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Recognition, differentiation, and the knowledge about mimic expressions of emotions among patients diagnosed with schizophrenia

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Summary

Aim. The study aims at assessing the ability to recognize and differentiate mimic expressions of emotions, as well as the knowledge about them among the people diagnosed with schizophrenia.

Material and method. The study involved 100 patients diagnosed with schizophrenia, and 100 healthy volunteers. Participants performed three tasks in a computer-based experiment aimed at recognition of mimic expressions. It used the faces of 30 people (14 men and 16 women) from the Warsaw Set of Emotional Facial Expression Pictures. The photographs present six basic emotions (happiness, fear, disgust, anger, sadness, surprise).

Results. Patients diagnosed with schizophrenia achieved lower results in recognition and differentiation of selected emotional expressions vs. healthy volunteers. The patients also revealed less knowledge about mimic expressions of emotions.

Conclusions. The study evidenced that problems with recognizing emotions result not only from dysfunctions in the early phases of perception regarding mimic expressions of emotions, but also from dysfunction in the central processing of affective stimuli. The results of the study form the basis for developing training aimed at recognition of mimic expressions. Such training should teach the patients to correctly categorize emotions and improve their knowledge on emotional expressions.

Key words: facial expression, emotion recognition, schizophrenia

Introduction

The main conclusion from the meta-analyses of studies [1, 2] involving patients diagnosed with schizophrenia is that such persons are characterized by a poorer ability to recognize emotional facial expressions compared to healthy participants. The methodology of studies addressing this problem typically involves patients checking (marking) the specific name of the recognized emotional expression [3]. The aforementioned

scheme, however, prevents the assessment of the phase in which the processing of affective information is distorted. Before patients allocate an appropriate verbal label to the expression presented to them, they must have competences in the area of differentiating mimic expressions. The patients' problem may be related to both naming the expressions and perceiving differences among them. The patients' knowledge about emotions is also important. This knowledge may draw the patients' attention toward searching for indicators of the emotions they anticipate.

The study presented in the article thus aims to assess the ability to correctly recognize, differentiate, and name facial expressions of emotions, as well as the knowledge about them among patients diagnosed with schizophrenia. This will allow for the assessment of the anticipated dysfunctions in the area of recognizing facial expressions of emotions from the perspective of three phases of processing affective content.

Material and methods

Participants

The study involved 200 participants, including 108 women (54% of all participants) and 92 men, aged 18-68 (M = 38.70; SD = 14.77). The group of healthy volunteers comprised 100 people, selected to match the sex of the patients with schizophrenia. Healthy volunteers included 54 women and 46 men, aged 19-65 (M = 35.21; SD = 14.99). The analyzed groups were statistically different with respect to age. The group of patients with schizophrenia was statistically significantly older than the group of healthy volunteers (t = 3.43; p = 0.001). Based on the interview, it was also determined that the healthy volunteers had no record of mental illness, were not addicted to psychoactive substances, and had no other health-related problems. They also did not meet the diagnostic criteria for schizophrenia.

The group of patients with schizophrenia comprised 100 participants, including 54 women and 46 men, aged 18-68 (M = 42.18; SD = 13.77). These were patients admitted to psychiatric wards. They were all diagnosed by psychiatrists with paranoid schizophrenia according to ICD-10 criteria. Patients with severe somatic diseases, neurological disorders, or those addicted to alcohol or other psychoactive substances were excluded from the study. The participants were also not subject to any changes in pharmacotherapy. All patients were treated with antipsychotic medication. Among the 100 patients with schizophrenia, 86 were administered atypical antipsychotic agents (olanzapine n = 41, risperidone n = 25, clozapine n = 17, quetiapine n = 3), while 14 were treated with typical antipsychotic agents (fluanxol n = 9, haloperidol n = 4, perazine n = 1).

Before enrollment in the study, all participants signed an informed consent form. The study protocol was approved by the Senate Ethics Committee for Empirical Research on Human Subjects. The study meets the ethical requirements of the American Psychological Association.

Measure

Experiment of facial expression recognition and differentiation

The experiment was conducted using Inquisit 4 software. It used the faces of 30 people (14 men and 16 women) from the *Warsaw Set of Emotional Facial Expression Pictures* [4]. The photographs present six basic emotions (happiness, fear, disgust, anger, sadness, surprise) across three intensity levels (low, average, high). Each of the photographs was presented only once. The experiment comprised three tasks.

The first task in the experiment refers to the ability to differentiate between facial expressions of emotion. The participants are presented with two facial expressions at a time on the monitor screen for a duration of 2000 ms. Next, they are asked whether the faces in the photographs depict the same emotion. The participants provide their answers using the keyboard. If their answer is "YES", they press the 'T' key on the keyboard; if "NO", they press the 'N' key. Half of the presentation (18 pairs of photographs) is presented simultaneously, while the other half (18 pairs of photographs) sequentially.

The second task involves the presentation of individual facial expressions, where the participant is asked to use the left mouse button to click on the name of the exhibited emotion on the monitor screen. This task assesses the ability to name the facial expressions of emotion. The first 18 photographs are displayed with a long exposure time (2000 ms), while the remaining 18 photographs are displayed with a short exposure time (500 ms).

The third task refers to knowledge of facial expressions of emotion. The participants are presented with a description of a given emotion without providing its full name. Then, a photograph of a facial expression of an emotion is displayed. After the photo has been displayed, a question appears on the screen asking whether the person in the photograph is experiencing the emotion related to the presented description (e.g., fear: "Is the person in the photograph experiencing an emotion related to the occurrence of a specific direct physical threat or existential threat?"). The descriptions used were sourced from the EREME experiment conducted by Wawrzyniak [5] and were developed based on Lazarus' relational themes [6]. Half of the presentation is displayed for a short duration (500 ms), while the other half is displayed for a long duration (2000 ms).

Procedure

During the first phase of the study, the participants were informed about its purpose, anonymity, voluntary nature, procedure, and results presentation. After signing the informed consent form, the participants completed the computer-based experiment of recognition and differentiation of facial expressions. The study was performed individually with each participant in an office located within the psychiatric ward or, in the case of healthy volunteers, in a private psychologist's office in Szczecin.

Results

Descriptive statistics

The collected data were subjected to statistical analysis in SPSS Statistics 23.0 software. Kurtosis and skewness values close to the range <-2; 2> indicated that the distribution of the results for the examined variables was consistent with a normal distribution. Descriptive statistics of the examined variables are presented in Table 1.

Table 1. **Descriptive statistics of the examined variables**

Task	Type of emotion	Group	*N*	Min.	Max.	*M*	*SD*	Skewness	Kurtosis
1. Accuracy of differentiation	Happiness	Study	100	0	6	3.71	2.15	-0.36	-1.42
		Control	100	0	6	4.49	1.91	-1.16	0.15
	Anger	Study	100	1	6	3.29	1.14	0.03	-0.15
		Control	100	1	6	3.48	1.08	-0.12	-0.50
	Disgust	Study	100	0	6	3.39	1.79	-0.31	-0.67
		Control	100	0	6	5.27	1.08	-2.32	2.24
	Fear	Study	100	0	6	3.47	1.65	-0.21	-0.92
		Control	100	1	6	4.22	1.37	-0.43	-0.48
	Sadness	Study	100	0	6	3.32	1.79	-0.25	-1.01
		Control	100	0	6	4.12	1.26	-0.64	0.10
	Surprise	Study	100	0	6	3.47	1.65	-0.19	-0.96
		Control	100	0	6	4.30	1.48	-1.03	0.48
2. Accuracy of labeling	Happiness	Study	100	0	6	2.33	1.05	-0.49	1.08
		Control	100	0	4	2.60	0.84	-1.52	2.23
	Anger	Study	100	0	5	1.93	1.22	-0.20	-0.85
		Control	100	0	4	2.32	0.96	-0.89	0.05
	Disgust	Study	100	0	4	1.55	1.20	0.08	-1.19
		Control	100	0	4	1.82	1.23	-0.45	-1.30
	Fear	Study	100	0	4	0.66	0.74	1.25	1.80
		Control	100	0	3	0.64	0.86	1.16	0.43
	Sadness	Study	100	0	5	2.23	1.68	-0.15	-1.47
		Control	100	0	5	2.92	1.40	-0.72	-0.44
	Surprise	Study	100	0	5	1.75	1.26	0.11	-1.01
		Control	100	0	5	2.02	1.12	-0.48	-0.40

table continued on the next page

3. Accuracy of response	Fear	Study	100	3	18	10.64	4.21	-0.10	-1.21
		Control	100	2	18	12.12	4.23	-0.95	-0.38
	Disgust	Study	100	1	18	10.79	4.50	-0.25	-1.25
		Control	100	1	17	12.22	4.63	-0.94	-0.58

Differentiation of emotions – task 1

In order to assess the differences in differentiating facial expressions of emotions between people suffering from schizophrenia and healthy people, a two-way repeated-measures *ANOVA* was conducted in the following scheme: 2 (health status: people suffering from schizophrenia vs. healthy people) x 6 (emotion type: happiness vs. anger vs. disgust vs. fear vs. sadness vs. surprise). The within-subjects factor was the type of emotion. The between-subjects factor was health status. The dependent variable was the number of correct distinctions.

As expected, a significant main effect of health status was observed: $F(1, 198) = 28.53$; $p < 0.001$; $\eta 2 = 0.126$. Lower accuracy in differentiating emotions was found in the group of individuals with schizophrenia ($M = 3.44$; $SE = 0.12$) than in the group of healthy people ($M = 4.31$; $SE = 0.12$). A significant main effect of emotion type was observed: $F(4, 769) = 15.53$; $p < 0.001$; $\eta 2 = 0.073$. Lower accuracy in differentiating emotions was found in the case of anger ($M = 3.39$; $SE = 0.08$) than in the case of happiness ($M = 4.10$; $SE = 0.14$; $p < 0.001$), disgust ($M = 4.33$; $SE = 0.11$; $p < 0.001$), fear ($M = 3.85$; $SE = 0.11$; $p < 0.001$), sadness ($M = 3.72$; $SE = 0.11$; $p < 0.05$) and surprise ($M = 3.89$; $SE = 0.11$; $p < 0.001$).

A significant interaction effect of health status and type of emotion was also observed: $F(4, 792) = 3.16$; $p < 0.05$; $\eta 2 = 0.016$. Lower accuracy in differentiating emotions was found in the group of people suffering from schizophrenia than in the group of healthy people in the case of happiness ($M = 3.71$; $SE = 0.20$ vs. $M = 4.49$; $SE = 0.20$; $p < 0.01$), disgust ($M = 3.39$; $SE = 0.15$ vs. $M = 5.27$; $SE = 0.15$; $p < 0.001$), fear ($M = 3.47$; $SE = 0.15$ vs. $M = 4.22$; $SE = 0.15$; $p < 0.001$), sadness ($M = 3.32$; $SE = 0.16$ vs. $M = 4.12$; $SE = 0.16$; $p < 0.001$) and surprise ($M = 3.47$, $SE = 0.16$ vs. $M = 4.30$, $SE = 0.16$, $p < 0.001$). There were no between-subject differences in the differentiation of the emotion of anger. In the group of people suffering from schizophrenia, no differences were found in the accuracy of differentiation between individual emotions. However, healthy people differentiated the emotion of disgust most accurately and the emotion of anger least accurately. It can therefore be assumed that people suffering from schizophrenia exhibit greater deficits in differentiating facial expressions of emotions than healthy people. The discussed effect is presented in Figure 1.

*** p < 0.001; ** p < 0.01

Figure 1. **Interaction effect of health status and emotion type on the number of correct differentiations**

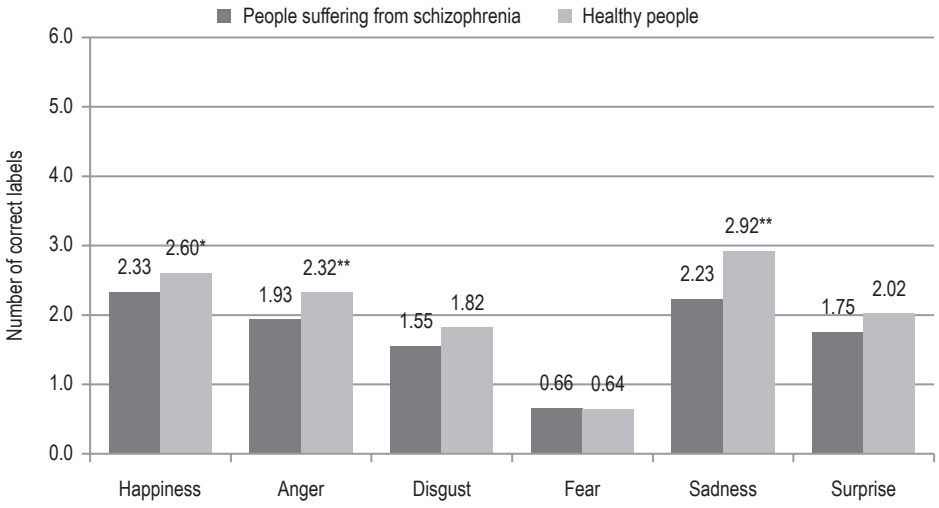
Accuracy of labeling emotions – task 2

In order to assess the differences in labeling facial expressions of emotions between people suffering from schizophrenia and healthy people, a two-way repeated-measures *ANOVA* was conducted in the following scheme: 2 (health status: people suffering from schizophrenia vs. healthy people) x 6 (emotion type: happiness vs. anger vs. disgust vs. fear vs. sadness vs. surprise). The within-subjects factor was the type of emotion. The between-subjects factor was health status. The dependent variable was the number of correct identifications.

As expected, a significant main effect of health status was observed: $F(1, 198) = 6.98$; $p < 0.01$; $\eta 2 = 0.034$. Lower accuracy in labeling emotions was found in the group of patients with schizophrenia ($M = 1.74$; $SE = 0.08$) than in the group of healthy people ($M = 2.05$; $SE = 0.08$). A significant main effect of emotion type was observed: $F(5, 898) = 125.79$; $p < 0.001$; $\eta 2 = 0.388$. Higher accuracy in naming emotions was found for happiness ($M = 2.47$; $SE = 0.08$) and sadness ($M = 2.58$; $SE = 0.11$) than for anger ($M = 2.13$; $SE = 0.08$; $p < 0.001$), disgust ($M = 1.69$; $SE = 0.09$; $p < 0.001$), fear ($M = 0.65$; $SE = 0.06$; $p < 0.001$) and surprise ($M = 1.89$; $SE = 0.08$; $p < 0.001$). No differences were found between happiness and sadness (*ni*.).

A significant interaction effect of health status and type of emotion was also observed: $F(5, 916) = 3.42$; $p < 0.01$; $\eta 2 = 0.017$. Lower accuracy in labeling emotions was found in the group of patients with schizophrenia than in the group of healthy people in the case of happiness ($M = 2.33$; $SE = 0.10$ vs. $M = 2.60$; $SE = 0.10$; $p < 0.05$), anger ($M = 1.93$; $SE = 0.11$ vs. $M = 2.32$; $SE = 0.11$; $p < 0.01$) and sadness ($M = 2.23$;

SE = 0.16 vs. *M* = 2.92; *SE* = 0.16; $p < 0.01$). There were no between-subject differences in naming the emotions of disgust, fear and surprise. Both among people suffering from schizophrenia and healthy people, the emotions of happiness and sadness were most often correctly named, while the emotion of fear was least often correctly named (patients with schizophrenia: *M* = 0.66; *SE* = 0.08; healthy people: *M* = 0.64; *SE* = 0.08). This confirms that individuals with schizophrenia have poorer recognition of facial expressions of emotions than healthy people. However, the differences in emotion recognition concern only three out of six emotions presented to the subjects. These emotions were both positive (happiness) and negative (anger, sadness). The discussed effect is presented in Figure 2.



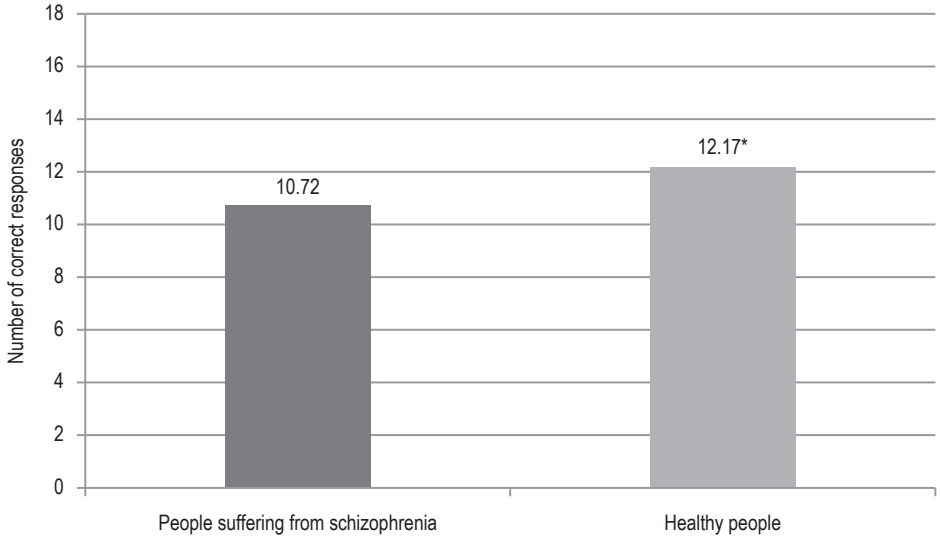
** p < 0.01; * p < 0.05

Figure 2. **Interaction effect of health status and emotion type on the number of correct labels**

Knowledge about facial expressions of emotions – task 3

In order to assess the differences in knowledge about facial expressions of emotions between people suffering from schizophrenia and healthy people, a two-way repeated-measures *ANOVA* was conducted in the following scheme: 2 (health status: people suffering from schizophrenia vs. healthy people) x 2 (emotion type: fear vs. disgust). The within-subjects factor was the type of emotion. The between-subjects factor was health status. The dependent variable was the accuracy of responses. In the third task, participants were asked to assess whether the emotions presented to them matched the description of emotions presented to them earlier. This description did not include the name of the emotion, but rather focused on descriptions of disgust and fear.

The conducted analyses showed a significant main effect of health status: $F(1, 198) = 6.08$; $p < 0.05$; $\eta 2 = 0.030$. Lower accuracy of response was found in the group of people suffering from schizophrenia ($M = 10.72$; $SE = 0.42$) than in the group of healthy people ($M = 12.17$; $SE = 0.42$). The discussed effect is presented in Figure 3. However, there was no significant main effect of the type of emotion, $F(1, 198) = 0.14$, and no interaction effect of health status and type of emotion, $F(1, 198) = 0.02$; *ni.*



* $p < 0.05$

Figure 3. **The effect of health status on the number of correct responses**

Discussion

The results obtained in the study indicate, as expected, that people suffering from schizophrenia perform worse at naming and therefore recognizing emotions such as happiness, anger and sadness than healthy people. These findings conform to results achieved by other researchers [7, 8]. Some studies [9, 10], however, did not reveal any differences between patients with schizophrenia and healthy volunteers in recognizing facial expressions of happiness. Some researchers [10, 11] suggest that deficits in the recognition of facial expressions of emotions by patients diagnosed with schizophrenia only refer to negative emotions. The results of this study, however, indicate poorer recognition of both negative and positive emotions.

Before one can recognize emotions in the presented face, one must first register sensory data. Next, the transferred information is analyzed at higher levels of the nervous system, including cerebral cortex analysis [12]. This is referred to as bottom-up processing [13]. Distortions in visual perception among patients with schizophrenia

may result from irregularities within neuronal structures [14] and neurotransmitter systems [15, 16]. These factors may be related to irregularities in the area of bottom-up processing of affective information. The study presented in this article indicates that patients exhibit deficits already in the early phase of differentiating emotional expressions. The process requires the ability to compare and assess both the common and differentiating elements of the presented faces. This means that problems related to the recognition of emotional expressions originate already in the phase preceding the correct labeling of emotions.

The presented study also evaluated patients' knowledge of facial expressions of emotions. The patients demonstrated poorer knowledge about facial expressions of emotions than healthy volunteers. This knowledge may draw the patients' attention toward searching for indicators of the emotions they anticipate. This is referred to as top-down processing, whereby knowledge about the factors triggering given emotions plays a major role in the process of perceiving facial expressions. The results of the study thus also point to dysfunctions in the area of top-down processing of affective information.

Based on the results of the study, a theoretical model can be proposed. According to the proposed model, interferences in the phase of differentiating facial expressions of emotions result in dysfunctions in their correct labeling. Recognition of emotions also requires involvement of memory processes that direct the search for and interpretation of sensory perceptions. Poor knowledge about emotions is related to secondary dysfunctions in the area of differentiation and labeling of emotional expressions. Participants with poor knowledge of mimic expressions of emotions do not pay attention to the facial areas that convey emotions. This prevents their accurate differentiation and further labeling. The process constitutes a vicious circle of pathogenesis of deficits in recognizing facial expressions by patients, leading to reinforcement of the deficits.

Patients with schizophrenia are characterized by both functional and structural changes to the brain [14]. Phillips and Silverstein [17] claim that weakening of neuronal connections that integrate brain functions is a factor leading to the breakdown of cognitive coordination in patients, resulting in symptoms of disintegration, including distorted thinking in schizophrenia. Neuronal dysfunctions in patients may inhibit, at the level of neuronal circuits, the process of building cognitive representations of emotions. Drawing attention to this process is of major importance for developing future training in recognizing facial expressions. At the neurobiological level, the training must be directed at building connections between the group of neurons responsible for perceiving facial features characteristic of specific facial expressions. The training should be preceded by a preliminary diagnosis, whereby an expert would assess the phase of recognizing facial expressions where the patient has problems. Next, the therapist should develop the patient's competences in differentiating and labeling facial expressions of emotion, and enhance the patient's knowledge about them. Development of training in recognizing facial expressions of emotions may help patients with improving their interpersonal skills and the quality of their social functioning in the future.

Limitations

The main limitation of the study involves the fact that the compared groups statistically differed in age. The group of patients with schizophrenia was statistically significantly older than the group of healthy volunteers. Studies, however, indicate that age is not a significant factor in differentiating groups' ability to recognize facial expressions of emotion [18].

Conclusions

The following conclusions can be drawn from the results of this study:

1. People suffering from schizophrenia are less accurate at differentiating facial expressions of basic emotions exposed to them than healthy people.
2. People suffering from schizophrenia are less accurate in labeling facial expressions of basic emotions exposed to them than healthy people.
3. People suffering from schizophrenia have less knowledge about facial expressions of emotions than healthy people.

The study revealed that problems with identification of emotional expressions do not refer as much to the process of their labeling as to their correct differentiation, and this is what future therapeutic training should focus on. Apart from the training in verbalizing emotions, one must first create adequate cognitive representations that allow patients to differentiate between facial expressions. It would only be the next step to allocate the aforementioned cognitive representations to verbal labels and to improve patients' knowledge on facial expressions of emotions. Possibly, development of the suggested training will help patients to interpret the behaviors and intentions of other people more accurately in the future, thus improving their social functioning.

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