Correlates of Interhemisphere Transfer Task Performance in Schizophrenics

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Abstract

The correlates of performance on a task previously used to assess interhemispheric transfer were determined in schizophrenics. The patients were administered an IQ test in addition to the interhemispheric transfer task. Age, gender, age of onset, paranoid versus nonparanoid diagnosis, marital status, years of education, and antipsychotic drug dosage were obtained. The best predictors of interhemispheric transfer performance were greater education and lesser age. Variables that contributed to prediction in the multivariate analyses were younger age of onset and lower Quick Test IQ with the latter finding being unexpected. Variables that did not relate to task performance were antipsychotic drug dosage, marital status, gender, and paranoid versus nonparanoid diagnosis". It was concluded that degree of process schizophrenia seemed more related to task performance than the specific neuropsychological status under consideration. Research implications were discussed.

The purpose of the present study was to relate a task of interhemisphere transfer (IHT) to clinical and demographic characteristics of schizophrenics. The empirical justification for IHT research in schizophrenics rests upon two sorts of evidence — the schizophrenic-like symptoms of some patients with corpus colossal pathology, and corpus callosum abnormality in some schizophrenics. In regard to the former, the symptoms found in conditions such as corpus collosum tumors, lesions, infarctions, demyelination disease, gliosis and agenesis could include apathy, stupor, mental deterioration, hallucinations, tactile deficits, slowness, and more errors on psychological tasks (Nasrallah & McCalley-Whitters, Bigelow & Rauscher (1983). Bigelow, Nasrallah and Raucher (1983) found the abnormal thickening was greater in younger than in older patients so as to suggest a pathological brain process that causes swelling but that slowly resolves over a number of years.

Research has established that schizophrenics tend to do poorly on tasks presumed to assess IHT (Schwartz, Winstead & Walker, 1984; Tress, Kugler & Caudrey, 1979; Green, 1978; Carr, 1980). However, the correlates of IHT task performance within a schizophrenic population has not yet been determined. Such a determination would appear to shed light upon the individual differences associated with IHT task performance in schizophrenia and upon the clinical and theoretical significance of such performance.

Thus, the composite perspective of interhemispheric transfer in schizophrenics is not clear. Not all schizophrenics display a deficit in IHT transfer tasks. Also, the previous research has not controlled for general psychological deficit. Furthermore, the previous research has not employed multivariate analysis.

The present study attempted to determine, with multivariate analysis, the variables that relate to IHT task performance in schizophrenics. It employed variables associated with recognized and possibly relevant characteristics of schizophrenics, and used variables that have been found related to IHT in normal persons and neurological patients. The former variables are paranoid vs. nonparanoid DSM III diagnosis, age of first hospitalization, marital status and education. It has been recognized since the process-reactive research began (Phillips, 1953) that better premorbid and current psychosocial functioning are positively associated with prognosis and overall functioning. It has also been established that paranoid

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schizophrenics tend to have a higher level of cognitive and psychosocial functioning than other schizophrenics (Lewis, Nelson & Eggersten, 1979; Goldstein & Halperin, 1977).

Age in adults ordinarily is negatively associated with cognitive functioning, at least outside of verbal and acquired information realms. Because of this and because age is inversely related to corpus collosum thickness in schizophrenics, it was chosen as a variable in the present study. Gender was chosen because females have a larger corpus collusum and presumably less lateralization than males (Lacoste-Utamsing & Holloway, 1982) and because there is some evidence that male schizophrenics tend to be more deteriorated than female schizophrenics (Lewine, 1981; Panteleeva & Belyaev, 1984).

Method

Subjects

The participants in this study were 55 patients obtained from mental health services of a Central California county and a psychiatric inpatient facility within the same region. The patients were volunteers who were recovering from an acute phase of their illness. To be included in the study, the participants must have met the DSM-III criteria for schizophrenia, have volunteered for the study, and have no history of serious head injury. For ethical reasons, the participants were not discontinued from antipsychotic medications. However, the Abnormal Involuntary Movement Scale (National Institute of Mental Health) and The Targeting of Abnormal Movement Effects (Wojcik, Gelenberg, LaBrie & Mieske, 1980) was used. Only one of the original 56 subjects had to be excluded because of meeting the motor side effects criteria of Germer, Seraydarian & McBrearty (1984). Antipsychotic medication dosage was converted to chlorpromazine standard of Appleton (1982) and mean daily dosage was 1279.36 milligrams (SD = 1179.27).

The sample consisted of 38 males and 17 females. The mean age of the participants was 35.91 years and the standard deviation was 12.37. The mean number of years of education for the entire sample was 11.35 and the standard deviation was 2.58. The mean age of the participants at first hospitalization was 24.64 and the standard deviation was 8.50. The number of nonpara-noid participants was 33, and the number of paranoid was 22. The number of participants who were single and had never been married was 40; those who were separated, divorced, widowed, or remarried was 14; and there was 1 participant who was continuously married.

Procedures

The participants were seen on two occasions, ranging from one to two weeks apart. This enabled the IHT task to be repeated so that an estimate of test-retest reliability could be obtained. The obtained correlation of the first and second assessments was 0.76. Later, within 1 to 2 weeks, the Quick Test (Ammons & Ammons, 1962) was administered by a graduate student in psychology and yielded a mean IQ of 91.60 (SD = 14.62).

Determining IHT Impairment

The apparatus was constructed so as to be the same as that used by Green (1978). A variation of the procedure used by Green was employed. His study established that the IHT task in which the object and feedback were given to opposite hands showed significant differences between schizophrenics and controls. Significant differences with the same hand were not obtained. Thus, conditions in which the object and feedback were given to the same hand were not used in the present study. There were two types of objects. Objects used in the training procedures were meaningful in shape. The shapes of these objects were a circle and a square. Participants were given these objects to speed the time of administration of the practice session, as schizophrenics are known to easily transfer meaningful information to which a verbal label can be attached.

Non-meaningful shaped objects were used in the test administration because schizophrenics are unable to transfer non-meaningful shape information to which no verbal label can be attached (Kleinman & Cloninger, 1973; Carr, 1980). These objects were selected after determining objects to which the association of verbal

labels was difficult as well as having characteristic differences from each other.

A screen blocked the participant's view so that the examiner or task materials could not be seen during the training or test trials. The participant could reach the objects and boxes easily by placing one hand under the screen.

The participants were required to learn to place objects into the correct box. Initially, each participant was allowed to manipulate the objects with both hands and to become familiar with the boxes in a standard manner. The training procedures were conducted with a non-test object with a meaningful shape.

The following statements were made to the participant by the examiner when explaining the task: "I am going to ask you to put wooden objects in these boses' ' *(E* points to boxes), "but you will not be able to look at the objects or the boxes because of this screen" *(E* points to screen). "You will have to remember which object goes in each box by its feel. Each object will have a different shape, and you can tell each box by its position. Put your hand on the boxes and you can feel that 3 of them are set forward and 2 of them are set back so that you can tell the position of each box. I will give you an object in one hand and I want you to pass your other hand along the row of boxes, stopping briefly at each box. I will tap your opposite hand when the object is at the correct box. When I tap your hand, drop the object into the box and return to the starting point to receive another object."

"First, I am going to give you a chance to practice. Let's start with your right (or left) hand. This is the hand in which I will put the object. Put your right hand here with the palm up" *(E* points to the mark) Put your left (or right) hand here with the palm down" (pointing to the mark). "This is the hand that I will tap. Here is object number 1" *(E* places object number 1 in the participant's hand). "Go ahead and feel the object. Good" (after the S feels the objects), "now pass it over the boxes until I tap your left (or right) hand, go ahead" (repeated for each of the five objects).

After the procedure was repeated for all of the objects and boxes, using the same hand, the participants attempted to replace the objects in the correct box when the objects were given to the participant by the examiner. They were given one at a time. The examiner gave the following instructions: "Now I want you to replace the objects as I give them to you one at a time. Put them back in the box where they belong."

As soon as an object was misplaced, the examiner said, "No, that is not correct. I will teach you again." The procedure was repeated to a criterion of 100% success.

As soon as the participant was able to repeat the initial trials to the criterion, the same performance was asked to be repeated by the opposite hand, or the hand which was tapped. The following directions were given: "Now, I want you to return the objects to the correct boxes when I put them in your left (or right) hand. Put your hand here with the palm up and I will give you the same objects" (pointing to the mark).

As soon as an object was misplaced, the examiner said, "No, that is not correct. I will teach you again." The procedure was repeated to a criterion of 100% success with the original procedure.

After the practice session was completed to a 100% criterion, the examiner said to the participant: "This time the objects will be different, but you will still do the same thing that we just did. Are you ready? Let's start with your right (or left) hand. Again, put your right hand here with the palm up" *(E* points). "Put your left (or right) hand here with the palm down" (pointing to the mark). "This is the hand that I will tap. Here is object number 1 (or 2, 3, 4, or 5), pass it over the boxes until I tap your hand, go ahead."

A record was made of the number of trials needed to reach the criterion in each of these conditions: left-right (LR) and right-left (RL). In each of these conditions, the first word was the hand given the object and the second word was the hand given the feedback by a hand tap. The task was always performed with either the left or right hand, but feedback on the participant's performance (hand tap) was given to the opposite hand.

The order of presentation of the conditions was counterbalanced, thus, each condition was presented either first or second

on an equal number of occasions. The object order within each condition, and the sequence of objects used during the training and test sessions was randomized. The total IHT impairment score was the sum of the number of initial trials to achieve a correct performance and the number of trials necessary to transfer a correct performance on the first IHT administration.

Results

Thirty-seven of the subjects were able to complete the IHT task and 18 were unable to complete it. Since the score was based upon the time required for completion and a limitation on the number of trials was used, no score could be given to the noncompleter group. Therefore, two analyses were done. In the first analysis, only the 37 completers were used. In the second analysis, the completers below the IHT median score were assigned a score of one, and the noncompleters were assigned a score of two. It should be borne in mind that for both analyses, the higher the score the less effective the performance. That is, a negative correlation with an independent variable indicates that the variable is positively associated with better performance. Also, it is to be noted that score for the first IHT administration were used in all analyses.

Table 1 displays the product movement correlations between the number of IHT trials needed to complete the task and the independent variables for the completers. Table 1 contains the correlations between the independent variables and the IHT performance for all of the subjects — the noncompleters, the completers with above median IHT scores, and the completers with below median IHT scores. In both analyses, it is apparent that less effective performance was associated with less education and greater age.

In order to determine if significant differences existed between the more effective, less effective, and noncompleter groups, one-way ANOVAs were performed for age, dosage, IQ, number of years of education, and the age of first hospitalization variables. The results showed significant differences between the groups only for age and education. Post-hoc comparisons of the groups using the Newman-Keuls method were performed. Noncompleters were older and attained less education when compared to the more effective and less effective completer groups. The mean differences between the groups failed to reach significance for dosage, IQ, and age of first hospitalization. The results of the. ANOVAs are presented in Table 2.

Table 3 contained the multiple regression summary using the IHT score for the subjects who completed the task. Education was the best predictor variable. More effective performance was associated with more education. The IQ variable, which was not significant univariately, provided a significant increment for prediction of IHT above that of the education variable. That is, lower IQ in combination with more education accounted for 38% of the variance in predicting effective performance.

To determine if the IHT score of the subjects was relater[1] to level of IQ within educational groups, the distribution of IHT scores of completers was divided into the following groups: high school dropouts (less than 12th grade), high school graduate (12th grade completed), and college (partial or graduated). The IQ distribution was divided into the following levels: low IQ was less than 87, moderate IQ was from 87 to 98, and high IQ was greater than 98. The mean differences between the IHT scores by IQ level failed to reach significance for the high school dropouts, $F(1,11) = 0.84$, $p < .05$; the high school graduates, $F(2,9) = 0.29$, $p < .05$; or the college group, $F(2,9) = 0.99$, $p < .05$. Thus, there were no differences in IHT scores as a function of level of IQ for the education groups. Table 4 contains the frequency, mean, and standard deviation by education group and IQ level.

Table 5 contains the multiple regression summary using IHT performance for all participants with 0 = more effective completers, 1 = less effective completers, and 2 = noncompleters. A combination of higher education, younger age, and older age at first hospitalization accounted for 38% of the variance in predicting more adequate IHT performance.

Table 1

Correlation of Independent Variables with IHT Performance

	Completers (N = 37)	All Subjects (N = 55)
Age	.38*	.37*
Sex (1 = male, 2 = female)	.04	.12
Dosage	-.04	.04
IQ	-.05	-.09
Education	-.51*	-.44*
Marital Status (0 = single; 1 = separated, divorced, widowed; 2 = married)	.14	.16
Age of First Hospitalization	.11	-.03
Symptoms (1 = paranoid, 2 = nonparanoid)	-.01	.10

*p<.01

Table 2

Summary of Analysis of Variance for Effect of Level of IHT Performance for Continuous Variables

Variable	SS	df	MS	F
Age				
Performance Level	1261.48	2	630.74	4.68*
Within	7001.03	52	134.64	
Total	8262.51	54		
Dosage				
Performance Level	2259280.00	2	1129640.00	0.81
Within	72836900.00	52	1400710.00	
Total	75095180.00	54		
Quick Test IQ				
Performance Level	85.75	2	42.88	0.19
Within	11470.00	52	220.58	
Total	11555.75	54		
Education				
Performance Level	70.80	2	35.40	6.40*
Within	287.64	52	5.53	
Total	358.44	54		
Age of First Hospitalization				
Performance Level	108.92	2	54.46	0.75
Within	3795.82	52	73.00	
Total	3904.64	54		

* p < .05

Table 3

Summary Table of Stepwise Multiple Regression Analysis Predicting the Number of IHT Trials for Completers (N = 37)

Predictor Variable	Multiple R	R^2	Change R^2	Simple r	Beta
Education	.51	.26	.26	-.51	-.78
QT IQ	.61	.38	.12	-.05	.43

F (2,34) = 10.28, p < .01

Table 4

Frequency, Mean, and Standard Deviation of the IHT Scores for Education Group by IQ Level (Low = <87, Moderate = 87-98, High = >98) (N = 37)

Education Group		IQ Level Low	Moderate	High
High School Dropout	n	4	9	0
	M	16.75	14.89	—
	SD	13.67	12.16	—
High School Graduate	n	3	7	2
	M	11.00	12.00	14.00
	SD	4.58	3.00	8.49
College	n	2	4	6
	M	8.50	7.50	13.17
	SD	0.71	1.29	8.77

Note: Higher scores indicate poorer IHT task performance.

Table 5

Summary Table of Stepwise Multiple Regression Analysis Predicting IHT Performance (0 = More Effective Completer, 1 = Less Effective Completer, 2 = Noncompleter) (N = 55)

Predictor Variable	Multiple R	R^2	Change R^2	Simple r	Beta
Education	.44	.19	.19	-.44	-.36
Age	.50	.25	.06	.37	.57
Age of first hospitalization	.62	.38	.13	-.03	-.48

F(3, 51) =10.47, p<.01

Discussion

The major finding of the present study was that those schizophrenics who were younger and had more education did better on the IHT task. Since more highly educated people tend to do better on tests of cognitive ability, and since most cognitive abilities decline after early adult life, these findings were certainly not surprising. Schizophrenics who were functioning at a high level generally did better on the IHT tasks.

The findings seem to indicate that the subjects who conformed more to the description of the "reactive" rather than the "process" schizophrenic did better on the IHT task. The process-reactive conceptualization has been well studied in scores of studies since the 1950's. The reactive schizophrenic has been described as having higher premorbid psychosocial adjustment, less deterioration, more adequacy, an onset at an older age with more stressful precipitance, and better prognosis. The process schizophrenic has been described as having less ego strength, a less adequate premorbid personality, an insidious onset at an earlier age, and a less favourable prognosis. A similar but more recent and more biologically oriented conceptualization is that of the distinction between primary and secondary schizophrenia (Templer & Cappelletty, 1986). The primary schizophrenic has more deterioration, less psychosocial adequacy, more genetic etiology, and more brain atrophy than the secondary schizophrenic who has more brain trauma etiology.

The present finding of participants with more education doing better on the IHT task meshes with a reactive-process formulation. Congruent with this finding is the increment of prediction provided by age of first hospitalization in the multiple regression for all subjects. Later age of first hospitalization in combination with more education was associated with better IHT task performance.

The lower IQ combined with higher education in predicting better IHT performance does not permit unequivocal interpretation. However, it would seem to be consistent with reactive-process formulation. It is suggested that the schizophrenics who were well educated in view of their IQ, in comparison to other schizophrenics were relatively high achievers in contrast to under-achieving schizophrenics. This finding also is consistent with the inference that the schizophrenic with more of a process or primary element is better on the task under consideration.

The neuropsychological implications of the findings are not clear. Since males have greater lateralization than females, and females have a more developed corpus callosum, one might predict more effective IHT performance by females. However, these results did not occur in the present study. Since a decrease in the width of the corpus callosum with age has been reported in schizophrenics, one might have predicted better performance to be positively associated with age at least with the multivariate analyses. However, the opposite was found in both the simple correlations and the multiple regressions.

A possible explanation of any negative results is that of lack of reliability of measurement. However, in the present study, the correlation between the two IHT assessments was .76. Furthermore, the findings did converge to a cohesive perspective. Thus, the schizophrenics who performed more effectively on the IHT task functioned generally more adequately in life and have a less serious schizophrenic disorder. To assume that functioning on a task that presumably assesses interhemispheric transfer actually taps that or any specific neuropsychological entity may not be warranted. The burden of proof that such a specific function is being assessed would seem to rest upon those researchers who make such assumptions.

Nevertheless, the thrust of the present findings does not warrant the inference that the task under consideration does not tap neuropsychological processes. Specific neuropsychological deficits such as interhemisphere transfer may be overshadowed and masked by the relatively gross and pervasive neuropsychological deficits of primary or process schizophrenia. As Goldstein (1984) stated: "In essence, the major differential diagnostic problem regarding neuropsychological assessment of chronic schizophrenic patients is that many of them perform on the standard neuropsychological tests in a manner that is

indistinguishable from that of patients with generalized, chronic brain disorders. This overlap is so pervasive that even when schizophrenic patients acquire structural brain damage through head injury, vascular disease or other processes, they cannot be distinguished from nonbrain-damaged schizophrenics (Goldstein & Halperin, 1977). It appears that the cognitive deficits associated with schizophrenia almost totally mask deficits that can be attributable to structural brain disorder."

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