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# A Test Movie to Study Elementary Abilities in Perception and Recognition of Mimic and Gestural Expression

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**Summary.** A test movie consisting of 13 different silent movie scenes, each 10s in duration, was developed to test in patients the elementary abilities, perception and recognition of mimic and gestural expression. Each scene was subjected to 10 (2x5) verbal or non-verbal multiple-choice tests. Quantitative analysis of normal control group results is described. All sub-tests were very easy for normals and resulted in error scores below 5%. Thus the test is not designed to differentiate within a group of normal subjects but to characterize a pathological reduction in mimic, gesture and person recognition in schizophrenic and brain-lesioned patients.

By measuring the dependency of correct recognition of the different movie scenes on the inspection duration, it was shown that the projection time of 10s applied in the full test led to a fairly high amount of informational redundancy. This was intentional so that stimulus material could be well perceived and recognized even by patients with somewhat fluctuating attentiveness.

**Key words:** Face recognition – Mimic recognition – Gesture recognition – Non-verbal social communication

## Introduction

Perception and recognition of mimic and gestures is a function important to normal social communication. It assists in social understanding and facilitates or modifies verbal communicative signals. The motor programs leading to mimic and gesture signals contain inborn components which are very similar in all men. Mimic and gestures expressing joy (happiness), fear, anger etc., are understood universally and can serve to form initial contacts between persons who do not understand each other's language (Darwin 1872; Eibl-Eibesfeldt 1967). The right cortical hemisphere is believed to play a more important role than the left hemisphere in perception and recognition of mimic and gestures (review: Hécaen 1981), but the details and degree of lateralization are still unclear (Meadows 1974; Damasio et al. 1982; Jeeves 1984).

In neuropsychological tests perception and recognition of mimic and/or gestures have been studied mainly by means of photographs or drawings, i.e. with "stationary" visual stimuli (review: Salzen 1981). Such photographs, however, may have lost some of the essential properties of mimic and gesture coded in the temporal sequence of motor acts. As we had become interested in the ability of brain-lesioned and schizophrenic patients to recognize and understand non-verbal communicative signals, we developed a simple film test composed of 13 different silent movie scenes, each 10s in duration. The perception, recognition and understanding of each scene was tested with 10 verbal or non-verbal multiple-choice tests. All tests were found to be very easy for normal adults, while schizophrenic patients responded with a high error score (Berndl et al. 1986).

In the following we will describe the test movie and the results obtained in 78 normal adults. These data serve as control group data for the studies in patients.

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## The Different Scenes Shown in the Test Movie

Seven female and seven male students served as volunteer actors (21 to 28 years of age). They were all dressed in black and wore no glasses or jewelry. After a short training period repeated scenes were filmed (colour film, homogeneous background, matt green curtain) and simultaneously colour photos were taken. The former professional experience of one of us (R.-H. K) as a stage director was helpful in directing the players. Each actor or actress played different scenes but only one scene from each was selected on the basis of optimal pantomime for the final colour film used in the test. Each silent scene expressing one mimic/gestural event was 10s in duration. Actors were presented above the waist line only, and 13 different scenes played by 13 different actors or actresses were selected. In the test procedure the first scene SI was for the purpose of instruction, and the scores were not used in the data evaluation. The following 12 movie scenes (S) were presented twice to all subjects. In the first part of the test the sequence was SI, SII, ..., SXIII, in the second part SI, SXIII, SXII, SXI, ..., SII. Five multiple-choice tests were applied after each scene in the first part of the movie; in the second part five other tests were applied. Projection size was $70 \times 90$ cm, corresponding to about $16 \times 20°$ for the standard viewing distance of 250 cm. Average luminance was about $6.4\,\mathrm{cd} \cdot \mathrm{m}^{-2}$.

### *1. The Action of the Movie Scenes*

In the following we will briefly describe the 13 silent movie scenes SI to SXIII. The first scene served as instruction for the subject only.

*SI: Nausea.* A man pantomimes increasing nausea ending with vomiting.

*SII: Silence.* A woman puts her index finger to her lips, mouthing the sound "sh", nods her head slightly, both arms outstretched forwards in a pacifying up and down motion.

*SIII: Fear.* A man pantomimes increasing fear with upraised arms, splayed fingers, eyes wide open ending in an expression of extreme terror.

*SIV: Farewell.* A woman leans sideways, looking off into the distance, waves her hand back and forth, smiles as if seeing someone off on the train.

*SV: Physical Effort.* A man pantomimes weight-lifting. The weight is not seen. Facial expression of intense straining. Some of the normal subjects saw the actor as trying to start an unsuccessful "chin-up". In the verbal tests this response was also accepted as correct.

*SVI: Offensive Smell.* A woman makes a grimace, turning up her nose, then moves her head away from the source of the smell, tongue stuck out, and finally closes her nostrils between thumb and forefinger.

*SVII: Noise.* A man begins the scene with a sharp jerk of the head, covers his ears with the palms of the hand repeatedly, moves his body to avoid the painful effect of the loud noise.

*SVIII: Ignorance and Perplexity.* A woman continuously shrugs her shoulders, shaking her head with outstretched arms to the side and corresponding mimic expressions of helplessness and ignorance.

*SIX: Quiet Grief (Sorrow).* A man stands holding his hand against his cheek, shakes his head slightly in disbelief, eyes turned downwards. Since some of the normal subjects saw the expression as one of helplessness, this interpretation was also accepted as correct.

*SX: Pain.* A woman demonstrates chest pain, features in a grimace, hands pressed to the thoracic region, shoulders hunched, while bending forward slightly.

*SXI: Fatigue.* A man alternates between letting shoulders hang and stretching while yawning simultaneously.

*SXII: Anger.* A woman plays a short scene shaking clenched fists while mouthing shrieking sounds. Progression from anger to fury.

*SXIII: Laughter.* A man mimics laughing increasing in intensity, rocking back and forth with arms folded over abdomen.

### 2. *The Sub-Test Following Each Movie Scene*

Following each scene the subjects had to solve 5 non-verbal multiple-choice tasks in part 1 of the test and 5 verbal or non-verbal multiple-choice tasks in part 2. These 10 different subtests will be designated T1, T2, ..., T10. In part 1 we always began with T1, in part 2 with T6 and always ended with T10. For the other tests (T2–T5 in part 1 and T7–T9 in part 2) the order was changed at random. The response time was measured with a stop-watch. This was not noticed by the subjects.

*T1: Recognition of the Person I.* As in the following four tests and test 10, the subjects were shown five $8 \times 13$ cm (colour) photographs mounted on black cardboard. Each photograph depicted an actor of the same sex as in the preceding movie scene in a neutral stance, one of whom was the actor from the preceding scene. Question: "Which of these men (women) did you see in the preceding movie scene?" (Fig. 1).

**Fig. 1.** Example of test 1 (recognition of the person I): Five colour photographs mounted on dark cardboard depicting an actor of the same sex as in the preceding movie scene. The actors are in a neutral stance and the subjects had to detect the actor from the preceding scene

*T2: Identification of Mimic and Gesture Expression.* Five $8 \times 13$ colour photographs depicted the actor from the preceding movie scene, pantomiming five of the scenes SI–SXIII, one of which was the scene from the preceding movie. "Typical" photographs were selected. Question: "The man (woman) you saw in the preceding scene performed a certain act. Which of these photographs depicts that act?" (Fig. 2).

*T3: Recognition of Expression in Another Person.* Five colour photographs of another actor (or actress) taken from five different scenes were shown. One of the mimic/gestural expressions corresponded to that seen by the subject in the preceding film but played by another actor. Question: "In these photographs another man (woman) is shown portraying the same expression as the man (woman) in the preceding movie. In which photograph can you see the same expression?"

*T4: Recognition of Person and Expression.* A typical photograph of the preceding film scene with the same actor and four other photographs with other actors (actresses) pantomiming

**Fig. 2.** Example of test 2. Five colour photographs. The actor seen in the preceding movie scene mimes five different scenes. The subject had to determine which photograph depicts the act of the preceding movie scene

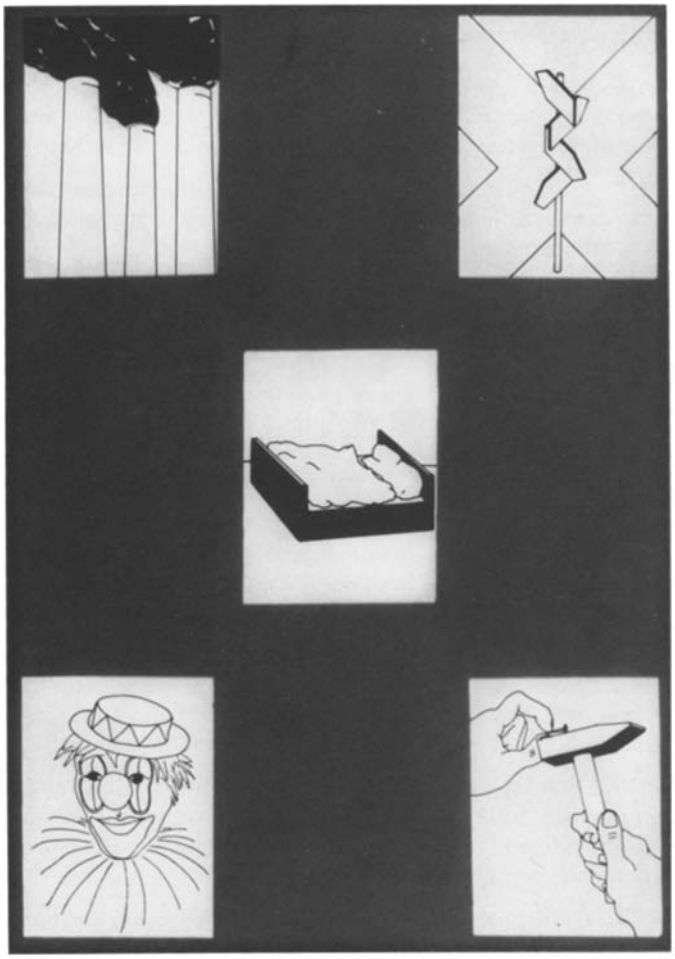

**Fig. 3.** Example of test 7. Five simple drawings depicting different events or situations. The subjects had to decide which picture fitted best the action seen in the preceding movie scene

different expressions were shown to the subject. Question: "Which of these men (women) did you see in the preceding film sequence?"

*T5: Recognition of the Person II.* Colour photographs of five different actors (actresses) from five different pantomime scenes were displayed. None of the scenes corresponded to that seen in the preceding movie. The actor who played the preceding movie scene was shown in one of the photographs pantomiming another expression. Question: "Which of these men (women) did you see in the preceding film scene?"

In the second part of the test the movie scenes were repeated and three other multiple-choice tests, one direct verbal test and one non-verbal test were applied.

*T6: Verbal Description.* Question: "What event or mood was depicted by the actor (actress) in the preceding movie scene?" The subjects were asked to answer this question in a few words or sentences. A verbal protocol was taken.

*T7: Association of Expression and Adequate Situation.* Photographs of five simple drawings depicting the situation or event which could have evoked the mimic/gestural expression seen in the preceding movie scene were shown to the subject (Fig. 3). Question: "Which picture fits best to the action you saw performed by the man (woman) in the preceding movie scene?"

*T8: Verbal Response I (Reading).* Five words were written in white (8 mm high) "Letraset" letters on black cardboard. Question: "Which word best describes the action you saw performed by the man (woman) in the preceding movie scene?"

*T9: Verbal Response II (Listening).* The investigator read aloud the same five words as in T8. He asked the patient: "Please tell me which word fits best to the action you saw the actor (actress) performing in the preceding movie scene".

*T10: Recognition of Expression in Another Person.* This test was identical to test 3 and served as a control.

*Scoring.* The test answers were scored as correct (1) or wrong (0). This could be done without difficulty in T1 to T5 and T7 to T10. In T6 a score of 1 was given when the subject described the scene correctly with the main expressions. When the subject described the movement correctly but did not fully understand the expression, 0.5 points were scored. When the subject missed both totally, he received 0 points. In the movie scene SIX (quiet grief, sorrow) 1 point was also given in T6, T8 and T9 for the answer "perplexity". When the subject said

**Table 1.** Normal subjects. Distribution of level of education (**a**) and age in the female and male subjects (**b**)

| (a) | Education | 1 | 2 | 3 |
|---|---|---|---|---|
| | *n* | 25 | 16 | 37 |

1 = "Hauptschule" (elementary school)
2 = "Realschule" (middle school)
3 = "Gymnasium" (high school)

| (b) | Age (years) | Total | Male | Female |
|---|---|---|---|---|
| | $\bar{x}$ | 40.3 | 38.9 | 41.2 |
| | SD | 16.9 | 13.6 | 19.4 |
| | SE | 1.9 | 2.3 | 2.9 |
| | Median | 36.5 | 34.5 | 39.5 |
| | *n* | 78 | 36 | 42 |

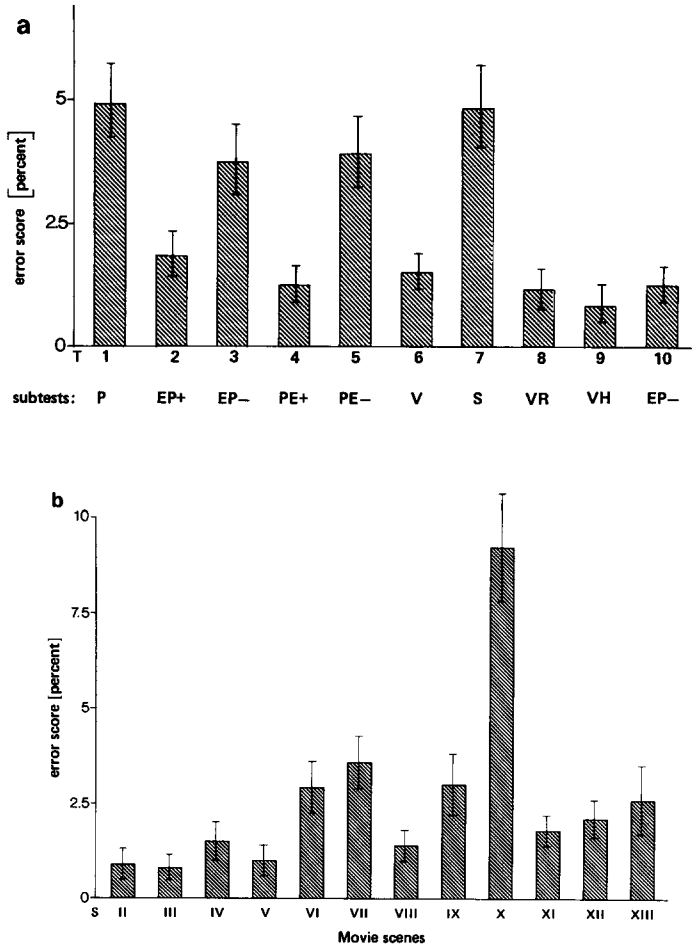


**Fig. 4. a** Overall error score (± SE) in the different sub-tests (T1–T10) in 78 normal subjects. The results indicate that in normals the tests T1 (person recognition I), T3 (recognition of expression in another person), T5 (person recognition II) and T7 (association of expression and adequate situation) were about twice as difficult as the other 7 tests. **b** Average error score of 78 normal subjects for all tests of the 12 different movie scenes SII-SXIII. The results indicate that, with the exception of SX, the degree of difficulty of the different movie scenes varied very slightly

that he was not able to answer a question, 0 was scored. This never occurred with subjects from the normal group and in less than 0.1% of the sub-tests with the group of schizophrenic patients.

## Results in Normal Control Group

In total 78 unpaid volunteers from West Berlin, Kaufbeuren – a small city in Bavaria (Oberschwaben) – and a rural region of the Bavarian Forest were tested. The procedure was the same as in the patient group. After the first half of the test a 10 to 15-min break was allowed during which the subject was served coffee, tea and cookies. Otherwise no rewards were given for participation in the test. The age, sex and educational level of the subjects are shown in Table 1. Figure 4a depicts the error scores in the 10 different sub-tests, while in Fig. 5 the overall error score (a) and the error scores for all verbal tests (b; T6, T8, T9), all tests in which recognition of persons was involved (c; T1, T4, T5) and all tests in which recognition of mimic expression and gesture was involved (d; T2, T3, T4, T10) are summarized.

Our data revealed a slight tendency for the overall error score to decrease with increasing educational level (Table 2); it increased slightly with age of the subjects (linear correlation coefficient $r = 0.47$; slope b = 0.075 error percent per year). The normal female subjects performed better than the normal males in most of tests T1–T10 and in the overall error score (Table 3), but statistical significance for this female superiority was only reached in test T1 (*t*-test; $P < 0.05$). Some differences in the test performance of the three groups from the three different parts of Germany were found (Table 4).

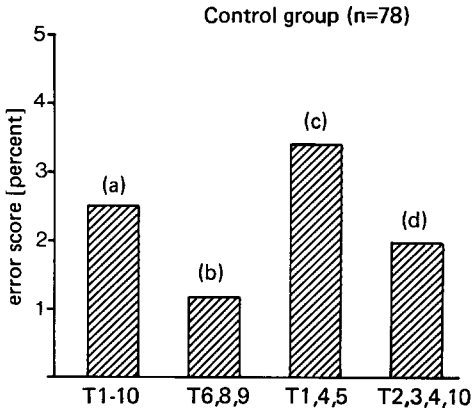


**Fig. 5. a** Overall average error scores (T1–T10), **b** for all verbal tests (T6, T8, T9), **c** all person recognition tests (T1, T4, T5), and **d** all mimic and gesture recognition tests (T2, T3, T4 and T10)

**Table 2.** Overall error score and educational level

| Educational level | 1 | 2 | 3 |
|---|---|---|---|
| *n* | 25 | 16 | 37 |
| Error score percent | | | |
| $\bar{x}$ | 4.17 | 1.75 | 1.75 |
| SE | 0.67 | 0.50 | 0.33 |

**Table 3.** Error scores for the 10 different sub-tests. Control group ($n = 78$)

| Subjects | Error score (%) | T1–T10 | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total ($n = 78$) | $\bar{x}$ | 2.53 | 4.92 | 1.83 | 3.75 | 1.25 | 3.92 | 1.50 | 4.83 | 1.17 | 0.83 | 1.25 |
| | SD | 2.70 | 7.20 | 4.20 | 6.80 | 3.30 | 6.60 | 3.30 | 7.80 | 4.00 | 3.40 | 3.30 |
| Female ($n = 42$) | $\bar{x}$ | 2.14 | 3.30 | 1.20 | 4.20 | 1.20 | 2.80 | 1.80 | 4.30 | 0.80 | 1.80 | 1.20 |
| | SD | 2.54 | 6.60 | 3.50 | 7.70 | 3.50 | 5.10 | 3.80 | 6.70 | 4.00 | 4.20 | 2.90 |
| Male ($n = 36$) | $\bar{x}$ | 2.92 | 6.80 | 2.60 | 3.30 | 1.40 | 5.30 | 1.20 | 5.30 | 1.60 | 0.70 | 1.40 |
| | SD | 2.84 | 7.40 | 4.80 | 5.80 | 3.20 | 7.80 | 2.60 | 8.90 | 3.90 | 2.30 | 3.80 |

**Table 4.** Overall error score and home location

| Home location | City | Small town | Village |
|---|---|---|---|
| $n$ | 43 | 15 | 20 |
| Error score percent | | | |
| $\bar{x}$ | 2.13 | 2.11 | 3.73 |
| SE | 0.30 | 0.61 | 0.86 |

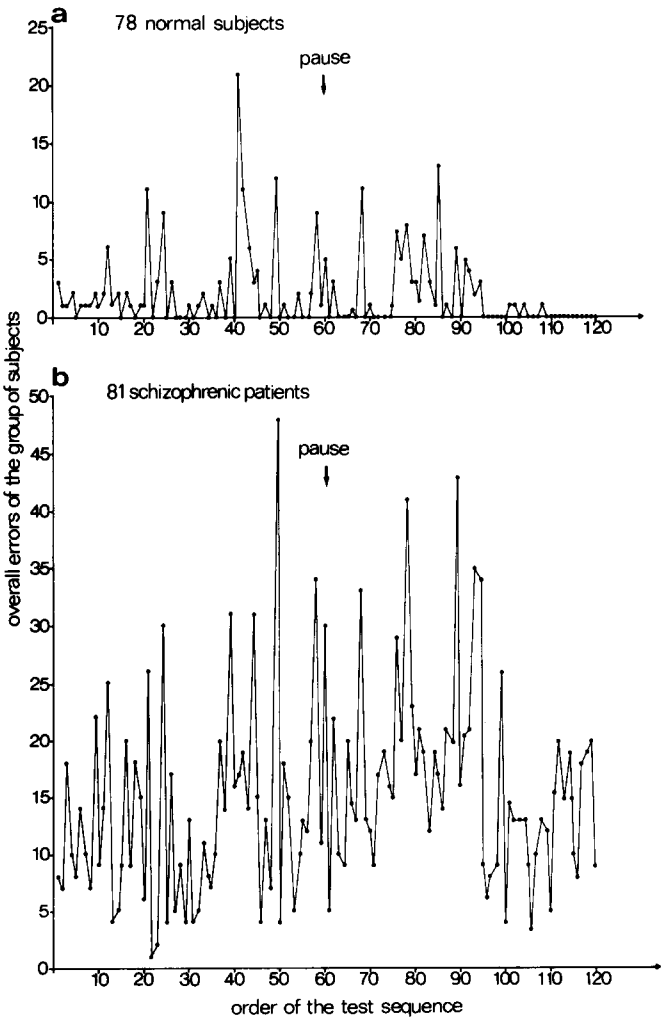


**Fig. 6a, b.** Overall number of errors *(ordinate)* for each of the 120 successive tests performed by each subject. **a** Errors of 78 normal subjects. **b** Errors of 81 schizophrenic patients

The distribution of the overall error score revealed (Fig. 2 in Berndl et al. 1986) that a fairly large percentage of subjects (31% of the female, 14% of the male) made no errors in the whole test. Therefore, the error distribution was not symmetrical around the mean. In other words all 10 sub-tests were very easy for normal subjects and from a psychological test standpoint could be considered to be "too easy" since a better score than 0 errors was not possible.

This would be a disadvantage in a test designed to differentiate between normal subjects. Since our test was created with a view to studying patients seriously handicapped in their cerebral function, this structure was acceptable. Even before we applied this test to two independent groups of schizophrenic patients and a group of brain-lesioned patients, we had suspected that error scores in these groups would be significantly higher than in normals. Then the problem of the test being too easy would be irrelevant. The dramatic increase in errors in mimic and gesture recognition caused by a brain lesion or schizophrenia confirmed this expectation even more than anticipated.

The overall performance in the 10 different tests following each film sequence depended slightly on the different scenes (Fig. 4b), but the error score differences were marginal except for SX. In SIX the results would also have deviated if we had not scored the verbal response "helplessness" in addition to the desired response "quiet grief" as correct. The variability in the average errors in the different sub-tests in the diverse scenes only gave a small S × T dependency, i.e. the overall variability between the different error scores was small.

In summary, this analysis indicated that for normals the tests were not only simple but also fairly homogeneously structured with respect to possible errors. The latter statement also holds for test data obtained in schizophrenic patients. The results of the sub-tests T1 to T10 obtained for the scenes SII-SXIII indicated that the different scenes were about equally difficult to recognize (Fig. 4a). The data obtained in T3 and T10 showed a slightly lower error score in T10 for both schizophrenic patients and normals. This indicated that subject fatigue in the second part of the test (after the coffee break) as compared to the first part had no measurable impact on test data. The analysis of the data sequence of the 120 tests performed by each subject supported this statement (Fig. 6a, b).

## The Dependency of Correct Recognition on the Duration of the Movie Scenes

In a lecture hall experiment the movie scenes were projected onto a large (260 × 240 cm) screen. Voluntary subjects (50 in

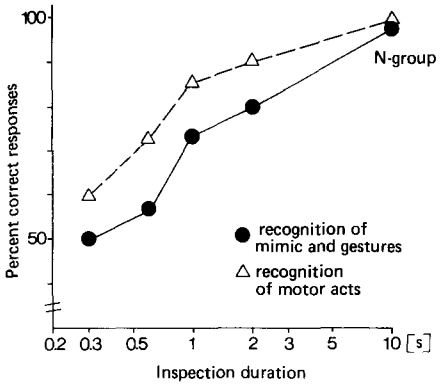


**Fig. 7.** Dependency of correct recognition of the 12 different movie scenes *(ordinate)* on duration of movie inspection (log scale, *abscissa*). Data from 50 normal subjects (0.3–2s projection time) and from 78 normal subjects (10s projection time, T6)

total, 29 male, 21 female 2nd year medical students) were informed that we would show them short movie scenes of different lengths played by an actor or actress and that we were interested in whether they could find out the "meaning" of the scenes. They were asked to describe the content of each scene in one or two words and to record these on a prepared protocol sheet within about 6s following projection. During the first run of the 13 movie scenes the projection time, which was controlled by an electromagnetic shutter placed in front of the lense of the 16mm movie projector, was either 0.3 or 0.6s. During the second run a projection time of 1 or 2s was chosen. Usually segments of the middle part of each film sequence were selected for the short projection time. About 1s before the short projection period a verbal signal ("Achtung") was given to obtain the subjects' attention and to ensure that they fixated the screen. The subjects were also asked not to alter the words once recorded, an instruction followed without exception.

After this test we evaluated the subjects' responses by comparing the "characteristic words" chosen with the content of the movie scenes SI to SXIII as described previously. The individual responses were scored as correct (1) or wrong (0). Correct description of the movement without recognition of the "meaning" was also scored. The dependency of the percentage of "correct" responses on the projection time is shown in Fig. 7. It demonstrates that with a probability of about 80% an inspection period of 2s was sufficient to grasp the meaning of the scenes, while description of the movement was possible in about 90% of the cases. Also in this study the performance of the female subjects was slightly superior to that of male subjects (statistically not significant). One could conclude from this finding that the projection time of 10s applied in the full test led to a fairly high amount of informational redundancy. This was intentional in the construction of the test, because we wanted to use stimulus material which would be well perceived and recognized even by patients with somewhat fluctuating attentiveness.

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