

Concreteness in Schizophrenia and Normal Subjects: A Psychophysiological Approach

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Background: Subtle forms of thought disorder are encountered in normal subjects. Their relationship to cognitive functioning is not enough investigated.

Objectives: 1) to test the hypothesis that P300 could index subtle forms of thought disorder in normal subjects through the use of Proverbs test, known to be sensitive for impairment of the abstraction ability in schizophrenics.

2) to test the validity of Rakhaw's Proverbs test in relation to P300, a well known indicator of cognitive functioning.

Subjects and Method: The Egyptian Proverbs' test was used to test concreteness in 20 schizophrenics and 20 normal subjects, matched for age, sex and education. P300 was recorded at 5 sites using an odd ball paradigm.

Results: The sensitivity of the proverbs test was 85% and its specificity was 80%. P300 amplitude was significantly lower in schizophrenics, while latency was prolonged. P300 amplitude correlated negatively with the ability to abstract in both groups.

Conclusion: The hypothesis that impairment in abstraction ability in schizophrenics as well as in normal subjects results from attentional impairment is supported.

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INTRODUCTION

The specificity of thought disorder as pathognomonic of schizophrenia has been questioned due to the fact that it was found in other psychiatric population groups, e.g. manics (Andreasen & Grove, 1986); depressives (Braff et al, 1988). Moreover, 6% to 12% of normal subjects show some degree of thought disorder on a variety of recent assessment measures (Andreasen & Grove, 1986; Harrow et al., 1986). Using Object Sorting Test OST, a measure of looseness of association

developed in the forties of this century, McConaghy and Clancy (1963) found that university students scoring low on this test performed as well as high scorers in examinations. Ward et al. (1993) also found that looseness of association detected by OST in normal subjects was not correlated with many measures of pathology. In a study on normal university students by Allen & Schuldberg, (1989), the authors found a subclinical positive thought disorder in some subjects which was not correlated with general intelligence. Those subjects scored lower than control on unfamiliar proverbs, but not familiar ones. McCoghany et al (1993) hypothesized that looseness of association in normal subjects is due to a genetically determined reduction in strength of an inhibitory process that limits the spread of activation of semantic associations

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and results in predisposition to schizophrenia. This hypothesis was supported by their finding that P300 could index looseness of associations in normal subjects and thought disorder in schizophrenics.

In a report by Braff & Saccuzzo (1981), it was observed that impaired attentional abilities may lead to abstraction deficits at least in schizophrenics. The impaired filtering hypothetically causes the higher centres to become overwhelmed and results in distortion of abstraction and reasoning (Saccuzzo & Braff, 1986). Whether this relationship is consistent in normal subjects remains to be investigated.

Proverb interpretation is an established assessment technique in the diagnosis and study of thought disorder in schizophrenics. A proverb may be defined as a brief statement characterized by having two stems that both require desymbolization into abstract meaning, which includes a moral injunction in keeping with the ethics and world view of a culture or subculture (Allen & Schulberg, 1989).

This work aimed to test the hypothesis put forward by McConaghy et al (1993) that P300 could index subtle forms of thought disorder in normal subjects through the use of a different tool, Proverbs test, known to be sensitive for impairment of the abstraction ability in schizophrenics. Another objective was to test the validity of Rakhawy's Proverbs test in relation to P300, a well known indicator of cognitive functioning.

SUBJECTS AND METHODS

20 inpatients at Kasr El-Aini department of Psychiatry, fulfilling DSM IV criteria for schizophrenia and 20 normal subjects with no family

history of schizophrenia participated in the study. The two groups were for matched for age: mean age was 28.9 (9.11) in schizophrenics and 26.6 (6.31) in the control group ($t = .72$; $df = 39$, $p > 0.1$). They were also matched for sex, with each group comprising 18 male and two female subjects.

Rakhawy's Egyptian Proverbs test, a measure of abstract thinking and thought disorder (1986) comprising 5 proverbs with increasing degree of difficulty was applied. We are reporting on results of the first step (abstraction) in which the subject is asked to give the meaning of the proverb after it is read in a clear voice. The rating ranges from 0 to 4, which is scored only if the subject decodes all the symbols of the proverb correctly.

In order to assess the possible relationship between concreteness and thought disorder in the schizophrenic group, the thought, language, communication scale (Andreasen, 1986) was used.

P300 was assessed in all the subjects using 4 channel- Nihon Kohden apparatus. Electrodes were placed according to the international 10-20 system. In the first trial, P300 was evoked at three midline-points, Fz, Cz, Pz. In the second trial, two more points C3 and C4 (left and right hemisphere respectively) were involved to test the asymmetry index (P3 amplitude left/ P3 amplitude right) and its possible correlation with concreteness. The reference was connected ears. All normal subjects completed the two steps. All schizophrenic subjects participated in the first trial, while only 8 completed the second step.

An odd ball paradigm was used with frequent tones (frequency 1 K Hz, rise and fall time 10 ms, stimulation rate .5 Hz) and frequent tones (frequency 2 K

Hz), occurring at 20% random level. Intensity of the stimulus was 70 dB. The subject had to count the infrequent tones, and samples were included only if errors did not exceed 10%. Analysis time was 1 second including 200 ms prestimulus delay time.

The P300 latency was calculated to the highest peak between 290 and 750 ms; and amplitude was calculated between this peak and average voltage of the 200-ms prestimulus base line.

Means and standard deviations for abstraction scores and P300 parameters were calculated. Comparison between the two groups on all items was carried out using Mann-Whitney Test.

The sensitivity and specificity of the proverb test was assessed through discriminant function analysis.

In order to investigate the relationship between concreteness and amplitude of P300, Pearson moment correlation coefficients were calculated. In order to control for the effect of education on the level of correlation, partial correlation coefficients were calculated, after correction for educational level.

To test the hypothesis that impairment in abstraction ability might result from attentional impairment reflected in the reduced P300 amplitude,

linear regression analysis was performed. The dependent variable was the score on abstraction, while the independent variable was P300 amplitude at Cz. R square, indicating degree of variance explaining the studied phenomenon, was also calculated.

RESULTS

Proverb test:

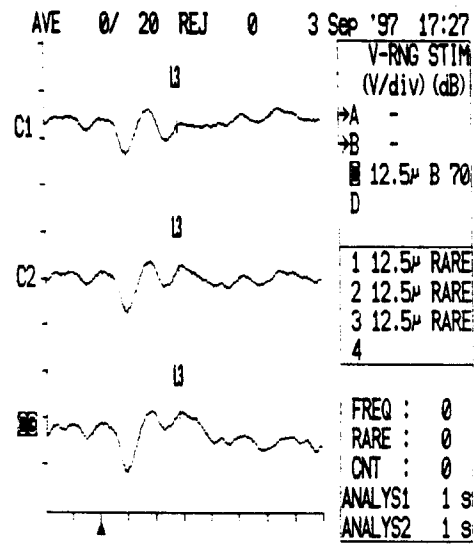
Mean score on abstraction in the schizophrenic subjects was 9.7 (4.281), while it was 14.1 (3.421) in the control group. The difference was statistically significant ($t = -3.36$, $p = .002$).

The sensitivity of the proverb test, i.e., its ability to detect schizophrenic subjects was 85% (17 subjects were correctly diagnosed as schizophrenic), while its specificity was 80% (16 normal subjects were correctly identified).

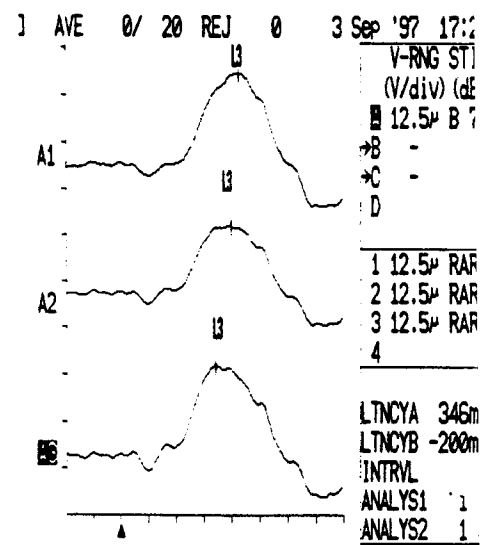
A retrospective examination of the P300 amplitude in the misdiagnosed subjects in both groups showed that the three schizophrenic patients diagnosed as normal in discriminant analysis also had high P300 amplitude that fell in the normal range, while the four normal subjects assigned to the schizophrenic group had P300 amplitude lower than the normal limits (figure 1).

Table 1
Comparison between P 3 Amplitude and Latency in Schizophrenics and Control Group (Mann Whitney Test)

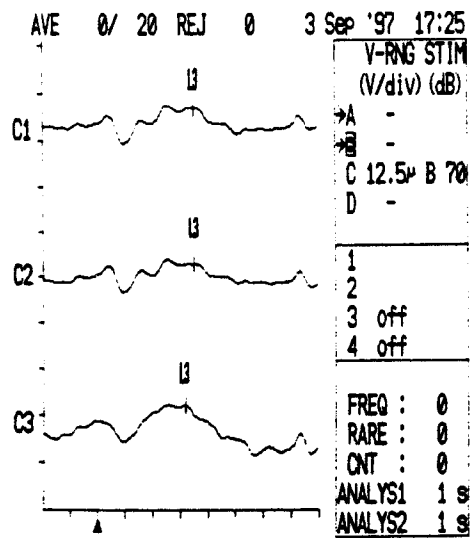
amplitude	Schizophrenics mean (SD)	Control mean (SD)	Z Score	P Value
Fz	4.63 (± 4.6)	8.13 (± 4.15)	-3.057	.002
Cz	6.00 (± 5.44)	8.74 (± 4.04)	-2.673	.01
Pz	6.92 (± 4.85)	9.43 (± 4.2)	-3.555	.002
C3	4.71 (± 3.47)	12.89 (± 6.92)	-3.214	.001
C4	3.66 (± 2.11)	9.43 (± 4.2)	-3.282	.001
latency				
Fz	393 (± 64.78)	330.1 (± 31.29)	-3.456	.001
Cz	388 (± 61.01)	331.1 (± 26.54)	-3.456	.001
Pz	382 (± 65.19)	331.6 (± 28.66)	-2.856	.004
C3	388 (± 56.69)	339.1 (± 35.52)	-1.97	.04
C4	387.1 (± 58.81)	336.7 (± 35.24)	-2.109	.03



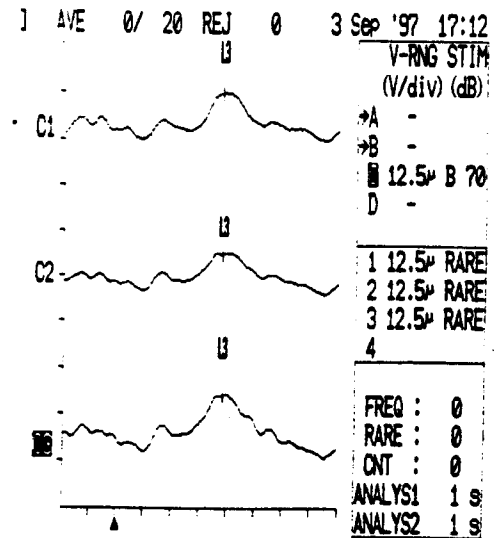
(a) normal subject with low abstraction



(b) normal subject with high abstraction



(c) schizophrenic with low abstraction



(d) schizophrenic with high abstraction

Figure (1)
L3 : P3
Channel 1: Fz
Channel 2: Cz
Channel 3: Pz

Table (1) shows the results of Mann Whitney U-Wilcoxon test comparing P3 amplitude and latency in the two research groups. The P3 amplitude in schizophrenics is much reduced as compared to that in the normal subjects, with p value ranging from .01 to .001. On the other hand, the P3 latency is longer in schizophrenics than in the control group with statistically significant differences found at all electrode sites, the significance ranging from .04 to .001.

In table 2, Pearson moment correlation coefficients between P300 amplitude at Fz, Cz, Pz, C3 and C4, on one hand, and scores on abstraction for both groups, on the other, are demonstrated.

In normal subjects, there is a statistically positive correlation between abstraction and P300 amplitude at all midline sites, more so at Cz and Pz. There is also a tendency towards significance at the left hemisphere side, while no such relationship is present for the right hemisphere. The contribution of the left hemisphere to abstraction ability is further evidenced by a statistically significant positive correlation between asymmetry index (P3 amplitude left/ P3 amplitude right) and abstraction ($p < .05$).

In the schizophrenic group, P3 amplitude was also correlated with the ability to abstract at Fz, Cz and Pz.

In the same table, results of partial correlation after control for education level are also presented. The level of correlation between the ability to abstract and the P3 amplitude became stronger in both groups at Fz, Cz, Pz in both groups. When education level was controlled for, the P3 at the right hemisphere seems to play a significant role ($r = .60$, $p = .02$) in the control group, while the correlation between asymmetry index and abstraction consequently became nonsignificant.

An analogous analysis of the contribution of both hemispheres was not possible statistically due to the small number of the subjects where P3 was recorded at C3 and C4 (8 subjects).

Since correlation does not necessarily mean causality, regression analysis was performed to test the effect of P3 amplitude on the ability to abstract in both groups. The results are demonstrated in table (3).

The ability to abstract seems to be dependent on the P300 amplitude in both groups explaining 39% of the phenomenon in normal subjects and 47% in schizophrenics. The level of significance is high in both groups

Table 2
Correlation between P300 Amplitude and Abstraction

		Fz		Cz		Pz	
		N	Sc.	N	Sc.	N	Sc.
(r)	abstraction	.46	.42	.55	.41	.61	.43
	p value	.04	.05	.01	.05	.01	.04
(Pr)	abstraction	.53	.49	.60	.57	.72	.49
	p value	.04	.07	.20	.01	.01	.03
		C 3		C4		A 1	
		N		N		N	
(r)	abstraction	.44		.28		.50	
	p value	.07		NS		.04	
(Pr)	abstraction	.65		.60		.30	
	p value	.01		.02		NS	

N: normal subjects
Sc: schizophrenics
A1: asymmetry index
r: correlation coefficient
Pr: partial correlation (correlation coefficients corrected for educational level)

Table 3
Effect of P3 Amplitude on Concreteness

	Normal	Sch
R square	.39	.47
T	- 3.4	-3.15
Sig T	.003	.01

DISCUSSION

Impairment of abstraction ability in schizophrenics, as measured by Proverbs test, was marked in comparison to the control group. The same test was used by Girgis (1987) and schizophrenics also showed lower scores on abstraction. The mean score in that study was 7.56, slightly lower than in the present study. This might be attributed to different criteria of selection, as patients in the present study had to be cooperative enough to undergo the neurophysiological testing, and consequently were less impaired.

Two questions are to be considered in any new method of psychological testing, viz. sensitivity and specificity. The sensitivity of the Egyptian Proverbs test EPT in discriminating schizophrenics was high (85%). This supports its validity, as its sensitivity is comparable to the widely used Gorham's Proverbs test (Gorham, 1956). The validity of the EPT is further supported by correlation between its results and P300 amplitude, a parameter known to reflect neurocognitive functioning.

Only by including psychiatric and normal control groups are we able to answer questions regarding specificity of any observed deficit (Chapman & Chapman, 1973). The specificity of the Egyptian Proverbs test in the present work was 80% in relation to normal

subjects. Further psychiatric populations are needed to assess its specificity in different diagnoses.

The results of the present investigation are in accordance with the almost universal agreement that the amplitude of P300 is reduced in schizophrenia (Morstyn et al., 1983; MaCarley et al., 1991). P300 amplitude was reduced at all electrode sites. P300 latency was also prolonged at all sites in the schizophrenic compared to the control group. Souza et al (1995) found P300 latency to be prolonged in schizophrenics at midfrontal, midparietal and left temporal, but not right temporal sites. Delayed P300 latency in schizophrenia correlated with enlargement of the lateral ventricles and bilateral reduction in the size of the anterior cingulate gyrus (Blackwood et al., 1991), suggesting that P300 abnormalities are associated with an underlying neuropathology that gives rise to impaired neuropsychological performance.

The P300 abnormalities in schizophrenics seem to be independent of medication, sex, and clinical state at time of testing, thus fulfilling many of the criteria for useful biological markers (Souza et al., 1995). When large families affected with schizophrenia are examined, the P300 abnormalities exhibit a bimodal distribution in the clinically unaffected relatives, consistent with the expectation for a trait marker (Blackwood et al., 1991).

Abstract reasoning impairment in chronic schizophrenics was found to be more persistent than other forms of thought disorder after symptomatic remission (Spohn et al, 1986), supporting the view that it is related to a basic underlying pathology, irrespective of the current state. In the present work, highly significant correlation was found

between abstraction and P300 amplitude in both groups; this correlation being independent of the level of education. This is further supported by results of regression analysis showing that impairment of abstraction is determined to a large extent (47% of variance) by the P300 amplitude which reflects impaired information processing. The same was true for the control group where P300 could explain 39% of the variance.

Therefore, abstraction impairment in both schizophrenic and normal subjects seems to be dependent on attentional impairment.

The finding that abstraction was correlated with asymmetry index and P300 amplitude in the left hemisphere is consistent with the notion that speech is lateralized to the left hemisphere. The generalization of this notion, however, is thought by some researchers to be false (Cutting, 1992). Some of the highest and most human aspects of language as metaphor (Winner & Gardner, 1977) and figurative meaning (Brownell et al, 1984) have been shown to be affected in right hemisphere lesions. Understanding metaphors and figurative meanings are important aspects of proverb interpretation (Gibbs & Beitel, 1995). Two experiments by Gibbs and coworkers (1994) provided evidence that the consistency in people's mental image for proverbs is due to the conceptual metaphors that provide part of the link between proverbs and their figurative interpretation. Direct evidence for involvement of the right hemisphere in proverb interpretation was given by Benton (1968) in patients with right-hemispheric lesions. This is supported by the finding, in the present work, that correlation between right hemispheric function was statistically significant after education was

controlled for. This might imply that education would reinforce an analytical mode of decoding symbols.

To conclude, the results of the present work lend support to the validity of Rakhawy's Egyptian Proverbs test as a sensitive tool in assessment of abstraction in schizophrenia and normal subjects. The hypothesis that impairment in abstraction ability in schizophrenics as well as in normal subjects results from attentional impairment is also supported.

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La Pensée Concrète chez les Schizophrènes Une Approche Psychophysiologique

Le phénomène de troubles de la pensée n'est pas uniquement observé chez les malades schizophrènes. On trouve de troubles de la pensée chez autres groupes pathologiques et également chez les sujets normaux. L'origine de ces troubles n'est pas encore bien étudiée.

Le but de ce travail était de vérifier la hypothèse que les troubles de la pensée peuvent résulter des troubles de l'attention.

20 malades schizophrènes et 20 sujets normaux ont été évalués. La pensée concrète a été étudiée en utilisant le test de l'amplitude des proverbes Egyptiens IPE. P300 a été étudiée.

On a correctement différencié les schizophrènes (85%) et le groupe de control (80%) en utilisant IPE. L'amplitude de P300 était moins chez les schizophrènes que chez les sujets normaux, cependant que la latence de P300 était prolongée chez les schizophrènes. Une corrélation significative a été observée entre l'amplitude de P300 et la pensée concrète chez les deux groupes.

On peut déduire que les troubles de la pensée peuvent résulter des troubles de l'attention.

التفكير العياني لدى الفصامين والأسوياء

من مدخل سيكوفيزيولوجي

تشير تقارير متعددة إلى وجود أنماط من اضطراب التفكير لدى الأسوياء، ولكن علاقة ذلك الاضطرابات بالوظائف المعرفية لم تدرس بعد على نحو وافي. وتهدف هذه الدراسة إلى إثبات الفرض القائل بأن الموجة ٣٠٠ من الجهد المثار يمكنها التنبؤ باضطراب التفكير لدى غير المرضى، حيث تم تقويم جانب من اضطراب التفكير باستخدام اختبار الأمثال العامة المعروف بحساسيته لاضطراب التجريد لدى مرضى الفصام، كما استهدفت الدراسة أيضاً قياس صدق هذا الاختبار في علاقته بالموجة ب ٣٠٠ كمؤشر معروف للوظائف المعرفية. وقد أجرى البحث على عشرين مريضاً بالفصام وعشرين من الأسوياء وتم قياس الجهد المثار السمعي باستخدام نموذج درجة الصوت غير الشائعة. وقد أظهرت الدراسة أن درجة حساسية اختبار الأمثال العامة ٨٥٪ بينما كانت درجة النوعية ٨٠٪ وكان طول الموجة ب ٣٠٠ وزمن الانتقال أعلى في مرضى الفصام بالمقارنة بالأسوياء، وكان معدل الارتباط بين القدرة على التجريد وطول الموجة ذا دلالة إحصائية في كل من المجموعتين. وهكذا تدعم النتائج صدق اختبار الأمثال العامة، كما تدعم الفرض بأن اضطراب التفكير في الفصام والسواء ينتج عن خلل في وظائف الإنتباه.