# A DIFERENT NEUROPSYCHOLOGICAL APPROACH IN PROBLEM SOLVING ASSESSMENT OF PARANOID SCHIZOPHRENIA PATIENTS

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**SUMMARY**

Schizophrenic patients have deficiences for solving problems, but their nature and specificity is still a motive of controversy. Based on the theory which holds that verbal thought is the organizing function of all intellectual activity, 30 paranoid schizophrenic patients were studies and compared to 30 healthy subjects paired by age, sex and academic education. Wechsler Adult Intelligence Scale (WAIS) was used but initial results showed no major differences, except in the IQs. However, thought multiple regression models, factorial analysis and structural analysis, significative qualitative differences were found in the structure relating the functions within the groups. The model obtained for the control group is consistent with the neuropsychological theory on problem solving, while that obtained for the schizophrenic group suggests that there are dysfunctions in the integration of the information as a result of the disvinculation of thought from the other cognitive abilities.

**Key words:** Neuropsychology, problem solution, cognition, verbal thought, schizophrenia.

**RESUMEN**

Los ezquizofrénicos tienen deficiencias para solucionar problemas, pero su naturaleza y especificidad es aún motivo de controversia. A partir de la teoría que sustenta que el pensamiento verbal es la función que organiza toda actividad intelectual, se estudió a un grupo de 30 pacientes con esquizofrenia paranoide, en comparación con 30 sujetos sanos, pareados por edad, sexo y escolaridad. Se utilizó la Escala de Inteligencia para Adultos de Wechsler (WAIS) y los resultados iniciales no mostraron diferencias, salvo en el nivel de desempeño. Sin embargo, por medio de modelos de regresión múltiple, de análisis factorial y de análisis estructural, se encontraron diferencias en cuanto a la estructura que relaciona las funciones dentro de los grupos. El modelo obtenido por el grupo control es congruente con la teoría neuropsicológica en torno a la solución de problemas, mientras que el obtenido para el grupo de esquizofrénicos, sugiere que tienen trastornos en la integración de la información, como resultado de la desvinculación del pensamiento con las otras habilidades cognoscitivas.

**Palabras clave**: Neuropsicología, solución de problemas, cognición, pensamiento verbal.

## INTRODUCTION

Results of schizophrenia reserach have constantly shown that patients have different cognitive deficiences, but there are no neuropsychological models for undestanding their problem solving disabilities. By means of neuropsychological trials and histopathological, neurochemical or neuroimage studies, alterations in different regions of the central nervous system have been documented. Some studies show the involvement of the functioning of the frontal dorsolateral sector, others show the involvement of the superior temporal gyrus or of the temporal limbic region. Also alterations at the cingulate cortex and at the accumbens or dorsomedial nuclei of the thalamus, or at the cerebellar or basal gangly have been found.

From a neurochemical point of view, studies have centered on the activity of the dompaminergic or colinergic systems, while neuropsychologic investigation shows that patients have difficulties for solving problems as a result of multiple alterations in the cognitive apparatus involving different functions. Active attention dysfunctions have been identified, as well as defects in the attention filter, automonitoring deficit, difficulties for maintaining the set, failure when forming concepts, inestability in visual and verbal memory, dysfunctions in explicit memory and in temporal information memory, lack of cognitive flexibility, incapability for planning, poor performance in directed discourse tasks, lack of common sense and errors in affective recognition (18,21,23).

Laws et al. (14) affirm that cognitive heterogeneity is characteristic of schizophrenia as a different manifestation of the same underlying dysfunction. However, after revising thirty two studies, Zalewski, et al. (26) arrived to the conclusion that results are incongruent and investigations have been developed under so dif-

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ferent methodological conditions that its joint interpretation is unreliable. Green and Nuechterlein (12) indicated that findings on neurocognitive defects in schizophrenia have emerged rapidly, but in a chaotic way due to the lack of referential theoretical frames.

The neurocognitive dysfunctions of schizophrenic patients have been studied by means of different cognitive paradigms. Spitzer (22) centered his studies in the analysis of the dysfunction of the schizophrenic thought from cognitive neuroscience, and affirmed that the combination of electrophysiological methods and functional cerebral images, with paradigms derived from cognitive psychology, is the path to be followed for elaborating cognitive neurobiological models of psychopathology, as neural net models provide information on the computational functions, and are necessary for vinculating the mental and biological areas. Such mathematical models of mental and biological processes support a theoretical frame from which new hypotheses are generated and may be confirmed in these models.

On the other hand, Andreasen et al. (1) indicate that early efforts for locating schizophrenic symptoms within a determinate cerebral region have been replaced by models suggesting that there is an alteration in circuits distributed in parallel or in dynamic circuits, but the fundamental problem in investigation is the development of a neuroanatomical model for explaining the multiple and diverse symptoms of schizophrenia. According to Gray (10), postmortem pathology in schyzophrenia indicates that the temporal and frontal lobes are involved, so that in an integrative model any theory might have to include both areas and their respective functions. Downing et al. (4) conclude that schizophrenics suffer from a frontosubcortical dysfunction, with a more important frontal than subcortical implication in the frontostriated circuit, while Ferman et al. (6) point out that the alteration in the interconnection of the frontal and temporal systems is responisble for the inattention of schizophrenics. Gruzelier et al. (13) affirm that the temporoparietal sector is lateralized towards the right side in active syndroms and towards the left side in retracted syndroms.

Accumulated knowledge indicates that neurobiologic dysfunction in schizophrenia may not be easily attributed to a specific abnormal site in the cerebral cortex as it was previously thought. It is true that in many studies, clinical signs, which are characteristic of frontal alterations, have been found, but it is also true that the normal functioning of this integrative high density cortical zone depends on the functional organization of multiple regions of the nervous system. Therefore, a neuropsychological question may inversely arise from that followed in this area of investigation.

If according to the results of various studies, in the basic neurobiological deficiency of schizophrenia is involved not an specific site in the nervous system, but a neuronal net vinculating the high level integration zones of information, such as the frontal and temporal territory of the cerebral cortex, then which is the main integrative neuropsychological function not located in a particular and only site in the nervous system, but depending on a complex functional system in which the interaction of different cortical integration areas participate and might be related to the high level cognitive activity, and whose dysfunction might generate multiple signs in several cognition spheres?

Due to the wide variety of dysfunctions at different levels of the information prosessing it might be valid to believe that these dysfunctions are due to the basic deficiency of a certain function related to others. Some authors, whose concepts are considered as pillars in contemporary neuropsychology (16,24), have indicated that thought, or internal language, is the basis of active attention, autoregulation and monitoring; that it is the main behavioral mediator as well as the basis of memory. From this perspective, thought is related to all cognitive abilities, and its dysfunction may be the underlying mechanism to a cognitive disorganization as vast as that suffered by schizophrenic patients. Soviet authors also believe that thought, as a neuropsychological function, is organized from different processes in charge of different regions of the central nervous system.

Due to this theoretical statement a set of paradigms was used for investigating how the thought of the schizophrenic patient is organized for solving problems not only by means of a quantitative design limited to interpreting or comparing the average performance score, but throught the possible interactions ocurring among the different functions implicit in task solution, which cannot be observed when designing studies for measuring isolated neuropsychological functions.

On the other hand, in most reports of neuropsychological studies on schizophrenic patients, the different types of this illness are grouped in a single category due to the heterogeneity of the patients symptomatology constantly complicating the interpretation of results.

## METHOD

In this investigation only a group of patients with paranoid schizophrenia was considered when comparing their performance to that of the healthy subjects in a control group (Table 1). According to Lezak's (15)

indications, thirty patients were studied and compared to thirty healthy subjects of the same age, sex and academic education, by means of the application, scoring and neurologic interpretation of the set of paradigms which form the Wechsler Adult Intelligence Scale (25).

## STATISTICAL ANALYSIS

Once the profiles resulting from the application of the instrument in both groups were obtained, the factor analysis (tables 3 and 5) and the correlations between the subscales were studied (table 6). Then, an analysis of the trajectories was carried out by means of multiple regression models (tables 2 and 4) for the purpose of analyzing and interpreting in a comparative way and within the neuropsychological frame, the models resulting from each group. The adjustment of the data obtained by the schizophrenic patients in the structure of the controls was evaluated, and a Goodness of Fit Index AGFI = 34.1% with an [$x^2$/df=3.01; p close < 0.001], indicated that the empiric data of the schizophrenic patients differ significantly from the structural model of controls.

**TABLE 1**
**Schizophrenic and control groups. Demographic characteristics**

| | *Control* | *Schizophrenia* | |
|---|---|---|---|
| *N* | *30* | *30* | |
| *Gender* | | | |
| Female | 13.3% (4) | 16.7% (5) | |
| Male | 86.7% (26) | 83.3% (25) | $x^2$ (1) = 0.13 p = 0.718 |
| Education (years) | 13.3 ± 3.5 | 12.0 ± 2.5 | F (1,58) = 2.88 p = 0.095 |
| Age (years) | 29.6 ± 5.9 | 29.6 ± 6.1 | F (1,58) = 0.002 p = 0.966 |
| Duration of illnes (years) | | 9.3 ± 5.9 | |

**TABLE 2**
**Multiple regression models for the prediction of each subscale compared to the other subscales. Control group**

| *Dependent Variable* | *Independent Variable* | *β Standard* | *Determination Coefficient* |
|---|---|---|---|
| Information | Vocabulary | 0.49 | |
| | Similarities | 0.41 | $R^2$ = 71.4% |
| Comprehension | Arithmetic | 0.43 | |
| | Information | 0.46 | $R^2$ = 58.7% |
| Arithmetic | Digit Symbol | 0.32 | |
| | Comprehension | 0.57 | $R^2$ = 52.0% |
| Similarities | Picture Arrangement | 0.24 | |
| | Information | 0.38 | |
| | Vocabulary | 0.40 | $R^2$ = 73.1% |
| Digit Span | Similarities | 0.39 | |
| | Block Design | 0.34 | $R^2$ = 28.1% |
| Vocabulary | Similarities | 0.41 | |
| | Information | 0.49 | $R^2$ = 71.1% |
| Digit Symbol | Arithmetic | 0.52 | $R^2$ = 24.7% |
| Picture Completion | Arithmetic | 0.50 | |
| | Picture Arrangement | 0.45 | $R^2$ = 47.7% |
| Block Design | Digit Span | 0.44 | $R^2$ = 16.3% |
| Picture Arrangement | Similarities | 0.57 | $R^2$ = 29.6% |
| Object Assembly | Information | 0.41 | $R^2$ = 13.4% |

## DISCUSSION

In the control group (fig. 1) the interpretation of the trajectory diagram was coherent with the theory on the organization of the high nervous processes for solving problems, based on the strategies emerging from language "as a second signal system" (17). In the first factor (table 3) a close link between knowledge and the categorization level of the verbal elements is obtained. This is an important process which the Soviet school calls "the primary process of thought". According to Luria and Tsvetkova (17), the activity of the occipital-parieto-temporo crossroad provides the integration of information coming from different analyzers in order to transform perception into thought.

In the trajectory diagram, a strong association between semantic knowledge, represented by the amount of information, the ability to use speech and the grouping of the elements in semantic categories was found. This verbal triad is also representative of the semantic memory, considered as the stock containing the organized knowledge of the objects, the facts and the concepts, as well as of the words and the meanings (15). In thought, the complexity and the variability of experiences are reduced to a limited concept structure permitting the categorization of knowledge, in which concepts are not arbitrary mental constructions (3,8). In general, the anterior, lateral and inferior parts of the temporal lobes give neurobiologic support to this semantic memory which is very important for the intellectual activity.

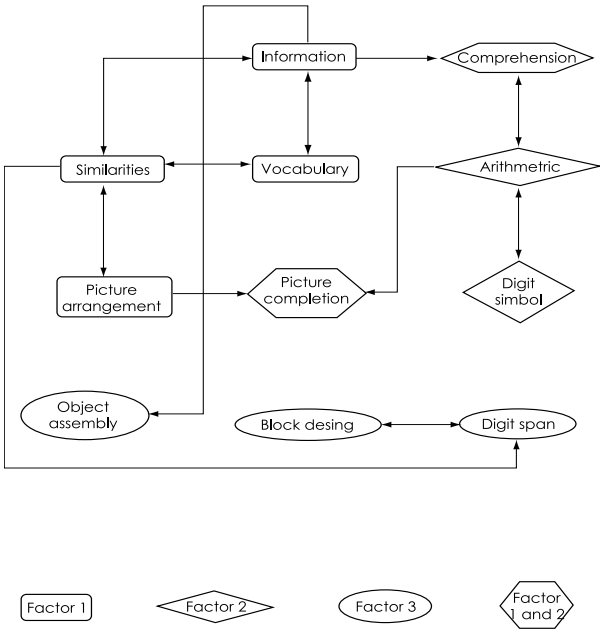


**Figure 1. Trajectories Diagram for subscales. Control group**. The execution model represented by this structure was validated by means of an AMOS structural analysis, 3.6 SPSS version (Arbuckle, 1997). This analysis confirmed the empiric data adjustment to the trajectories diagram with an AGFI=73.68% Goodness of Fit Index; $x^2$/df=0.988, p close 0.613. It may be concluded that the model is adequately adjusted to the empiric data.

**TABLE 3**
**Factor analysis. Control group**

| | *Factor 1* | *Factor 2* | *Factor 3* |
|---|---|---|---|
| Information | **0.812** | 0.251 | 0.318 |
| Comprehension | **0.558** | 0.152 | **0.551** |
| Arithmetic | 0.321 | 0.097 | **0.898** |
| Similarities | **0.863** | 0.269 | 0.191 |
| Digit Span | 0.296 | **0.384** | 0.286 |
| Vocabulary | **0.742** | 0.283 | 0.325 |
| Digit Symbol | -0.024 | 0.184 | **0.587** |
| Picture Completion | **0.478** | 0.085 | **0.449** |
| Block Design | 0.050 | **0.980** | 0.194 |
| Picture Arrangement | **0.646** | -0.079 | -0.024 |
| Object Assembly | 0.261 | **0.352** | 0.050 |
| Explained Variance | 28.9% | 13.9% | 18.4% |
| Pooled Variance | 28.9% | 42.8% | 61.2% |

On the trajectories diagram of the control group it may be observed that the organization of these primary processes of thought is followed by reasoning. The Comprehension subscale requests the incorporation of the previous experience to the theoretical analysis on the hypothetically suggested formulations. With this organized knowledge, the subject asks himself a question by means of a selective activity which analyzes the elements of the problem, elaborates solution strategies and compares the results to the original conditions. Thus, the activity of the occipital temporoparietal crossroad of the left hemisphere is linked in the complex functional system to the activity of the frontal lateral and anterior sectors of the cerebral cortex.

In this first verbal factor the ability to establish logical causal relations is also linked as part of this discursive logical thought. The primary processes of thought, in terms of the semantic structure of knowledge, are strongly linked to the synctactic structures of language for building the matrix determining the dynamics of thought, and secures the deduction operations and supports the capacity for emitting practical judgement. Thus, the demands imposed by the paradigm Picture Arrangement are once again covered by the processes

**TABLE 4**
**Multiple regression models for the prediction of each subscale compared to other subscales. Schizophrenic group**

| *Dependent Variable* | *Independent Variable* | *β Standar* | *Determination Coefficient* |
|---|---|---|---|
| Information | Vocabulary | 0.81 | $R^2$ = 64.8% |
| Comprehension | Digit Symbol<br>Picture Completion | 0.42<br>0.53 | $R^2$ = 58.8% |
| Arithmetic | Block Design<br>Vocabulary | 0.44<br>0.59 | $R^2$ = 74.3% |
| Similarities | Vocabulary<br>Picture Completion | 0.53<br>0.37 | $R^2$ = 59.9% |
| Digit Span | Block Design | 0.40 | $R^2$ = 13.3% |
| Vocabulary | Arithmetic<br>Information | 0.44<br>0.54 | $R^2$ = 76.7% |
| Digit Symbol | Block Design<br>Comprehension | 0.36<br>0.44 | $R^2$ = 43.5% |
| Picture Completion | Comprehension<br>Similarities | 0.49<br>0.45 | $R^2$ = 59.9% |
| Block Design | Picture Arrangement<br>Arithmetic | 0.49<br>0.36 | $R^2$ = 58.5% |
| Picture Arrangement | Information<br>Block Design | 0.34<br>0.64 | $R^2$ = 62.2% |
| Object Assembly | Block Design | 0.61 | $R^2$ = 35.1% |

resulting from the fronto-parietal activity of the cerebral cortex.

However, the capacity for recognizing and visual closing is also linked to the verbal factor; the denomination, or the word, organizes the perception (24) while conferring meanings to search for the omitted elements in the image of familiar stimuli which are present in the Picture Completion subscale. This subscale evaluates, according to Lezak (15), the elemental judgement of common sense, the general knowledge on the environmental stimuli and, at its basic level, the visual recognition emerging from the activity of the secondary zones of the occipital sector of the cerebral cortex.

In the third factor, the processes of logic reasoning are strongly linked to those of numerical reasoning, in which a verbal factor also predominates, because the logical discursive thought, associated to formal training, supports the solution of social and arithmetic problems evaluated with the Comprehension and Arithmetic subscales. Performance in both paradigms may be considered as the result of the capacity to use symbolic information, combined with learning and memory, which predic the level of visual recognition and the ability for the visuospatial management of stimulation, with a component of recent associative visual memory. Therefore, the presence in this third factor —which is the second most important— of the Comprehension, Arithmetic, Incomplete Figures, and Symbols and Digits subscales may be then explained.

**TABLE 5**
**Factor analysis. Schizophrenic group**

| | *Factor 1* | *Factor 2* | *Factor 3* |
|---|---|---|---|
| Information | **0.766** | 0.181 | 0.182 |
| Comprehension | **0.368** | 0.193 | **0.910** |
| Arithmetic | **0.619** | **0.552** | 0.339 |
| Similarities | **0.785** | 0.198 | 0.149 |
| Digit Span | 0.174 | **0.470** | -0.054 |
| Vocabulary | **0.898** | 0.255 | 0.174 |
| Digit Symbol | 0.025 | **0.576** | **0.495** |
| Picture Completion | **0.486** | 0.271 | 0.477 |
| Block Design | 0.192 | **0.841** | 0.250 |
| Picture Arrangement | **0.360** | **0.679** | 0.313 |
| Object Assembly | 0.221 | **0.581** | 0.279 |
| Explained Variance | 27.4% | 23.7% | 15.8% |
| Pooled Variance | 27.4% | 51.1% | 66.9% |

The second factor is considered as one of selective attention and concentration with non verbal thought processes. The paradigms of the Block Design and Object Assembly subscales evaluate the visual analytic and synthetic abilities, specially the first one, which requires the elaboration of a visual unfamiliar image, while the second is related to the management of meaningful stimuli. From a neuropsycological point of view, the solution to these tasks depends on the activity of the right cerebral hemysphere, which processes the analysis of the parts, its integration within the gestalt and its localization in space by means of the attention and recognition processes linked to the work of the posterior tertiary sector, while in the monitoring and planning of the motor response the anterior tertiary zones participate. This is the perceptual organization factor.

According to Lezak (1995), the Block Design subscale is a constructive task which also evaluates the different levels of visuospatial conceptualization. In the trajectories diagram it is stroungly linked to the Digit Span subscale, suggesting that in these construction processes, selective attention, automonitoring and concentration play a very important role. The performance level in Block Design may be predicted from Digit Span, which in turn is linked to the first verbal factor by means of Similarities. This relation may be interpreted as a different functional system in which the anterior frontal activity of the cortex guides the execution of the construction tasks whose perceptual organization depends on the work of the posterior tertiary zone. According to Luria (16) this is one of the main functional systems which may be evaluated by means of constructive paradigms.

On the other hand, the Object Assembly subscale is linked to the rest of the scheme only from the Information subscale. The level of general knowledge is linked to training and image memory in order to carry out this constructive task with familiar material. Lezak (15) indicates that this subscale varies independently from the others, and that in order to perform these tasks little abstract thought is needed. In an average performance the capacity to form a visual image and transferring it to the manual response is involved. In the diagram of trajectories of the control group, Lezak's asseveration seems to be confirmed in view of the fact that this subscale is little related to the others.

In contrast, the structure found in schizophrenic patients (fig. 2) is significantly different to that of controls, and suggests that problem solution in the schizophrenic patients occurs due to their mnesic resources and their visuomotor or visuospatial organization abilities, while verbal subscales do not seem to orientate

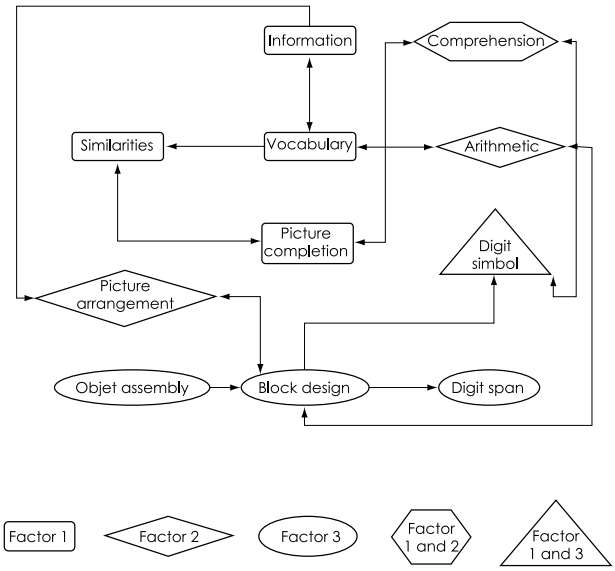


**Figure 2. Trajectories Diagram for subscales. Schizophrenic Group**. The execution model represented by this structure was validated by means of an AMOS structural analysis, 3.6 SPSS version (Arbuckle, 1997). This analysis confirmed the adjusment of empiric data to the trajectories diagram with an AGFI=76.1% Goodness of Fit Index; $x^2$/df=0.87, p close 0.873 significance. It may be concluded that the model adequately adjusted to the empiric data.

their solution strategies. In other words, more than approximating by means of an abstract attitude, patients do it from their mnesic file from where they obtain the acquired information or strategies. This type of approximation limits their capacity to deal with situations not previously learned.

An important fact is that the Similarities subscale is not significantly linked to the rest of the verbal subscales; instead, it predicts Picture Completion and viceversa, as if the categorization would not be linked to the rest of the information, while visual attention and general knowledge levels are related to one another.

Vocabulary predicts Similarities, but not inversely, as in the controls. It seems that categorization is not related to the verbal repertory. In schizophrenics, Information is strongly linked to Vocabulary, therefore general stimulation and remote verbal memory are the dominant psychological functions in the solution of these tasks in which the knowledge acquired during life is directly used for implementing the answers. It seems there is no abstract attitude, but only the capacity to answer in relation to remote memory. According to this result, it may be inferred that the paranoid schizophrenic patient, in terms of the semantic memory, has the information and recaptures it in an organized way. However, the disvinculation of the categorization processes from the use he makes of this

**TABLE 6**
**Subscale correlation in comparison with total I.Q. of each Group**

| N | *Control* 30 | *Schizophrenia* 30 | *p-value* Contrast z |
|---|---|---|---|
| Information | **0.89** | 0.65 | 0.001* |
| Comprehension | 0.79 | 0.73 | 0.458 |
| Arithmetic | 0.68 | 0.79 | 0.208 |
| Similarities | **0.81** | 0.57 | 0.013* |
| Digit Span | 0.53 | 0.54 | 0.942 |
| Vocabulary | **0.82** | 0.60 | 0.016* |
| Digit Symbol | 0.42 | **0.73** | 0.012* |
| Picture Completion | 0.68 | 0.58 | 0.387 |
| Block Design | 0.39 | **0.76** | 0.002* |
| Picture Arrangement | 0.49 | **0.76** | 0.017* |
| Object Assembly | 0.48 | 0.59 | 0.422 |

* Significant correlation

knowledge, limits the abstraction levels of the meanings and the possible recapturation strategies; this could explain their poor performance in the specific tasks of explicit memory.

On the other hand, instead that the organized theoretical knowledge may predict the level of reasoning as in the controls, in schizophrenics Comprehension is predicted by Picture Completion and viceversa, while Digit Symbol and Comprehension predict one another. Therefore, the quality of reasoning in the schizophrenic patient depends on his observation capacity and his visual memory, and not on a thought integrated from the primary processes.

The characteristics of this first factor as a whole (table 5), containing subscales with an important verbal component, are specially important for understanding how the paranoid schizophrenic patient meets the demands of the problems he must solve. From a neuropsychological point of view there are integration deficiencies suggesting that the posterior association area of the left cerebral hemisphere is involved, but from a cognitive perspective they show an erratic strategy in which, independently from the score level reached in the subscale, its performance will depend on the amount of memorized information and not on its organization by means of meanings.

If the solution of problems depends on the discursive logical thought developed from the set of meanings organized as concepts in order to turn experience into thought and determine the dynamics for the elaboration of judgements, securing the deduction and reasoning operations, then the quality of this first verbal factor in the schizophrenic patients shows basic deficiencies from the first stages of thought on, which alter the higher stages. Therefore, errors in reasoning and judgement, common in this type of patients, do not seem to result directly from the dysfunction in the executive functions of the frontal lobes, but from a basic deficiency in the programs guaranteeing the comprehension and the symbolic managment of the material.

The second factor, formed by Arithmetic, Digit Span, Digit Simbol, Block Design and Picture Arrangement, was the predictive factor of the total I.Q. value (table 6), in which there is no clear command of the verbal symbolic processes, but of the concentration, previous learning and general knowledge functions. In this second factor, Picture Arrangement, which measures the capacity for organizing events within the temporal-spatial sequencies to find the logical-causal relation and emitting a practical judgement instead of being linked to a verbal abstraction process as in the control, in schizophrenics it depends on the amount of formal knowledge they may have. Therefore, if the patient has a learned answer for the formulated demand, his performance in these tasks will be appropriate. The contrary occurs when in his behavioral repertory there is no previous similar experience, as ther are uncapable, according to this result, of reorganizing their schemes for making deductions.

On the other hand, Block Design appears as a predictive subscale of Digit Span, Digit Simbol and Picture Arrangement. This turns it into the central subscale of this second factor predicting, at the same time, the I.Q. value. The ones with a better performance in this battery will be the ones with a better performance in Cube Design, while in controls, the verbal symbolic complex is the center in command. Therefore, in contrast with the control group, the quality of the performance of the schizophrenic patients depends on a visual perceptual organization and attention factor. In other words, it depends on the information in their concrete and immediate environment.

Comprehension and Digit Symbol are enclosed in the third factor, in which the factorial charge of Comprehension explained 82% of its variance. The fact that this factor is dominated by the Comprehension subscale indicates that the inherent processes to this subscale are in a certain way independent from the rest, and at the same time it is a high predictor of the I.Q. value as if reasoning would be unlinked and would not perform an important role in the rest of problem solution. However, if these patients are capable of emitting appropriate social and logical answers their performance in the battery will be better, but not due to the

symbolic management of the information, but to correct learning experiences and a good attention capacity at that moment, resulting from the predictive relation between Comprehension and Digit Simbol, which appears in the trajectories diagram.

Finally, in this diagram, Arithmetic is strongly linked to Vocabulary, Information and Block Design, while in the control model it is linked to reasoning. In other words, the calculation ability of the schizophrenic patient depends on his previous training and on his capacity to pay attention to all parts integrating the problem as a whole.

The contrast in the trajectory diagrams indicates that independently from the quantitative characteristics or of the performance level of the patients, they show a very different approximation when solving the different paradigms used. The most important thing in relation to the problem stated in this study is the way in which the different evaluated psychological functions interrelate. As it was expected, there is a clear relation between the measurements of the processes of thought in the control group, significantly different from that of the patient group. There seems to be a basic deficiency in internal language, that as a second signal system does not support the intellectual activity of the paranoid schizophrenic patient. Therefore, if thought is not a complete net linked to the solution of different tasks it is evident that the executive functions do not operate in these patients, as indicated in previous investigations.

Deficiencies in the integration of the basic processes of thought modify the interpretation of the failures of the executive functions. Studies dealing only with the evaluation of these functions indicate that there is a direct relation between the deficits found and a dysfunction in the frontal territory of the brain, but the fact that the integration of other basic processes of thought is altered, suggests that the posterior tertiary sector of the cortex may be involved. If such would be the case, deficiencies in the excecutive functions may be due not only to a particular dysfunction in the frontal lobe, but to a dysfunction in the development of the cognitive activity. The changes in the anatomically related zones are primary and produce pathological signs in the frontal territory, as Goldman-Rakic and Selemon had questioned (9).

Thought it is true that cognitive neuropsychology has shown multiple dissociations among the subjacent processes to the different functions of the adult brain (5), contrary to the initial idea of the hierarchical organization of functions suggested by Luria (16), from the point of view of the immature brain in evolution, the theory of the Soviet school on the display and retreat of functions along the neuropsychological development should be taken into consideration. Researchers (24) indicate that this process determines a change in the cognition structures from basic processes to more complex cognitive structures. In other words, it develops as in a pyramidal structure similar to the hierarchical organization of the functions suggested by Luria (16). Following this theory, the executive functions are highly developed functions whose structures appear in the late stages of development and after the integration of the basic processes of thought that play an essential role in the formation of symbols, thus supporting abstration. This interpretation agrees with that of other authors, such as Andreasen et al. (1); Gur et al. (11) and Raedler et al. (20) on the importance of considering this dysfunction occurring during the neurodevelopment as part of the neurobiological model of schizophrenia.

It is true that there is a functional specialization of the left cerebral hemisphere for the processing of verbal codes, but language is not located in a specific site of the brain. On the contrary, it may be considered as a cognitive function processed in dynamic neuronal circuits as the resulting characteristic of the organized work of the brain as a whole in a complex functional system. Therefore, the study of the different processes of verbal thought may be included in the current neurobiological models not pretending to locate the schizophrenic symptoms in only one cerebral region, but considering it as the product of the dysfunction of the circuits distributed in parallel or in dynamic circuits, as indicated by Andreasen et al. (1). Besides, if the concept of "cognitive dysmetry" described by these authors when referring to the clinical alterations produced by the nauroantomical and functional dysfunctions of the brain is analyzed, in the opposite direction, thought, as a second system of signals, might represent the neuropsychological function, responsible for the "cognitive symmetry". Recently, Friston (7) analyzed the hypothesis of disconnection in schizophrenia, whose physiopathology is expressed at the modulation level of associative changes in synaptic efficacy, specifically the plasticity modulation of the cerebral systems responsible for learning, memory and emotion.

The results of this investigation indicate, for the time being, that the paranoid schizophrenic patient has deficiencies in the integration and the management of the processes of thought in a problem solution situation, resulting in the activity dysfunction of the left cerebral hemisphere, but it still cannot be affirmed that this failure is located in a single cerebral region. The cognitive dysfunction goes beyond the neurological dysfunction that the electrophysiological or neuroimage studies may topographically show. Paulus et al. (19) conclude, as we

do that the cognitive problem of these patients is that of quality more than that of quantity. These results also support the idea that the neurobiological deficiency in schizophrenia involves not only an specific site of cerebral dysfunction but a vast communication circuit in the different regions of the system.

On the other hand, at least in this group of patients, the neuropsychological interpretation explains why they can function better in very structured environments for which they have been previuosly trained, and fail most of the time in different psychosocial situation in which they have to face a series of changing demands typical of common environments.

In search for neurobiological models of this illnes, the results obtained justify the study of an specific line of investigation, with particular paradigms measuring the processes of thought from a predominantly qualitative —more than quantitative— approximation, incorporating to this study other electrophysiological or functional cerebral image techniques for trying to integrate a cognitive neuroscience methodology as suggested by Spitzer (22). Following this line of investigation, the results of the evaluation of the different groups of schizophrenic patients formed according to their particular type of illnes will be compared.


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