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Comparative Studies on Recognition of Faces, Mimic and Gestures in Adolescent and Middle-aged Schizophrenic Patients

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Summary. In adolescent and middle-aged schizophrenic patients and normals 10 different multiple-choice tests of 12 scored movie scenes lasting 10 s were applied, measuring the ability to recognize faces, persons and mimic expressions. In all tests errors were significantly higher by a factor of 7 to 14 in patients as compared to normals. The relative impairment of adolescent schizophrenic patients (as compared to adolescent normals) was somewhat stronger than that of adult schizophrenics. This supports the hypothesis that the impairment found in schizophrenic patients is caused by the disease and not by other factors such as duration of illness or hospitalization.

Key words: Face recognition – Mimic recognition – Gesture recognition – Schizophrenia – Adolescent schizophrenics

Introduction

Clinical observations indicate that schizophrenic patients differ from normals in their ability to encode and decode mimic and gestural signals. This has been confirmed by formal studies indicating that adult schizophrenic patients are seriously impaired not only in their ability to recognize faces and emotional expressions, but also to respond adequately to such signals (Izard 1959; Levy et al. 1960; Iscoe and Veldman 1963; Dougherty et al. 1974; Muzekari and Bates 1977; Neal 1978; Pilowsky and Bassett 1980; Cutting 1981; Novic et al. 1984; Walker et al. 1984; Mandal and Palchoudhury 1985; Grüsser and Kremer, unpublished work). Nearly all these studies were carried out with photographs or a slide projection technique. Recently, using a movie test we demonstrated that schizophrenics also perform less accurately than normal controls in facial discrimination and gesture recognition tasks (Berndl et al. 1983, 1986a, b). The results from an extensive semiquantitative psychopathological evaluation of the psychotic symptoms correlated with the test data, indicated that the degree of acute psychosis had only a slight influence on the error score (certainly less than 10%), and the duration of illness, type of schizophrenia and somatic therapy exerted no significant effect on the cognitive ability studied. The error score increased, however, with the estimated degree of schizophrenic defect. Age affected the test data in normals and in patients to a similar extent. From these findings we deduced the hypothesis that the impairment in recognition of faces, mimic expression and gestures might be a symptom which is essentially caused by the process underlying the disease, i.e. the high error score appearing in the test results is a neuropsychological sign of impairment of certain brain functions controlling elementary mechanisms of social interaction. Feinberg et al. (1986) investigated the ability of normals, schizophrenics and depressive patients to recognize and match faces and emotional expressions in photographs. They found deficits in schizophrenic patients in all tasks, while depressive patients were inferior to normals only in emotion labelling. These findings support our hypothesis of a disease-specific defect in face and mimic recognition in schizophrenics. If this hypothesis is correct, impairment of face recognition should also be found in patients suffering from a psychotic episode for the first time and in adolescent schizophrenic patients with a short history of illness. Recently Walker et al. (1980) and Walker (1981) using a photo test demonstrated that in child and adolescent schizophrenics the impairment in recognition of emotional expression (as compared to matched normal control groups) is similar to that in adult schizophrenics.

There is good clinical and experimental evidence that specialized cortical areas exist in the basal occipito-temporal region of man (and a homologuous area in the middle temporal cortex of monkeys) which are responsible for the remarkable ability of man and other primates to recognize faces and mimic expression. Bilateral lesions in this region cause prosopagnosia, while unilateral lesions lead to a reduction but not an elimination of face and mimic recognition abilities (man: Bodamer 1948; Meadows 1974; Hécaen 1981; Damasio et al. 1982; Jeeves 1984; Grüsser 1984; monkeys: Perret et al. 1982, 1984; Rolls 1984; Desimone et al. 1984; Rolles et al. 1985). In primates these neo-cortical structures evidently have close connections with the limbic system (part of the nucleus amygdalae; Rolls 1984; Rolls et al. 1985), which presumably conveys the emotional aspects of face and mimic signals.

In the following we will describe results obtained from a group of adolescent schizophrenic patients (15–22 years) in which the same movie test was applied as in the preceding

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studies with the adult patients. The results obtained in this adolescent group were compared with data from middle-aged schizophrenics (30–50 years). The latter group was selected for comparison since we assumed that age-dependent degenerative processes would be minimal. Data from two groups of normals of comparable age were used as controls. The results of the present study corroborate the hypothesis mentioned above: recognition of faces, mimic and gestures was impaired in adolescent schizophrenic patients at least as severely (relative to the performance of the control group) as in middle-aged patients.

Methods

Patients. Data were compiled from 28 adolescent schizophrenic patients (19 male and 9 female) with an average age of 19.0 years ± 0.4 (SE) from the Bezirkskrankenhaus Kaufbeuren, the Jugendpsychiatrische Klinik Marburg and the Jugendpsychiatrisches Heim "Leppermühle", Giessen. The age of the males (19.6 ± 0.5 years) compared to the females (17.8 ± 0.4 years) was not significantly different. The corresponding age of the normal control group ($n = 9$) was 18.2 ± 0.9 years. The middle-aged group of patients ($n = 38$) was selected from our preceding study and was comprised of all patients older than 29 and younger than 51 years (average age 40.0 ± 0.9 years). The corresponding group of normal controls ($n = 33$) had an average age of 39.4 ± 1.1 years. All schizophrenic patients fulfilled the diagnostic criteria of "schizophrenia" according to the DSM-III.

Since the groups studied in the present investigation were small and no significant differences in error scores had been found in the preceding study between patients suffering from different types of schizophrenia, we formed one patient group for the adolescent and adult patients respectively. The distribution of the different educational levels within the four experimental groups is shown in Table 1.

A standardized exploration of at least 1 hour duration was applied to evaluate the psychopathological state of the patients. From the data obtained only one set is mentioned in the present study (Fig. 3). The degree of schizophrenic defect was estimated and four classes were formed: 0 = no defect, 1 = defect only apparent on thorough psychiatric examination, 2 = defect evident in everyday behaviour, 3 = severe defect with considerable thought disorders.

Table 1. Educational level of normal and patient groups

	Educational level			
	0	1	2	3
Patients Young				
Error score (%)	21.4	11.08	12.3	
SD	11.14	7.97	15.76	
SE	4.98	2.06	5.58	
Median	17.08	10.08	7.5	
n	5	15	8	0
Patients Middle-aged				
Error score (%)	16.67	24.73	18.2	14.2
SD		12.9	13.3	18.3
SE		3.33	2.97	12.92
Median		23.75	16.5	14.17
n	1	15	20	2
Control group Young				
Error score (%)		2.3	0.17	1.9
SD		0.88	0.37	0.29
SE		0.63	0.17	0.21
Median		2.3	0	0.19
n		2	5	2
Control group Middle-aged				
Error score (%)		4.3	2.5	1.9
SD		4.05	2.97	2.27
SE		1.12	1.48	0.57
Median		0.21	1.67	1.25
n		13	4	16

The movie scenes and the tests applied. The test by which we tried to evaluate the ability of the subjects to perceive and recognize mimic and gestures has been described in detail in a preceding report (Berndl et al. 1986a). This test consisted of 13 movie scenes lasting 10 s each. In each scene an actor dressed in black presented a short pantomime depicting a simple mimic and gestural expression. The titles of the 13 scenes were SI: nausea, SII: silence, SIII: fear, SIV: farewell, SV: physical effort, SVI: offensive smell, SVII: noise, SVIII: ignorance and perplexity, SIX: quiet grief (helplessness), SX: pain, SXI: fatigue, SXII: anger, SXIII: laughter.

The first movie scene SI was used for instruction purposes, the other 12 were scored. In the first run each scene was followed by 5 non-verbal multiple-choice subtests (T1–T5) in which 5 colour photographs were used to measure the ability of the subject to recognize the person, the gesture and the mimic expression shown in the preceding movie scene. At the end of the tests following the movie scene SXIII a 10- to 15-min break was taken during which the patients were served coffee and cookies. Afterwards, the 13 movie scenes were seen again in the reverse order (SI, SXIII, SXII, ..., SII). Following each scene 5 multiple-choice tests (1 out of 5) were again applied, 3 verbal and 2 non-verbal. Of the non-verbal tests one (T10) was identical to T3 of the first half; in the other the subjects had to select 1 out of 5 simple drawings of scenes that would fit best to the pantomime seen in the preceding movie (T7). In one test a short verbal description of the movie scene was required (T6), while in the two others the patients had to select 1 out of 5 words read (T8) or heard (T9) which in their opinion fitted the movie scene best. For details the reader is referred to the description of the tests published elsewhere (Berndl et al. 1986a).

Statistical Analysis. A digital computer (HP 1000) was used for further processing of the experimental data. Each patient was identified by a code number. Age, sex, educational level, social group, the test results and some semi-quantitative psychopathological and clinical data were stored in the computer memory, in total 184 items for each patient. No names or other personal information were stored in the data bank, which was safeguarded by a security code known only to the authors. All computer print-out material was locked-up to prevent any misuse of patient or normal subject data. At the end of the analysis the computer files were erased.

For data analysis, standard programs computing algebraic mean, standard deviation (SD), standard error of the mean

Table 2. Results of the 12 different movie scenes in the four groups

	SII	SIII	SIV	SV	SVI	SVII	SVIII	SIX	SX	SXI	SXII	SXIII
Control group Y ($n = 9$)												
Error score $\bar{x}$	0	0	0.22	0	0.11	0.06	0	0.22	0.28	0.11	0.22	0
%	0	0	2.20	0	1.10	0.60	0	2.20	2.80	1.10	2.20	0
SD	0	0	0.44	0	0.33	0.17	0	0.44	0.57	0.33	0.44	0
SE	0	0	0.15	0	0.11	0.06	0	0.15	0.19	0.11	0.15	0
Median	0	0	0	0	0	0	0	0	0	0	0	0
Control group M ($n = 33$)												
Error score $\bar{x}$	0.09	0.09	0.15	0.12	0.33	0.17	0.12	0.36	1.30	0.18	0.21	0.27
%	0.90	0.90	1.50	1.20	3.30	1.70	1.20	3.60	13.00	1.80	2.10	2.70
SD	0.38	0.29	0.51	0.42	0.74	0.63	0.42	0.78	1.65	0.39	0.42	0.84
SE	0.07	0.05	0.09	0.07	0.13	0.11	0.07	0.14	0.29	0.07	0.07	0.15
Median	0	0	0	0	0	0	0	0	0	0	0	0
Patients Y ($n = 28$)												
Error score $\bar{x}$	1.27	0.91	1.39	1.39	0.95	1.30	1.13	1.95	2.61	1.54	0.98	1.50
%	12.70	9.10	13.90	13.90	9.50	13.00	11.30	19.50	26.10	15.40	9.80	15.00
SD	1.95	1.60	1.75	1.51	1.17	1.49	1.46	1.88	2.41	1.87	1.15	1.69
SE	0.37	0.30	0.33	0.28	0.22	0.28	0.28	0.35	0.45	0.35	0.22	0.32
Median	0.25	0	0.75	1.00	0.75	0.75	1.00	1.25	2.00	1.00	0.75	1.00
Patients M ($n = 38$)												
Error score $\bar{x}$	1.58	1.99	1.41	1.45	1.63	2.47	2.00	2.30	3.42	3.08	1.70	2.58
%	15.80	19.90	14.10	14.50	16.30	24.70	20.00	23.00	34.20	30.80	17.00	25.80
SD	1.87	2.16	1.74	1.47	1.73	2.14	2.10	2.20	2.16	1.82	1.70	2.00
SE	0.30	0.35	0.28	0.24	0.28	0.35	0.34	0.36	0.35	0.29	0.28	0.32
Median	1.00	1.50	0.25	1.00	1.00	2.50	1.00	2.00	3.00	2.00	1.00	2.00

Table 3. Results of the 10 different tests in the four groups

	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
Control group Y ($n = 9$)										
Error score $\bar{x}$	0.44	0	0.11	0	0.11	0.11	0.33	0	0	0.11
%	3.67	0	0.92	0	0.92	0.92	2.75	0	0	0.92
SD	0.53	0	0.33	0	0.33	0.33	0.71	0	0	0.33
SE	0.18	0	0.11	0	0.11	0.11	0.24	0	0	0.11
Median	0	0	0	0	0	0	0	0	0	0
Control group M ($n = 33$)										
Error score $\bar{x}$	0.45	0.30	0.52	0.21	0.58	0.15	0.67	0.24	0.18	0.18
%	3.75	2.50	4.33	1.75	4.83	1.25	5.58	2.00	1.50	1.50
SD	0.62	0.64	0.94	0.42	0.87	0.36	1.14	0.66	0.58	0.39
SE	0.11	0.11	0.16	0.07	0.15	0.06	0.20	0.12	0.10	0.07
Median	0	0	0	0	0	0	0	0	0	0
Patients Y ($n = 28$)										
Error score $\bar{x}$	1.96	1.43	2.07	1.14	1.89	2.20	2.32	1.29	1.50	1.21
%	16.33	11.92	17.25	9.50	15.75	18.33	19.33	10.75	12.50	10.08
SD	1.82	1.37	1.51	1.18	1.57	2.48	2.84	2.21	2.19	1.57
SE	0.34	0.26	0.29	0.22	0.30	0.47	0.54	0.42	0.41	0.30
Median	2.00	1.00	2.00	1.00	1.50	1.25	1.00	0	0.50	1.00
Patients M ($n = 38$)										
Error score $\bar{x}$	2.39	1.87	2.47	1.29	2.61	2.43	3.84	2.84	2.89	1.92
%	19.92	15.58	20.58	10.75	21.75	20.25	32.00	23.67	24.08	16.00
SD	1.91	1.56	1.81	1.37	2.03	1.95	2.68	3.16	3.08	1.78
SE	0.31	0.25	0.29	0.22	0.33	0.32	0.43	0.51	0.50	0.29
Median	2.00	2.00	2.00	1.00	2.50	1.75	3.50	1.00	2.00	1.00

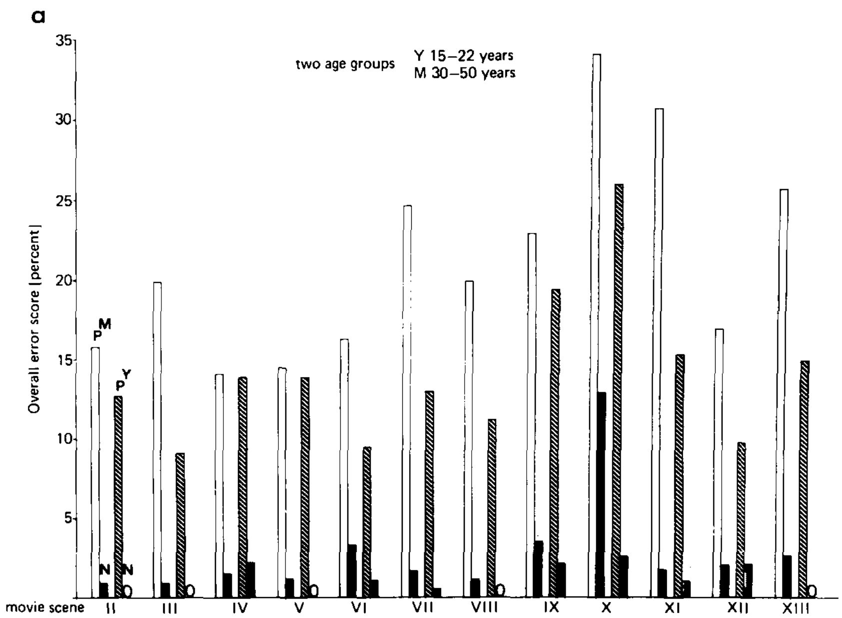
(SE), median and other characteristics of the distributions such as kurtosis or skewness, linear correlation coefficients etc. were computed.

All patients participated in the test on a voluntary basis and displayed no overt visual or oculomotor disease which could have hindered them in perceiving the movie scenes or test cards. The experimenters judged their cooperation to be very good. Additional pauses during the tests were made when required. This was the case, however, in less than 5% of the middle-aged schizophrenic patients and in none of the adolescent patients and normals. As far as we could discern, attention was good during inspection of the movie scenes and the tests. We allotted all subjects the decision time required and avoided all unnecessary stress. None of the subjects showed any signs of elementary disturbances in short-term memory or motor ability.

Results

As described in methods, 10 multiple-choice tests (one out of five) were applied for each of the 12 scored movie scenes and the average error score was computed for the four different experimental groups. Tables 2 and 3 show the distributions of these error scores averaged over all 10 tests for each of the 12 scored movie scenes (SII–SXIII) and for each of the 10 tests (T1–T10) obtained in the 12 scored movie scenes. Figures 1a and 1b demonstrate the corresponding graphs from which the reader can easily deduce the following conclusions:

(a) The 12 scored movie scenes SII–SXIII led on average to fairly homogeneous results. Error scores varied in a similar manner for the four different age groups and very little between the different movie scenes, i.e. the test had a fairly regular structure (Fig. 1a).



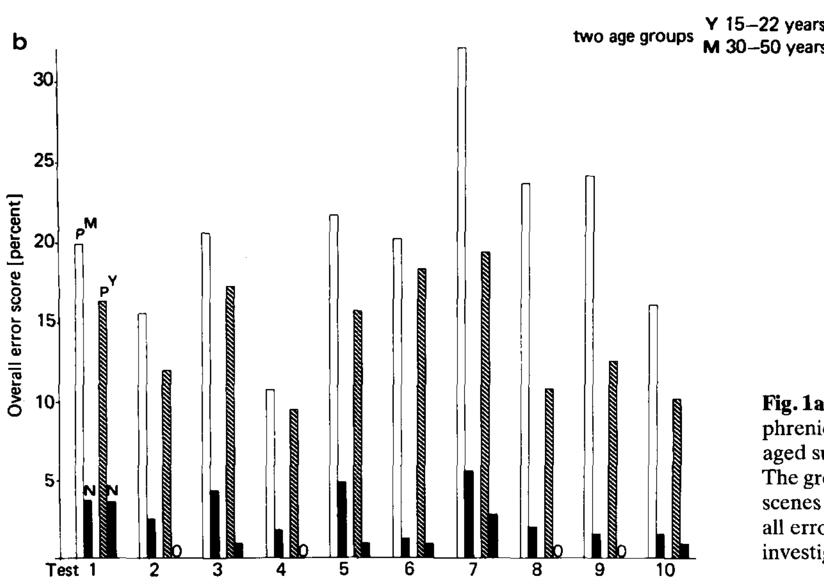


Fig. 1a, b. a Error score obtained in normals *(N)* and schizophrenic patients *(P)* from adolescent subjects *(Y)* and middle-aged subjects *(M)*. The errors are given in percent *(ordinate)*. The group of young adolescent normals had no errors in movie scenes II, III, V, VIII and XIII; this is marked with 0. **b** Overall error scores (percent, ordinate) in the four different groups investigated. Data from the 10 different tests; symbols as in **a**

(b) In all 10 tests (T1–T10) error scores in normal and patient adults were higher than in the corresponding adolescent groups (Fig. 1b, Table 3). This difference was in most cases significant at a $P<0.01$ or $P<0.05$ level (t-test). The overall error score of patients was higher by a factor 14 in the adolescents and 7 in the middle-aged group as compared to the errors found in the respective group of normals (patients Y: $x=14.2\%$; control group Y: $x=1.0\%$; patients M: $x=20.5\%$; control group M: $x=2.9\%$. The difference in test performance between patients and normal subjects was smaller in the tests measuring recognition of person, mimic and gestures (T1–T5, T10) than those in which the movie scene had to be correlated with a sketch or with one of five words heard or read (T7–T9). Significant differences between the performances of adolescent and middle-aged patient groups were found only for the tests T7 ($P<0.05$), T8 ($P<0.05$) and T9 ($P<0.05$; t-test); the older patients exhibited more errors than the younger ones. The linear correlation coefficients for the average data obtained in the four test groups for the 12 movie scenes and the 10 tests are shown in Table 4.

Table 4. Correlation coefficients. A: Movie scenes SII–SXIII; B: Tests T1–T10

A \ B	Young control group	Middle-aged control group	Young patients	Middle-aged patients
Young control group		0.61	0.64	0.41
Middle-aged control group	0.62		0.66	0.55
Young patients	0.55	0.83		0.63
Middle-aged patients	0.27	0.58	0.70	

(c) A loose positive linear correlation was found for the error scores obtained in the 10 different tests T1–T10 in the two age groups (M,Y) of normals and the two age groups of patients: $r=0.60$, $M=0.8Y+2.2$ (% error) in normals and $r=0.63$, $M=1.0Y+6.4$ (% error) in patients.

(d) The impairment in performance of adolescent schizophrenic patients in the different tests was somewhat smaller relative to the corresponding normal control group (Fig. 2a) than the impairment of older patients (Fig. 2b), when the differences between the error scores of the control group and corresponding patient group were compared. The relative increase in error score Q was computed by the following formula

$$Q = (p - n)/(p + n)$$

where p was the error score in the patient group and n the error score in the corresponding group of normals. Figure 2c depicts the values obtained for Q in the 10 different tests, while Fig. 2d shows the differences in error scores between middle-aged subjects (M) and young subjects (Y) for the corresponding group of normals and patients. These data indicate that the group of adolescent schizophrenic patients exhibited essentially the same or even a somewhat stronger relative impairment in recognition of faces (persons), mimic and gestural expression than the middle-aged patients. Error score increase due to age was more pronounced in patients than in normals. This was especially true for tasks T7, T8 and T9 (complex scene, verbal tasks, Fig. 2d). The statistical evaluation of test performance in all tests T1–T10 in relation to that of the corresponding control group confirmed that the relative impairment of young schizophrenic patients in test performance was at least as strong as that of the middle-aged patients ($P<0.001$; t-test).

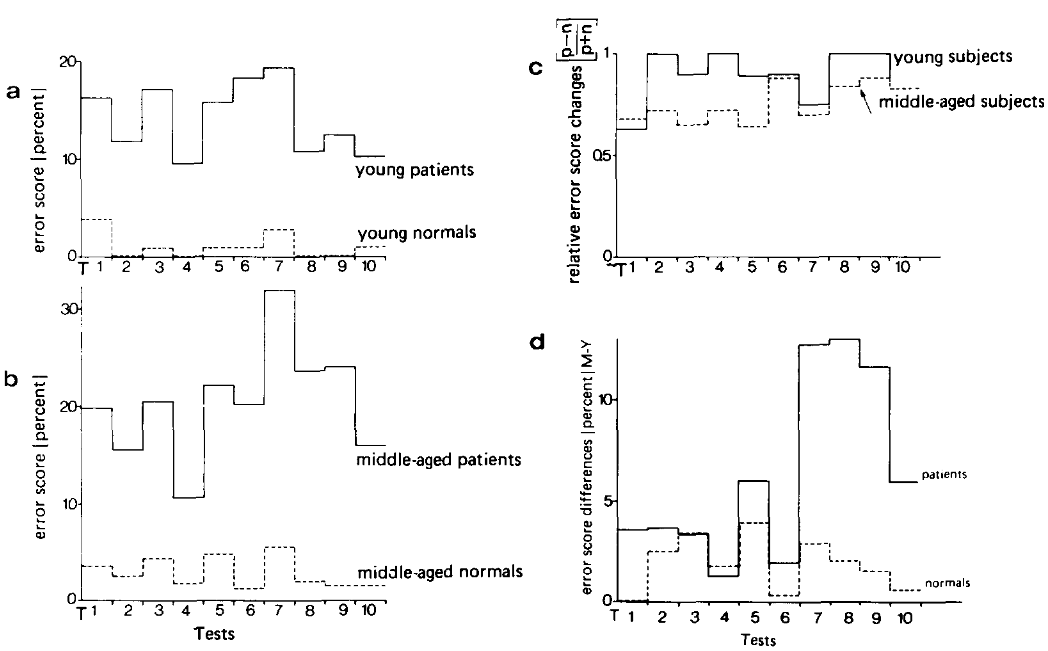


Fig. 2a–d. Comparison of the test performance (error scores) of the two groups of patients and the two groups of normals. **a** Error scores for the different tests in young patients and young normals. **b** Same for middle-aged patients and middle-aged normals. **c** Relative error score as given by (p − n)/(p + n) for the group of young subjects (patients p and normals n) and middle-aged subjects. **d** Error score differences in percent obtained in the middle-aged group M and the adolescent group Y (patients and normals). Data from the 10 different tests T1–T10

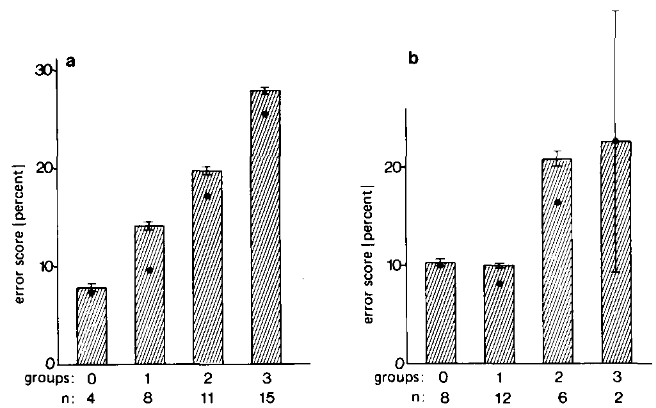


Fig. 3a, b. Relationship between the degree of schizophrenic defect *(abscissa)* and the error score. Data from the 38 middle-aged patients (**a**) and 28 adolescent patients (**b**). The *abscissa* gives the four different classes of schizophrenic defect as defined in *Methods* (Mean $\bar{x}$ ± SE·median)

Further Correlations Between the Overall Error Score and Other Test Data

As mentioned in *Methods,* we tried to obtain a semi-quantitative evaluation of the psychopathological state of the patients (for details see Berndl 1985; Berndl et al. 1986b). In addition, some other data of the patients were used for correlation statistics. Some results of this analysis will be discussed in the following.

(a) Sex Effects. In normal adolescents, the overall test performance of female subjects was similar to that of male subjects (overall error score in 6 female subjects = 1.1 ± 0.5% errors, in 3 male subjects 1.0 ± 0.6% errors). Female superiority in test performance was found in the group of adolescent patients: 10.4 ± 2.9% errors in the 9 female patients and 17.6 ± 2.8% errors in the 19 male patients. The difference, however, was not statistically significant ($P > 0.05$; *t*-test). In the group of middle-aged patients the corresponding values were 21.5 ± 2.8% errors for 18 female patients and 19.7 ± 3.2% errors for 20 male patients. Thus in the middle-aged group the female patients had lost their superiority in test performance, present in the control group (2.2 ± 0.8% errors for 14 female subjects and 3.5 ± 0.8% errors for 19 male subjects). These data indicate that during the course of schizophrenic disease a certain levelling of task performance develops. Female schizophrenic patients lose their superiority over male subjects in recognizing and responding to averbal social signals.

(b) Duration of Illness. The average duration of schizophrenia was of course longer in the middle-aged patient group (13.2 ± 1.4 years) than in the younger patients (2.4 ± 0.3 years). No correlation between duration of disease and overall error score was found in the group of adolescent patients ($r = 0.05$), while a slight positive linear correlation coefficient existed for the corresponding values in the middle-aged patients ($r = 0.36$).

(c) Degree of Schizophrenic Defect. Figure 3 shows the relationship between the degree of schizophrenic defect as evaluated by clinical observations and exploration (Berndl 1985; Berndl et al. 1986b) and the error score. In middle-aged patients a fairly steady increase in error score with degree of schizophrenic defect was found, while the error score in younger patients with very few signs of schizophrenic defect, if at all, (groups 0 and 1) was considerably below the average error scores of patients exhibiting stronger symptoms of schizophrenic defect (groups 2 and 3). Thus, the general tendency found in an earlier study, that the degree of schizophrenic defect had some effect on test performance, was confirmed in the present study and seems to be valid for younger patients.

Discussion

The schizophrenic process affects cognitive abilities (Kasanin 1946; Yates 1966; Reed 1970; DeWolfe et al. 1971; Alpert and Martz 1977; Matthysse et al. 1979; Abrams et al. 1981; Taylor and Abrams 1984). Clinical studies have indicated that this impairment increases, at least in some of the patients, with the duration of the illness (Aarkrog 1975; Aarkrog and Mortensen 1985). The defect in recognition of persons (faces), mimic and gestures found in the preceding studies of adult schizophrenics could be considered as a symptom of a general impairment in cognitive abilities and a reduction in attention and memory. It could also be a more specific defect, however, if the pathological process responsible for the disease affects distinct brain functions involved in the processing of signals important for social interaction and communication. The assumption of such specific impairments could explain the major difficulties of schizophrenic patients in the social field. In addition, it is well known that schizophrenics frequently not only misinterpret social communicative signals but also produce inappropriate mimic and gestural signs. Paramimic movements are certainly not just side effects of drug therapy (if at all) as they were observed before the advent of modern neuroleptic drugs.

Sometimes disturbances in the recognition of faces and mimic expressions are the dominant psychopathological symptoms of the psychosis. In the report to one of the authors (O.-J. G.), a 23-year-old female student suffering from a paranoic-hallucinatory schizophrenia for at least the previous 6 months described how many people, but not relatives and other persons known to her, appeared to have very long eye-teeth ("like Dracula") and to always be grinning in a stereotype manner while "radiating special beams" from their eyes to different parts of her body. Simultaneously she experienced how she could "force" other persons to produce the same mimic expression as she did. This was also the case with female news announcers on TV. The young patient experienced strongly alienating and mainly frightening effects with other subjects' faces and she frequently mistook persons in her surroundings for someone else and responded inappropriately. In addition she perceived "similarities" in faces of unknown subjects with those of friends. She also misinterpreted facial expressions and gestures of male persons as an indication of their strong love for her. Some of her auditory hallucinations were voices commenting on the strange facial expressions she perceived, some were hissing sounds not related to other subjects' faces. Her own facial expression was strongly reduced and mask-like, presumably caused by the neuroleptic medication.

In addition to the retina and afferent visual system, those brain functions involved in the processing of averbal social communicative signals include operations of the extrastriate visual cortices (areae V2–V4, areae MT, MST etc.) in which colour, spatial patterns or visual movement are the most effective stimuli, as well as the inferior temporal cortex and the occipitotemporal areas. In some parts of this cortical region face-specific signals are processed (cf. Introduction). The limbic system moreover is certainly employed in the tasks required in our tests. In addition to the face- and mimic-specific neuronal signal processing, which evidently occurs in part of the limbic system, the short-term memory functions (storage and recall) necessary to execute our test are to some extent also limbic functions. On the other hand, all cortical functions mentioned are dependent upon attention mechanisms. Thus one explanation for the deficits in performing our test could be the assumption of a general lowering of "attention" in schizophrenic patients. Some findings exist to support this interpretation (e.g. Pishkin 1966; Asarnow et al. 1977; Nuechterlein 1978; Wood and Cook 1979; Asarnow and MacCrimmon 1981). The attention hypothesis, however, is not corroborated by the fact that the amounts of neuroleptic drugs given during the test period had no statistically significant impact on the test results (Berndl 1985).

Our assumption that the schizophrenic process leads to a more specific impairment of those brain mechanisms specialized in the recognition of signals important for averbal social communication would explain, at least in part, the difficulties experienced by schizophrenic patients in social interaction and integration. When comprehension of social signals is made more difficult experimentally, paranoic responses can appear in normals. Since gestures, mimic expression and facial structure are not only linked to genetic and racial factors but are also strongly dependent on learning and cultural tradition, normal persons in alien social surroundings misinterpret social signals which might induce paranoic behavioural patterns. Such reactive paranoic symptoms disappear, as a rule, when the foreign language and some knowledge of the cultural patterns and behaviour of the new society have been acquired. Our data indicate that the schizophrenic process seems to impair the neuronal operations of averbal social signals processing to a greater extent than normally believed. It would be interesting to apply the movie test to schizophrenic patients who are not institutionalized and to their relatives. We are in the process of developing a shorter version of our test, lasting less than 20 min, for this purpose.

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