AN ANALYSIS OF FAMILIAL DATA ON PSYCHIATRIC PATIENTS: PARENTAL AGE, FAMILY SIZE, BIRTH ORDER, AND ORDINAL POSITION

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INTRODUCTION

Most mature students of human personality are agreed that normal and abnormal characteristics are determined by the complex interaction of numerous biological (*e.g.* genetic, neuro-endocrine, or metabolic), psychological, social, and cultural factors (Kluckhohn, Murray, and Schneider, 1953). However, there still exist wide differences of opinion as to the relative importance of various determinants in the causation of specific anomalies of personality and behaviour. While we are sometimes told that the nature-nurture controversy has long since been resolved, there are still many who view personality and its aberrations predominantly from either a genetical or an environmental aspect. The divergent opinions frequently represent at best no more than educated guesses, and at worst merely personal bias which results in unsolved problems being approached with preconceived convictions and consequent distortion of both observations and their interpretation.

Among the important consequences of differences in the orientation of the observer is the interpretation placed on studies of the families of mentally ill patients. There is much evidence of greatly increased incidence of mental illness among other members of the families of patients with certain mental disorders (*e.g.* Pollock, Malzberg, and Fuller, 1939; Kallmann, 1953). However, while some authorities maintain that such intra-familial concentration of these disorders represents mainly random genetic transmission (*e.g.* Kallmann, 1952, 1953; Slater, 1950, 1953), others regard transmission from parent to child as the result of harmful early experiences associated with intricate intra-familial relationships (*e.g.* Masserman, 1946; Lidz and Lidz, 1949; Weiss and English, 1949; Gerard and Siegel, 1950; Bowlby, 1952; Lidz, Parker and Cornelison, 1956).

In view of the observed concentration of mental

disorders in the families of some patients, and the amount of speculation concerning both genetic transmission (Penrose, 1950) and functional interpersonal relationships or dynamics (Cleckley and Thigpen, 1955), it is at first sight remarkable how little is yet known about the structure or composition of the families of the mentally ill. It might perhaps be argued that without such information our investigations of function bear some similarity to the study of physiology in the absence of any knowledge of anatomy. However, the accumulation and analysis of data concerning the families of the mentally ill present serious technical difficulties and have often yielded barren results. Nevertheless, this is a most important area deserving the attention of both the biologist and the social scientist.

Among the familial studies that have been undertaken hitherto have been a number of investigations of parental age, family size, birth order, and ordinal position. Scientific interest in these variables developed during the latter part of the 19th century, in association with publications by Galton and other writers on heredity and eugenics. In the early years of the 20th century several quite extensive studies of family size and birth order were made, but early statistical techniques of analysis led to erroneous conclusions.

In their classic work on the determination of family size and of the distribution of characters in order of birth, Greenwood and Yule (1914) subjected to critical analysis earlier studies by Karl Pearson (1907), David Heron (1907), and Charles Goring (1913), which had appeared to indicate unduly large families, combined with an increased incidence in firstborn, in cases of tuberculosis, insanity, and criminality.

These latter findings had previously been criticized on various grounds by other writers' (Weinberg, 1910, 1913; Ploetz, 1913; Macaulay, 1912), and in their analysis of the data Greenwood

and Yule (1914) showed that the sizes of the families involved were not in fact unduly large, but if anything below average. They also failed to find any pathological weighting of the earlier born members of the sibships containing Heron's insane patients, although some degree of such weighting was evident among the sibships of tuberculous patients and criminals. In a series of imbeciles, which had been reported on by Pearson and other writers, they found a definite excess of first and second born children (amounting to about 10 per cent.), but also a proportionately greater excess of birth orders from the eighth onwards (amounting to over 40 per cent.). However, it is not clear to the present author whether this sample of imbeciles was drawn only from completed families, failing which the method of analysis would of itself tend to produce undue weighting in the later birth orders (McKeown and Record, 1956).

Pearson (1914) wrote at some length on the handicapping of the first born, and the impression has since remained that the latter are indeed more vulnerable with respect to the physical and mental abnormalities which are evident at birth or very early in life. An exception is provided by mongolism which occurs in the last born in about 50 per cent. of cases. However, this anomaly is also associated with advanced maternal age at birth of the affected child, and Penrose (1934) was able to demonstrate that the incidence of mongolism depends upon maternal age and not upon birth order (a conclusion reflected in a more recent statistical study by Malzberg, 1950). Achondroplasia occurs frequently in last born children, but is associated with increased age of the father rather than the mother. Anencephaly, on the other hand, shows no appreciable association with the age of either parent (Record and McKeown, 1949) and is more common in the early birth ranks. The interpretation of such findings has been discussed recently by Penrose (1955) and McKeown and Record (1956).

The studies on parental age and birth order outlined above have been of interest mainly to biologically-oriented scientists. Ordinal position in the family, on the other hand, has been of greater concern to those with a predominantly psychosocial conceptual framework. For several decades, theories relating ordinal position to personality characteristics, and to the incidence of neurosis and other disorders, have been associated in many persons' minds with the name of Adler. Unfortunately, Adler's rather dogmatic assertions were based on impressions derived from clinical experience rather than on scientific observation, and his

views appear to have undergone some modification with the passage of time. Thus, in 1918, he stated that "the restless neurotics are, to a preponderating degree, second born children", while subsequently (quoted by Ansbacher and Ansbacher, 1956) he remarked that "in my experience the greatest proportion of problem children are oldest children; and close behind them come the youngest children".

Numerous other authors have added their own clinical impressions regarding the supposed vulnerability of some particular ordinal position. Thus Brill (1922) remarked that it would be best for the individual as well as the race that there should be no only children, while Hill (1945) asserted that a large proportion of eldest children develop into problem children, and also that a large number of youngest children fill the ranks of problem children, neurotics, and criminals.

Concurrently, there have been numerous attempts to relate ordinal position to various traits of personality, but when Murphy, Murphy, and Newcomb (1937) reviewed several hundred of these studies they found conflicting results. More recently attempts have been made to study ordinal position in relationship to the sex of the child, social class, and childhood experiences based on intra-familial interaction (*e.g.* Krout, 1939; Sears, 1950, 1957; Roberts and Myers, 1954).

The only articles with which the present author is familiar that include numerical comparisons of psychiatric disorders according to ordinal position (*e.g.* Norton, 1952; Wahl, 1954, 1956) use percentage figures, which depend in part upon the frequency distribution of family sizes in the sample. Estimates of mean family size reported in these articles also appear to be biased in the manner described by Greenwood and Yule (1914). However, Norton's study also includes interesting data on maternal age, birth order, and loss of a parent, and the data are so presented that further analysis is possible. In addition, Norton (1957) has been kind enough to provide supplementary unpublished data concerning both his series of psychiatric patients and of physically ill controls.

In the present article, it is planned to analyse further the data recorded by Norton (1952, 1957) on a large series of psychiatric patients (predominantly neurotic), and also certain data recorded by Malzberg (1938) concerning patients with dementia praecox and with manic-depressive psychoses, which he examined with regard to birth order (with negative findings).

METHOD

SOURCES OF DATA

Malzberg's cases consisted of 549 first admissions with dementia praecox, and 498 first admissions with manic-depressive psychoses, received at Manhattan State Hospital, New York, from 1930 to 1935. The patients were selected from the hospital records in the order of admission, but were excluded from tabulation when information was not sufficiently detailed, or when the patient was illegitimate, or had a half-sibling. The mean age at admission of patients with dementia praecox and with manic-depressive psychoses were 31.5 and 32.3 years respectively. These cases included both whites and Negroes, and Malzberg (1957) estimates the proportion of Negroes as somewhat in excess of 20 per cent.

Norton's 2,500 psychiatric patients were derived in two ways. 500 were a random sample of patients aged 15 years or more attending the psychiatric department of a general hospital (The London Hospital, England) during the period July, 1947, to July, 1948. Particulars of a further 2,000 patients who had attended the department between 1943 and 1947 were abstracted from their records. Most of the patients were suffering from psychoneuroses or personality disorders; those having florid psychoses and organic mental disorder were excluded, but the series contains a few mild endogenous depressives accounting for less than 10 per cent. of the total. The median age of the sample of 500 patients, calculated from unpublished data (Norton, 1957), was 30.4 years.

Norton's 500 controls were physically ill patients selected from the general in-patients of the hospital, who were matched for age and sex (and, less reliably, for social class). Patients referred for psychiatric consultation were rejected, as were those admitted for skin and neurological disorders. The period covered in collecting information about the control series was December, 1947, to March, 1949.

Since the publication of each of the two articles under consideration, detailed data has become available on the distribution of family sizes in the general populations from which the subjects were drawn (U.S. Bureau of the Census, 1943, 1947; Royal Commission on Population, 1954), and these sources of information have been used for comparative purposes in the present study.

NATURE OF DATA

In the case of Malzberg's two series of psychotic patients, the data analysed here consist of Tables

giving the numerical distribution of order of birth by size of family.

Similar Tables were utilized for both Norton's psychiatric patients and his controls, additional data being derived in this instance from Tables giving order of birth by maternal age and by paternal age, and also a Table comparing age differences between parents.

COMPARISONS UNDERTAKEN

Several types of comparison which were undertaken are listed below:

- (i) Between maternal age, paternal age, and parental age differences, for 500 of Norton's psychiatric patients and his physically ill controls;
- (ii) Between maternal ages for these two groups and for the general population of England and Wales;
- (iii) Between observed and expected frequencies of birth order and ordinal position. This was based on a reconstruction of sibships by the Greenwood-Yule method (to examine family size and birth order) and an extension of this method (to examine ordinal position) for Norton's psychiatric patients and controls, and for both of Malzberg's series of patients;
- (iv) Between family sizes of Norton's patients and controls, and of Malzberg's two groups of patients;
- (v) Between family sizes for these various groups and the general populations from which they were drawn.

Greenwood-Yule Reconstruction of Sibships, and an Extension of this Method to examine Ordinal Position.

—The method developed by Greenwood and Yule (1914) enables the calculation of corrected family sizes, and of expected frequencies of different birth orders, from samples taken through members of the sibships. The arithmetic involved is simple, but the method is not too widely known or understood, and it has been at times applied incorrectly as shown by McKeown and Record (1956). Some attempt at explanation might be considered desirable on these grounds alone, but in addition an extension of the method has here been used to examine ordinal position, which may require elucidation.

Table I shows the distribution of a model sample of affected subjects by size of sibship and birth order, and Table II shows the reconstruction of

the sibships of which the affected subjects are members. Let us consider separately certain aspects of the calculations concerning family size, birth order, and ordinal position.

The necessity of making a correction for family size depends on the fact that the likelihood of meeting a member of a sibship of any given size in the general population is proportionate to the size of the sibship. Thus, if there were equal numbers of sibships containing x members and of sibships containing only one member, the chances of meeting individuals from sibships containing x members would be x times the chances of meeting only children (provided the sample is small in comparison with the total population). In order to obtain the approximately unbiased frequencies of family size that would have been obtained by taking a sample of *mothers*, it is therefore necessary to divide the biased frequencies obtained through members of the sibships (F_x), by the number of individuals in each sibship (x). Now the *biased* mean size of family is given by the formula $\sum(x F_x)/\sum(F_x)$. The unbiased or *corrected mean family size* is obtained by substituting (F_x/x) for (F_x) in the preceding formula, and is hence given by the formula $\sum(F_x/x)/\sum(F_x/x)$.

It is the distribution (F_x/x) for which other measures of central tendency, and standard deviation, should be derived. In calculating the *standard errors* of the mean, median, and standard deviation, however, there is some doubt whether the number of observations on which the standard error is based should be taken as $\sum(F_x)$ or as $\sum(F_x/x)$. Record (1957) considers that this number lies somewhere between the two, but that it is wiser to err on the conservative side by using the figure $\sum(F_x/x)$, so that estimates of the standard errors will be maximal (McKeown and Record, 1957), and this advice has been followed in calculating the standard errors given in the present study.

It is also the distribution (F_x/x) that must be examined when any comparison is made between sizes of family from which affected individuals came, and sizes of families in *samples obtained through mothers* (as in census figures on fertility). It is necessary to point out, however, that, in order to be comparable, other frequency distributions by size of family must refer to:

- (i) *The same time period, locality, and socio-cultural group;*
- (ii) *All children ever born* (not merely those still living at home, as recorded in some census statistics on housing and families);

(iii) *Completed families* (usually considered as the families of women over the age of 45);

(iv) *Children of mothers only* (figures for number of children ever born per woman reporting, or per married woman, are not comparable).

In the case of **birth order**, Greenwood and Yule calculated expected frequencies on the assumption that within each family of a given size each member or birth order should be affected equally frequently. The expected frequency of each order of birth then is obtained by summing the distribution (F_x/x) from the bottom upwards. The logical basis for this procedure should be apparent from examination of Tables I and II (overleaf). The expected frequency of each birth order may then be compared with the observed frequency by means of the χ^2 test.

To proceed now to the examination of **ordinal position** is very simple, since the distribution (F_x/x) gives the expected frequency of each specific ordinal position (*i.e.* eldest, youngest, and penultimate) for each size of family. Summing (F_x/x) from the bottom upwards (which has already been done in calculating expected frequencies of birth order) will therefore also give the expected total number in each specific ordinal position. Thus it appears that the expected frequency of eldest children (in all families having two or more children) is the same as that for youngest children, and both are the same as the expected frequency of children in the second birth order (E_2). The expected frequency of penultimate children (in all families having three or more children) is the same as that for children in the third birth order (E_3), and the expected frequency of intermediate children is obtained by differencing. In similar manner, the expected frequency of eldest, youngest, or penultimate children in families having x or more members is given by the frequency E_x (see Tables XII and XIII, pp. 54 and 55).

It will have been noted that *these calculations on ordinal position exclude the only child*, although the latter has hitherto been traditionally considered as an ordinal position (*e.g.* Glueck and Glueck, 1950; Norton, 1952; Wahl, 1954, 1956). However, it appears to the present author more appropriate to consider the frequency of only children in relation to the frequency distribution of family sizes (*vide supra*).

The present author has concluded that, when used with caution, the Greenwood-Yule method and the extension described are well suited to examining the sibships of psychiatric patients,

TABLE I
DISTRIBUTION OF SAMPLE OF AFFECTED SUBJECTS BY SIZE OF SIBSHIP AND BIRTH ORDER*
MODEL FOR DEMONSTRATING RECONSTRUCTION OF SIBSHIPS BY METHOD SHOWN IN TABLE II

Birth Order	Size of Sibship (x)						Totals = Observed Frequency of Each Birth Order (O_x)
	1	2	3	4	5	6	
1	a	b ₁	c ₁	d ₁	e ₁	f ₁	$O_1 (a + b_1 + c_1 + d_1 + e_1 + f_1)$
2		b ₂	c ₂	d ₂	e ₂	f ₂	$O_2 (b_2 + c_2 + d_2 + e_2 + f_2)$
3			c ₃	d ₃	e ₃	f ₃	$O_3 (c_3 + d_3 + e_3 + f_3)$
4				d ₄	e ₄	f ₄	$O_4 (d_4 + e_4 + f_4)$
5					e ₅	f ₅	$O_5 (e_5 + f_5)$
6						f ₆	$O_6 (f_6)$
Totals = Frequency of each Sibship of Size x (= F_x)	$F_1 (=a)$	$F_2 (= \sum b)$	$F_3 (= \sum c)$	$F_4 (= \sum d)$	$F_5 (= \sum e)$	$F_6 (= \sum f)$	$N (= \sum F_x = \sum O_x)$

*Dotted lines indicate ordinal positions (eldest, youngest, penultimate, and intermediate).

TABLE II
GREENWOOD-YULE RECONSTRUCTION OF FAMILY SIZE AND BIRTH ORDER OF MODEL SAMPLE OF AFFECTED SUBJECTS SHOWN IN TABLE I AND EXTENSION OF METHOD TO EXAMINE POSITION IN SIBSHIP

Size of Sibship (<i>x</i>)	Frequency of Sibship obtained from Sample of Affected Subjects (<i>F_x</i>)	Weighted Frequency (as would have been obtained from sample of mothers)* (<i>F_x/x</i>)	Expected Frequency of Each Birth Order (summing <i>F_x/x</i> from bottom upward) (<i>E_x</i>)	Observed Frequency of Each Birth Order (<i>O_x</i>)	$\frac{(O_x - E_x)^2}{E_x}$
1	<i>F</i> ₁ (= <i>a</i>)	<i>F</i> ₁ /1 (= <i>a</i>)	<i>E</i> ₁ (<i>a</i> + $\bar{b}$ + $\bar{c}$ + $\bar{d}$ + $\bar{e}$ + $\bar{f}$)	<i>O</i> ₁ (<i>a</i> + <i>b</i> ₁ + <i>c</i> ₁ + <i>d</i> ₁ + <i>e</i> ₁ + <i>f</i> ₁)	..
2	<i>F</i> ₂ (= Σb)	<i>F</i> ₂ /2 (= $\bar{b}$)	<i>E</i> ₂ ($\bar{b}$ + $\bar{c}$ + $\bar{d}$ + $\bar{e}$ + $\bar{f}$)	<i>O</i> ₂ (<i>b</i> ₂ + <i>c</i> ₂ + <i>d</i> ₂ + <i>e</i> ₂ + <i>f</i> ₂)	..
3	<i>F</i> ₃ (= Σc)	<i>F</i> ₃ /3 (= $\bar{c}$)	<i>E</i> ₃ ($\bar{c}$ + $\bar{d}$ + $\bar{e}$ + $\bar{f}$)	<i>O</i> ₃ (<i>c</i> ₃ + <i>d</i> ₃ + <i>e</i> ₃ + <i>f</i> ₃)	..
4	<i>F</i> ₄ (= Σd)	<i>F</i> ₄ /4 (= $\bar{d}$)	<i>E</i> ₄ ($\bar{d}$ + $\bar{e}$ + $\bar{f}$)	<i>O</i> ₄ (<i>d</i> ₄ + <i>e</i> ₄ + <i>f</i> ₄)	..
5	<i>F</i> ₅ (= Σe)	<i>F</i> ₅ /5 (= $\bar{e}$)	<i>E</i> ₅ ($\bar{e}$ + $\bar{f}$)	<i>O</i> ₅ (<i>e</i> ₅ + <i>f</i> ₅)	..
6	<i>F</i> ₆ (= Σf)	<i>F</i> ₆ /6 (= $\bar{f}$)	<i>E</i> ₆ ($\bar{f}$)	<i>O</i> ₆ (<i>f</i> ₆)	..
Totals ..	ΣF_x (= <i>N</i>)	$\Sigma(F_x/x)$	ΣE_x (= $\Sigma F_x = N$)	ΣO_x (= $\Sigma F_x = N$)	χ^2_x
Characteristics of Corrected Family Size (<i>F_x/x</i>) Mode= Median= Mean= Standard Deviation=			Goodness of Fit of Expected and Observed Frequencies of Birth Order $\chi^2 = \chi^2_p$ Degrees of Freedom = <i>n</i> ¹ Probability = <i>p</i>		
Ordinal Position in Sibship (of affected member)		Expected Frequency of Position (<i>E_p</i>)	Observed Frequency of Position (<i>O_p</i>)	$\frac{(O_p - E_p)^2}{E_p}$	Goodness of Fit for Position in Sibship
Eldest		<i>E</i> ₂ ($\bar{b}$ + $\bar{c}$ + $\bar{d}$ + $\bar{e}$ + $\bar{f}$)	<i>O_E</i> (<i>b</i> ₁ + <i>c</i> ₁ + <i>d</i> ₁ + <i>e</i> ₁ + <i>f</i> ₁)	..	$\chi^2_p =$ <i>n</i> ¹ = 3 <i>p</i> =
Youngest		<i>E</i> ₂ ($\bar{b}$ + $\bar{c}$ + $\bar{d}$ + $\bar{e}$ + $\bar{f}$)	<i>O_Y</i> (<i>b</i> ₂ + <i>c</i> ₂ + <i>d</i> ₂ + <i>e</i> ₂ + <i>f</i> ₂)	..	
Penultimate		<i>E</i> ₃ ($\bar{c}$ + $\bar{d}$ + $\bar{e}$ + $\bar{f}$)	<i>O_{pu}</i> (<i>c</i> ₃ + <i>d</i> ₃ + <i>e</i> ₃ + <i>f</i> ₃)	..	
Intermediate		$\Sigma E_x - (E_1 + E_2 + E_3)$	$\Sigma O_x - (a + O_E + O_Y + O_{pu})$	..	
Totals		$\Sigma E_x - F_1$ (= <i>N</i> - <i>a</i>)	$\Sigma O_x - F_1$ (= <i>N</i> - <i>a</i>)	χ^2_p	

* F_x/x also constitutes the expected frequency distribution of each specific ordinal position in the sibship (i.e. eldest, youngest, or penultimate) by size of family. See also Table XII.

since the abnormality is not fully recognized until adult life, and hence:

- (i) The sibships are complete, which is a pre-requisite for application of the method (as otherwise the estimated family sizes are too small, and there is artificial weighting in late birth orders and ordinal positions);
- (ii) Mental illness that is recognized in adult life does not apparently cause increased mortality during childhood.
- (iii) Since the child that will later become mentally ill is not recognized as such by the parents, the latter cannot decide to limit the number of subsequent children on this account (as may occur in the case of some congenital abnormalities).

However, McKeown and Record (1957) have pointed out that the investigation of maternal age and birth order is extremely difficult in mental illness, because of the difficulty of assembling an acceptable control group, or of using the Greenwood Yule method in the case of conditions manifested over a wide age range. Moreover, there now appears to be some doubt whether birth rank comparisons are distributed as χ^2 (Halperin, 1953). A number of possible sources of error are discussed following the presentation of the results (*vide infra*).

THE RESULTS OF ANALYSIS ARE NOW PRESENTED AS FOLLOWS:

- (i) The *parental ages* and age-difference of Norton's psychiatric patients are compared with those of his physically ill controls, and the median maternal ages of both groups are compared with figures of the general population of England and Wales;
- (ii) The distribution of *family sizes* of Norton's psychiatric patients is compared with those of his controls and of the general population of England and Wales.
The distribution of *family sizes* of Malzberg's two groups of psychiatric patients are compared with each other and with selected samples of the population of New York City;
- (iii) The expected and observed frequencies of *birth order* are compared for each of the four samples under analysis;
- (iv) The expected and observed frequencies of different *ordinal positions* are examined for each of the four samples, for families of all sizes, and for families containing four or more members.

RESULTS

(1) PARENTAL AGE (Table III and Table IV, overleaf)

The *mean maternal age* of Norton's psychiatric patients exceeds that of his controls by 1.04 years, which is 2.58 times the standard error of the difference, so that the probability of this difference having occurred by chance is one in a hundred.

Comparison of the *median maternal ages* of both psychiatric patients and controls with the estimated median maternal age for women in England and Wales married in the period 1910-14 (given in the last column of Table IV as 29.79 years) shows good agreement for the controls, but again the difference for the maternal age of the psychiatric patients amounts to about 2.6 times its standard error.

In the case of *paternal age*, comparable figures were not available for the general population, and the nature of the data (Norton, 1957) did not enable the exact calculation of mean, standard deviation, and standard errors, but it may be noted that the median paternal age for patients exceeded that for controls by 0.96 years (as compared with 1.21 years difference between the recorded median ages of the mothers of these two groups).

The *differences between the median ages of father and mother* amounted to 2.08 years in the case of psychiatric patients, and 2.33 years in the case of controls. The latter figure corresponds closely with the figure of 2.3 years given by Penrose (1955) as the difference in mean parental ages for the population of England and Wales in 1939.

TABLE III
MATERNAL AGE AT BIRTH OF 500 OF NORTON'S PSYCHIATRIC PATIENTS (PREDOMINANTLY NEUROTIC) AND OF 500 CONTROLS (PHYSICALLY ILL PATIENTS MATCHED FOR AGE, SEX, AND SOCIAL CLASS), THE LONDON HOSPITAL, ENGLAND, 1947-49 (a) (b) (c)

Characteristics of Maternal Age (yrs)	Psychiatric Patients	Physically Ill Controls
Median	30.74 $\pm$ 0.36	29.53 $\pm$ 0.36
Mean	31.14 $\pm$ 0.28	30.10 $\pm$ 0.29
Standard Deviation ..	6.35 $\pm$ 0.20	6.42 $\pm$ 0.20

Difference between the Two Means: 1.04 $\pm$ 0.404; $t=2.58$; $p<0.01$

NOTES

- (a) *Median age of father at birth* was 32.82 years for 500 of Norton's psychiatric patients, and 31.86 years for his 500 controls (calculated from unpublished data, 1957).
- (b) *Difference between median ages of father and mother* was therefore 2.08 years for Norton's psychiatric patients and 2.33 years for his controls. The latter corresponds with 2.3 years for the differences in mean maternal ages for the general population of England and Wales, 1939 (Penrose, 1955).
- (c) *Mother one or two years older than father* in 74 out of 500 of Norton's psychiatric patients as compared with 47 out of 500 controls. Difference = 5.4 per cent. $\pm$ 2.02; $t=2.67$; $p<0.01$.

TABLE IV

AGES OF WOMEN AT FIRST MARRIAGE AND WHEN HALF OF ALL CHILDREN HAD BEEN BORN, BY DATE OF MARRIAGE, ENGLAND AND WALES, 1900-24.

Date of Marriage	Mean Ages at Marriage by Broad Social Status Groups(a)			Median Ages at Marriage(b)	Median Duration of Marriage when Half of All Children had been Born(c)	Median Age of Mother when Half of All Children had been Born(d) (add two preceding columns)
	Non-Manual	Manual	Both Groups			
1900-09	25·39	24·17	24·61	24·10	5·75	29·85
1910-14	27·76	24·46	24·94	24·40	5·39	29·79(e)
1915-19	25·79	24·77	25·15	24·49	4·93	29·42
1920-24	25·57	24·33	24·78	24·21	4·50	28·71

(a) Royal Commission on Population, Papers Volume VI, The Trend and Pattern of Fertility in Great Britain (1954) pt. 1, p. 105 (Table 33), H.M.S.O., London.

(b) *Ibid.*, pt. I, p. 84 (interpolated from Table 13).

(c) *Ibid.*, pt. I, p. 162 (interpolated from Table 1).

(d) Corresponds closely with mean maternal age of 28·6 years for England and Wales, 1939 (Penrose, 1954).

(e) Median age of Norton's psychiatric patients and of his physically ill controls was 30·4 years by 1947-49 (calculated from unpublished data, 1957). It is estimated that the median date of marriage for the mothers of both groups was approximately 1912. The median maternal age of the general population married around this time corresponds closely with that of Norton's physically ill controls (see Table III).

Norton's unpublished data (1957) also indicate that 74 out of 500 psychiatric patients, as compared with 47 out of 500 controls, had *mothers one or two years older than their fathers*. This difference amounts to 5·4 per cent. which is 2·67 times its standard error, so that the probability of its being due to chance is less than one in a hundred.

(2) FAMILY SIZE (Tables V, VI, VII, VIII, IX, X, and XI)

Characteristics of family size for *Norton's psychiatric patients* (Table V, opposite) show no significant differences from those of his physically ill controls (Table VI, overleaf).

The mean size of family for both these samples is significantly less than the mean size of family for all social status groups of mothers in England and Wales married in the period 1910-14, but is well within the limits of family size differences between the two broad status groups, being weighted on the side of the non-manual group (see Tables VII and VIII, overleaf).

However, the distributions of both Norton's psychiatric patients and his physically ill controls show an unusual feature—namely a mode of unity. Now it may be seen from Table VIII that a mode of one was not found in marriages of the appropriate duration, except in the case of marriages taking place when the mother was over the age of 30. Moreover, no family recorded in Table VIII that had a mode of only one had a mean exceeding 2·6 (whereas the means of the two samples under discussion were approximately 3·1).

It appears therefore that both Norton's samples contain an unduly high proportion of families in which the affected member was an only child.

Both *Malzberg's series of patients*, on the other hand (see Tables IX and X, pp. 52 and 53), show distributions by size of family (F_x/x) that agree reasonably well with what might be expected after consideration of their mixed white and Negro composition, and after comparison with available figures for New York City (see Table XI, p. 54).

However, there is a suggestive difference of 0·5 between the mean family sizes of Malzberg's two groups of patients, which amounts to 1·69 times its standard error, and which could therefore be attributed to chance with a probability of slightly less than one in ten.

(3) BIRTH ORDER (Tables V, VI, IX, and X)

This variable was investigated in the original studies by both Malzberg (1938) and Norton (1952), and nothing need to be added to their own analyses. It was, however, necessary to calculate expected frequencies of each birth order for the purposes of the present article (as a preliminary to analysis of ordinal position), and it was relatively easy to apply the χ^2 test to expected and observed frequencies of birth order.

In *Norton's psychiatric patients* (Table V, opposite), there was a lower observed incidence than expected in was a lower observed incidence than expected in the early birth ranks and a moderately increased incidence was observed in the later ranks, findings which could have occurred on the basis of chance less than once in fifty trials. These findings are

TABLE V

RECONSTRUCTION OF SIBSHIPS OF NORTON'S 2,500 PSYCHIATRIC PATIENTS (PREDOMINANTLY NEUROTIC),
THE LONDON HOSPITAL, ENGLAND, 1943-48(a)

Size of Sibship (x)	Frequency of Sibship obtained from Sample of Affected Subjects (F_x)	Weighted Frequency (as would have been obtained from sample of mothers) (F_x/x)	Expected Frequency of Each Birth Order (summing F_x/x from bottom upward) (E_x)	Observed Frequency of Each Birth Order (O_x)	$\frac{(O_x - E_x)^2}{E_x}$
1	226	226.0	794.68	751	2.58
2	358	179.0	568.68	553.5	0.32
3	374	124.67	389.68	369	1.10
4	348	87.0	265.01	266.5	0.01
5	335	67.0	178.01	207	4.72
6	225	37.5	111.01	121	0.90
7	178	25.43	73.51	87	2.49
8	139	17.38	48.08	52	0.32
9	118	13.11	30.70	34	0.36
10	84	8.4	17.59	24	2.33
11	33	3.0	9.19	15	6.10
12	30	2.5	6.19	5	
13	25	1.92	3.69	6	
14	9	0.65	1.77	2	
15	9	0.6	1.12	4	
16	2	0.12	0.52	1	
17	3	0.18	0.40	2	
18	3	0.17	0.22	0	
19	1	0.05	0.05	0	
Totals	2,500	794.68	2,500.10	2,500	21.23
Characteristics of Corrected Family Size (F_x/x) Mode = 1 Median = 1.96 ± 0.10 Mean = 3.14 ± 0.08 Standard Deviation = 2.34 ± 0.06			Goodness of Fit of Expected and Observed Frequencies of Birth Order $\chi^2 = 21.23(a)$ $n^2 = 10$ $\therefore p < 0.02$		
Ordinal Position in Sibship (of affected member)		Expected Frequency (E_p)	Observed Frequency (O_p)	$\frac{(O_p - E_p)^2}{E_p}$	Goodness of Fit for Position in Sibship
Eldest		568.68	525	3.38	$\chi^2 = 15.88(a)$ $n^2 = 3$ $\therefore p < 0.01$
Youngest		568.68	639	8.7	
Penultimate		389.68	409	0.96	
Intermediate		746.96	701	2.84	
Totals		2,274.00	2,274	15.88	

(a) This sample is approximately five times as large as each of the other three samples analysed here. Hence figures for χ^2 given in Table V (relating to distributions by birth order and ordinal position) are also five times as large as would have been obtained from equivalent distributions in a sample of 500 patients.

in contrast to those for his series of controls, which showed remarkably good fit between observed and expected values (Table VI, overleaf), but may be at least partly attributable to the much larger size of the sample of psychiatric patients examined here.

Expected and observed frequencies of birth order also showed no significant differences in either of *Malzberg's groups of patients* (Tables VIII and IX, pp. 51 and 52).

(4) ORDINAL POSITION (Tables V, VI, IX, X, XII, and XIII)

Here there are a number of significant findings.

Norton's psychiatric patients (Table V) exhibit a poor fit of observed and expected frequencies that could have resulted from chance only once in several hundred trials (there being a moderate

excess of observed over expected frequency of youngest children, with a relative deficiency of eldest and intermediate). *Norton's controls* (Table VI, overleaf), on the other hand, show a remarkably good fit between the frequencies observed and those expected (although part of this difference may be attributable to the much larger sample of psychiatric patients examined here).

Turning to *Malzberg's patients with dementia praecox* (Table IX, p. 52), there again appears to be an unexpectedly high frequency of youngest children, but in this instance it is not statistically significant. However, in *Malzberg's manic-depressive patients* there is an extremely significant distribution (a relative excess of eldest and youngest associated with a deficiency of penultimate children).

In order to examine ordinal position in relation to family size, two further Tables were constructed.

TABLE VI

RECONSTRUCTION OF SIBSHIPS OF NORTON'S 500 PHYSICALLY ILL CONTROLS, THE LONDON HOSPITAL, ENGLAND, 1947-49(a)

Size of Sibship (x)	Frequency of Sibship obtained from Sample of Affected Subjects (F _x)	Weighted Frequency (as would have been obtained from sample of mothers) (F _x /x)	Expected Frequency of Each Birth Order (summing F _x /x from bottom upward) (E _x)	Observed Frequency of Each Birth Order (O _x)	$\frac{(O_x - E_x)^2}{E_x}$
1	42	42.0	160.98	159	0.025
2	78	39.0	118.98	121	0.033
3	95	31.67	79.98	89.5	1.13
4	74	18.5	48.31	42.5	0.72
5	39	7.8	29.81	27	0.27
6	47	7.83	22.01	19.5	0.28
7	36	5.14	14.18	14.5	0.01
8	23	2.87	9.04	9	0.09
9	22	2.44	6.17	7	
10	11	1.1	3.73	2.5	
11	11	1.0	2.63	4.5	
12	6	0.5	1.63	1	
13	9	0.69	1.13	1	
14	2	0.14	0.44	0	
15	2	0.13	0.30	1	
16	1	0.06	0.17	0	
17	1	0.06	0.11	1	
18	0	0.0	0.05	0	
19	1	0.05	0.05	0	
Totals	500	160.98	499.70	500	2.56
Characteristics of Corrected Family Size (F _x /x)			Goodness of Fit of Expected and Observed Frequencies of Birth Order		
Mode = 1 Median = 1.99 ± 0.22 Mean = 3.10 ± 0.18 Standard Deviation = 2.30 ± 0.13			$\chi^2 = 2.56$ $n^2 = 7$ $\therefore p > 0.9$		
Ordinal Position in Sibship (of affected member)	Expected Frequency (E _p)	Observed Frequency (O _p)	$\frac{(O_p - E_p)^2}{E_p}$	Goodness of Fit for Position in Sibship $\chi^2 = 0.24$ $n^2 = 3$ $\therefore p > 0.95$	
Eldest	118.98	117	0.03		
Youngest	118.98	123.5	0.17		
Penultimate	79.98	78.5	0.03		
Intermediate	140.06	139	0.01		
Totals	458.0	458.0	0.24		

(a) Calculated from Norton's unpublished data (1957).

TABLE VII

NUMBER OF LIVE CHILDREN EVER BORN (BY 1946) PER MARRIED WOMAN REPORTING, AND PER MARRIED MOTHER, BY DATE OF MARRIAGE, ENGLAND AND WALES(a)

Date of Marriage	Mean Number of Live Births per Married Woman (childless or mother)	Percentage of Married Women remaining Childless	Number of Live Births per Married Mother		
			Mean	Median	Mode
Before 1890	5.14	6.8	5.51	4.52	3
1890-99	4.34	8.1	4.73	3.61	2 = 3
1900-09	3.53	10.2	3.93	2.80	2
1910-14	2.98	12.3	3.40	2.24	2
1915-19	2.60	14.6	3.05	1.97	2
1920-24	2.41	14.8	2.83	1.79	2

(a) Royal Commission on Population, Papers Volume VI, The Trend and Pattern of Fertility in Great Britain, 1954, pt. I, p. 81 (extracted and calculated from Table 7). H.M.S.O., London.

In Table XII, (p. 54), expected frequencies of specific ordinal positions for each size of sibship may be compared directly with observed values. From examination of this Table it appeared that there might be greater differences between incidence according to ordinal position in large families than in small. Hence comparisons were made between total expected and observed frequencies of ordinal position among *patients from sibships having four or more members*. The results (Table XIII, p. 55) are of great interest. They reveal a statistically significant lack of correspondence between observed and expected frequencies in all three types of psychiatric patient, although there is once more a good fit in the case of Norton's controls. In all three groups of psychiatric patients, however, the observed frequency of youngest children is unduly

TABLE VIII

MEAN AND MODAL NUMBER^(a) OF LIVE CHILDREN EVER BORN (BY 1946) PER MARRIED MOTHER, BY YEAR OF MARRIAGE, AGE AT MARRIAGE, AND BROAD SOCIAL STATUS GROUP, ENGLAND AND WALES, 1900-24^(b)

Year of Marriage ..		1900-09		1910-14		1915-19		1920-24	
Social Status Group ..		Manual	Non-Manual	Manual	Non-Manual	Manual	Non-Manual	Manual	Non-Manual
Age at Marriage (yrs)	Under 20	5.7 (4)	4.4 (3)	5.0 (4)	3.8 (3)	4.4 (2)	3.3 (2)	3.9 (2)	3.1 (2)
	22½-25	4.0 (2)	3.2 (2)	3.6 (2)	2.8 (2)	3.3 (2)	2.6 (2)	2.8 (2)	2.3 (2)
	25-27½	3.5 (2)	2.9 (2)	3.1 (2)	2.5 (2)	2.8 (2)	2.3 (2)	2.6 (I)	2.1 (2)
	27½-30	3.2 (2)	2.7 (2)	2.9 (2)	2.4 (2)	2.7 (2)	2.1 (I)	2.4 (I)	2.0 (I)
	30-32½	2.9 (2)	2.6 (I)	2.6 (I)	2.3 (I)	2.5 (I)	2.1 (I)	2.3 (I)	2.0 (I)
	40-45(c, d)	2.5 (I)	1.7 (I)	2.0 (I)	1.6 (I)	2.0 (I)	1.6 (I)	1.9 (I)	1.6 (I)
All Ages under 45		4.36 (2)	3.21 (2)	3.76 (2)	2.77 (2)	3.36 (2)	2.50 (2)	3.04 (2)	2.29 (2)
and All Social Status Groups		3.93 (2)		3.40 (2)		3.05 (2)		2.83 (2)	

(a) Mode given in brackets (in italics). Dotted line separates families of modal size 1 from those with a mode of 2 or more. Note that with a mode of 1 the mean does not exceed 2.6

(b) Royal Commission on Population, Papers Volume VI. The Trend and Pattern of Fertility in Great Britain, 1954, pt. II, p. 66-73, 120-129, and 138-147 (calculated from Tables C. 10, 20, 30, and 40, and from among Tables G. 1-40 and H. 1-40). H.M.S.O. London.

(c) Percentage of married women remaining childless rises with increasing age at marriage. Ratio of mean number of live births per mother (tabulated above) to mean number of live births per woman reporting (childless as well as mothers) depends on the percentage of women remaining childless, and hence also rises with increasing age at marriage.

(d) Modal number of live births for all married women reporting (childless as well as mothers) was zero for all ages at marriage from 32½ yrs. upward (for both broad social status groups, and throughout the period 1900-24).

high, and in both Malzberg's series it was approximately double the observed frequency recorded for penultimate children (although the expected frequencies in this instance are identical).

DISCUSSION

(1) POSSIBLE SOURCES OF ERROR IN RESULTS

There are several possible types of bias which require consideration before any tentative interpretations are placed upon the results that have been presented.

First, the question might be raised whether the physically ill patients selected by Norton provide suitable controls for his series of psychiatric patients—particularly in view of recent findings indicating a high incidence of psychiatric abnormality in a random sample of surgical ward patients (Zwerling, Titcher, Gottschalk, Levine, Culbertson, Cohen, and Silver, 1955; Titchener, Zwerling, Gottschalk, Levine, Culbertson, Cohen, and Silver, 1956). However, it may have been noted that Norton's physically ill controls were selected by age, and to a considerable extent also by diagnosis (both on account of the age selection, and by exclusion of neurological dermatological and any suspected psychiatric disorders), from among the general in-patients of the hospital. Moreover, they closely approach the

statistical expectations for characteristics under examination in the present study. Thus, their median maternal age and their mean family size correspond closely with those estimated for mothers in the general population marrying in the period 1910-1914; the difference between the median ages of their fathers and mothers agrees with the difference between the mean parental ages for the control population given by Penrose (1955); their observed frequency distributions by birth order and by ordinal position closely resemble the frequencies expected on the basis of chance. Their only anomalous features, indeed, are an unexpectedly high proportion of only children, and 20 per cent. excess of observed over expected frequency of youngest children in families having four or more members (both of which observations were found also in the psychiatric patient group).

The other possible sources of bias considered here concern the Greenwood-Yule method of examining family size and birth order, and the extension which has been introduced in order to examine ordinal position.

It has been mentioned earlier that this method is inapplicable unless the sibships containing the affected member have been completed, as otherwise the estimate of mean family size is too low, and there is an apparent excess in the larger (later)

TABLE IX

RECONSTRUCTION OF SIBSHIPS OF MALZBERG'S 549 PATIENTS WITH DEMENTIA PRAECOX, MANHATTAN STATE HOSPITAL, NEW YORK, 1930-35

Size of Sibship (x)	Frequency of Sibship obtained from Sample of Affected Subjects (F_x)	Weighted Frequency (as would have been obtained from sample of mothers) (F_x/x)	Expected Frequency of Each Birth Order (summing F_x/x from bottom upward) (E_x)	Observed Frequency of Each Birth Order (O_x)	$(O_x - E_x)^2$ E_x
1	27	27.0	154.66	153	0.02
2	73	36.5	127.66	126	0.02
3	95	31.67	91.16	96	0.26
4	69	17.25	59.49	59	0.00
5	67	13.4	42.24	34	1.61
6	65	10.83	28.84	24	0.81
7	43	6.15	18.01	25	2.72
8	45	5.62	11.86	19	4.30
9	21	2.33	6.24	4	0.29
10	20	2.0	3.91	3	
11	9	0.82	1.91	2	
12	3	0.25	1.09	2	
13	5	0.38	0.84	0	
14	4	0.29	0.46	1	
15	0	0.0	0.17	1	
16	1	0.06	0.17	0	
17	1	0.06	0.11	0	
18	0	0.0	0.05	0	
19	0	0.0	0.05	0	
20	0	0.0	0.05	0	
21	1	0.05	0.05	0	
Totals	549	154.66	549.02	549	10.03
Characteristics of Corrected Family Size (F_x/x) Mode = 2 Median = 2.49 ± 0.24 Mean = 3.55 ± 0.19 Standard Deviation = 2.36 ± 0.13			Goodness of Fit of Expected and Observed Frequencies of Birth Order $\chi^2 = 10.03$ $n^1 = 8$ $\therefore p < 0.30$		
Ordinal Position in Sibship (of Affected member)	Expected Frequency (E_p)	Observed Frequency (O_p)	$(O_p - E_p)^2$ E_p	Goodness of Fit for Position in Sibship	
Eldest	127.66	126	0.02	$\chi^2 = 4.91$ $n^1 = 3$ $\therefore p < 0.20$	
Youngest	127.66	145	2.35		
Penultimate	91.16	76	2.52		
Intermediate	175.52	175	0.00		
Totals	522	522	4.91		

birth orders (particularly the last born of small families). In all the four series of cases examined in the present study, the mean age was in the neighbourhood of 30 years, and the youngest known member was 15 years of age, so that these sibships may be regarded as very probably complete. However, there might be a slight under-representation of the earlier born members of large families (these being recorded as slightly smaller than their ultimate size), and hence a small relative excess of the later born members of large families (affecting the higher birth orders and penultimate as well as youngest children).

Malzberg (1938) felt that there was a great probability of the observed number of first born being in excess of the true total, because a number of the patients might have lost older siblings in infancy and grown up in ignorance of such events.

It might be argued that such individuals grew up psychologically as first born and should rightly be considered as such, but in the present instance the matter is largely academic since it is an excess of younger rather than older members of sibships that has to be accounted for.

A further possible source of bias suggested by Malzberg (1938) concerned the assumption that, since the (cumulative) rate of mental illness advances with age, this would lead to an apparent excess of earlier born among the patients. The present author does not believe that this problem arises, provided that the recording of a given sibship depends upon the affected member being diagnosed or admitted to hospital within a given time period, and also provided that the recording of the affected member does not in any way lead to the recording of any other member of the sibship affected before

TABLE X

RECONSTRUCTION OF SIBSHIPS OF MALZBERG'S 498 PATIENTS WITH MANIC-DEPRESSIVE PSYCHOSES, MANHATTAN STATE HOSPITAL, NEW YORK, 1930-35

Size of Sibship (x)	Frequency of Sibship obtained from Sample of Affected Subjects (F_x)	Weighted Frequency (as would have been obtained from sample of mothers) (F_x/x)	Expected Frequency of Each Birth Order (summing F_x/x from bottom upward) (E_x)	Observed Frequency of each Birth Order (O_x)	$\frac{(O_x - E_x)^2}{E_x}$
1	16	16.0	122.89	140	2.40
2	45	22.5	106.89	101	0.33
3	63	21.0	84.39	78	0.49
4	73	18.25	63.39	62	0.03
5	79	15.8	45.14	37	1.47
6	71	11.83	29.34	37	2.00
7	48	6.86	17.51	15	0.36
8	36	4.5	10.65	9	0.26
9	21	2.33	6.15	7	0.01
10	10	1.0	3.82	1	
11	9	0.82	2.82	2	
12	10	0.83	2.00	1	
13	7	0.54	1.17	2	
14	5	0.36	0.63	3	
15	1	0.07	0.27	0	
16	1	0.06	0.20	0	
17	0	0.0	0.14	1	
18	0	0.0	0.14	0	
19	1	0.05	0.14	1	
20	0	0.0	0.09	0	
21	0	0.0	0.09	1	
22	1	0.05	0.09	0	
23	1	0.04	0.04	0	
Totals	498	122.89	497.99	498	7.35
Characteristics of Corrected Family Size (F_x/x) Mode = 2 Median = 3.11 ± 0.28 Mean = 4.05 ± 0.23 Standard Deviation = 2.52 ± 0.16			Goodness of Fit Expected and Observed Frequencies of Birth Order $\chi^2 = 7.35$ $n^1 = 8$ $\therefore p < 0.50$		
Ordinal Position in Sibship (of Affected Member)		Expected Frequency (E_p)	Observed Frequency (O_p)	$\frac{(O_p - E_p)^2}{E_p}$	Goodness of Fit for Position in Sibship
Eldest		106.89	124	2.75	$\chi^2 = 16.58$ $n^1 = 3$ $\therefore p < 0.001$
Youngest .. .		106.89	124	2.75	
Penultimate .. .		84.39	54	11.0	
Intermediate .. .		183.83	180	0.08	
Totals		482	482	16.58	

that time. Again, this possible form of bias would result in apparent weighting of earlier and not later born members of sibships.

Norton (1957) raises a valid difficulty when he points out that apparent weighting of younger members of large families may result from diminishing numbers of large families in the general population (it therefore being relatively somewhat more likely that we should meet a younger member of a large family started, let us say, before the end of the 19th century, than that we should meet an older member of a family of the same size started at a later date). In addition to causing an apparent weighting of youngest members of large families, this would of course lead to a relative weighting of penultimate members, and also a relative weighting of higher birth orders as a whole—neither of which was found in the case of Norton's physically

ill controls (see Tables VI and XIII) or in either of Malzberg's series (Tables IX, X, and XIII).

The other possible source of error that will be examined here concerns the number of cases encountered during the recording of data for which birth order and/or size of family could not be ascertained. It appears possible that such "unascertained" cases might be more likely to belong to large families and intermediate positions. Some light may be thrown on this problem by examining the distribution of "unascertained" cases recorded by Malzberg (1950) in a statistical analysis of mongols in the registers of the New York State schools for mental defectives on April 1, 1948. Out of 880 mongols so recorded, the birth order alone could not be ascertained in 95 cases, the size of family alone in only four cases, and neither birth order nor family size in a further 23 cases. The total number

TABLE XI

PERCENTAGE DISTRIBUTION BY SIZE OF COMPLETED FAMILY, FOR MOTHERS OF MALZBERG'S PSYCHOTIC PATIENTS (ADMITTED TO MANHATTAN, STATE HOSPITAL, NEW YORK, 1930-35), AND FOR MOTHERS AGED 50 TO 74 YEARS LIVING IN NEW YORK CITY, 1940(a)

Characteristics of Sample	Mean Number of Children ever Born per Mother	Percentage of Mothers with Number of Children (completed families)									
		1	2	3	4	5	6	7	8	9	10 and Over
Mothers(b) of Malzberg's Patients with Dementia Praecox (F_x/x)	3.55(c)	17.5	23.6	20.7	11.2	8.7	7.1	4.0	3.6	1.5	2.5
Mothers(b) of Malzberg's Manic-Depressives(F_x/x)	4.05(c)	13.0	18.3	17.1	14.8	12.8	9.6	5.6	3.6	1.9	3.1
White Mothers, New York City, aged 50-74 in 1940(d)	3.60	18.0	22.1	18.6	14.6	9.4	6.0	3.9	2.7	1.9	3.0
Non-White Mothers, New York City, aged 50-74 in 1940(d)	3.35	24.0	25.8	17.3	7.5	7.0	6.2	2.8	4.4	2.1	2.8

(a) U.S. Bureau of the Census (1943), 16th Census of the United States 1940, Population - Differential Fertility 1940 and 1910, Fertility for States and Large Cities, Washington, D.C., U.S. Government Printing Office, Pp. 222 and 226 (calculated from Tables 40 and 41).

(b) Mean ages of Malzberg's patients on admission (1930-35) were 31.5 years (dementia praecox) and 32.3 years (manic-depressives). If it is assumed that the mean ages of their mothers at marriage was 25, and at the time of the patient's birth 30 years, then the mean date of their mother's marriage would have been 1895, and the mean ages of their mothers in 1940 (if still living) would have been 70 years.

(c) The difference between the mean number of children in the sibships of Malzberg's patients with dementia praecox and of the manic-depressives is 0.50 ± 0.296 . Hence $t = 1.69$; $p < 0.10$.

(d) Figures for the fertility of women in the United States by date of marriage were not published, nor were figures for the fertility of women in New York City by duration of marriage in 1940. However, the figures tabulated above for white mothers, New York City, aged 50-74 in 1940, are very similar to others calculated for white mothers, North-eastern States, aged 65-69 and married for 40-49 years in 1940, and also for those aged 70-74 and married for 45-54 years in 1940 (U.S. Bureau of the Census, 1947).

TABLE XII

DISTRIBUTION OF EXPECTED AND OBSERVED FREQUENCIES OF PATIENTS BY ORDINAL POSITION AND SIZE OF SIBSHIP.

NORTON'S 2,500 PSYCHIATRIC PATIENTS AND 500 PHYSICALLY ILL CONTROLS.
MALZBERG'S 549 PATIENTS WITH DEMENTIA PRAECOX AND 498 MANIC-DEPRESSIVES(a)

Ordinal Position		Size of Sibship										Totals(b)
		2	3	4	5	6	7	8	9	10	Over 10	
Norton's Psychiatric Patients	Expected (F_x/x)	179	124.7	87	67	37.5	25.4	17.4	13.1	8.4	9.2	568.68
	Observed { Eldest	172	124	89	41	36	24	11	11	6	11	525
	{ Youngest	186	122	91	89	41	35	21	18	17	19	639
	{ Penultimate	—	128	77.5	73.5	40	32	22	14	7	15	409
Norton's Physically Ill Controls	Expected (F_x/x)	39	31.7	18.5	7.8	7.8	5.1	2.9	2.4	1.1	2.6	118.98
	Observed { Eldest	49	23	11	6	12	6	2	4	1	3	117
	{ Youngest	29	36	20.5	10	5.5	7	4	5	1	5.5	123.5
	{ Penultimate	—	36	21.5	6	3.5	5	1	3	0	2.5	78.5
Malzberg's Patients with Dementia Praecox	Expected (F_x/x)	36.5	31.7	17.2	13.4	10.8	6.1	5.6	2.3	2.0	1.9	127.66
	Observed { Eldest	41	30	16	15	10	4	6	0	3	1	126
	{ Youngest	32	32	24	17	13	9	12	1	2	3	145
	{ Penultimate	—	33	10	7	8	4	4	2	2	4	76
Malzberg's Manic-Depressives	Expected (F_x/x)	22.5	21	18.2	15.8	11.8	6.9	4.5	2.3	1.0	2.8	106.89
	Observed { Eldest	27	25	17	24	14	7	7	2	0	1	124
	{ Youngest	18	23	16	15	23	8	6	5	1	9	124
	{ Penultimate	—	15	17	11	4	3	1	2	0	1	54

(a) See also Tables V, VI, IX, X, and XIII

(b) Totals for sibships of two or more children (three or more children, in the case of penultimate patients)

TABLE XIII

EXPECTED AND OBSERVED FREQUENCIES OF ORDINAL POSITIONS AMONG PATIENTS FROM SIBSHIPS HAVING FOUR OR MORE MEMBERS

NORTON'S PSYCHIATRIC PATIENTS AND PHYSICALLY ILL CONTROLS
MALZBERG'S PATIENTS WITH DEMENTIA PRAECOX AND MANIC-DEPRESSIVE PSYCHOSES^(a)

Ordinal Position in Sibship	Expected Frequency in Model Sample ^(b)	Norton's Psychiatric Patients ^(c)		Norton's Physically Ill Controls		Malzberg's Patients with Dementia Praecox		Malzberg's Manic-Depressives	
		Expected	Observed	Expected	Observed	Expected	Observed	Expected	Observed
Eldest	E_4	265.01	229	48.31	45	59.49	55	63.39	72
Youngest ..	E_4	265.01	331	48.31	58.5	59.49	81	63.39	83
Penultimate ..	E_4	265.01	281	48.31	42.5	59.49	43	63.39	39
Intermediate ..	$\Sigma E_4 - (E_1 + E_2 + E_3)$	746.97	701	140.07	139	175.53	175	183.83	180
Totals ..	$\Sigma E_4 - (F_1 + F_2 + F_3)$	1,542	1,542	285	285	354	354	374	374
Goodness of Fit of Expected and Observed Ordinal Positions		$\chi^2 = 25.2$ ^(c) $n^2 = 3$ $\therefore p < 0.001$		$\chi^2 = 3.06$ $n^2 = 3$ $\therefore p < 0.50$		$\chi^2 = 12.7$ $n^2 = 3$ $\therefore p < 0.01$		$\chi^2 = 16.7$ $n^2 = 3$ $\therefore p < 0.001$	

^(a) See also Tables V, VI, IX, X, and XII^(b) See Tables I and II^(c) The sample of Norton's psychiatric patients examined here is approximately five times as large as each of the other three samples. Hence figures for χ^2 given in Table V, and above, are also five times as large as would have been obtained from equivalent distributions in a sample of 500 patients.

of mongols in which birth order remained unascertained was therefore 118, and their distribution by size of family is shown in Table XIV. This Table also shows the distribution by family size of the estimated total numbers of mongols in whom birth order was unascertained (after redistribution of cases in which family size was unascertained), and the expression of the latter as a percentage of all the mongols in each family size.

This Table shows that the proportion of cases in which birth order was not ascertained tended to increase with the size of family, and it was also found that, for families having four or more members, the ratio of cases in which birth order was unascertained to those in whom it was established was about 1:4. If it were assumed that all cases in which birth order was unascertained were either intermediate or penultimate, for families having four or more members the ratio of unascertained penultimate to unascertained intermediate (if evenly

distributed) would have been approximately 1:3. If these figures were applied to Malzberg's patients with dementia praecox and manic-depressive psychoses from families with four or more members (Table XIII), the result would be about ninety additional unascertained cases in either group, and of these about 24 could have been penultimate. Hence, even on the assumption that all unascertained cases would be intermediate or penultimate children, the marked difference between observed incidence in youngest and penultimate in these two groups would not be nearly eliminated. In fact, however, this assumption is clearly unjustified, since, even in families having only two members (*i.e.* only eldest and youngest), the birth order was unascertained in at least ten out of 186 cases. This source of error, therefore, is one which requires consideration in future studies of this nature, but one which could not have been responsible for certain differences in incidence according to ordinal position noted in the present analysis.

TABLE XIV

DISTRIBUTION BY SIZE OF FAMILY OF CASES IN WHICH BIRTH ORDER WAS NOT ASCERTAINED, IN A SERIES OF MONGOLS ANALYSED BY MALZBERG (1950)

Size of Family	1	2	3	4	5	6	7	8	9	10 and Over	Not Known	Totals
Total Number of Mongols	72	186	174	109	89	83	53	24	17	46	27	880
Number of Mongols for whom Birth Order was Unascertained	0	10	13	16	10	15	12	8	2	9	23	118
Estimated Number of Mongols for whom Birth Order was Unascertained, if all Family Sizes were Known ^(a)	0	12.4	16.1	19.8	12.4	18.6	14.9	9.9	2.5	11.2	—	118
Estimated Percentage of Total Mongols for whom Birth Order was Unascertained ^(b) ..	0	7	9	18	14	22	28	41	15	24	—	—

^(a) Obtained by multiplying row above by 1.24 (118/(118-23))^(b) Row above expressed as percentage of top row.

(2) POSSIBLE INTERPRETATIONS OF RESULTS

If findings such as have been presented here can be freed from any type of methodological error and are repeated consistently in similar studies they are of considerable aetiological significance. McKeown and Record (1956) point out that association between incidence and parental age or birth order provides strong presumptive evidence of environmental influence, even if the action of this influence were confined to the germ cells and expressed itself through mutations in ways outlined by Penrose (1955). Similarly, an association between incidence and ordinal position points to some form of environmental influence. It would appear that any characteristic not uniformly distributed among different birth ranks and ordinal positions cannot be attributed solely to genetic transmission (although random distribution of itself is not proof of such genetic causation).

Penrose (1955) has drawn attention to the importance of parental age in differentiating causes of mutation, and he notes that the influence of the father's age is of critical significance. When there is an association between father's age and incidence (as in achondroplasia), the hypothesis of fresh gene mutation as the cause is strengthened, whereas when there is no such association (as in mongolism) other causes must be sought. He also postulates that a slight (approximately equal) increase in the mean ages of both parents would be expected in conditions originating in mutations caused by radiation.

McKeown and Record (1956) distinguish between types of environmental influence operative at different stages of development. They note that it is the early pre-natal environment that seems to determine the incidence of mongolism and anencephaly, while there is evidence to suggest that the intra-natal environment (*e.g.* relative anoxaemia) may affect the incidence of patent ductus arteriosus, and that the post-natal environment may affect the onset of infantile hypertrophic pyloric stenosis. These authors state that, unlike the uterine environment, the post-natal environment favours children in low birth ranks and at late maternal ages (due to the absence of older siblings who may convey infectious disease, and to the more favourable economic circumstances of parents). However, it may be questioned whether these generalizations apply equally to psycho-social environmental factors which may influence the development of certain psychiatric disorders.

In the light of such considerations as the foregoing, we may now proceed to examine a few of

the possible interpretations that may be placed on specific findings that have emerged in the present study.

Parental Age.—In Norton's psychiatric patients, there was a slight increase in mean and median maternal ages (as compared with controls and general population), more marked than the apparent slight associated increase in median paternal age. The difference between the median ages of father and mother was somewhat low for these psychiatric patients, which would render mutation an unlikely hypothesis (Penrose, 1955). On the other hand, the excess among the patient group of mothers one or two years older than fathers might favour the hypothesis of maternal dominance throughout the individual's development as a possible aetiological factor.

Family Size.—The corrected mean size of family for Heron's insane patients, as calculated by Greenwood and Yule (1914), was 4.17 which would appear to be an unduly low figure for the children of parents in England and Wales married a considerable time before the end of the 19th century (Table VII).

Mean family sizes hitherto calculated for juvenile delinquents (Glueck and Glueck, 1950), neurotics (Norton, 1952) and schizophrenics (Wahl, 1954, 1956) all appear to be biased estimates (appreciably larger than figures that would have been obtained through samples of their mothers). Malzberg (1950) used the Greenwood-Yule correction in calculating mean family sizes on his group of mongols and obtained 2.9 as the mean size of all families (a number of which were probably incomplete) and 4.2 as the mean size for the presumably completed families of mothers aged 40 years and over.

It is known that the incidence of certain mental disorders is related to social class (*e.g.* Redlich, Hollingshead, Roberts, Robertson, Freedman, Myers 1953; Hare, 1955), and it is also well established that size of family is related to social class. It might therefore seem logical that the mean size of family for a given category of psychiatric patients should be related to the social class from which that category is predominantly derived. The mean family size of Norton's neurotic patients is indeed compatible with this hypothesis. However, if this hypothesis were true, it would be expected that schizophrenics derived predominantly from lower socio-economic strata than manic-depressives would also tend to come from larger families, whereas the opposite was observed in Malzberg's two groups. It appears, therefore, that Malzberg's patients with

dementia praecox came from unduly small families, or his manic-depressives from unduly large families, or possibly both.

Before leaving the topic of family size, it is appropriate to mention the situation of *the only child*, which should be considered in this context rather than in relation to ordinal position (*vide supra*). It has already been noted that neither of Malzberg's series show an undue representation of families with only one member, but that both Norton's psychiatric patients and his physically ill controls exhibit an unexpectedly high frequency of only children. It is possible that this may be a characteristic of the local population from which they were drawn, but it appears at least as likely that there is a raised incidence of certain types of both psychiatric and "physical" illness among only children.

Birth Order.—Greenwood and Yule (1914) found no appreciable inequality between observed and expected frequencies of the various birth ranks among *Heron's insane patients*, although admittedly the latter group were presumably heterogeneous and probably included some cases with epilepsy and mental deficiency (Malzberg, 1938).

However, though subsequent investigations have shown associations between birth order and some congenital abnormalities (as mentioned earlier), no consistent association has so far been demonstrated between birth order and the incidence of functional psychiatric disorders. Thus Malzberg (1938) obtained negative findings in *schizophrenia* (supported by Böök's findings on a much smaller series, 1953) and in *manic-depressive psychoses*. These findings appear to be corroborated by a current study of patients admitted to mental hospitals in Western Ontario (Wanklin, 1957).

In Norton's *psychiatric patients* (1952) the excess of observed over expected frequencies in the later birth ranks may be significant of itself, but appears to be partly attributable to the specific increase in observed incidence in youngest children (*vide infra*).

Ordinal Position.—Previous investigators have examined the percentage distribution of cases among the various ordinal positions, with which they have also included only children (*e.g.* Glueck and Glueck, 1950; Norton, 1952; Wahl, 1954, 1956). The only significant information that this form of distribution gives would appear to consist of possible differences in the observed percentages of eldest and youngest children (which should be approximately identical if the incidence in both is the same). Böök (1953)

and Wanklin (1957) have also compared observed and expected frequencies of eldest and youngest children in small series of psychiatric patients, without obtaining statistically significant results.

However, the results of investigation of ordinal position in the four samples analysed here, by the extension of the Greenwood-Yule method that has been described, are suggestive and provocative. The most significant of these findings is an excess of observed over expected incidence in youngest children of families with four or more members, most marked in Malzberg's two series of psychotic patients. If statistical bias can be excluded as the cause of these observations (*vide supra*), we are led to speculate on what peculiarities in the situation of the youngest child might render him more vulnerable to psychiatric abnormality, and the following possibilities may be suggested:

- (i) Advanced ages of parents at the birth of the youngest child might result either in biological handicapping (as in mongolism and achondroplasia), or in relative psycho-social handicapping.
- (ii) Termination of the parents' marriage shortly after the birth of the child (who then remains the youngest), either through death or through the separation of the parents. Norton (1952) indeed found that a significantly higher proportion of his psychiatric patients than of his controls had lost their father before they reached the age of 10 years. However, this observation leads to the question whether, in such cases, the significant aetiological situation might be economic deprivation, loss of a normal paternal relationship, or consequent unopposed maternal dominance with accentuation of any pathological features in the mother-child relationship.
- (iii) The youngest child might well be such because of deliberate family limitation on the part of the parents, and would thus appear to be the most likely member of the family to have been unwanted. In this event, the parents might harm the child before birth by unsuccessful attempts at abortion, or after birth by behaviour resulting from conscious or unconscious rejection. In this connexion, Sears (1957) has found (with a considerable degree of statistical confidence) that both mothers and fathers were more likely to have been displeased at the mother's becoming pregnant with the youngest child of larger families than with any other. It may also be relevant to mention here that the Royal Commission on Population (1954,

vol. VI, part I. p. 273) reported that over 17 per cent. of women in England and Wales had more than the number of children they had planned, so that the problem is one of considerable magnitude.

- (iv) Sears (1957) has made some other interesting observations on child training according to the sex and ordinal position of the children. His findings appear to indicate that youngest children are not the coddled "babies" of the family, but that they are least often breast-fed, severely weaned, and rarely praised, and that "modesty" training is begun early.

In concluding these remarks on the possible significance of findings with regard to parental age, family size, birth order, and ordinal position, the comments of McKeown and Record (1956) seem most appropriate—namely, that the examination of such variables is of limited interest unless the significance of an observed association is explored further; that the same association may have very different explanations in different circumstances; and that, when taken with other clinical and pathological evidence, such information may suggest profitable lines of inquiry.

SUMMARY

The investigation of parental age, family size, birth order, and ordinal position offers hope of information on the relative influences of genetic and environmental factors in the aetiology of mental disorders. Some of the relevant literature concerning these variables has been reviewed.

Certain data relating to these variables, previously recorded by two other investigators, have been subjected to further analysis. These data involve groups of psychiatric patients and physically ill controls seen in a general hospital in London and two groups of psychotic patients admitted to a mental hospital in New York State.

The Greenwood-Yule method of determining family size and expected frequencies of birth orders (from samples taken through members of the sibships) has been outlined, together with an extension of this method devised to estimate expected frequencies of different ordinal positions.

A slight, but statistically significant, increase in mean and median maternal ages was noted for Norton's group of predominantly neurotic patients, together with an apparent (though less marked) increase in median paternal age. There was also a significant excess of these patients (as compared

with controls) having mothers one or two years older than their fathers.

The mean family size of Norton's psychiatric patients was approximately the same as that of his controls and of the section of the general population with which both samples were considered comparable, but the frequency of only children was unexpectedly high in both groups.

The mean family size of Malzberg's manic-depressives slightly exceeded that of his group of patients with dementia praecox and that of the general population.

Norton's psychiatric patients showed a relative excess of observed over expected incidence in the higher birth orders, but no such association with birth order was noted for the other three samples examined.

Analysis of ordinal position revealed an excess of observed over expected incidence in youngest children of families containing four or more members, most marked in Malzberg's two series of psychotic patients.

The foregoing results have been discussed, with reference to a number of possible sources of error, and some alternative explanations have been considered.

It is concluded that further investigations of such variables as parental age, family size, birth order, and ordinal position are indicated, and may well yield profitable information.

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