Cerebral Dominance and Creativity as Measures of Cognitive Style in a Schizophrenic Population

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Abstract

Twenty patients with Research Diagnostic Criteria diagnoses of either schizo-affective disorder or schizophrenia were voluntarily enrolled in the research protocol of the Research Unit at Broughton Hospital. Subjects were administered the Barron-Welsh Revised Art Scale of the Welsh Figure Preference Test in addition to a neuropsychological research battery and the Brief Psychiatric Rating Scale in order to explore the relationship of cerebral dominance and creativity as measures of cognitive style in a schizophrenic population. Subjects diagnosed with schizophrenia scored significantly higher on the Barron-Welsh Revised Art Scale than subjects with schizo-affective disorder. Among cerebral laterality measures, both diagnostic groups were moderately left hemisphere lateralized. Part 1 of the Crawford Small Parts Dexterity Test further differentiated the two groups with schizophrenics using their left hand for fine motor control more often than the schizo-affective subjects. Results were discussed by hypothesizing a functional inhibition of the dominant (left) hemisphere causing a shift to the non-dominant (right) hemisphere and its qualitative type of cognitive processing in schizophrenics. Schizo-affective subjects appeared to have functionally shifted to left hemisphere dominance, resulting in lowered scores on the Barron-Welsh Revised Art Scale and greater right hand fine motor control.

Introduction

The study of the psychological processes of the creative person has long been a subject of interest to psychologists. Freud (1961) analyzed Dostoevsky as a neurotic, moralist and sinner but felt that psychoanalysis could not do justice to an understanding of his creative talents. Psychological biographers (Terman, 1947) have long investigated the histories of famous "geniuses" for incidences of psychological disturbance. Yet, systematic evidence of the relationship between psychopathology and creativity has been equivocal, perhaps due to the difficulty of reliably defining the concepts of creativity and psychopathology.

Early systematic studies focused on the interaction of personality variables and creativity. Barron's (1957) assessment of this relationship with traditional psychometric tests yielded high loadings on measures of verbal fluency which in turn were significantly related to intelligence. When Barron partialled out the effects of intelligence, the remaining significant variables related to creativity and originality were labled as "responsiveness to impulse and emotion" (p. 736). In his psychologically normal subject group these variables were noted with high correlations on the Impulsivity scale of the California Psychological Inventory (CPI), the under-control dimension of the Block Ego-Control scale and $\Sigma \underline{C}$ responses to the Rorschach Test.

MacKinnon (1962, 1965) utilized an election process to select architects identified by deans of architecture schools, architecture professors and peers as being most creative in terms of individual

accomplishments. Among the assessment devices used, the Minnesota Multiphasic Personality Inventory (MMPI) yielded valid profiles which were on the average elevated on all clinical scales 5 to 10 points above the general population. MacKinnon argues that these elevations, occuring in highly functioning persons, indicate a "complexity and richness of personality, general lack of defensiveness and candor in self-description" (p. 488). A second significant variable in this group is the preference for perceptual complexity and asymmetry, as indicated by scores on the Barron-Welsh Art Scale (RA) of the Welsh Figure Preference Test (WFPT).

Barron (1969) further analyzed the personality variables of identified creative groups. MMPI scores from creative writers on the clinical scales of Depression (2), Hysteria (3), Psychopathic Deviance (4) and Schizophrenia (8) averaged in the upper 15% of the population. Yet analysis of the additional Ego Strength scale of the MMPI and the ego strength of the CPI placed this group in significant elevations above the general population. Barron's argument parallels Mackinnon by suggesting that while a greater than average level of psychopathology exists in identified creative groups, a greater capacity for constructively dealing with the psychopathology also exists.

Guilford and Hoepner (1971) factor analyzed the Structure of Intellect dimensions identified as predictive of creativity in normal populations, primarily Ideational fluency, and found negative loadings toward a composite measure of neuroticism, i.e., depression and nervousness. This contradiction with Barron and MacKinnon is

best explained by probable differences in studied populations. Their subjects were 212 U.S. Coast Guard Academy Students, not identified on the basis of creative products.

Welsh (1975) originally attempted to construct a non-verbal psychometric device to differentiate types of psychopathology. Later, working with Barron and MacKinnon at the Institute for Personality Assessment and Research at the University of California, Berkeley, he standardized his test on nominated groups of creative individuals. Those scoring high on the Barron-Welsh Art Scale (RA) of the Welsh Figure Preference Test, indicating a preference for complex, asymmetrical visual stimuli, were those of the sample rated as accomplishing the most creative products. While these subjects described themselves as cynical, pessimisstic and overtly hostile, they were described by others as having "good taste."

Arieti (1975) added a cognitive analog to the traditional psychoanalytic analysis of creativity. Traditional analysis dictates that creativity derives from sublimated sexual curiousity working to regain the goals of primary process thinking. Other psychoanalytic thinkers (Kris, 1942; Kubie, 1958) added a coordination with secondary process thinking through "regression in service of the ego," resulting in creative rather than chaotic products.

Arieti (1978) further analyzed the parallel process of logic in both schizophrenic and creative thinkers. Both the creative and schizophrenic thinker depart from traditional Aristotlean logic of identity through subject similarity for the "paleologic" of identity with predicates, thus increasing the set of identifications possible

through either loosening of associations or metaphor and simile. What distinguishes the creative from the schizophrenic thinker is the "consciousness of abstraction" that remains in creative cognition.

Recent investigations into the neuropsychology of cerebral functioning have localized creativity as a right hemisphere process. Sperry (1964), reviewing his work in cerebral commissurectomy, defines a cognitive division of labor between the two cerebral hemispheres. Early findings are that the specialization of the left cerebral hemisphere can be characterized as "symbolic, categorical, logical and analytic" while the right hemisphere is "holistic, intuitive and synthetic."

Gazzaniza (1970), while not directly addressing the concept of creativity, details the separate and independent motor and language functions of each hemisphere and addresses the possibility of a double consciousness existing in one split-brain person, although evidence is equivocal.

Gur, Levy and Gur (1977) reported on lateral differences in tachistoscope studies. The right visual half-field (thus, the left hemisphere) is superior for the recognition of any form of verbal material while the left visual half-field (thus, right hemisphere) is superior in the recognition of visuo-spatial stimuli (dot localization and binocular depth perception). Similarly, dichotic listening studies conclude that the right ear (with projections to the contralateral hemisphere) is superior for recognition of verbal material (words and digits) while the left ear is superior for recognition of "environmental sounds, laughs, musical chords or muscial melodies" (p. 130).

Galin (1974) reviewed the effects of unilateral brain lesions, lateralized electroencephalograph (EEG) recordings and unilateral and bilateral electroconvulsive therapy (ECT) on autonomic response, perception and behavior. He concludes that each hemisphere is specialized by a cognitive style that is both sensitive to and specialized in processing stimuli in a logical vs. affective dichotomy. Further, he argues for a neuropsychological substrate for personality processes by suggesting that the right hemisphere is responsible for the primary cognitive processes suggested by psychoanalytic thinkers and especially for the defense mechanism of repression which he posits as occuring in cerebrally intact persons by a functional inhibition of neural transmission across the inter-hemispheric commissures.

Bakan (1969) argues that lateral shift in eye movement in response to reflective questions is mediated by Brodman's area 8, controlling contralaterally the frontal eye fields. In his undergraduate experimental group, the left eye-movers (indicative of right hemisphere activation) were found to be significantly more susceptible to hypnotism, to major in "softer" academic areas (i.e., psychology, English, political science and communications, etc.) and to score lower on the mathematics scale of the Scholastic Aptitude Test while having greater clarity of mental imagery in answering questions.

Harnad (1972) in a study of lateral saccades found that among university mathematicians, those who were left-lookers in response to reflective questions used more visual imagery, were more artistically diverse and were given higher creativity ratings by their graduate students. Among non-university left lookers, higher scores on the

Mednick Remote Associations Test and more extreme aesthetic ratings to prose passages of contemporary writers were recorded.

Galin and Ornstein (1974) found that lateral and vertical eye movements differed between groups occupationally utilizing a verbal-analytic vs. a spatial-holistic style of cognitive processing, i.e., lawyers vs. ceramicists. Ceramicists made more Up movements and less Down movements than lawyers. Among question types asked, verbal questions elicited more Down and Right movements and less Stares (negligible movements). The authors conclude that vertical eye movements rather than being indicative of unilateral hemispheric activation, reflect bilateral activation (more often occuring with spatial questions) and that verbal questions reflect left hemisphere activation.

Studies of functional brain asymmetry and its relationship to subgroups of psychoses suggest different cerebral lateralization for schizophrenic and schizo-affective (Procci, 1976; Croughan, Welner, and Robins, 1974) or affective psychoses. Boklage (1977) in a study of concordance for handedness in monozygotic (MZ) twins of which one twin was diagnosed schizophrenic found 96% concordance in right-handed pairs and 40% concordance in pairs with only one right-handed twin. The former group had nuclear schizophrenic etiologies, i.e., closer to the core of the schizophrenic syndrome, while the later had peripheral etiologies and were more often classified as schizo-affective. The two etiologies seem to differ by genetic programming on one hand (right-handed MZ pairs) and disruptions of "embryonic cellular laterality commitments" (p. 28) on the other.

In a comparison of lateralized power spectrum EEG recordings in schizophrenics, manic-depressives and controls, Flor-Henry (1976) observed that schizophrenics had left fronto-temporal lobe abnormalities while manic depressives had right fronto-temporal lobe abnormalities. Further, the foci of the EEG abnormalities in schizophrenics occured over the area of the left temporal lobe associated with language, Wernicke's area.

Tachistoscopic studies of cognitive processing in schizophrenics (Gur, 1979) indicate that for recognition of verbal and spatial material, the left visual half-field (projecting from the right cerebral hemisphere) is superior. This is contrary to performance of normal subjects who demonstrate a left visual half-field superiority for spatial material and a right visual half-field superiority for verbal material (Springer, 1971).

In a discrimination task with simultaneous presentation of visual designs, schizophrenics are significantly slower than controls in selecting the correct experimental design (Gur, 1979). In a related study of motor laterality imbalance in schizophrenia, Gur (1977) observed that schizophrenics were significantly more left hand dominant in motor tests than normals. Concluding from these studies, she hypothesizes that schizophrenia is characterized by a dysfunctional left hemisphere and a simultaneous overactivation of this dysfunctional left hemisphere. In summary, Gur parallels the neuropsychological dysfunction of visual and motor performance to the dysfunction of logico-linguistic processing in schizophrenia.

Utilizing regional cerebral blood flow studies, Franzen and Ingvar (1975) examined the dominant (left) hemisphere of schizophrenic in-patients. Contrary to findings with normal controls during restful wakefulness, schizophrenics had lowest indices of blood flow over the premotor and frontal regions and highest indices of blood flow over the temporal and parietal areas. This was further contrasted to the total lowered blood flow in organic brain disorders. The authors argue that this flow pattern is mirrored in behavior reflecting loss of goal direction, ambivalence, autism and speech dysfunctions, as these are primarily frontal functions.

A primary problem in clinical research is that of the reliability and validity of the diagnosis of patient populations (Holzman, 1969; Garfield, 1979). Current trends in diagnosis propose the use of an objective, behavioral diagnostic standard which would minimize diagnostician bias. Development of the Research Diagnostic Criteria (Freighener, Robins, Guze, Woodruff, Winokur and Munoz, 1972) and the draft Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 1978) will facilitate establishment of verifiable diagnoses.

The current study proposed to synthesize the subject areas reviewed above, creativity and cerebral dominance, into a new model for exploring schizophrenic illness. Evidence has suggested that schizophrenic thinking is a necessary condition for creative cognition. Further, the cerebral division of labor suggested that subjects who are right-hemisphere dominant would manifest greater creative cognition than those who are left-hemisphere dominant.

Following the current development of cerebral lateralization of psychotic illnesses (Manning, Goode and Middleton, Note 1), it was hypothesized that subjects diagnosed as schizo-affective by the Research Diagnostic Criteria (RDC) would be right-hemisphere dominant on several cerebral laterality measures and would score significantly higher on the Barron-Welsh Revised Art Scale (RA) of the Welsh Figure Preference Test (WFPT) than subjects with schizophrenia who were left hemisphere dominant.

Method

Subjects

Twenty patients voluntarily enrolled in the research protocol of the Research Unit at Broughton Hospital with diagnoses of either schizo-affective disorder or schizophrenia were administered the Barron-Welsh Revised Art Scale of the Welsh Figure Preference Test in addition to the standard neuropsychological research battery and the Brief Psychiatric Rating Scale (Overall and Gorham, 1962). Subjects for the Research Unit were selected from the entire Broughton Hospital population. Primarily, subjects were multiple admission patients between the ages of 18 and 65 who had been unable to be stabilized on the usual psychotrophic medications. Additionally, subjects had no evidence of neurological disease, epilepsy or mental retardation.

Apparati

The Barron-Welsh Revised Art Scale (RA) of the Welsh Figure Preference Test (WFPT) (Welsh, 1959) was presented to all subjects. The test consists of 86 black and white visual stimuli (line drawings, geometric figures, etc.) printed in a booklet which subjects view and

then mark on an answer sheet either "Like" (indicating liking for the figure) or "Don't Like" (indicating dislike for the figure). Scoring is computed by summation of correct "Like" and "Dislike" responses, as standardized against identified creative groups.

The visual half-field (VHF) laterality measurements were obtained by use of a Lafayette model 42015 constant illumination tachistoscope. Subjects were presented with a four-letter word pair symmetrically balanced by a fixation digit, i.e., GOLD 5 LADY, for a 40 msec exposure time. On practice trials, subjects met criteria before the 80 experimental trials were presented. Subjects were required to report the fixation digit first, then either or both of the stimulus words. A laterality coefficient was assessed by dividing the difference in correct right and left VHF responses by the sum of correct right and left VHF responses (Lc = Rc-Lc/Rc+Lc). The laterality coefficient ranges from -1 to +1, with positive scores indicating a right VHF (left hemisphere) advantage.

Dichotic listening (DL) was measured by the subject's report of the correct monosyllablic stimulus nouns in dissimilar three word pairs presented to each ear simultaneously. Word pairs, computer matched for accuracy of presentation, were delivered over a Bell and Howell Stereo Tape Recorder using a pair of Koss K/135 stereo headphones (audio range of 10 to 18K hertz). A laterality coefficient identical to that of the VHF coefficient was computed from the number of correctly identified right and left ear stimuli.

Items from the Lateral Dominance Examination (LDE) of the Halstead-Reitan Battery were administered along with the Finger Oscillation Test

(Motor Tapping Test) and part 1 of the Crawford Small Parts Dexterity Test (CSPDT). Dominance or use of the right hand in performing a test was given a score of three, dominance or use of the left hand was given a one and use of both hands was given a two. Scores were totaled to a maximum of 42, indicating complete right hand use.

Scales of withdrawal-retardation (R), thinking disturbance (S), paranoia-interpersonal disturbance (P), anxiety-depression (D) and total pathology (TOT) were scored from a monthly administration of the Brief Psychiatric Rating Scale (BPRS).

Procedure

Before admission to the Research Unit subjects were interviewed and diagnosed by a professor of psychiatry, a psychiatric resident or both. Subjects had to meet criteria for schizo-affective disorder or schizophrenia as defined by the RDC.

Subjects were tested individually. The LDE was first administered with subjects timed on writing their name with each hand, drawing and copying geometric designs, demonstrating use of household objects and performing the motor tests. The VHF test was presented after a trial criteria was met. Next, the DL test was presented after a trial criteria was met. Lastly, the RA scale of the WFPT was administered. The experimenter was blind to the subject's diagnostic category.

At the time of testing, subjects were in the last week of a one month drug administration of one of three trial drugs (Loxitane, Moban, or Navane) as part of the research protocol. Also, during this week, a psychiatrist or psychiatric resident, blind to laterality measures, administered the BPRS to subjects.

Subjects were re-tested approximately one month later (M = 1.25, SD = .46) to test reliability of all measures.

Results

The means and standard deviations of creativity, laterality and psychopathology measures for both groups are presented in Table 1. The group diagnosed as schizophrenic scored significantly higher on the RA scale of the WFPT than the group diagnosed as schizo-affective, $t(18) = -3.11$, $p \leq .006$, two tailed probablity. A difference score computed on part 1 of the CSPDT was significant for left hand performance by the schizophrenic group, $t(18) = 2.26$, $p \leq .037$.

While VHF scores for schizo-affective were less left hemisphere dominant than schizophrenics, differences were not significant. Scores on DL were less left hemisphere dominant for schizophrenics than for schizo-affectives, but not significantly. No significant differences were obtained between groups on the Motor Total coefficient or on any of the sub-tests computing this score. Also, no significant differences were obtained on the sub-scales or the total pathology scale of the BPRS between groups, although both groups scored greater than the population in general.

Multiple linear regression analysis was performed to obtain the best equation for predicting the RA creativity score from among all variables. Regressions were then re-run to include only terms with F ratios statistically significant at the .05 level or better. The following equation resulted from this analysis: RA creativity score = diagnostic group (13.61) + right hand CSPDT (.84) - race (6.8) - DL (.004) + difference in motor tapping (.14) + P (.124) - 2.367. This formula accounts for 61% of the RA creativity score variance.

Table 1

Mean Scores for Creativity, Laterality

and Psychopathology Measures

	Group				
	Schizo-affective[a]		Schizophrenia[b]		
Test	M	SD	M	SD	t
RA Creativity Scale	15.69	8.08	26.29	5.25	-3.11*
Visual Half-field	.14	.77	.26	.83	-0.32
Dichotic Listening	.22	.52	.20	.41	0.08
Lateral Dominance Examination	36.61	9.38	36.29	4.92	0.10
Left Motor Tapping	37.15	10.34	34.57	13.19	0.48
Right Motor Tapping	39.08	14.84	37.14	15.76	0.27
Left Crawford Parts	11.54	4.94	13.00	3.16	-0.70
Right Crawford Parts	14.85	4.91	12.00	2.45	1.73
Withdrawal-Retardation BPRS	4.85	2.91	6.14	2.54	-1.43
Thinking Disturbance BPRS	4.23	4.20	6.71	4.07	-1.27
Paranoia BPRS	3.23	3.29	4.00	4.12	-0.46
Anxiety-Depression BPRS	5.76	4.43	3.43	2.57	1.27
Total Pathology BPRS	21.54	9.07	24.71	13.54	-0.63
Right-Left Difference on Crawford Parts	3.31	4.69	-1.00	2.38	2.26**

[a] $n = 7$

[b] $n = 13$

* $p \leq .006$

** $p \leq .037$

Test-retest reliability on all measures of creativity and laterality was significant at the .05 level or better. Ratings on the BPRS were unchanged for measures of thinking disturbance and anxiety-depression. BPRS test-retest scores for paranoia-interpersonal disturbance, withdrawal-retardation and total pathology were not significantly correlated. T tests between the mean scores for these measures showed no significant reduction of psychopathology between the two testings.

Discussion

The results of this study indicate that the Barron-Welsh Revised Art Scale of the Welsh Figure Preference Test is a significant discriminator between schizophrenia and schizo-affective disorder as diagnosed by the Research Diagnostic Criteria. The schizophrenic group performed significantly higher on the RA creativity scale than the schizo-affective group. The mean score of the schizophrenic group is comparable to scores for creative male mathematicians (M = 26.9) (Helson, 1969), industrial research scientist (M = 30.7) (Gough, 1961) and is higher than scores for men-in-general (M = 17.33$\pm$11.46), women-in-general (M = 19.33$\pm$12.20), male Veterans Administration neuropsychiatric patients in Minnesota (M = 14.39$\pm$11.66) (Welsh, 1959) and in California (M = 20.7$\pm$11.9) (Lim and Ullman, 1961).

No significant differences on the major laterality measures or the psychopathology measures were obtained between the two diagnostic groups. Using the dichotic listening procedure, Wexler and Heninger (1979) found no significant differences in cerebral laterality among RDC groups of schizophrenics, schizo-affectives or primary major depressives or between these groups and normal subjects. Using some of

the same subjects as the present study, Manning (Note 2) reported no significant differences in laterality measures due to drug conditions or between patients and controls and on retesting of controls.

The present findings that schizophrenics (all right handed) score higher on the RA scale and have a left hand advantage in part 1 of the CSPDT appear to support the findings of Gur (1977, 1979) and Flor-Henry (1976). As they argued that schizophrenia results in dysfunction and overactivation of the left cerebral hemisphere, the results of the present study can be explained by a shift on laterality to the right hemisphere for some cortical functioning.

The WFPT is primarily a test of aesthetic judgement of visual-spatial designs. The CSPDT involves coordination of visual, spatial, tactile and fine motor control to achieve high scores on the test. Visual and spatial abilities are primarily served by the right hemisphere (Milner, 1971). Geschwind (1975) argued that while the hemisphere dominant for language is usually also dominant for learned motor behavior, the non-dominant hemisphere can contain storage of motor learning which is released when the dominant hand or hemisphere is inhibited.

While the higher cortical functions of visual perception and auditory processing in this group remain in the left hemisphere, their coefficients do not indicate strong left hemisphere lateralization. Additionally, the motor laterality coefficient for this group is not strongly left hemisphere lateralized.

Similarly, the schizo-affective group (with three left handed subjects) had laterality scores indicative, but not greatly, of left hemisphere functioning. Their significantly lower RA scores and

significant right hand advantage on the CSPDT argue for a shift in laterality toward the left hemisphere for some cortical functions.

This functional shift in laterality as observed by a qualitative difference in cognitive processing and change in dominance of fine motor control appears to be an attempt of the cerebrum to compensate for the cerebral hemisphere dysfunctioning due to the specific type of psychotic process. This type of shift is similar to that observed in patients with a lateralized organic lesion (Rausch, 1971).

Comparison of these results with laterality measures for identified creative groups would clarify analysis, but such data is not currently available. Also, comparison of previously reported valid measures of lateral eye movements, handedness and creativity to laterality measures of higher cortical functioning would help analysis when such data is available.

Further, examinations of RDC diagnosed groups of schizophrenic, schizo-affective and primary major affective disorder subjects may provide further validation of the WFPT as a psychometric diagnostic instrument.

Finally, while the size of the sample in this study was relatively small, subjects were carefully reviewed before enrollment in the research protocol. By limiting the subjects to the Research Unit, several possible sources of confound were eliminated. Primary among these were variability in diagnostic criteria, effects of multiple medication, possible organic involvement and differences resulting from varied psychotherapeutic intervention. Nevertheless, replication of this study with a larger sample under similar conditions is definitely needed.

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2. Manning, A.A. Personal communication, June 13, 1979.

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