13.5 (<.01)**	.01 (.94)	.86 (.36)
Semantic fluency	20.25 (5.79)	28.06 (7.01)	20.38 (6.72)	27.63 (6.44)	**14.37 (<.01)**	.02 (.89)	.06 (.81)
Letter fluency (F)	10.31 (5.44)	12.06 (4.33)	9.69 (4.62)	11.75 (4.12)	1.54 (.22)	.63 (.43)	.07 (.79)
Letter fluency (S)	11.81 (7.27)	14.31 (4.53)	11.44 (6.87)	16.69 (4.73)	2.87 (.10)	3.52 (.07)	**6.38 (<.05)**
Symbol coding	42.75 (12.14)	62.56 (8.57)	43.44 (11.52)	64.94 (9.98)	**32.60 (<.01)**	2.19 (.15)	.66 (.42)
Tower of London	15.88 (3.52)	17.50 (3.01)	16.50 (3.01)	18.25 (3.24)	2.42 (.13)	**4.60 (<.05)**	.04 (.85)
Benton Face Recogn. Test	46.50 (4.18)	48.20 (3.08)	47.19 2.59	49.38 2.94	3.09 (.09)	2.00 (.17)	.03 (.87)

Numbers printed in bold depict the significant main effects and interaction.

2. Methods

2.1. Design

A 2 × 2 design comprised the quasi-experimental between-subjects factor 'group' (schizophrenia patients vs. healthy controls) and the within-subjects factor 'time' (measurement at baseline T0 and after six weeks T1). The dependent variables were performance in the affect recognition task (percent of correct answers) and the number and mean duration of fixations in white space and the relevant feature areas. The study was approved by the ethics committee of the University of Düsseldorf and conducted in compliance with the Declaration of Helsinki. Written informed consent was obtained from each participant.

2.2. Participants

Sixteen post-acute patients who fulfilled the diagnostic criteria for schizophrenia as assessed with the Structured Clinical Interview for DSM-IV (First et al., 1995) and 16 healthy controls with no history of psychiatric disorder participated in the study. The clinical sample was recruited at the Department of Psychiatry and Psychotherapy of the University of Düsseldorf, Germany, i.e. the sample originated from an unselected pool of psychiatric inpatients of the whole treatment sector of the city of Düsseldorf. All of the patients were medicated with atypical antipsychotics. The mean duration of illness was 10.67 years (SD 8.6) and the mean number of acute psychotic episodes was 3.88 (SD 1.89). The healthy controls were recruited by word of mouth (see Table 1 for demographic and cognitive characteristics).

At baseline, all participants were assessed to check inclusion and exclusion criteria (i.e. age 18–60 years; intelligence quotient (IQ) > 80; good German language skills; no neurological diseases). The patients' symptom severity was rated before both measurements by using the Positive and Negative Syndrome Scale (PANSS) (Kay et al., 1987). Patients had only mild symptoms: Mean PANSS positive score at T0 = 12.5 (SD 4.23), mean negative score = 11.9 (SD 4.49), and mean global score 25.9 (SD 6.17); and mean PANSS positive score at T1 = 12.0 (SD 4.71), mean negative score = 12.2 (SD 6.89), and mean global score = 26.5 (SD 6.49). While the groups did not differ with respect to age and gender, the patients' premorbid IQ, assessed with the multiple choice vocabulary test (Lehrl, 2005), and the years of education differed significantly from those of the healthy controls. None of these variables was significantly related to the dependent variables.

Participants were excluded from gaze data analyses if their gaze was recorded in ≤90% of the time (i.e. tracking ratio TR ≤ 90%) or if the calibration did not reach a predefined accuracy criterion (x-/y-deviations ≤ 1.0°). Four patients and one healthy participant fulfilled these criteria and were excluded from the analyses. The gaze data of one further control subject could not be analyzed because of his corneal irregularity and strong contact lenses, which led to difficulties during the calibration process and unusable data. Hence, we analyzed the performance data of 16 patients and 16 controls and the gaze data of 12 patients and 14 controls (mean TR = 96.3%; SD = 3.84; mean x-deviation = .47, SD = .26; mean y-dev. = .52, SD = .24).

2.3. Remediation program

The TAR is a social cognitive remediation program that is conducted in 12 group sessions of 45–60 min twice a week. Two patients per group are successively trained to recognize facial emotions. Based on an errorless learning approach, the process of affect recognition is modified by conveying a sequence of different strategies (e.g. verbalization, self-instruction, using situational anchors), both in paper and pencil tasks as well as in PC tasks. Starting with single faces the training ends with complex social scenes (for more details, see Frommann et al., 2003).