Intelligence in Schizophrenia: Meta-Analysis of the Research

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Abstract

This article combines a review and meta-analysis of research on IQ in schizophrenia, with emphasis on areas of convergence in the findings, as well as questions that remain to be answered. Taken together, the findings suggest that early-onset and adult-onset schizophrenia are associated with intellectual deficits across the lifespan. Preschizophrenic children, adolescents, and young adults perform below matched controls on a variety of standardized measures of intelligence. Significant IQ deficits are also apparent after the onset of the disorder. Moreover, IQ is positively related to several indices of prognosis, and, among hospitalized patients, there is negative within-subject covariance between intellectual performance and symptom severity. Although there is fairly consistent evidence that Verbal IQ is higher than Performance IQ among schizophrenic patients, a more specific pattern of subtest performance is not apparent. A central question raised by the results is whether IQ is an independently determined factor that can serve to mitigate the vulnerability of individuals who are constitutionally predisposed to schizophrenia, or whether intellectual deficit is one manifestation of the constitutional predisposition to the disorder. The findings also raise the question of possible sex differences in the developmental determinants of schizophrenia: Meta-analyses revealed that premorbid IQ deficits are more prevalent among males than females.

Since the early 1900s when standardized intelligence tests were first being developed, a great deal of speculation and research has been devoted to determining whether relationships exist between IQ and certain forms of psychopathology. Much of the early research in this area sought to discover patterns of subtest performance that could distinguish among diagnostic categories. For example, Wechsler (1958) characterized schizophrenic patients as having high scores on the Information and Vocabulary subtests of the Wechsler Adult Intelligence Scale, and low scores on the Object Assembly and Digit Symbol subtests. While more recent research has continued to look for ways in which intelligence tests can be used diagnostically, a number of other important questions related to this topic have also been addressed. Researchers have sought to determine whether intelligence deteriorates as a result of schizophrenia, whether individuals with lower IQs are more susceptible to schizophrenia, or whether IQ may be related to such variables as severity or chronicity of the disorder. Unfortunately, despite the great amount and variety of research on the relation between intelligence and schizophrenia, there is currently no comprehensive theory regarding the nature of this relationship. One reason for this is the abundance of presumably contradictory results. As a case in point, while one investigation provided evidence that childhood intelligence is not related to length of hospitalization for schizophrenic patients (Watt and Lubensky 1976), "the most striking result" of another investigation "is that schizophrenics with low childhood IQs . . . remain institutionalized significantly longer than schizophrenics with average IQs" (Offord and Cross 1971, p. 431). Similarly, while several investigators

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have described patterns of subtest scores that distingush schizophrenic patients from normals (Wechsler and Jaros 1965), other studies fail to support the hypothesis of differential impairment in schizophrenic patients' test performance (Binder 1965).

The intent of this article is to review the findings of research on intelligence and schizophrenia. A review of the research is important at this time for several reasons. First, the most recent comprehensive reviews of the literature in this area (Payne 1960; Winder 1960) are over 20 years old. During the past 20 years, a great deal of research has been conducted that sheds new light on the issue of intellectual factors in the developmental course of schizophrenia. Another reason for reviewing the literature at this time is to provide a firmer ground for future research. The notion that certain cognitive characteristics may serve as premorbid indicators of risk for schizophrenia has received increasing attention (Zubin and Steinhauer 1981), and a significant proportion of current research on the disorder focuses on cognitive processes. Moreover, recent interest in symptomatological, and possible etiological, heterogeneity in schizophrenia has led to the suggestion that a subgroup of patients may be suffering from structural central nervous system impairment and concomitant cognitive deficits (Andreasen and Olsen 1982). A better understanding of the lifespan characteristics of intellectual performance in schizophrenia may enhance our ability to pursue the questions of specific cognitive deficits and subgroup distinctions. As Rieder, Broman, and Rosenthal (1977) point out, a thorough understanding of the IQ-schizophrenia relationship is important in order to develop the most efficient and productive strategies for future research *and* intervention. Certain developments in methodology, such as longitudinal high-risk studies, offer new opportunities for investigating the relationship between schizophrenia and IQ. Thus, this review is intended not only to resolve contradictions of past research, but also to highlight the questions that remain to be answered. Although our review will generally be restricted to studies reported since the publication of the last reviews (i.e., 1960), earlier studies will be mentioned when their procedures or results are particularly salient.

The discussion will be organized around the major questions that have been addressed by researchers. These questions are:

- Do schizophrenic patients differ from normals, or other psychiatric patients, in IQ?
- Is schizophrenia associated with premorbid IQ deficits?
- Is schizophrenia associated with a pre- or post-onset decline in IQ?
- Are clinical improvement, length of hospitalization, or prognostic indicators related to premorbid or postmorbid [1] IQ?
- Are there patterns of premorbid or postmorbid subtest performance (e.g., large Verbal IQ-Performance IQ discrepancies, large intratest scatter) that characterize and/or predict schizophrenia?

The issue of premorbid intellectual functions in schizophrenia is of particular interest because of its relevance to theories of etiology. Moreover, the literature addressing the question of premorbid IQ in schizophrenia lends itself to the application of meta-analytic techniques, due to both the number of studies and their relative methodological consistency. In this review, meta-analyses are applied to these studies in order to determine combined probabilities and effect sizes (Rosenthal 1978). Quantitative techniques for summarizing the results of independent investigations offer a more direct approach to the resolution of controversies in this important area of the literature.

Before beginning our review of the literature, we should note that it will be limited to those studies that have used standardized intelligence tests, such as the Wechsler Adult Intelligence Scale (WAIS), the Wechsler Intelligence Scale for Children (WISC), and standardized group tests of intelligence. While numerous studies have examined the performance of schizophrenics or children at high risk for schizophrenia on other tasks that presumably tap intellectual functioning (e.g., object-sorting tasks, Piagetian tasks, subjective measurements of creativity, and school performance), these measures are too disparate to provide results that can meaningfully be compared to the results from standardized IQ tests.

Several methodological issues should also be noted. First, the investigations discussed here have been conducted over a broad period of time and in a variety of settings; as a result, they employ diverse diagnostic criteria. Because of the volume of literature to be reviewed, a comparative analysis of the effects of diagnostic criteria on the outcomes of the studies is not possible. It can generally be assumed, however, that the diagnostic criteria used in most of

[1] Throughout this review, the term "postmorbid IQ" will be used to refer to IQs obtained from tests administered after the onset of psychiatric disorder.

these studies (usually hospital diagnoses) roughly correspond to the broader schizophrenia category defined by *DSM-II* (American Psychiatric Association 1968) as opposed to the narrower criteria of *DSM-III* (American Psychiatric Association 1980). Second, although many of the investigations focus exclusively on adult-onset patients, others use mixed samples of early (childhood and adolescence) and adult-onset patients. Very few focus exclusively on early-onset patients. This review will present information regarding age at onset of illness when it is provided by the authors. A third issue is that many reports fail to mention the medication status of patient subjects. However, based on the results of research on the effects of neuroleptics on cognitive functions (Gilgash 1961; Spohn, Lacoursiere and Thompson 1977; Braff and Saccuzzo 1982), medication tends to enhance at least some aspects of cognitive performance in psychotic patients and would therefore tend to reduce, rather than inflate, patient deficits. Finally, most of the studies discussed here do not examine the effects of sex on their dependent measures. This is unfortunate because, as we shall see, there is evidence that gender is related to premorbid IQ in schizophrenia.

Do Schizophrenic Patients Differ From Normals or Other Psychiatric Patients in IQ?

Not surprisingly, many of the earliest studies of schizophrenia were conducted to determine whether persons suffering from the disorder manifested deficits in IQ. Only a few studies published within the past two decades have addressed this question. Before 1939, when the Wechsler-Bellevue scale was introduced, the most commonly used test in this kind of research was the Stanford-Binet. Unfortunately, as Hunt and Cofer (1944) point out, the Stanford-Binet did not provide adult norms. Therefore early research using this test compared the IQs of mental patients with the norms derived from groups of children. Roe and Shakow (1942) attempted to overcome this problem by including a control group of 65 surgical and orthopedic patients. The average mental age of this group was 160–164 months, as compared with an average IQ of 140.6 months among 300 schizophrenic patients. A study by Kendig and Richmond (1940) reports a similar average of 138 months for a group of 500 schizophrenics. Other early investigations (Wells and Kelley 1920; Michaels and Schilling 1936) reported higher Stanford-Binet IQs for schizophrenics than the Roe and Shakow (1942) and Kendig and Richmond (1940) studies, and still others (Pressey 1917; Cornell and Lowden 1923; Wentworth 1924; Jastak 1937) reported lower average IQs. However, previous reviewers (Hunt and Cofer 1944; Winder 1960) consider the Kendig and Richmond (1940) and Roe and Shakow (1942) samples as being the most representative of the general population of schizophrenic patients. Thus, as Hunt and Cofer (1944) conclude, results from the best-controlled of the early studies using the Stanford-Binet indicate that schizophrenic patients institutionalized in state hospitals show an average intellectual deficit of approximately 20 months.

Following its introduction in 1944, the Wechsler-Bellevue Scale was the preferred measure in many studies of schizophrenia. The majority of these investigations were not, however, aimed at determining whether the average IQ of schizophrenic patients was different from that of the general population. Instead, they were interested in examining patterns of subtest scores in order to determine whether such patterns could distinguish between schizophrenic and other mental patients, and among various subtypes of schizophrenia. Payne (1960) reviewed 28 studies which reported Wechsler-Bellevue scores for groups of psychiatric patients with various disorders. For the 1,284 schizophrenic patients tested in these studies, Payne calculated an average IQ of 96.08. Payne notes, however, "it is almost certainly not the case" that the groups of schizophrenic patients tested in these studies were representative of the general schizophrenic population. From the 14 studies which reported demographic data for schizophrenics, Payne determined that the patients sampled by these studies were considerably younger than the average schizophrenic patient. He also speculated that the more uncooperative and unresponsive psychotic patients were not included in some of the studies he reviewed, thus making the samples even more unrepresentative. Payne therefore suggests that the average IQ of 96.08, derived from studies that tested schizophrenics on the Wechsler-Bellevue, is probably higher than would be obtained from a randomly selected sample. Winder (1960) speculates that the results of several studies using the Wechsler tests are indicative of an average deficit of 10 IQ points.

Thus, early investigations using the Stanford-Binet and the Wechsler tests suggest that schizophrenic patients perform at least slightly below average on tests of intelligence. Although these early studies failed to compare schizophrenic patients to normal controls matched on socioeconomic status and geographic

origin, recent studies that use matched controls draw the same conclusion (Pollack, Woerner, and Klein 1970; Lehman, Chelune, and Heaton 1979). In the study of Pollack, Woerner, and Klein (1970), scores obtained from schizophrenic patients on the WISC or WAIS during the fourth week of hospitalization were compared to scores obtained from their siblings at the same time. The average Full Scale IQ score for 27 schizophrenic patients was 106.6; the average score for their closest-in-age normal sibling was 114.7. Thus, while scores for both the schizophrenic patients and their siblings were well within the normal range, the schizophrenic patients scored significantly lower. The results of the study of Pollack, Woerner, and Klein (1970), and earlier studies, lead us to conclude that the intellectual performance of diagnosed schizophrenic patients is lower than would be predicted from family and environmental variables.

There have been relatively few well-controlled studies of IQ in patients with various psychiatric diagnoses. The limited data that are available suggest that adult schizophrenic patients do not show deficits in IQ when compared to patients with other psychotic disorders (Payne 1960; Cohler et al. 1977), or personality disorders (Pollack, Woerner, and Klein 1970), but they do manifest deficits when compared to alcoholic and neurotic patients (Payne 1960; Holland, Levi, and Watson 1979). Schizophrenic children have been found to score below both neurotic and personality-disordered children on the WISC (Schoonover and Hertel 1970).

Given the pervasive cognitive, affective, and motoric symptoms frequently associated with a diagnosis of schizophrenia, it is not surprising or particularly illuminating that these patients manifest mean performance deficits on standardized tests of intelligence. Recent investigations have been more concerned with the etiological and prognostic implications of intelligence for schizophrenia. Thus, researchers have focused upon premorbid intellectual development and postmorbid correlates of IQ.

Is Schizophrenia Associated With Premorbid IQ Deficits?

A number of investigators have sought to determine whether lower IQ occurs as a precursor to schizophrenia, or occurs only concomitantly with the overt expression of the illness. Most of these are retrospective studies which compare premorbid IQs of schizophrenic patients with IQs of their peers, schoolmates, or siblings. In addition to these studies, results from some of the longitudinal prospective investigations of children at risk for schizophrenia (offspring of schizophrenic parents) are just beginning to become available.

Retrospective Studies. Because regularly scheduled IQ testing and systematic record keeping in the schools are a fairly recent development, early investigations that sought to determine the relationship between premorbid IQ and schizophrenia looked at premorbid scores from army intelligence tests or from child guidance clinic records. Both of these methodologies are limited by the nonrepresentativeness of their preschizophrenic samples; yet, some of the studies yielded results that are consistent with those that use more representative samples. Based on Army induction test scores, it appears that preschizophrenic males do show IQ deficits in young adulthood. Mason (1956), for example, compared premorbid scores on the Army General Classification Test for 368 schizophrenic patients, 188 nonschizophrenic psychiatric patients, and 290 army inductees who had experienced no mental disorders. The comparison revealed that the schizophrenic patients as a group had scored significantly lower than the controls, while nonschizophrenic patients did not differ significantly from the controls on premorbid IQ. Similarly, Miner and Anderson (1958) found that men who were discharged from military service because of psychotic illness had obtained lower Army General Classification Test scores at the time of induction than men who experienced no later disorder. No reliable differences were found, however, between premorbid scores of psychotics and psychoneurotics. The one study that failed to find premorbid IQ deficits in military men who later developed schizophrenia is reported by Schwartzman, Douglas, and Muir (1962); however, their sample included only 23 patients.

Studies of child guidance clinic populations have yielded contradictory results. Frazee (1953) compared boys who had been referred to a child guidance clinic between the ages of 5 and 16, and who later became schizophrenic, with boys from the same clinic who experienced no later psychiatric disorder. She found a mean IQ of 88.7 for the children who later became schizophrenic, compared with a significantly higher mean of 97.7 for those who experienced no later disorder. In a similar study by Birren (1944), scores from child guidance clinics were obtained for 38 psychiatric patients and 53 nondisturbed adult controls (gender not indicated). Unlike Frazee (1953), Birren found that the schizophrenic

patients had significantly *higher* childhood IQs than the controls and other psychiatric patients (whose disorders included brain disease, paresis, severe mental deficiency with psychosis, and psychoneurosis). It is interesting to note, however, that the average premorbid IQ of the schizophrenic patients in Birren's study (87.5) was quite similar to that found by Frazee (88.7). The large discrepancy in control group means (80.8 for Birren vs. 97.7 for Frazee) may be explained by the types of problems exhibited by the two guidance center populations. In the Birren study almost all children were referred to the clinic for "school retardation or backwardness," while most of the children in the Frazee study were referred for antisocial, delinquent, or acting-out behavior.

As schools began routinely administering group IQ tests, and keeping records of scores, it became possible for researchers to compare premorbid scores of schizophrenic patients with childhood IQ scores of normal peers and siblings. Because scores were available for children who were more representative of the general population of school children than the samples obtained from child guidance clinics, the results of these later studies are much easier to interpret. The mean IQs yielded by the studies are listed in table 1. In the Offord and Cross (1971), Offord (1974), and Watt and Lubensky (1976) studies, control subjects are classroom peers matched with the preschizophrenic children on age, sex, and socioeconomic status. The reports by Lane, Albee, and colleagues (Albee, Lane, and Reuter 1964; Lane and Albee 1968) use the mean IQ for all children in the same grade and school district as the basis for comparison. Bower, Shellhamer, and Daily (1960) used a randomly selected control group of classroom peers. As indicated in the table, five studies derived an average IQ for each subject based upon multiple tests administered over several grade levels. In cases where preschizophrenic children had more than one sibling for whom IQ data were available, Watt and Lubensky (1976) and the Lane and Albee group derived an average of the siblings' IQ scores and considered each set of siblings as a single observation. Offord (1974) and Offord and Cross (1971) treated each sibling as a separate observation, and computed the average IQ across siblings. Pollack, Woerner, and Klein (1970) used only the nearest-in-age sibling. Finally, it should be noted that some of the articles report data on samples that contain subjects from previous publications. These overlapping samples are noted in the table.

When male and female preschizophrenic children were combined, all studies found significantly lower IQs for preschizophrenic children compared to controls. However, when the sexes were considered separately, Watt and Lubensky (1976) failed to find differences for males with an IQ measure from the early elementary years, and for females with an IQ measure from high school. Yet the studies by Offord (1974) and Bower, Shellhamer, and Daily (1960) included larger numbers of subjects, and both report significantly lower IQs for male and female preschizophrenic children when compared to same-sex controls. Taken together, the results of these investigations suggest that preschizophrenic children do manifest IQ deficits, whether contrasted with randomly selected or matched-peer controls.

A statistical summary of the results of the four nonoverlapping studies that compared preschizophrenic to peer control children is presented in table 2. Two methods were used for combining probabilities across studies; the method of adding probabilities ($p = (\Sigma p)N/N!$) and the method of adding unweighted "Z"s ($Z = \Sigma Z/N^{1/2}$)(see Rosenthal 1978, for a comparative analysis of various methods of combining probabilities). These methods were selected because of their appropriateness with small numbers of studies. Cohen's (1977) procedure was used to determine the mean effect size. Cohen's d gives the size of the effect defined as the proportion of the pooled standard deviation estimate from the two samples being compared.[2] As table 2 illustrates, the magnitude of the probability across studies indicates that there is a real difference between the IQs of preschizophrenics and their peers.

The results of comparisons of preschizophrenic children and their siblings are less consistent than those contrasting preschizophrenic children and peer controls. Examination of the means in table 1 reveals that, with the exception of females in the Offord (1974) study, all mean IQs for preschizophrenic children are below those of their siblings. However, the differences between these means fail to reach statistical significance in 6 out of 16 comparisons. Pollack, Woerner, and Klein (1970) and Watt and Lubensky (1976) found no differences between mixed-sex groups of preschizophrenic children and their siblings in IQ measured from the third through eighth grades. Similarly, Schaffner, Lane, and Albee (1967) find no difference with a measure of IQ taken from the fourth through sixth grades. Offord (1974) finds no difference for preschizophrenic

[2] Effect sizes were also determined using the procedure suggested by Glass (1980), and the results were comparable.

Table 1. Mean IQs of preschizophrenic children, their siblings, and peer controls

Study	Grade level when tested	Preschizophrenic IQ(SD)[1]	Sibling IQ(SD)	Control IQ(SD)
Males				
Bower, Shellhamer, & Daily (1960)	High school	99.3(__) (*n* = 44)	—	106.3(__)[2] (*n* = 44)
Offord (1974)	Through 9th grade	88.2(17.5) (*n* = 51)	95.9(17.9)[1] (*n* = 50) (male sibs only)	100.6(11.9)[2] (*n* = 51)
Watt & Lubensky (1976)	Kindergarten-6th grade	104.25(__) (*n* = 16)	—	106.38(__) (*n* = 16)
	7th-12th grade	100.56(__) (*n* = 16)	—	107.00(__)[2] (*n* = 16)
Females				
Offord (1974)	Through 9th grade	97.1(13.2) (*n* = 65)	97.0(12.4) (*n* = 63) (female sibs only)	101.8(14.7)[2] (*n* = 65)
Watt & Lubensky (1976)	Kindergarten-6th grade	106.56(__) (*n* = 18)	—	111.83(__)[2] (*n* = 18)
	7th-12th grade	106.28(__) (*n* = 18)	—	108.83(__) (*n* = 18)
Male and female subjects combined				
Albee, Lane, & Reuter (1964)	2nd grade	93.9(11.5) (*n* = 122)	—	100.8(10.1)[2] (*n* = 2613)
	6th grade	89.4(15.0) (*n* = 154)	—	99.4(15.7)[2] (*n* = 4166)
	8th grade	90.6(16.2) (*n* = 103)	—	99.6(17.2)[2] (*n* = 4960)
Lane & Albee (1964) (subgroup of Albee et al. 1964)	2nd grade	91.7(8.8) (*n* = 36)	100.8(9.1)[2] (*n* = 36)	—
Lane & Albee (1965) (Subgroup of Albee et al. 1964—preschizophrenics with siblings)	2nd grade	91.6(__) (*n* = 55)	99.0(__)[2] (*n* = 55)	—
	6th grade	86.5(__) (*n* = 60)	94.2(__)[2] (*n* = 60)	—
	8th grade	89(__) (*n* = 42)	96.2(__)[2] (*n* = 42)	—
Lane & Albee (1968) (Subgroup of Lane & Albee 1965—subjects who were tested in both 2nd and 6th grade)	2nd grade	87.8(14.9) (*n* = 41)	95.9(11.8)[2] (*n* = 41)	100.9(9.8)[2] (*n* = 4597)
	6th grade	87.9(11.6) (*n* = 41)	92.3(10) (*n* = 41)	98.9(18.0)[2] (*n* = 4166)

Table 1. Mean IQs of preschizophrenic children, their siblings, and peer controls—*Continued*

Study	Grade level when tested	Preschizophrenic IQ(SD)[1]	Sibling IQ(SD)	Control IQ(SD)
Schaffner, Lane, & Albee (1967)[3] (high SES, suburban sample)	Kindergarten-3rd grade	106.6(17.1) (n = 25)	111(16)[2] (n = 25)	—
	4th-6th grade	107.6(20.5) (n = 26)	111.1(14.5) (n = 26)	—
	7th-9th grade	107.7(16.3) (n = 32)	114.3(16.8)[2] (n = 32)	—
Pollack, Woerner, & Klein (1970)	Kindergarten-2nd grade	104.4(16.4) (n = 15)	114.5(16.0)[2] (n = 15)	—
	3rd-5th grade	105.5(17.1) (n = 14)	114.6(10.6) (n = 14)	—
	6th-9th grade	113.4(15.2) (n = 11)	114.9(13.1) (n = 11)	—
Offord & Cross (1971) (Subgroup of Offord 1974)	Through 9th grade	86.6(20) (n = 29)	94.3(16.4)[2] (n = 77)	98.5(13)[2] (n = 87)
Watt & Lubensky (1976) (IQs of male and female preschizophrenics combined, and their sibs and controls)	3rd-8th grade	102.86(__) (n = 50) (all preschizophrenics)	—	107.66(__)[2] (n = 50)
		102.91(__) (n = 33) (preschizophrenics with siblings)	105.27(__) (n = 33)	—

[1] (__) = Standard deviation not listed by the authors.
[2] Significantly higher than mean IQ for preschizophrenics.
[3] The authors list mean IQ scores and standard deviations, but conduct their comparisons with transformed scores.

females and their siblings, but does find a difference for males.

The statistical summary of the nonoverlapping studies of preschizophrenic children and their siblings is presented in table 3. Again, both the method of adding probabilities and the method of adding "Z"s yield a significant effect across studies. Although the combined effect size of .55 is somewhat greater than the effect size of .43 resulting from comparisons of preschizophrenic children and peer controls, the difference in effect sizes is not statistically significant.

Offord (1974) has speculated on factors that may be contributing to the lack of consistent significant findings across studies of preschizophrenic-sibling differences in IQ. His major criticism of the early studies by the Lane and Albee group is that these researchers excluded from their analyses the preschizophrenic children and siblings who were in special classes in school. Since the siblings' IQ was calculated by averaging the IQs of only those siblings who attended regular classes, it is quite possible that many siblings with IQs lower than those of the preschizophrenic children were excluded from the sample, thus raising the sibling IQ measure, and enhancing preschizophrenic-sibling IQ differences. The Offord (1974) study, on the other hand, included all probands and siblings who attended the school system, whether or not in special classes.

Offord (1974) offers a similar criticism of the study of Pollack, Woerner, and Klein (1970), noting that these investigators compared the preschizophrenic with his or her nearest-in-age *normal* sibling only. A normal sibling was one who was judged free of current symptomatology, beyond a mild degree, and who had no history of psychiatric treatment or impairment of function that would have warranted treatment. Offord (1974), in contrast, compared each patient with all of his or her siblings for whom data were available, and did not exclude any of

Table 2. Statistical summary: Preschizophrenics vs. school controls

Study	Grade level when tested	t[1]	df	One-tailed p	Effect size (d)	Z
Bower, Schellhamer, & Daily (1960)	High school (all males)	2.10	86	.0182	.45	2.09
Albee, Lane, & Reuter (1964)	2nd grade	7.33	2733	.0000	.28	6.40
	6th grade	7.74	4318	.0000	.24	6.50
	8th grade	5.26	5061	.0000	.15	4.90
Watt & Lubensky (1976)	K-6th grade					
	Females	1.86	34	.0341	.64	1.82
	Males	.89	30	.3078	.33	.50
	7-12th grade					
	Females	.89	34	.3083	.31	.50
	Males	1.98	30	.0270	.72	1.93
Offord (1974)	Through 9th grade					
	Females	1.92	128	.0264	.34	1.94
	Males	4.18	100	.0002	.84	3.60
		Σp = .722		Σd = 4.3	ΣZ = 30.18	
		$\bar{X}p$ = .072		$\bar{X}d$ = .43[3]	$\bar{X}Z$ = 3.02	
		P = .000[2]			Z = 9.55[4]	
					($p <$ .000)	

[1] Values were recomputed and, if necessary, corrected when sufficient information was available.
[2] $P = (\Sigma p)\ N/N!$
[3] $d = (\bar{X}_1 - \bar{X}_2)/S$
[4] $Z = \Sigma Z/N^{1/2}$

the siblings for reasons of poor mental health.

In summary then, Offord argues that when preschizophrenic children are compared with all of their siblings on IQ, no significant differences are found. But when preschizophrenic children are compared with those siblings who show no mental retardation or behavioral disorder, the preschizophrenic children do show IQ deficits. However, this explanation was not sufficient to account for the Offord and Cross (1971) finding of significant preschizophrenic-sibling differences, or the Offord (1974) finding that preschizophrenic males from families with an average IQ of 95 or less score lower than their siblings, while those from families with higher IQs do not. In neither of these studies were subjects excluded because of special class assignment or poor mental health.

In order to explain these findings, Offord (1974) proposed a hypothesis based on the assumption that both IQ and the predisposition to schizophrenia are largely genetic, but independently inherited, traits. A high IQ, Offord suggests, can protect a predisposed person from becoming overtly schizophrenic, while a low IQ offers no such protection. Consequently, if the predisposition for schizophrenia is only slight, overt expression of schizophrenia will occur only in families of low IQ. On the other hand, in a high-IQ family with a schizophrenic child, the predisposition for schizophrenia must be quite severe—if it were not, none of the children would show overt signs of the illness. Thus, Offord hypothesizes that IQ level acts as a mediating factor in the overt expression of schizophrenia, and is crucial only in the low-IQ families. In addition, Offord proposes that the lack of preschizophrenic-sibling differences among females from low-IQ families may be due to an increased vulnerability to schizophrenia among low-IQ males. He suggests that this increased vulnerability may be mediated by greater susceptibility to central nervous system damage in male offspring. The question of sex differences in premorbid IQ will be addressed in greater detail later in this section.

Offord's (1974) hypothesis

Table 3. Statistical summary: Comparisons of preschizophrenics with their siblings[1]

Study	Grade level when tested	*t*	*df*	One-tailed *p*	Effect size	*Z*
Lane & Albee (1965)	2nd grade	6.73	108	.0000	1.30	5.00
	6th grade	4.81	118	.0000	.89	4.00
	8th grade	3.13	82	.0014	.69	2.98
Watt & Lubensky (1976)	3rd-8th	.89	64	.3092	.22	.50
Offord (1974)	*Through 9th grade*					
	Males	2.19	99	.0145	.44	2.18
	Females	−.04	126	.5165	.00	−.04
Pollack, Woerner, & Klein (1970)	K-2nd grade	1.71	28	.0474	.65	1.67
	3rd-5th grade	1.69	26	.0497	.66	1.64
	6th-8th grade	.25	20	.4009	.11	.25
		Σ p = 1.34		Σ d = 4.96	Σ Z = 18.18	
		X̄p = .15		X̄d = .55	X̄Z = 2.02	
		P = .000			Z = 6.06	
					(*p* < .000)	

[1] The Schaffner, Lane, & Albee (1967) results are not included in the statistical summary because the analyses were conducted on transformed scores that are not published in their report; thus, it was not possible to derive an effect size.

regarding familial IQ level is generally compatible with the results of other studies that have looked for sibling-preschizophrenic IQ differences. For example, the studies by Lane and Albee (1964, 1965, 1968), which compared IQ scores of siblings and preschizophrenics were conducted in urban neighborhoods of lower socioeconomic status. In these studies (all of which found sibling-preschizophrenic differences) the preschizophrenic children's mean IQ was below 95 across grade levels, and IQs were generally in the high 80's. The siblings' mean IQ was below 101 at all grade levels, and IQs generally fell in the mid-90's. Similarly, the study by Offord and Cross (1971), which likewise found sibling-preschizophrenic differences, reports a mean IQ of 86.6 for the preschizophrenic children and 94.3 for the siblings. In contrast, the Watt and Lubensky (1976) study, which found *no* preschizophrenic-sibling differences, reports a mean of 102.91 for preschizophrenic children, and 105.27 for siblings. The average IQs for the preschizophrenic children in the study of Pollack, Woerner, and Klein (1970) were 104, 105, and 113 at the K-2, 3-5, and 6-8 grade levels, respectively, and were 114.5, 114.6, and 114.9 for the siblings at the three grade levels. (Significant sibling-preschizophrenic differences were found only for K-2 test scores.) Thus, in each of these studies, samples with lower than average mean IQs showed sibling-preschizophrenic differences, while those samples with higher than average mean IQs generally showed no such differences. The only study which provides results contradictory to this conclusion is the study of Schaffner, Lane, and Albee (1967), which found preschizophrenic-sibling differences in samples from middle and upper class suburbs. The average IQs for preschizophrenic children were between 106.6 and 107.7 (at three grade levels); the IQs for siblings were between 111 and 114.3.

For a more direct evaluation of the hypothesis that preschizophrenics from low IQ families are more likely to manifest IQ deficits relative to their siblings, we derived the coefficient of correlation (Pearson *r*) between mean sibling IQs and the effect sizes listed in table 3. The resultant coefficient of -.22 does not reach statistical significance, but it is in the direction predicted by Offord's hypothesis. Also, it should be noted that this negative coefficient is in the direction opposite to what would be predicted by regression toward the mean.

There are alternative approaches to interpreting the above results. Longitudinal studies of children who suffered perinatal complications or manifested early developmental delays indicate that familial socioeconomic status (SES) is a significant

determinant of outcome (Drillien 1964; Davie, Butler, and Goldstein 1972; Rubin and Balow 1979). When such children have been reared in lower SES homes by parents with limited educational backgrounds, signs of cognitive and neuromotor deficits are more likely to persist. In contrast, at-risk infants born to middle and upper SES families tend to improve and, as a group, are often indistinguishable from the norm by middle childhood. It is possible that the genotype for schizophrenia has pleiotropic effects that can be manifested in intellectual deficits, but only when the child is reared in a lower SES home where the parents have limited educational backgrounds. Thus, standardized IQ tests may be tapping, at least partially, cognitive deficits associated with a genetic predisposition to schizophrenia. The apparent interaction between preschizophrenic IQ and familial IQ may therefore be related to the ameliorative effects of middle/upper SES child-rearing practices, rather than the protective effects of an independently transmitted genetic predisposition to high IQ. On the other hand, it may be that acquired subclinical brain damage is the primary etiologic factor for a subgroup of schizophrenic patients. Recent research using the positive/negative symptom distinction suggests that schizophrenia characterized by negative symptoms is associated with greater cognitive deficit and evidence of structural abnormalities in the central nervous system (Andreasen and Olsen 1982). Thus, a subgroup of preschizophrenic children may be suffering from an acquired, rather than inherited, organic impairment that is manifested in low IQ when the individual is reared in a low SES environment. Additional research will be necessary to evaluate the hypothesis that preschizophrenic children have lower IQs than their siblings only if they are from low-IQ families. Such research may provide important information regarding genetic determinants of both IQ and schizophrenia, and how these determinants interact.

Regardless of the validity of the proposed explanations for the discrepancy in results on preschizophrenic-sibling IQ differences, two important conclusions can be drawn from this research. First, it is important to note that while some studies showed the preschizophrenics to have lower childhood IQs than their siblings, and other studies showed no preschizophrenic-sibling IQ differences, none of the studies found evidence for *higher* IQs among the preschizophrenic children. This observation, along with strong evidence for preschizophrenic-control differences, suggests that it is not unreasonable to assume that low childhood IQ is associated with risk for schizophrenia. Consistent with this conclusion, Pollin and Stabenau (1968) found that for 20 monozygotic twin pairs discordant for schizophrenia, the schizophrenic twin had a lower premorbid IQ four times as often as the nonschizophrenic co-twin.

Furthermore, in those studies which included both sibling *and* control comparisons (Lane and Albee 1968; Offord and Cross 1971; Offord 1974; Watt and Lubensky 1976), the matched controls *always* scored higher than the siblings of the preschizophrenics, as well as the preschizophrenic children themselves. However, the authors of these studies did not conduct statistical tests of the difference between the IQs of siblings and controls. Three of the reports in table 1 provide mean IQs and standard deviations for sibling and control groups. We conducted *t*-test comparisons of these means and found significant differences (one-tailed) in four comparisons and a trend toward significance in one comparison (Offord and Cross 1971: $t = 1.83$, $p = .033$; Offord 1974: for males, $t = 1.55$, $p = .06$; for females, $t = 1.99$, $p = .023$; Lane and Albee 1968: 2nd grade, $t = 3.25$, $p = .000$; 6th grade, $t = 2.34$, $p = .009$). Thus, at least moderate IQ deficits may be present in the siblings of preschizophrenics, regardless of their clinical outcome, when compared to children who attended the same school. This result is consistent with the notion that the genotype for schizophrenia, although not always manifested in the schizophrenic phenotype, may have implications for cognitive development. On the other hand, it is also possible that exposure to environmental stressors (i.e, exposure to the preschizophrenic sibling or familial instability) is producing IQ deficits in the siblings of premorbid subjects.

Prospective Studies. Another research approach that holds promise for providing information about premorbid IQ is the longitudinal high-risk method. In this paradigm, children are considered to be at high risk for schizophrenia if they have at least one parent who has been diagnosed as schizophrenic. For most of the studies discussed here, the high-risk children have only one schizophrenic parent, usually the mother. While the types of variables examined in high-risk research projects vary greatly, almost all have included some measure of IQ. Because the majority of these projects have not yet followed their subjects through the major risk period for schizophrenia, most of the reports emanating from them rely on comparisons between all high-risk children and various control groups.

However, it should be noted that only 10–15 percent of subjects with one biological schizophrenic parent are expected to manifest the disorder (Gottesman and Shields 1982). Consequently, group comparisons are limited in the information that they can offer regarding premorbid indicators.

The mean IQs reported in the high-risk studies are listed in table 4. Two reports not listed in the table stated that they found no significant IQ deficits in high-risk children when compared to controls; however, the authors did not report mean scores (Hanson, Gottesman, and Heston 1976; Grunebaum et al. 1978). An investigation by Landau et al. (1972) is also not listed in table 4 because the authors did not report mean scores; however this study *did* reveal significant IQ deficits in high-risk children. Another report showing IQ deficits in high-risk children (Winters et al. 1981) is not listed because it presented only raw scores from a subset of Verbal and Performance subtests.

A statistical summary of the nonoverlapping high-risk studies that provided adequate information for deriving effect sizes is presented in table 5. Because psychiatric control groups were included in only a small number of studies, and the composition of these groups is heterogeneous across studies, table 5 is restricted to comparisons of high-risk children and matched offspring of normal parents. Both methods of deriving combined probabilities yielded statistically significant results, and the estimated effect size across studies is .39. Thus it appears that offspring of schizophrenic parents do score lower than children of normal parents; however, the mean effect size is not so large as those yielded by comparisons of preschizophrenic children with their siblings and peer controls.

When IQ scores of the offspring of schizophrenic parents are compared to those of children whose parents have affective disorders, no consistent differences are found. Winters et al. (1981) administered two Verbal and two Performance subtests of the WISC, and reported that offspring of unipolar depressive patients, as well as offspring of schizophrenic patients, had significantly lower Verbal subtest scores than children of bipolar patients, and normal controls. However, performance subtest scores were lower in children of unipolar depressive patients when compared to offspring of bipolar patients, schizophrenic patients, and normal controls. Comparisons of the full scale WISC IQs of the offspring of schizophrenic patients with those of the offspring of manic-depressive (Worland and Hesselbrock 1980) and unipolar depressive (Oltmanns et al. 1978) patients revealed no significant differences. Similarly, Worland et al. (1982) found no group differences in Verbal or Performance IQ when comparing offspring of patients with schizophrenia, schizoaffective disorder, and affective disorder; however, Performance IQs of the offspring of schizophrenic patients were less stable across time than those of the other groups. Finally, an investigation by Cohler et al. (1977) showed *lower* full scale IQs for children of psychotic depressed mothers when compared with children of schizophrenic and normal mothers. In summary, then, it appears that IQ deficits are not unique to children at risk for schizophrenia, but instead may be characteristic of the offspring of parents with a variety of psychotic disorders.

An examination of correlates of IQ by Rieder, Broman, and Rosenthal (1977) indicated that perinatal complications were significantly associated with IQ deficits in high-risk offspring, but not offspring of normal mothers. In contrast, SES was positively correlated with IQ for offspring of normals, but not for offspring of patients with schizophrenia. The authors interpret these results as suggesting that "one aspect of schizophrenic inheritance is a susceptibility to other factors that may lower IQ" (p. 799). The idea that genetic vulnerability may interact with external physical stressors in the development of schizophrenia is explored further in a recent article by Walker and Emory (1983). This idea offers yet another approach to the general question of the nature of the relationship between IQ and schizophrenia.

The high-risk studies that examined the relationship between parent and offspring IQs yielded inconsistent results. Lane and Albee (1970) found no significant relationship between the childhood IQs of adult schizophrenics and the IQs of their offspring. However, childhood IQs of the nonschizophrenic parents were significantly correlated with their offspring's IQs. In contrast, Worland and Hesselbrock (1980) found that the IQs of high-risk children showed a stronger relationship with the IQs of their schizophrenic parents than with those of their nondisturbed parents, although parent/child IQ correlations were somewhat lower overall for high-risk children when compared to offspring of normals and other psychiatric patients.

To date, only two longitudinal high-risk research projects have reported psychiatric followups of their subjects. The New York high-risk project (Erlenmeyer-Kimling et al. 1980) has examined 80 children of schizophrenic parents and 125 children of parents with nonschizo-

Table 4. Mean IQs of offspring of parents with and without psychiatric disorders

Study	Age level when tested	Offspring of schizophrenic parents	Offspring of normals	Offspring of parents with other disorders
Cohler et al. (1977)	Mean age 5½ years			Depressed
		Males: 109.7(16.2) (n = 14)	110.2(12.5) (n = 18)	101.0(21.9) (n = 5)
		Females: 105.6(10.3) (n = 10)	106.5(11) (n = 15)	92.3(22) (n = 5)
Rieder, Broman, & Rosenthal (1977)	7 years	Offspring of chronic patients:		
		Males: 101.5(11.7) (n = 30)	107.6(12.1)' (n = 30)	—
		Females: 103.3(14.3) (n = 15)	102.6(12.3) (n = 15)	—
		Offspring of acute patients:		
		Males: 101(4.9) (n = 6)	114.5(10.1)' (n = 6)	—
		Females: 110.3(11.4) (n = 9)	102.1(16.8) (n = 9)	—
Oltmanns et al. (1978)	6-15 years	94.32(24.18) (n = 156)	102.57(21.32)' (n = 139)	Depressed 99.12(22) (n = 102)
Worland & Hesselbrock (1980)	6-20 years	102.81(13.24) (n = 94)	108.95(15.98) (n = 119)	Manic-depressive 106.56(16.93) (n = 53) Physically ill 98.13(16.28) (n = 73)
Griffith et al. (1980)	13-21 years	100.7(__) (n = 207)	104.3(__)' (n = 104)	—
Watt, Grubb, & Erlenmeyer-Kimling (1982)	7-12 years	104.87(11.20) (n = 44)	117.66(11.90)' (n = 70)	—
Worland et al. (1982) (Subgroup of Worland & Hesselbrock 1980)	Mean age 7.9 years	112.45(__) (n = 10)	110.53(__) (n = 75)	Affective disorder 103.93(__) (n = 20)
				Schizoaffective disorder 101.86(__) (n = 17) Physically ill 104.52(__) (n = 31)
	Mean age 15.6 years	107.30(__) (n = 10)	109.74(__) (n = 75)	Affective disorder 100.01(__) (n = 20)

Table 4. Mean IQs of offspring of parents with and without psychiatric disorders—*Continued*

Study	Age level when tested	Offspring of schizophrenic parents	Offspring of normals	Offspring of parents with other disorders
				Schizoaffective disorder 101.64(__) (*n* = 17) Physically ill 99.81(__) (*n* = 31)

[1] Significantly higher than the mean IQ for high-risk children.

phrenic psychiatric disorders or no mental disorder. Initial administration of the WISC occurred when the children were between 7 and 12 years. Ten years later, at the time of the most recent report, five of the subjects had been hospitalized for psychiatric treatment. The mean WISC IQ of the five high-risk subjects who were hospitalized was 11 points below the mean for the entire high-risk group during initial testing, a statistically significant difference. In contrast, the Danish high-risk study (Griffith et al. 1980) found no premorbid IQ deficits. The subjects of the Danish study are 207 offspring of schizophrenic mothers. Initial testing on the WISC and other measures occurred in 1962, when subjects were adolescents. Followup psychiatric evaluations occurred in 1972. At the time of the 1972 followup nine male and eight female high-risk subjects had developed schizophrenia. When high-risk subjects who became schizophrenic were compared with those who did not, no significant premorbid IQ differences were found (Griffith et al. 1980).

Thus, initial findings from the two high-risk studies that have conducted followup psychiatric assessments are inconsistent. However, the subjects in these studies have not yet passed through the age period of greatest risk for schizophrenia: As these ongoing research projects complete additional followup evaluations of their high-risk samples, the results will shed greater light on the question of premorbid IQ. At this point, the findings of high-risk research provide evidence of IQ deficits in the offsprings of schizophrenic patients, when compared to the offspring of normals. However, IQ deficits are also sometimes found in children of parents with other psychotic disorders and, as stated earlier, Pollack, Woerner, and Klein (1970) report that patients who receive a diagnosis of personality disorder in adulthood score below their siblings on childhood measures of IQ. Thus, the available evidence suggests that premorbid IQ deficits are not unique to schizophrenia.

Sex Differences in Premorbid IQ. Before attention is turned to a discussion of pre- and post-onset decline in IQ, it should be noted that studies of preschizophrenic and high-risk children both suggest lower IQs in males. Offord (1974) found significantly lower IQs in male compared to female preschizophrenic children. A difference in the same direction is indicated by Watt and Lubensky (1976), but they did not conduct a statistical test of the significance of the difference. Similarly, Rieder, Broman, and Rosenthal (1977) found that only male offspring of schizophrenic patients showed IQ deficits when compared to controls, and Lane, Albee, and Doll (1970) reported that male, but not female, offspring of schizophrenic patients showed a trend toward lower IQ scores than their parents. To determine whether differences in the proportion of males included in the samples of preschizophrenic and high-risk children contributed to variability in effect sizes, coefficients of correlation (Pearson *r*) were derived between the proportion of males in the samples and effect size. The correlation between the proportion of males in the samples of preschizophrenic children and the effect sizes for comparisons with peer controls (table 2) is .14—positive, but not statistically significant. However, for comparisons of preschizophrenic children and their siblings (table 3), the coefficient is .57 ($p < .05$). The correlation between the proportion of males in the high-risk samples and the effect size for comparisons with matched controls (offspring of normals; table 5) is .62 ($p < .025$). Thus, it seems that males are contributing more than females to the size of the

Table 5. Statistical summary: Comparisons of high-risk children with offspring of normals

Study		*t*	*df*	One-tailed *p* value	Effect size (*d*)	*Z*
Rieder, Broman, & Rosenthal (1977)	Offspring of chronics:					
	Male	1.99	58	.0242	.52	1.97
	Female	−.144	28	.9211	−.05	−1.41
	Offspring of acutes:					
	Male	2.95	10	.0071	1.87	2.45
	Female	1.21	16	.8788	−.61	−1.17
Cohler et al. (1977)	Male	.10	30	.4589	.04	.10
	Female	.21	23	.4148	.09	.21
Oltmanns et al (1978)		3.11	293	.0012	.36	3.04
Worland & Hesselbrock (1980)		2.99	211	.0017	.41	2.93
Griffith et al. (1980)		2.00	309	.0218	.23	2.02
Watt, Grubb, & Erlenmeyer-Kimling (1982)		5.71	112	.000	1.08	5.18
		Σ p = 1.84 X̄p = .184 P = .000			Σ d = 3.94 X̄d = .39	Σ Z = 13.91 X̄Z = 1.39 Z = 4.40 (*p* < .000)

measured IQ deficit in the latter two comparisons. It is possible, therefore, that female preschizophrenic children either do not manifest IQ deficits relative to their siblings or manifest lesser deficits than males. Similarly, female offspring of schizophrenic patients may not differ significantly in IQ from control children. Some potential etiological implications of this sex difference are discussed later.

Is Schizophrenia Associated With a Pre- or Post-Onset Decline in IQ?

A number of studies have examined changes in IQ during the course of schizophrenia. These studies have looked for premorbid changes in IQ before overt schizophrenic symptoms appear (Lane and Albee 1963; Pollack, Woerner, and Klein 1970; Jones and Offord 1975; Watt and Lubensky 1976); differences between premorbid scores and scores at hospital admission (Lubin, Gieseking, and Williams 1962; Schwartzman, Douglas, and Muir 1962; Albee et al. 1963; Pollack, Woerner, and Klein 1970); and differences between scores at hospital admission and scores after several years of hospitalization or at remission (Haywood and Moelis 1963; Smith 1964; Hamlin and Ward 1965; Klonoff, Fibiger, and Hutton 1970). Unfortunately, because of the diversity in methodology and time periods covered, these studies do not lend themselves to statistical summary.

Premorbid IQ Stability. Addressing the question of premorbid IQ stability, the Lane and Albee studies (1964, 1968) compared IQ scores obtained in second grade with those obtained in sixth grade. When scores from preschizophrenic children were compared with city-wide averages, Lane and Albee (1968) found a statistically significant decline in scores between the second and sixth grades for the preschizophrenic subjects. However, when their scores were compared with scores from siblings and matched controls (Lane and

Albee 1968), it was found that a loss in IQ between the second and sixth grades was also characteristic of the matched controls and siblings. Similarly, Watt and Lubensky (1976) examined IQ scores of preschizophrenic children from grades 3–6 and grades 8–11 for downward and upward drift. They found that preschizophrenic children were slightly more consistent than their controls, corroborating Lane and Albee's (1968) conclusion that preschizophrenic development is not characterized by a significant drop in IQ between early and late childhood.

This conclusion is further corroborated by results from the study of Pollack, Woerner, and Klein (1970). In this investigation childhood IQ scores from grades K–2, 3–5, and 6–8 were correlated with one another, separately for preschizophrenic children and for their nearest-in-age normal siblings. For both the preschizophrenic children and their siblings, all intertest correlations were significant. Intertest correlations for the patients ranged from .56 to .97; correlations for the siblings ranged from .67 to .90. The authors argue that if the schizophrenics had experienced a significant decline in IQ during childhood, one would have expected their intertest correlations to be much lower than the intertest correlations for their siblings. Obviously, the absence of a difference in intertest correlations does not rule out a premorbid decline in IQ, since an IQ loss that is consistent across subjects would not affect the magnitude of the coefficient. Nevertheless, taken together, studies which looked for a prodromal decline in IQ by comparing early childhood IQ scores with later childhood IQ scores, or by correlating scores from tests taken at different ages, provide little convincing evidence for a decline in IQ before the overt appearance of schizophrenic symptoms.

In their 1965 study Lane and Albee correlated the childhood IQs of schizophrenic patients with the childhood IQs of their siblings. They found nonsignificant correlations of .06 for the second grade test, .17 for the sixth grade test, and .07 for the eighth grade test. When they examined the relationship between the childhood IQs of two nonschizophrenic siblings of the patients, the resulting average correlation was .43 for the three grade levels. The authors interpreted these data as supporting the hypothesis that the schizophrenic process lowers IQ prodromally and, since it does so irregularly, weakens the correlation between the IQs of the schizophrenic-to-be and his siblings. In order to test this hypothesis, Jones and Offord (1975) correlated scores of preschizophrenics and their siblings on high school IQ tests. They found that the correlation between the IQs of two siblings was essentially the same, whether or not one of them was preschizophrenic. Correlations varied between .40 and .50 for both groups. Jones and Offord then concluded the following:

> If schizophrenia lowers IQ prodromally, the proband-sibling correlation should be less than the one among siblings, because the probands' IQ would contain an additional source of variation unrelated to the siblings' IQs, namely, variations having to do with the clinical course and severity of the proband's illness. [p. 188]

Furthermore, their finding that preschizophrenic-sibling correlations did not differ from sibling-sibling correlations led them to argue for the independent transmission of IQ and schizophrenia. They explain the differences between their findings and the Lane and Albee (1965) findings by noting that Lane and Albee did not include subjects who had been in special classes as children. When Jones and Offord reanalyzed their data excluding special class subjects, they found that the preschizophrenic-sibling correlations were reduced from the mid-.40's to values centering around .20. However, another plausible explanation for the discrepant findings that was not entertained by Jones and Offord concerns the sex composition of the preschizophrenic samples. Over 75 percent of the preschizophrenic children in the Lane and Albee study were male, whereas only 44 percent of Jones and Offord's preschizophrenic children were male. If it is the case, as suggested above, that premorbid IQ deficits are primarily characteristic of male schizophrenic patients, then Lane and Albee's findings of low correlations between the IQs of preschizophrenic children and their siblings may reflect the inclusion of a high proportion of premorbid males with depressed IQs. Thus, although the results of the Lane and Albee study do not necessarily demonstrate the existence of an "irregular" prodromal decline in IQ, they are compatible with the assumption that male vulnerability to schizophrenia is accompanied by IQ deficit.

Post-Onset IQ Stability. To determine whether IQ deteriorates with the onset of schizophrenia, several studies compared premorbid and postmorbid IQs of schizophrenic patients. In an early study by Rappaport and Webb (1950), schizophrenic patients were administered the same intelligence tests they had taken during high school (before hospital admission). The premorbid mean IQ was 97.6, compared with a postmorbid mean of 63.9 (significant

at the .01 level). In more recent reports by Lubin, Gieseking, and Williams (1962), and Schwartzman and Douglas (1962), army intelligence tests were administered to schizophrenic patients, and their scores were compared to premorbid scores obtained at the time of the patients' induction into the army. In these studies, a deficit score was obtained for each subject by subtracting the current score from the premorbid score. Again, both studies found significantly greater deficits among the schizophrenic patients than among the controls, although the amount of deficit was not so great as that reported by Rappaport and Webb (1950).

The conclusion drawn from these studies of premorbid-postmorbid IQ was that the onset of schizophrenia is characterized by a drop in intellectual functions. However, a subsequent follow-back study by Albee et al. (1963) does not support this conclusion. In the Albee et al. study, the Wechsler-Bellevue test was administered to adult schizophrenic patients. No significant differences were found between the adult IQ scores and the childhood scores on the Stanford Binet, Kuhlmann-Anderson, and Cleveland Classification Test administered in the second and sixth grades. All mean scores were somewhat below normal (means ranged from 87.1 and 92.6). The authors conclude:

> Intellectual deficit as a characteristic of schizophrenia does not appear to be a concomitant of the severe or acute stages of the disorder but rather is a characteristic of the total life picture, at least from early childhood on, of those individuals who are eventually admitted to public mental hospitals. [p. 366]

Albee et al. suggest that the discrepancy between their findings and the findings of Lubin, Gieseking, and Williams (1962) is related to the nature of the tests administered after the onset of illness. The Wechsler-Bellevue tests used in the Albee et al. study are not so rigidly timed as the army tests used by Lubin, Gieseking, and Williams. Albee et al. argue that tests such as the army battery might be more affected than the Wechsler-Bellevue by the changes in motivation, attention, and persistence that often accompany schizophrenia. However, when Schwartzman and Douglas (1962) controlled for the speed factor in the army tests, the decrement manifested by the schizophrenic subjects was reduced, but still significantly greater than that of the controls.

Studies that have looked for premorbid-postmorbid changes in IQ are difficult to compare because of methodological inconsistencies. There are differences in the premorbid and postmorbid tests administered, in the ages at which premorbid tests were administered, in length of hospitalization and chronicity before the administration of postmorbid tests, and in demographic characteristics of the samples studied. Moreover, the studies of Lubin, Gieseking, and Williams and of Schwartzman and Douglas included only male subjects, while the Albee et al. study included both males and females. Thus, it is possible that decline from premorbid IQ level is predominantly characteristic of schizophrenic males, and therefore was only detected in the studies of Lubin, Gieseking, and Williams (1962) and Schwartzman and Douglas (1962).

Results from studies that examine changes in IQ level as schizophrenia progresses are more consistent than the findings from research comparing premorbid-postmorbid IQs. Investigations of IQ stability following the onset of schizophrenia suggest that symptomatological improvements are related to increases in IQ, while lack of symptom remission is associated with decrements. Payne (1960) obtained IQ scores for newly admitted schizophrenic patients and again after 4 to 13 months without remission. The average IQ for the whole group on admission was 82.8, and the average retest IQ was 75.2. The correlation between length of illness and drop in IQ for the whole group was .39. Payne concludes:

> Schizophrenic illness without remission tends to produce a deterioration of general level which is progressive. The longer the illness, the more severe the deterioration tends to be. [p. 204]

In another early study, Rabin (1944) tested schizophrenic and nonschizophrenic psychiatric patients on the Wechsler-Bellevue. The initial testing was carried out approximately 1 month after admission, and the followup testing occurred from 1 to 35 months later (mean interval was 13 months). The attending psychiatrists noted that there was a general improvement in clinical symptomatology among the patients at the time of the retesting. Of the 30 schizophrenic patients, 16 showed a rise of 5 or more points between the first test and the retest; eight showed a decline of 5 or more points. The figures were exactly the same for the nonschizophrenic patients. The average initial test score was 81.6 for schizophrenic patients and 76.8 for nonschizophrenic patients; average retest scores were 87.5 and 82.1, respectively. Rabin concludes that the rise in mental level among the majority of patients was due to their improved clinical picture and, possibly, to practice effects.

Increases in IQ were also found in a subsequent study by Smith (1964), although he does not report on

symptom changes. This author tested younger schizophrenic patients (mean age at first testing was 34 years) and older schizophrenics (mean age was 53) on the Wechsler-Bellevue test. Retesting occurred when the patients were still hospitalized, 8.4 years later. Although the younger group scored considerably lower on the initial testing than the older group (means = 79.81 and 100.6, respectively), both groups showed slight increases over the 8.4-year period (5.59 points for the younger schizophrenics, 1.96 points for the older schizophrenics). Smith concludes that the study revealed no signs of progressive deterioration purely as a function of hospitalization.

Hamlin (1969) followed up the sample described above in the Smith (1964) study. Hamlin was able to obtain Wechsler scores for 49 patients on tests taken 14 years after the initial testing described by Smith (1964). Twenty-five of the subjects in this study were younger nonparanoid schizophrenic patients (mean age at initial testing was 33 years). The remaining 24 subjects were older paranoid schizophrenic patients (mean age at initial testing was 51). Hamlin first examined unweighted Wechsler scores, which represent actual changes in performance over the years, with no allowance for normal aging. He found significant gains during the 14-year period for the younger nonparanoids, and no significant change for the older paranoid patients. When the two groups were compared on the final followup IQ scores, with a covariance adjustment for initial scores, no significant difference was found between the scores of paranoid and nonparanoid patients. Hamlin concludes that the stability of scores over 14 years was essentially the same for the paranoid and nonparanoid subgroups—that is, paranoid and nonparanoid patients do not represent two varieties of psychosis with respect to IQ changes during the chronic stage of the illness. Furthermore, when subjects were compared on Wechsler scores, which did take normal aging into account, significant gains were found for both groups. The effects of aging on IQ, he suggests, "may be counteracted by a general tendency toward alleviation of psychotic symptoms as the years pass. Instead of following an inevitable downhill course, schizophrenia may become less severe" (p. 501).

Hamlin also obtained information, at the time of followup testing, about the clinical status of 44 of the patients. The 14 patients who were rated as "improved" showed a mean gain of 16.1 points over the 14 years. No statistical tests were used to compare this gain with the gains of those patients who were not selected as improved; however, the change in IQ of the improved patients appears to be substantially higher than the mean gains of 11.43 and 4.48, respectively, for the other nonparanoid and paranoid patients. Comparable findings are reported by Klonoff, Fibiger, and Hutton (1970) who administered the WAIS to World War II veterans who had been classified as schizophrenic for approximately 20 years. Patients were retested 8 years later and the resultant data indicated a significant improvement from an average of 93.9 during the initial testing to an average of 100.54 during the followup testing. Ratings on the Malamud and Sands psychiatric rating scale indicated that the psychiatric status of schizophrenics had also improved significantly over the 8-year period.

In a study by Schwartzman, Douglas, and Muir (1962), the Canadian Army "M" test was administered to 23 schizophrenics after a mean of approximately 4 years of hospitalization (first postmorbid testing), and again 8 years later (second postmorbid testing). Between the first and second tests, 13 of the patients were released while 10 remained hospitalized. Schwartzman, Douglas, and Muir compared the change between the first and second postmorbid test scores for the released and nonreleased patients. While the nonreleased patients had a significant decline of 13.6 points, the released patients had a significant increase of 13.4 points. Schwartzman, Douglas, and Muir obtained premorbid scores from the time of army induction for the 23 subjects. They found that the released patients' second postmorbid scores were not significantly different from their premorbid scores. Thus, it appears that released patients gained back much of the intellectual functioning that they had lost when hospitalized with schizophrenia, while patients who remained in the hospital continued to decline. Schwartzman and his collaborators found no correlation between length of hospitalization and amount of drop between the premorbid and first postmorbid tests, between the premorbid and second postmorbid tests, or between the first and second postmorbid tests. The authors conclude that there was no evidence to suggest that length of hospitalization is correlated with amount of intellectual loss, but that the significant factor is whether the patient is in the hospital at the time of the testing.

In a similar study by Haywood and Moelis (1963), 20 improved male schizophrenic inpatients were matched on age and IQ, obtained at time of admission, with 20 unimproved male schizophrenic inpatients. Improvement was defined as psychiatrists' judgments that

psychotic symptoms had subsided. All patients were retested after a minimum of 16 months of hospitalization. The mean change for the improved group was an increase of 7.3 points; the mean change for the unimproved group was a decline of 2.65 points. Of the 20 improved patients, 16 gained IQ points and 3 lost. In the unimproved group, 5 gained and 13 lost. The authors conclude that "improved schizophrenics show improvement in intellectual functioning as compared with their performance on admission to the hospital, while unimproved schizophrenics may actually suffer further deficit" (p. 78). Haywood and Moelis's (1963) findings corroborate findings of an earlier study by Davidson (1939) in which 18 schizophrenic patients were tested on the Stanford-Binet and retested 6 months later. The three patients who showed clinical improvement had higher retest scores (compared with initial test scores); the seven patients who showed clinical deterioration had lower retest scores.

Overall, the results of these studies suggest that continual deterioration in intellectual functioning during the course of the illness is by no means a necessary characteristic of schizophrenia. Furthermore, it appears that improvement in IQ between initial (postmorbid) testing and retesting at some later date is related to improvement in psychiatric symptoms. Thus, in answer to our question regarding the covariation of IQ and clinical status, the following conclusions can be drawn from the literature: (1) There does not appear to be a decline in IQ before the overt appearance of schizophrenic symptoms. (2) Results are equivocal regarding premorbid-postmorbid declines—results may depend on the premorbid and postmorbid tests administered, the ages at which premorbid tests are administered, the length of the patient's hospitalization before the postmorbid test is administered, and sex of the patient. (3) Differences between scores obtained at admission and after several years of hospitalization appear to be related to changes in the patient's symptomatology. As Hamlin (1969) notes:

> Patients may lose abilities early in the psychosis, but once they have become chronic, their mean intelligence scores remain stable or even improve. . . . [The] severity of psychotic symptoms has a demonstrable relationship to intelligence scores. When symptoms improve, test scores increase. [p. 502]

Are Clinical Improvement, Length of Hospitalization, or Prognostic Indicators of Severity and Chronicity Related to Premorbid or Postmorbid IQs?

Several studies have looked at signs of clinical improvement (e.g., discharge ratings, and incidence of remission) and their relationship with IQ at hospital admission. In an early study by Stotsky (1952), schizophrenic patients who had been hospitalized for 2–4 years were compared with patients who were admitted at the same time but who had been released and had remained in remission for at least 6 months. IQ scores of remitted patients (obtained within 90 days of hospital admission) were significantly higher than the IQs of nonremitted patients. Similarly, Carp (1950) found that the pretreatment IQs of patients who responded favorably to therapy were significantly higher than the pretreatment IQs of unimproved patients.

Pollack (1960) and Pollack, Levenstein, and Klein (1968) also found a relationship between clinical improvement and IQ. Pollack (1960) obtained IQ scores and discharge ratings for adult and adolescent schizophrenic patients. (It is not clear when the IQ tests were administered, but they were apparently administered sometime during the patient's hospitalization.) The discharge ratings consisted of the classification of patients as unimproved, improved, much improved, and recovered. The unimproved subgroup had significantly lower IQs than the patients with more favorable ratings. In fact, 50 percent of the unimproved patients had IQs below 90. No significant differences in IQ were found among subgroups with ratings of improved, much improved, or recovered.

In the subsequent study by Pollack, Levenstein, and Klein (1968), adult and adolescent schizophrenic patients who were hospitalized for an average of 9 months were followed up 3 years after hospital discharge. At the time of followup, each subject was rated independently by two judges as belonging to one of six global outcome categories. Wechsler-Bellevue IQs had been obtained during hospitalization, at the end of a 4-week, drug-free period. IQ scores were significantly higher for patients in the excellent-good outcome categories than for those in the very poor category.

Prognosis has also been found to be associated with childhood IQ scores of schizophrenics. In a series of followup studies of boys treated at a child guidance clinic, Roff and his colleagues (Roff, Knight, and Wertheim 1976*a*, 1976*b*; Roff and Knight 1980) found that preschizophrenic boys with low childhood IQs had disproportionately unfavorable clinical outcomes and never-married status. In summary, then, the results suggest that higher premorbid and

postmorbid IQs (obtained during hospitalization) are related to better clinical outcome for schizophrenic patients.

Other investigators have looked at an alternative indicator of outcome, length of hospitalization, and its relationship to IQ. Heffner, Strauss, and Grisell (1975) obtained IQ scores from tests administered to male schizophrenic patients at the time of hospital admission. Subjects were divided into the categories of high (> 95) and low (< 95) IQ. Followup interviews were conducted to determine whether the subject had been readmitted during the third and/or fifth years following initial discharge. Patients were assigned to one of three outcome categories: (1) short-term (not rehospitalized), (2) intermediate (rehospitalized either during the third or fifth year following initial discharge), and (3) chronic (rehospitalized in both the third and fifth years). Chi-square analysis revealed a significant relationship between IQ and readmission ratings. Over 80 percent of the chronic patients had been in the lower IQ group at hospital admission. Although 70 percent of the high IQ group was never rehospitalized, this was true of only half of the lower IQ group.

While Heffner, Strauss, and Grisell found that IQ, as measured at admission, is related to length of hospitalization, the findings of three studies of premorbid IQ and length of hospitalization are inconsistent. Offord and Cross (1971) examined the relationship between childhood (premorbid) IQ and length of hospitalization for 29 schizophrenics at three age levels: 20 to 29, 30 to 39, and 40 or older. These investigators calculated the number of months of institutionalization for each of the subjects. For all three age groups, patients with lower childhood IQs had accumulated more institutional time. For patients who were at least 30, for example, those with childhood IQs under 80 had spent an average of 4 more years in institutional care than patients with IQs of 100 or above.

However, Watt and Lubensky (1976) found no relation between patient-sibling IQ discrepancies and length of hospitalization. As mentioned earlier, these authors obtained a childhood IQ score for 50 schizophrenic patients and their siblings by averaging scores from all IQ tests administered between kindergarten and high school. Subjects were matched with control classmates on the basis of sex, race, social class of origin, and migratory status. Watt and Lubensky determined the length of hospitalization for each patient during the first 4 years after initial admission, and then divided them into two groups: those hospitalized less the 260 days (short hospitalization) and those hospitalized for 260 days or more (long hospitalization). Although the preschizophrenic children had significantly lower test scores than their matched controls, long-hospitalized patients and short-hospitalized patients differed about equally from their siblings and matched controls. However, premorbid IQs of the long- and short-hospitalized groups were not directly compared; consequently the Watt and Lubensky study does not provide a direct test of the relationship between length of hospitalization and premorbid IQ. The only study that directly examined this relationship and found negative results was conducted by Schwartzman, Douglas, and Muir (1962). These authors found no relationship between premorbid test scores on the Canadian Army "M" test and length of hospitalization for 23 schizophrenic patients.

In summary then, Schwartzman, Douglas, and Muir (1962) found no premorbid IQ-length of hospitalization relationship, while the study of Offord and Cross (1971) provided some evidence for such a relationship. The difference between these two studies in age of subjects at premorbid assessment limits the comparability of the results. It is likely, however, that the sample of Schwartzman, Douglas, and Muir constituted a more select and restricted sample of preschizophrenic subjects—namely, those who were deemed eligible to serve in the armed forces. Offord and Cross's sample had an average childhood IQ of 86.6, while the Schwartzman group's sample had an average test score that did not differ significantly from the average score for all army inductees. It is possible, then, that premorbid IQ scores are related to length of hospitalization only when a broader range of premorbid IQs is considered.

There is considerable evidence that IQ is positively correlated with age at onset of illness. Offord and Cross (1971) found that premorbid IQ was associated with age at first hospitalization in their sample of schizophrenic patients: Patients with childhood IQs below 80 were hospitalized 4 years earlier than those with IQs between 80 and 99, and almost 10 years earlier than those with IQs above 100. Postmorbid IQs have also been found to vary with age at hospitalization. In the report by Pollack (1960), discussed above, schizophrenic and nonschizophrenic psychiatric patients (manic-depressives, psychoneurotics, behavior disorders) were divided into three groups: preadolescents (6–9 years), adolescents (13–18 years), and adults (19–44 years). At 1 year before the current admission, most of

these patients had never been hospitalized. Pollack found that for both the schizophrenic and nonschizophrenic patients, the mean IQ scores of the preadolescent patients were significantly lower than average (75.1 and 93.9, respectively), and were significantly lower than the mean IQs of the other age groups; the same was true for adolescents under 15 years of age. The differences among the age groups were much smaller, however, for the nonschizophrenic patients when compared to schizophrenic patients (a 40-point difference between the preadolescent and adult schizophrenic patients vs. a 19-point difference between the preadolescent and adult nonschizophrenic patients). The author concludes that age at onset of psychiatric disorder is positively related to IQ, and that this may be especially true for schizophrenic patients.

Several subsequent studies have yielded results that are consistent with this conclusion. Smith (1964) reports that younger schizophrenic patients scored significantly lower than older patients both on initial testing (mean = 80 vs. mean = 101) and on retesting 8 years later (mean = 86 vs. mean = 103). Pollack et al. (1968) found that schizophrenics who were between 30 and 57 years old at first admission had significantly higher mean IQ scores than those admitted before the age of 30. The results of this investigation also revealed that early onset (adolescence, early adulthood) schizophrenic patients were predominantly male, and showed evidence of minimal brain damage during childhood, as well as low IQ. Similarly, a retrospective study by Pollack, Levenstein, and Klein (1968) indicated that low IQ in adult schizophrenic patients is associated with academic performance deficits in childhood, and Belmont et al. (1964) report that schizophrenic patients with low IQs were more likely to have shown marked childhood behavior disorders. Consistent with Pollack, Levenstein, and Klein (1968), Belmont et al. (1964) also found that childhood behavior disturbance was more prevalent among male schizophrenics and tended to be associated with signs of central nervous system impairment.

In another study relating age of onset and IQ, Pollack, Woerner, and Klein (1970) subdivided their samples of schizophrenic and personality-disordered patients into three groups; those with age of onset of serious symptoms before 13 years, between 13 and 16 years, and after 16 years. For both diagnostic groups, patients with symptom onset before age 13 had the lowest mean IQ scores. When the patients' adult IQ scores were compared with the adult IQ scores of their siblings, it was found that the schizophrenic patients with childhood onset had significantly lower IQ scores than their siblings, whereas those with early adolescent (ages 13–16) or late adolescent-adult (16 years or older) onset did not differ from their siblings on IQ. Personality-disordered patients with childhood or early adolescent onset also had significantly lower IQ scores than their siblings. Thus, the findings of Pollack, Woerner, and Klein (1970) provide additional evidence for a strong relationship between IQ and age of onset of schizophrenia, and suggest that the relationship may hold for other disorders as well.

Jones (1973) examined the relationship between the premorbid IQs of schizophrenic patients and indirect measures of another prognostic indicator, heterosexual adjustment. His measures of heterosexual adjustment were marital status and fertility rates among 114 male and 108 female schizophrenic patients. For about one third of this sample, IQ scores were obtained from elementary or junior high school records. The rest of the patients were tested during hospitalization with either the WAIS or the General Aptitude Test Battery (test "G" from the latter test was rescored and used as the measure of IQ). There was a significant correlation between IQ and number of children for male patients, but not for female patients. Similarly, males with higher IQs were significantly more likely to have been married at some time than males with lower IQs. This relationship did not hold for the female patients. These results could be interpreted as indicating that male, but not female, sex role expectations for heterosexual relationships are linked to cognitive competency. Alternatively, it is possible that male patients with lower IQs are more seriously disturbed and consequently less capable of, or less interested in, establishing a relationship.

In general, the studies reviewed here suggest a fairly consistent relationship between higher IQ and more positive outcome for schizophrenic patients, whether outcome is indexed by psychiatric ratings, incidence of remission, or length of hospitalization. Similarly, prognostic indicators such as age at onset and heterosexual adjustment are positively related to IQ. Finally, it appears that a premorbid history of behavioral disturbance and low IQ is more common among males.

Are There Patterns of Premorbid or Postmorbid Subtest Performance That Characterize or Predict Schizophrenia?

As previously mentioned, many of

the early (i.e., pre-1960) studies investigating the relationship between schizophrenia and IQ were concerned with determining whether specific patterns of test performance characterize various mental disorders. The purpose of these studies was to provide information that would allow the IQ tests to be used as a tool in diagnosis. In a review of studies that looked for differential patterns of performance on the Stanford-Binet, Brody (1942) concluded that "the mental test pattern in the developed psychoses is remarkably constant. . . . The typical pattern is: vocabulary highest, verbal test ability second, non-verbal test ability lowest" (p. 255). Similarly, Wechsler (1958) characterized the performance of schizophrenics on the Wechsler-Bellevue and WAIS tests as generally showing a higher Verbal IQ than Performance IQ score.

Based on the observation that verbal scores, particularly scores on the Vocabulary subtest, are generally higher than nonverbal scores, several early investigators attempted to design methods for estimating general intellectual deterioration in schizophrenic patients. Payne (1960) reviews several of these methods, including the Babcock-Levy test for the measurement of efficiency of mental functioning (Babcock and Levy 1940), the Shipley-Hartford test of deterioration (Shipley 1940), and the Hunt-Minnesota test for organic brain damage (Hunt 1943). All of these tests, Payne notes, are based on the assumptions that vocabulary measures have a high correlation with other measures of general intelligence and, when scores of normal and psychotic groups are compared, the test yielding the smallest mean difference is generally a vocabulary test. Thus, early investigators in this area assumed that vocabulary is the ability least affected by mental illness, and that a patient's current vocabulary score is a good indication of his pre-illness level of overall intelligence. Payne notes, however, that none of the early methods for estimating pre-illness intelligence were ever directly validated or standardized on psychiatric patients.

Much of the early research that examined the issue of differential deterioration of intellectual abilities used the Babcock-Levy test, or other similar methods, to estimate premorbid intelligence. By comparing the schizophrenic patients' postmorbid scores on various subtests with their estimated premorbid level of intelligence, investigators drew conclusions about the intellectual abilities most affected by the disorder. Because of the lack of validation and standardization of the methods used to estimate premorbid intelligence, one must question the findings of studies that used this design. It is possible that the postmorbid pattern of performance detected in these studies actually predates the onset of symptoms and reflects the predisposition to schizophrenia. Also, these studies did not attempt to match subtasks on discriminative power (Chapman and Chapman 1973), so the results may represent spurious consequences of the differential psychometric properties of the tasks. One cannot, however, discount the possibility that differential postmorbid deterioration does occur in schizophrenia. In reviewing the studies that used the Wechsler, Stanford-Binet, or Thurstone tests, Winder (1960) concludes:

> It seems very plausible that differential deficit will be found only in certain schizophrenics, not as a characteristic of all or even the majority of schizophrenic patients. [p. 204]

Subsequent investigations have used somewhat more sophisticated paradigms to study differential deterioration in schizophrenia. These investigations can be divided into three groups: studies comparing subtest patterns of schizophrenic patients with those of controls; studies comparing patterns of schizophrenic subgroups; and those comparing subtest patterns on tests taken before the onset of the disorder, or at time of hospital admission, with patterns on tests taken after several years of hospitalization. The literature relevant to these three topic areas is discussed separately.

Differentiating Schizophrenic Patients From Normal Controls and Other Patient Groups. One of the few replicated findings from research on subtest performance is that schizophrenics, and some other patients, tend to show higher Verbal than Performance IQs. Parker and Davidson (1963) compared WAIS Verbal (VIQ) and Performance (PIQ) scores of 50 psychotic patients (mixed diagnosis) with scores of 50 student nurses who were matched with the patients on Full Scale IQ. For both groups, Verbal IQ scores were significantly higher than Performance IQ scores; however, the VIQ-PIQ difference was significantly greater for the psychiatric patients than for the controls. The mean VIQ-PIQ difference for 30 patients diagnosed as psychotic (including patients with schizophrenia, manic-depression, psychopathic personalities with psychosis, and involutional psychosis) was 9.96; the mean difference for the controls was 3.9. (No significance tests were conducted on the difference scores.)

Comparisons of schizophrenic patients with brain-damaged patients indicate that both groups are charac-

terized by higher VIQ than PIQ; however, there is limited evidence to suggest that these two groups differ on more specific subtest patterns. Watson (1965) compared WAIS scores of schizophrenic patients with those of patients with organic brain damage. Patients in the two groups were matched for mean age, education, Full Scale IQ, and total length of hospitalization. For both schizophrenic and brain-damaged patients, the mean Verbal IQ score was significantly higher than the mean Performance IQ score. The subtest × diagnosis interaction was significant only for the long-term hospitalized group (hospitalization > 37.5 months). Post hoc analyses indicated that the Digit Span score was significantly higher for long-term schizophrenics than for long-term brain-damaged patients.

Another similar pattern of subtest performance was reported by DeWolfe et al. (1971) who compared WAIS subtest scores of chronic schizophrenic patients with those of patients with nonlateralized brain damage. Patients in the two diagnostic groups were divided according to age, with patients in the older group being 60 years and over, and patients in the younger group being ages 26-59. For each subtest, a mean deficit score was calculated by subtracting each subject's subtest score from the mean of all his or her subtests. DeWolfe et al. found significant differences between schizophrenic and brain-damaged patients on deficit scores for the Digit Span and Comprehension subtests, with schizophrenic patients showing greater deficit on Comprehension and less deficit on Digit Span than the brain-damaged patients. For the older patients, significant differences between the two diagnostic groups were also found for the Picture Completion and Block Design deficit scores. Schizophrenic patients showed more deficit on Picture Completion than the brain-damaged patients, but less deficit on the Block Design subtest. However, subsequent attempts to replicate these findings have proved unsuccessful (Davis, DeWolfe, and Gustafson 1972; Chelune et al. 1979).

In a recent study, Lehman, Chelune, and Heaton (1979) compared WAIS scores of normal control subjects with scores from schizophrenic patients, patients with acute brain damage, and chronic brain-damaged patients (the latter two groups being distinguished according to the suddenness of onset and rapidity of progression). The normal controls obtained significantly higher Full Scale IQ scores than the other three groups, and the schizophrenics scored significantly higher than the acute brain-damaged patients. When groups were compared on intertest variability, the normals differed significantly only from the acute brain-damaged group. Comparisons of the normal group with the schizophrenic and the chronic brain-damaged groups reached marginal significance, with the normals showing the smallest amount of intertest variability. In another report from this research team, subtest performance patterns of the patient groups were compared (Chelune et al. 1979). A discriminant function analysis indicated no group differences in patterns of subtest scores.

Thus, comparisons of schizophrenic and brain-damaged patients suggest that both groups show intellectual deficits, and no specific pattern of subtest performance distinguishes them. Similarly, the results of research investigating subtest patterns among various psychiatric diagnostic groups indicate that there are no distinguishable patterns. For example, Pollack, Woerner, and Klein (1970) compared adult IQ scores of schizophrenic patients, personality-disordered patients, and their normal siblings. The subtest patterns were similar for all groups, with Verbal IQ scores being higher than Performance scores. For both diagnostic groups, patients' scores on Vocabulary, Digit Span, Digit Symbol, Comprehension, Picture Completion, and Object Assembly were significantly lower than those of their siblings. The mean scores of schizophrenic patients did not differ significantly from those of the personality-disordered group on any of the subtests. Similar results are reported by Schoonover and Hertel (1970), who examined WISC scores for children in the following nine diagnostic categories: mental deficiency, chronic brain syndrome, schizophrenic reaction, psychoneurotic disorder, personality pattern disturbance, personality trait disturbance, sociopathic personality disturbance, special symptom reaction, and transient situational personality disorder. The children in the schizophrenic reaction, mental deficiency, and chronic brain syndrome groups scored significantly lower than the other six groups on Full Scale IQ. No systematic relationship was found between diagnostic categories and VIQ-PIQ differences or subtest patterns. The authors conclude that their data do not support the hypothesis that diagnostic categories are differentiated readily by WISC scores alone.

Attempts to use Wechsler's (1958) subtest criteria for differentiating among diagnostic groups have also been unsuccessful. Wechsler and Jaros (1965) conducted a study to determine whether IQ patterns could discriminate between normal and schizophrenic children. For ages 8, 9,

10, and 11 years, WISC scores of 25 normal boys were compared with scores of 25 young schizophrenic males. It was concluded that five pattern "signs" could discriminate significantly between the two groups at each age level. These were: (1) three subtests, each deviating by 3 or more scaled score points from the mean; (2) Picture Arrangement score greater than Picture Completion score, and Object Assembly score greater than Coding score, each by 3 scaled score points; (3) Comprehension score greater than Arithmetic score, and Similarities greater than Arithmetic by 3 scaled score points; (4) Verbal IQ minus Performance = ±16 points; and (5) Sign #1 plus any one of the other signs. In a later study by Kissel (1966), four of the five signs found in the Wechsler and Jaros (1965) study were applied to WISC scores of delinquent and acting-out children. The signs were found to be almost as sensitive in detecting nonschizophrenic, emotionally disturbed children, suggesting that these IQ pattern "signs" are not unique to schizophrenia.

A recent investigation of subtest patterns among psychiatric patients was reported by Holland and Watson (1980). These authors administered the WAIS and the Minnesota Multiphasic Personality Inventory (MMPI) to 84 patients with organic brain syndrome, 162 schizophrenics, 86 neurotics, and 91 alcoholics shortly after hospital admission. The schizophrenic patients were subdivided into process and reactive types on the basis of whether they had ever been married. One-way analyses of variance on each of the WAIS subtests indicated that patients with process schizophrenia scored significantly lower than the mean for all patients on the Comprehension and Arithmetic subtests. Patients with reactive schizophrenia did not differ significantly from the mean on any of the WAIS subtests. When a multiple discriminant analysis was performed, three discriminant functions for the combination of WAIS and MMPI scores were statistically significant. One of these, which was most highly correlated with the Digit Symbol, Block Design, and Object Assembly subtests of the WAIS, significantly discriminated the process and reactive schizophrenic patients from the brain-damaged and alcoholic patients, but not from the neurotic patients. No direct comparisons were made to determine whether the groups differed significantly on any of these scales.

In summary then, studies that compare subtest patterns for various diagnostic groups suggest that VIQ-PIQ differences may be greater for *all* psychiatric patients than for normal controls, but that subtest score patterns do not consistently differentiate among schizophrenic patients, other psychiatric patients, brain-damaged patients, and normals.

Differentiating Among Schizophrenic Patients. Several studies have attempted to determine whether certain subtest patterns can distinguish between schizophrenic patients who differ on one or more of the following characteristics: age, length of hospitalization, neurological damage, presence of paranoid symptoms, premorbid status, and chronicity. DeWolfe et al. (1971) compared scores of older and younger psychiatric patients (schizophrenic and brain-damaged patients) and found a significant age × subtest interaction, indicating that subtest patterns differ for the young and old patients. As mentioned above, DeWolfe et al. found significant subtest differences between older schizophrenic and brain-damaged patients; schizophrenic patients showed more deficits on Picture Completion than brain-damaged patients; but less on Block Design. No direct comparisons of deficit scores for older vs. younger schizophrenics were performed, however. In a study that did directly compare older and younger patients, Smith (1964) found significant differences between young (mean age = 34 years) and older schizophrenic patients (mean age = 53) on the Comprehension, Arithmetic, Vocabulary, Picture Completion, and Block Design subtests of the Wechsler-Bellevue test. On all of these subtests, the younger patients performed better. Since these measures include verbal and nonverbal subtests, Smith concluded that the nature of impairment in the older schizophrenic patients is nonspecific. It should be noted, though, that the Smith study did not control for normal changes that accompany aging. Hamlin and Ward (1965) also found significant differences in patterns of subtest scores between older and younger schizophrenics: this pattern difference involved loss on perceptual-motor tasks, with stability or slight gains on symbolic tasks. However, they found the same differences for aging nonpatients, suggesting that differences found between young and old schizophrenic patients were not necessarily related to changes in the course of their illness.

We know of only two investigations (Davis, Dizzonne, and DeWolfe 1971; Goldstein and Halperin 1977) that have attempted to distinguish among diagnostic subgroups of schizophrenic patients on the basis of subtest patterns. Davis, Dizzonne and DeWolfe (1971) compared WAIS subtest scores for 40

schizophrenic patients equally divided among four groups on the basis of premorbid history (reactive vs. process) and the length of time they had been hospitalized (mean length of hospitalization for the short-term group was 1.08 years; mean hospitalization for the long-term group was 5.04 years). In all four groups, the patients performed more poorly on the performance measures than on verbal measures. Relative subtest scores were obtained for each patient by subtracting each subtest score from the subject's overall subtest score mean. Short-term patients tended to do better on the Similarities and Comprehension subtests and more poorly on the Arithmetic subtest than did the long-term patients. Patients with reactive schizophrenia scored significantly higher on the Digit Symbol test than did the patients with process schizophrenia. It should be noted that Holland and Watson's (1980) discriminant function analysis (described earlier) also found that the Digit Symbol test differentiated between patients with process and reactive schizophrenia.

Goldstein and Halperin (1977) administered the WAIS, Halstead-Reitan battery, and several other measures to 140 schizophrenic patients. Patients were divided into subgroups according to three criteria: paranoid vs. nonparanoid, long-term vs. short-term (< 1 year of hospitalization vs. > 1 year); and neurologically normal vs. abnormal. These authors used WAIS subtest scores, scores from the Halstead-Reitan battery, and associated measures as independent variables in stepwise discriminant analyses designed to distinguish between patients on the three criterion variables. Among the 10 measures which, when taken together, significantly discriminated between paranoid and nonparanoid subjects were the WAIS Arithmetic, Information, Comprehension, and Vocabulary subtest scores. The three WAIS subtests that contributed most to the discrimination between neurologically normal and abnormal patients were Object Assembly, Block Design, and Arithmetic Scores. Long-term vs. short-term hospitalization was best discriminated by WAIS Digit Span, Digit Symbol, Object Assembly, Picture Arrangement, and Picture Completion. (No direct comparisons were made to determine the direction or significance of differences between the groups.) In contrast, it should be noted that the study of Davis, Dizzonne, and DeWolfe (1971) found that Comprehension, Similarities, and Arithmetic were related to length of hospitalization. Thus, the results of these studies show little convergence and suggest that length of hospitalization is not related to specific subtest scores. However, additional research is needed to establish that premorbid status, neurological impairment, or the paranoid-nonparanoid distinction are related to subtest patterns.

Changes in Subtest Performance Patterns Over Time. Longitudinal studies have also examined subtest pattern changes in schizophrenic patients. Two studies (Lubin, Gieseking, and Williams 1962; Schwartzman and Douglas 1962) have compared premorbid subtest patterns from the time of army enlistment with postmorbid subtest patterns. Others have looked at subtest pattern changes that occur after 8 years of hospitalization (Smith 1964; Klonoff, Fibiger, and Hutton 1970). In the study of Lubin, Gieseking, and Williams (1962), premorbid scores on the Army Classification Battery (ACB) were compared to scores taken 1–3 months after hospital admission for paranoid schizophrenic, nonparanoid schizophrenic, brain-injured, and nonpsychiatric patients. No significant differences in amount or pattern of deficit were found between the two schizophrenic groups. For both paranoid and nonparanoid schizophrenic patients, all the ACB tests, except Pattern Analysis, showed a significant drop from premorbid levels. In general, the nonspatial tasks (Reading and Vocabulary, Arithmetic, Reasoning, and Army Clerical Speed) showed more premorbid-postmorbid decline than the spatial tests (Pattern Analysis and Mechanical Aptitude subtests). Comparing schizophrenic patients and controls, Lubin, Gieseking, and Williams found that schizophrenic patients showed significantly more decline than controls, and that this differentiation was particularly dependent on the nonspatial subtests of Reading and Vocabulary and Army Clerical Speed. Finally, in comparisons of schizophrenic and brain-damaged patients, it was found that schizophrenic patients have less overall impairment than brain-damaged patients, but that the general pattern of decline is similar. The results of the study of Lubin, Gieseking, and Williams are strikingly inconsistent with the assumption that verbal abilities, particularly vocabulary, are less affected by mental illness than other abilities. However, the findings of a similar study by Schwartzman and Douglas (1962) are consistent with the assumption that verbal abilities are less affected.

Schwartzman and Douglas compared subtest scores from the Canadian Army "M" tests for hospitalized schizophrenic patients, discharged schizophrenic patients, and normal veterans. For each

patient, scores on the "M" tests were obtained from the time of army induction and at postmorbid retesting. The "M" test is divided into three main parts: nonverbal, mechanical knowledge, and verbal abilities. The nonverbal section consists of three tests: picture completion, picture absurdities, and paper formboard. The two mechanical tests are tool recognition and mechanical information. The verbal section consists of arithmetic, vocabulary, and verbal analogies. The control subjects manifested no significant losses at retesting. In contrast, the patients showed significant decreases between premorbid and postmorbid testing on *all* subtests except paper formboard, vocabulary, and verbal analogies; the ex-patients showed significant loss *only* on tool recognition and mechanical information.

Thus, when examining premorbid-postmorbid subtest patterns, the Schwartzman and Douglas study lends support to the assumption that schizophrenic patients' verbal abilities remain intact while other abilities decline. But the results of the study by Lubin, Gieseking, and Williams (1962) contradict this assumption. There are at least two possible explanations for these contradictory findings. First, the inconsistent results may be due to differences in the measures used in these studies. Since the tests used by both Schwartzman and Douglas, and Lubin, Gieseking and Williams were strictly timed and contained similar content, it is unlikely that measurement differences are the crucial factor. Another possible source of the inconsistency is the difference in premorbid-postmorbid test intervals. Lubin, Gieseking, and Williams administered the postmorbid test 1 to 3 months after hospitalization, whereas Schwartzman and Douglas tested their patients more than 6 to 12 months after hospitalization. Thus it may be that *all* abilities show a decline with the onset of schizophrenia, but that after 6 or more months, premorbid verbal abilities are regained.

The findings from studies that have looked at subtest pattern changes over the course of the illness are also contradictory. Smith (1964) examined subtest changes of young nonparanoid schizophrenic and older paranoid schizophrenic patients on the Wechsler-Bellevue. Patients had been hospitalized for a mean of 8–9 years before the initial tests and were retested 8.4 years later. The younger schizophrenic patients showed slight losses on the Object Assembly subtest. The older group showed losses on Information, Comprehension, Similarities, Vocabulary, Picture Arrangement, Picture Completion, and Block Design. Using these same subjects, Hamlin (1969) found that the patterns of change over 14 years for Verbal and Performance scores were generally the same, and this held for both the younger nonparanoid and the older paranoid schizophrenic patients. Hamlin concludes that "deterioration does not occur in some intellectual functions, with other functions remaining intact" (p. 502).

In contrast, Klonoff, Fibiger, and Hutton (1970) found that VIQs of schizophrenics were more stable than PIQs. These authors compared WAIS scores upon hospital admission with scores from the same test administered 8 years later. VIQs showed significantly less change over the years than PIQs. As with the studies on premorbid-postmorbid changes, the inconsistencies in the findings of the studies of Smith (1964) and Klonoff, Fibiger, and Hutton (1970) may be due to differences in the times of testing. In this case, the studies differ in the times of initial as well as followup testing.

To date, the results of studies that have attempted to determine whether subtest patterns are related to chronicity or schizophrenic subtype must be considered inconclusive. There have been no reported attempts to replicate most of the findings presented here. However, the issue of subtest patterns has gained increasing relevance in light of recent theories regarding unilateral hemispheric dysfunction in schizophrenia (Walker and McGuire 1982).

Summary and Conclusions

This review has focused on research spanning the past two decades in order to address five major questions about the relationship between intelligence and schizophrenia. Although there is sufficient evidence to answer some of the questions with confidence, others must await the results of future research. We attempt, here, to summarize what we do and do not know.

There is strong evidence that diagnosed schizophrenic patients score lower on standardized measures of intelligence than would be predicted from family and environmental variables. Moreover, premorbid scores of schizophrenic patients, obtained during childhood, adolescence, and early adulthood, are lower than the scores of their siblings and peers with similar social class origins. Thus IQ deficits appear to be associated with schizophrenia across the lifespan. However, the results of our meta-analysis indicate that premorbid IQ deficit may be an exclusive, or more pronounced, characteristic of schizophrenic males. The data also provide some support for the hypothesis that IQ deficits of preschizophrenic children, relative to

their siblings, are less pronounced when the average IQ score for the siblings is higher. Given the likely higher SES of the families of these children, the results are consistent with the notion that environmental factors can ameliorate cognitive deficits (Rubin and Balow 1979).

There does not appear to be a prodromal decline in IQ for schizophrenic patients. That is, although premorbid IQ may be lower than would be expected from family and environmental variables, it does not appear to drop before the overt appearance of schizophrenic symptoms. Results from studies that have examined changes between premorbid and postmorbid IQs are equivocal. It is not known, then, whether deterioration in IQ is a concomitant of the overt manifestation of schizophrenia. However, it can be concluded that continual deterioration in intellectual functioning during the course of the illness is by no means a necessary characteristic of schizophrenia. Furthermore, when increases in IQ do occur during the course of the illness, they are usually accompanied by improvement in psychiatric symptoms.

Higher IQs obtained at hospital admission or during the course of hospitalization are associated with greater clinical improvement, better outcome ratings, shorter hospitalization, later onset of illness, and better heterosexual adjustment. It is not clear whether premorbid IQ scores are equally related to these outcome indicators. It is possible that the relationship between premorbid IQ and outcome was not detected by some investigators because of the restricted range of IQ scores represented in their samples (e.g., Schwartzman, Douglas, and Muir 1962).

Verbal IQ-Performance IQ discrepancies and intertest variability appear to be greater for schizophrenic patients than for normals. However, these indicators are not unique to schizophrenia, as other psychiatric and brain-damaged patients show similar patterns. It should also be noted that the consistent tendency for schizophrenic patients to manifest higher VIQs than PIQs would seem to weaken the analogy drawn between schizophrenic patients and patients with left hemisphere lesions (Flor-Henry 1976).

Along these same lines, it has not been established that any particular pattern of subtest scores can consistently distinguish among schizophrenics who differ on such characteristics as length of hospitalization, age, neurological damage, existence of paranoid symptoms, and reactive vs. process, chronic vs. acute, and discharged vs. nondischarged status. Nor do there appear to be consistent changes in subtest patterns between premorbid and postmorbid testing or between tests administered at hospital admission and tests administered after several years of hospitalization. These results may be interpreted as indicating that schizophrenia is associated with generalized deficits in cognitive functions. Alternatively, it may be that the measures used in the research, to date, were not capable of detecting the specific pattern of intellectual impairment associated with schizophrenia.

In summary, then, it appears that at least some cases of schizophrenia are associated with moderate intellectual deficits across the lifespan, that prognosis is related to IQ, and that variations in symptomatology are associated with changes in IQ. This pattern of results is interpretable from at least three perspectives. First, intellectual ability can be viewed as an independent mediating factor: High IQ may reduce susceptibility to schizophrenic breakdown, and enhance the likelihood of remission in those who develop the disorder. Thus, intellectual ability may determine the individual's capacity to cope with the environmental stressors that precipitate breakdown or worsen prognosis. From this perspective, the fluctuations in IQ that accompany symptomatological changes might be attributed to transient alterations in motivational state. However, the hypothesis that IQ is an independent, mediating factor is not sufficient to account for the apparent link between premorbid IQ and gender, or the IQ deficits noted in siblings of schizophrenic patients. As a second approach, intellectual deficit can be viewed as one manifestation of a genetically determined constitutional vulnerability to schizophrenia. This interpretation is compatible with the finding of IQ deficits in siblings of schizophrenics. Individual differences in premorbid and postmorbid IQ would therefore reflect individual differences in degree of liability predisposition, as well as episodic fluctuations in symptomatology. Third, if etiologic heterogeneity exists, IQ deficit may be associated with a specific subtype of schizophrenia. Acquired central nervous system dysfunction may be the primary determinant of this subtype, thus resulting in a higher incidence of premorbid IQ deficit in males. Finally, it is possible that all three perspectives have merit: Intellectual capacity may be partially determined by acquired or inherited constitutional vulnerability to schizophrenia, but at the same time act to mediate the effects of stressors on the vulnerable individual. Obviously, differentiating these effects is not an easy task. .

Several issues deserve attention in

future research. One question of tremendous importance is whether environmental enhancement of intellectual abilities can serve to mitigate vulnerability in individuals presumed to be constitutionally predisposed. A second area warranting further inquiry is schizophrenic subgroup differences in patterns of intellectual functioning. A few studies have addressed this issue; however, they have tended not to focus on the same subgroups. Consequently, there is no replicative support for the findings that have been reported to date. Studies of IQ using newer subgroup distinctions, such as positive versus negative symptom patients, may be illuminating. Finally, an extremely important issue that has yet to be directly addressed is the possible role of sex differences. Several studies have anecdotally reported sex differences in premorbid IQ; yet, there has been no systematic investigation of sex differences in the intelligence of schizophrenic patients or preschizophrenic children. The results of our correlational analyses indicate that the proportion of males in the samples of preschizophrenic and high-risk subjects is a significant predictor of the effect size obtained. Combined with the demonstrated association between sex and age at onset of schizophrenia (Lewine, 1981), these results point to the possibility of divergent etiological subtypes of schizophrenia in males and females. Specifically, it is possible that there is a subtype of schizophrenia that is characterized by premorbid intellectual deficits and to which males are more vulnerable than females.

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