

Hollow mask illusion – is it really a test for schizophrenia?

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Summary

Aim. The aim of the study was an assessment of the phenomenon of depth perception in schizophrenic patients compared to healthy subjects.

Method. We conducted a comparison of erroneous assessment of the concave side of the mask as convex, using the popular website presenting rotating Charlie Chaplin's mask. The study was performed in patients hospitalized at the Stanisław Kryzan Psychiatric Hospital in Starogard Gdanski diagnosed with paranoid and undifferentiated schizophrenia based on ICD-10 criteria and control group matched for age and education; each group included 58 subjects.

Results. The correct perception of depth in the hollow mask illusion regards approx. 30% of patients with paranoid and undifferentiated schizophrenia during exacerbation and it is three times higher in this group than in the general population. Except the number of relapses and hospitalization in anamnesis, it shows no correlation with another clinical and demographic data such as: the age of onset, the duration of illness, and results on Positive and Negative Syndrome Scale (PANSS).

Conclusions. The correct perception of the hollow mask may be potentially one of the subsequent premises for the diagnosis of schizophrenia in doubtful cases. The simplicity and general availability is also an argument for conducting the test.

Key words: schizophrenia, visual illusions, hollow mask illusion

Introduction

With reference to our paper on the perception of physiological visual illusions by individuals with schizophrenia [1] and the view from the Internet, that “the test of hollow mask/face illusion can diagnose schizophrenia”, we conducted an assessment of the phenomenon of depth perception with this test in schizophrenic patients compared to healthy subjects. The illusion of hollow mask (face) belongs to a group of perception biases, collectively referred to as “depth inversion illusion” (DII), relying on misjudging the depth as the convexity. It is known that this phenomenon occurs more often with objects familiar to the perceiver, and it is sometimes dependent on the ground on which the figure is presented. Generally, there is a tendency to interpret ambiguous, in terms of depth, presentation as convex [2].

It is also known that patients with schizophrenia are often very resistant to this type of illusion [2–6], but the studies thus far only twice exceeded the number of 20 patients.

Aim

The aim of the study was to compare erroneous assessment of the concave side of the mask/face as convex, using the popular website presenting rotating Charlie Chaplin’s mask (http://www.youtube.com/watch?v=QbKw0_v2clo).

Material and Method

The study was conducted in patients hospitalized at the Stanislaw Kryzan Mental Health Hospital in Starogard Gdanski diagnosed with paranoid and undifferentiated schizophrenia based on ICD-10 criteria and, as a control group, in employees of the Municipal Office in Kisielice and the District Office in Ilawa, ensuring the best adjusting of the age and education, which in the light of the research on illusions is considered to be a factor heavily determining their perception [1]. Besides these, the data on the course of the illness (the age of onset, the duration of illness, the number of acute relapses and hospitalizations) in patients were collected and Positive and Negative Syndrome Scale (PANSS) examination was performed. Subjects with unadjusted vision defect, reduced intellectual functions, concomitant neurological and psychiatric disorders (addiction, affective disorders, personality disorders), persons not understanding the presentation were excluded from the study. The study was conducted with the approval of the Independent Bioethics Commission for Research at the Medical University of Gdansk No. NKBBN/110/2014. The mask was presented on the 14-inch screen with resolution of 1366 x 768 pixels. According to the references [2] we assumed that most of the people see the mask as convex. In order to hide the main objective of the test we informed that we are measuring the time of change of mask’s concavity counted from the beginning of the film’s screening. When a subject stated the time we checked if he/she really saw the face as convex at the point of maximum rotation (in these cases he/she always confirmed) and the result of the test was positive. When he/she did not specify time we did not treat the test result automatically as negative, because it was

sometimes the result of attention disturbances and we verified it more accurately; repeatedly it turned out that at the point of maximum rotation a few subjects saw the mask as convex, without being able to give the time of the perception change due to poor attention span.

The data of both groups are presented in Table 1.

Table 1. **Demographic data of both groups**

| | Age | Years of education | Women |
|-----------------|-------------|--------------------|--------|
| Patients N = 58 | 42.8 ± 13.8 | 12.1 ± 3.1 | N = 19 |
| Controls N = 58 | 42.8 ± 14.6 | 13.2 ± 2.9 | N = 35 |

The perception of illusion in both groups is presented in Table 2.

Table 2. **The number of people perceiving the hollow mask illusion**

| | Patients | Controls |
|-----------------------------|----------|----------|
| Perceiving the illusion | 41 (71%) | 53 (91%) |
| Not perceiving the illusion | 17 (29%) | 5 (9%) |

The difference in distribution is statistically significant (Yates' chi-squared test $p = 0.0092$)

Table 3 presents the data on the clinical differences in the group of patients undergoing the illusion and the patients properly perceiving the inverted mask.

Table 3. **The clinical data of patients perceiving and not perceiving the hollow mask illusion**

| | Perceiving the illusion Mean ± Standard Deviation | Not perceiving the illusion Mean ± Standard Deviation | p (Mann-Witney U) |
|--|--|--|-------------------|
| Age | 43.4 ± 15.0 | 41.1 ± 10.5 | 0.651 |
| Years of education | 12.3 ± 3.4 | 11.8 ± 2.6 | 0.437 |
| Age at onset | 27.9 ± 9.9 | 24.2 ± 7.7 | 0.194 |
| Episode of schizophrenia | 7.5 ± 9.0 | 12.4 ± 11.3 | 0.043 |
| Number of hospitalizations | 6.7 ± 9.1 | 10.7 ± 11.3 | 0.033 |
| PANSS Positive scale | 20.7 ± 5.2 | 19.9 ± 6.9 | 0.614 |
| PANSS Negative scale | 26.4 ± 5.2 | 26.9 ± 4.9 | 0.422 |
| PANSS General Psychopathology scale | 51.0 ± 8.2 | 49.1 ± 11.8 | 0.746 |
| Duration of illness (years) | 15.5 ± 13.8 | 16.9 ± 12.0 | 0.457 |

As shown in Table 3, patients who correctly perceived concave side mask as its interior, had in their life statistically significantly more relapses and hospitalizations, other clinical data did not differentiate subjects.

According to our knowledge, the presented outcome is hitherto the first in Poland and the second most numerous study of the DII perception. The hollow mask illusion

is one of the simplest among these illusions and it is sometimes treated as synonymous with DII [3]. However, it has never been precisely presented: how many percent of patients with schizophrenia are concerned. Research usually related to more sophisticated procedures, the results were usually placed as bar charts, and discussion focused on the analysis of differences. The studies usually distinguished the type of perception, e.g., familiar objects vs. seen for the first time, faces vs. objects or landscapes, monocular vs. binocular vision, real objects vs. presentations on the computer screen, considered the theoretical concept of invulnerability of patients using functional magnetic resonance imaging. Typically, stationary objects were preferred, inversion depth achieved by reversing the presentation, this means displaying the left eye image to the right and vice versa. In addition, they were mostly based on small material.

The first study involved only 13 patients [6], the further – 20 patients with schizophrenia, 15 healthy individuals and 10 with an episode of depression [5]. Then the studies were conducted trying to include other dimensions of visual evaluation of the depth, attention functions or the endocannabinoid system, but the number did not increase (13 patients vs. 16 controls [3]; again, 13 with schizophrenia vs. 20 controls and 7 intoxicated with tetrahydrocannabinol [4]; the last one accurately presented the percentage of non-perception of the DII as $68.7 \pm 5.43\%$ in patients with schizophrenia vs. $8.7 \pm 2.18\%$ in healthy controls). The latest study (30 patients vs. 25 controls) has examined the procedure of depth perception with additional background [2]. The resistance to illusions was correlated with more hospitalizations in anamnesis, more positive symptoms and less appropriate affect; our study confirmed only the first of these factors. In the most numerous study of D. Koethe et al. (313 people; 81 healthy volunteers and six groups of patients: with the first episode of paranoid schizophrenia: 75 *drug naïve* and 74 shortly (on average 9 days) treated with antipsychotics, 22 with prodromal state of psychosis, 35 with an episode of major depression, 20 with bipolar affective disorder, 6 with Alzheimer's disease) the depth inversion was, i.a., the state of high risk of psychosis. The researchers have proposed incorporating this type of testing to the battery of neuropsychiatric examination of people suspected of schizophrenia [7].

The limitation of this study is providing dichotomous answers. It has been suggested that with responses graduating the degree of certainty (e.g., “certainly concave”, “convex, I guess” etc.) results may be different. However, Keane et al. point out the potential difficulties in this type of evaluations in people with schizophrenia – often ambiguous [2].

Conclusions

Perception disturbances are not core symptoms of schizophrenia and should be treated as additional symptoms. The results on the DII can be linked to disorders of volitional attention (up – down), and these, in turn, with the dysfunction of the pre-frontal cortex [2–6]. Therefore, they fit into potential concepts of pathophysiology of schizophrenia. They are a tool for the experimental evaluation and so far they cannot be used for diagnostic evaluation of individual patients. However, the simplicity of the test argues for a continuation of research. The scope of the research should be

expanded, i.e., by repeating the study in remission (full or partial) and once again verifying the inconsistent results on the relationship with positive symptoms using a more numerous group of patients.

To sum up: in the light of our preliminary report the correct perception of the depth in the hollow mask illusion concerns approx. 30% of patients with paranoid and undifferentiated schizophrenia during exacerbation. It is three times higher in this group than in the general population, it correlates with the number of recurrences and hospitalizations in anamnesis.

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