LANGUAGE DEVELOPMENT IN YOUNG TWINS: BIOLOGICAL, GENETIC AND SOCIAL ASPECTS

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The present study has confirmed previous evidence that young twins show a marked delay in language development. This delay averaged six months at the age of 48 months, compared to a control group of singletons; it was evenly reflected in all nine subtests of the Illinois Test of Psycholinguistic Abilities, and was shown equally in MZ and DZ twins. Biological variables such as birth weight, gestational age and reproductive complications were only weakly associated with language scores at four years. The twins were not significantly retarded on non-verbal tests of general intelligence, compared with population norms or with the singleton controls. Environmental factors, particularly social class and family size were strongly correlated with language scores, though the association was stronger in singletons than in twins. Middle class twins were relatively much more retarded in language development compared with middle class singletons than working class twins compared with working class singletons. Comparison of intra-class correlations between 28 MZ and 64 DZ pairs yielded a heritability index of 44% for the test as a whole, with considerable variations in h^2 *over the nine subtests. Heritabilities were highest for tests sampling the visual motor channel, and lowest for tests on the auditory-vocal channel. In confirmation of this finding, an examination of the test profiles of the singleton controls suggested that social class differences were most marked on tests of the auditory-vocal channel. It is suggested that the latter are more susceptible to environmental variables.*

INTRODUCTION

The majority of twin studies in psychology have been more concerned with twins as members of a pair than as individuals. Such studies have frequently failed to take account of the fact that twins are in some respects a 'special' population from both a biological and a social point of view, and that it may not be appropriate to regard them as representative of the population at large. We know from numerous studies that twins score below the national average on height and weight, on tests of intelligence and on measures of educational attainment (reviewed in Mittler 1971). They also experience considerable delays in learning to talk.

The reasons for these delays in development are far from clear, but in general two kinds of explanation have been put forward. These may be broadly characterised as biological and social. The biological argument stresses the prenatal, perinatal and postnatal hazards to which twins are exposed. One in six of twin pregnancies ends in the death of one or both twins. More than half of all twins weigh less than 3500 g at birth, and their average gestation period is only 37 weeks. Over a third are breech births, and the second born twin is held to be particularly at risk. The retardation in height and weight appears to persist at least until late adolescence. We know that singleton children exposed to such early hazards are more likely to show problems of development, particularly in relation to the growth of intellectual and linguistic abilities in early childhood, and it therefore seems reasonable to invoke a biological explanation for the slower development of young twins.

On the other hand, we should also consider the unique social environment inhabited by twins. Luria and Yudovitch (1959) and Zazzo (1960) have drawn attention to the social psychology of the 'twin couple', and have suggested that twins have less need to communicate through language. Many

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of them develop a private language in their early years, and may isolate themselves to some extent from the language learning model normally provided by the mother. The famous cotwin control study carried out by Luria and Yudovitch (1959) was based on the hypothesis of a reduced need to communicate, and succeeded in raising the linguistic skill of both twins by a combination of separation and structured teaching.

Strong support has now been given to the social environment argument by a study carried out in England by Record et al. (1970). They examined the intelligence test results of 148 11-year-old children whose cotwins had died at birth or within the first few months of life. The average IQ of these 'twin-survivors' was virtually identical to the population mean of 100, whereas the average IQ of a sample of over 2000 twins from the same city was 95 — a figure which corresponds closely to that reported by the Scottish survey (Scottish Council for Research in Education 1953), the French National Study (Zazzo 1960) and Koch's (1966) Chicago study. The surviving children were exposed to all the early biological hazards of being a twin, including low birth weight, but to none of the social aspects of the twin situation.

The first study of language development in 2 to 5-year-old twins was reported by Ella Day in 1932. She used a series of ad hoc language measures, including mean length of response, ratings of grammatical complexity and measures of egocentric and socialised speech based on Piaget's (1926) work. Her study showed a clear and striking inferiority of twins compared with singletons in respect of reduction of vocabulary, the use of immature and primitive sentence constructions, and a poverty in the use of constructions involving classification, abstraction and conceptualisation. However, the twins' inferiority on language tests was relatively much greater than on tests of general intelligence — a finding confirmed in my own study. Moreover, the gap between twins and singletons increased between 2 and 5 years.

Day's findings were essentially confirmed by Helen Koch (1966) in Chicago. She studied 90 pairs of 5 and 6-years-old twins and compared their performance with that of exceptionally well chosen control groups on tests of Primary Mental Abilities. Twins showed particularly poor scores on verbal tests; this was especially marked in the case of both MZ and DZ boys.

METHOD

In the present study, use was made of Osgood's model of language behaviour (Osgood 1957) which has resulted in the production of a sensitive language test — the Illinois Test of Psycholinguistic Abilities (ITPA) (McCarthy and Kirk 1961). This test consists of nine subtest, each measuring a different aspect of language. Osgood's model distinguishes between (*a*) channels of communication (e.g., auditory or visual input and vocal or motor output); (*b*) levels of organisation (meaningful representational or automatic-sequential); and (*c*) psycholinguistic processes, such as decoding, encoding association processes.

In using this test, I hoped to learn something not only about the overall linguistic maturity of the twins but also to discover whether they showed any characteristic pattern or profile of linguistic functioning. The use of a reasonably large and age restricted sample made it possible to compare identical with fraternal twins, and to examine the possible contribution of intelligence and of biological variables such as abnormalities of pregnancy, delivery and low birth weight, and social variables such as social class and family size.

SUBJECTS

The subjects in the present study were 200 twins, all of whom were within a month of their fourth birthdays, together with a sample of 100 singleton controls of the same age drawn from nursery schools in the same district. The twin series was drawn from public health records of twins living in an English county and was unselected except by age and parental cooperation. Middle class children were somewhat over-represented in both groups. 30% of the twin sample were identical (MZ) and 70% were fraternal (DZ); the latter were evently divided in respect by similarity indices, inspection of photographs, and also by dermatoglyphic analysis of palm and finger prints. Serological analysis was not undertaken.

RESULTS

The present report will limit itself to the following findings:

(1) Twin-singleton difference on total ITPA score;

(2) Twin-singleton differences on each of the nine ITPA subtests;

(3) Comparisons between MZ and DZ twins;
(4) Biological, cognitive and social factors associated with ITPA performance;
(5) Heritability estimates of the language measures.

1. *Twin-Singleton Differences on Total ITPA Scores*

Table 1 tabulates the means and standard deviations of ITPA total raw scores and 'language age' scores.

Table 1. *Means and standard deviations of four-year-old twins and singletons on total raw score and language age (in months) of the Illinois Test of Psycholinguistic Abilities*

	N	Raw score	SD	Language age	SD	*p*
Twin boys	103	64.72	24.20	42.43	8.95	< 0.001
Singleton boys	50	78.44	27.05	47.48	10.05	
Twin girls	85	65.05	22.34	42.58	8.06	< 0.001
Singleton girls	49	82.34	19.18	48.48	7.06	
All twins	188	64.87	23.39	42.49	8.56	< 0.001
All singletons	99	80.37	23.56	48.19	8.74	

It will be seen that the retardation of twins relative to singletons corresponds to some six months of language development at the age of 4. Differences between the two groups are significant at beyond at beyond the 0.001 level on *t* tests.

2. *Twin-Singleton Differences on Specific Psycholinguistic Abilities*

Fig. 1 illustrates the performance of the two groups on the ITPA profile analysis chart. The results are converted from raw scores to standard scores, with the horizontal line representing a standard score of zero, and each 'box' representing half a standard deviation from the mean.
Fig. 1 illustrates the overall similary in the general profile of the two groupe, but also shows that the retardation on the twins is fairly consistently at around two thirds of a standard deviation below that of the controls. Differences between twins and singletons are significant on eight of the nine subtests. Statistical analysis by means of multiple linear discriminant function indicates that a single canonical variate discriminates significantly between the groups when all nine subtests and the total ITPA score are considered.
The graph shows an overall similarity between the two groups. The performance of twins can best be described in terms of an overall linguistic immaturity. Twins do not not show a different profile or pattern of linguistic organisation. This negative finding is of some interest because it might have been predicted that twins would be relatively less immature in language comprehension than in language production.

3. *Zygosity and Sex Differences*

Identical twins, considered as individuals, did not differ significantly from fratenals on any of the language measures. Both types were equally retarded compared to singletons. It might have been predicted that identicals would be more language retarded than fraternals on both biological and social grounds: they have a higher incidence of reproductive complications, including low birth weight,

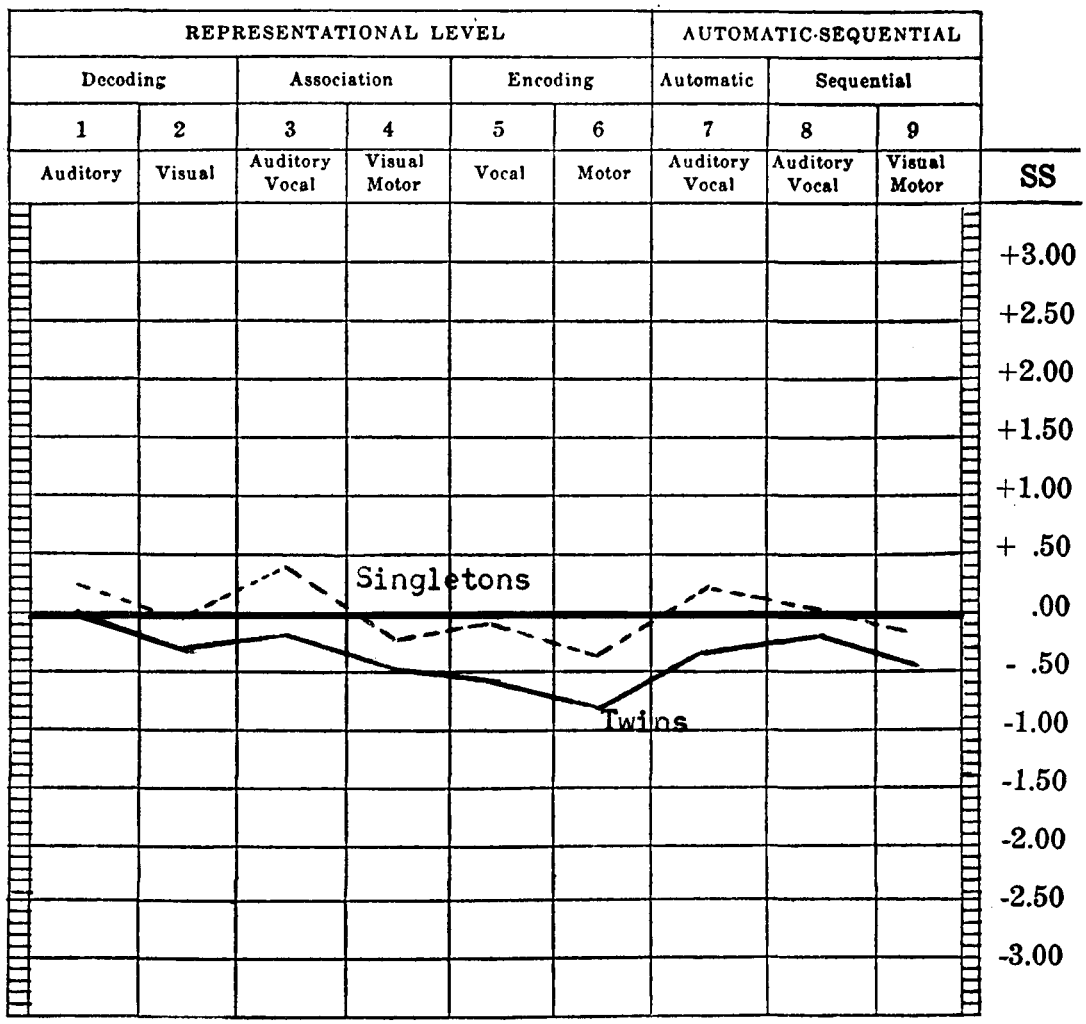

Fig. 1

and they are more likely to form a 'closed communication system' and to use a private language. Similarly, no significant sex differences were noted, though girls showed the usual marked tendency towards higher language scores.

4. *Associated Biological, Cognitive and Social Variables*

We can now consider the relationship between language scores and a series of biological, cognitive and social variables. This was done by multivariate statistical techniques involving discriminant function and multiple regression analyses (see Mittler 1969*a* and 1970 for further details).

In general, biological factors were only minimally associated with language scores at 4 years. This applied to difficulties of pregnancy, and to a lesser extent to low birth weight and gestational age. Twins with low birth weight certainly tended to have lower language scores, but the association was not at all powerful. No differences were found between first and second born twins.

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The poor language scores of the twins cannot be simply attributed to lower general intelligence. The twins produced average or above average scores on three nonverbal measures — the Seguin Form Board, the Draw-a-Man test and the Vineland Social Maturity Scale; they differed only slightly on these measures from the singleton controls. Results on a verbally biased test — the Peabody Picture Vocabulary Test — were identical to those obtained on the ITPA.

Table 2. *ITPA mean 'language age' comparisons (in months) by social class*

Social class	Twins mean	Singletons mean
I + II	44	53
III	44	48
IV + V	39	41

A much more powerful associations was found between language scores and a series of social and environmental variables. In particular, social class was the variable with the largest discriminatory power of all the analyses in the study, though this is not surprising in a language test. The data is crudely summarised in Table 2.

Two points of special interest may be noted from these figures. First, the effect of social class on language scores is more marked in the singletons than in the twins, though it is highly significant in both groups. Of greater interest is the result of comparing twins and singletons within a single social class. This suggests that the language of middle class twins is much more adversely affected compared to singletons than that of working class twins. Thus, we find a difference corresponding to nine months of language development between middle class twins and singletons; this falls to a four month difference in the intermediate social class III, and is reduced to an insignificant two months for working class twins.

Why middle class twins should be at a particular disadvantage in respect of language development is an intriguing question. It is possible that the twin situation makes them less able to take advantage of the kind of linguistically favourable environment traditionally associated with the middle class home, whereas the working class twin suffers less because the language to which he is exposed is already less rich and facilitating. Such an explanation is entirely speculative and largely untestable, though a small number of studies have suggested that it is possible to increase the language sills of young twins by a systematic programme of language teaching (Luria and Yudovitch 1959; Greenald 1972). These studies suggest that their language difficulties are not an inevitable or irremediable consequence of the twin situation.

5. *Genetic Aspects*

The data presented so far has mainly concerned the language development of twins considered as individuals rather than as a pair, but we can now consider genetic aspects of the study from the point of view of a classical comparison of intraclass correlations for MZ and DZ pairs. Attempts to derive heritability indices are of particular interest in the case of a test such as ITPA which should make it possible to estimate whether some language functions yield higher heritabilities than others. This has also been done in other studies using the Wechsler tests or tests of Primary Mental Abilities. In my own study, the Falconer h^2 index was used: $h^2 = 2(r_{mz} - r_{dz})$. This is similar to a formula suggested by Jensen (1967). It is worth mentioning that when the nine subtests are placed in rank order of all currently used heritability indices, we find a close agreement between them.

The genetic data is simply summarised in Table 3, which compares 28 MZ with 64 DZ pairs. The table shows that total ITPA scores yield an h^2 of 44, and that heritabilities vary greatly between the nine subtests (see Mittler 1969*b* for further details). One interesting feature of this pattern is tha

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Table 3. *Interclass correlations for MZ (= 28) and DZ (N = 64) twins on ITPA showing Falconer's heritability index (h^2)*

	MZ	DZ	h^2	Rank
Representational Level:				
Decoding				
1. Auditory	0.52	0.72	— 40.0	9
2. Visual	0.74	0.24	100.0	2
Association				
3. Auditory	0.81	0.68	26.0	6
4. Visual motor	0.78	0.15	126.0	1
Encoding				
5. Vocal	0.63	0.43	40.0	5
6. Motor	0.66	0.35	62.0	3
Automatic-sequential:				
Automatic				
7. Auditory vocal	0.82	0.55	54.0	4
Sequential				
8. Auditory vocal	0.56	0.49	14.0	7
9. Visual motor	0.46	0.49	— 6.0	8
Total	0.90	0.68	44.0	

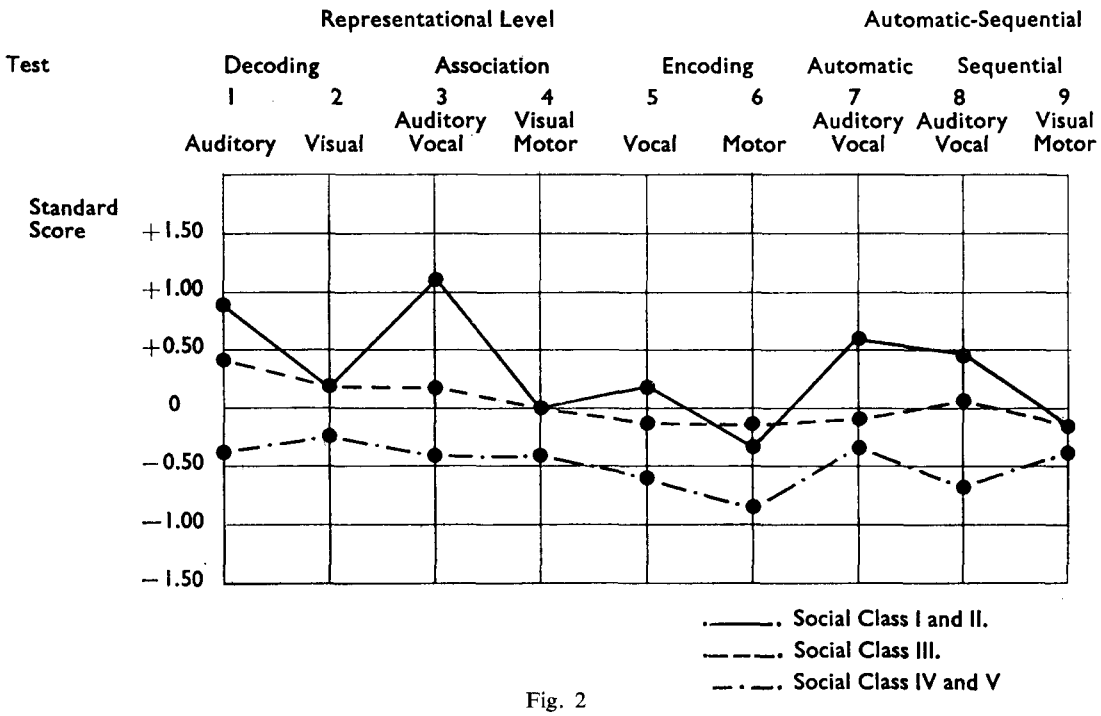

Fig. 2

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heritabilities appear to be higher for those subtests that emphasise visual-motor and non-verbal skills — e.g., the visual decoding, visual-motor association and motor enconding tests, none of which require the child to speak. In contrast, lower heritabilities are recorded for the more specifically verbal subtests — e.g., auditory decoding, auditory-vocal association and vocal encoding.

The finding that visual and motor channels tend to show higher heritabilities than the auditory and vocal channels suggests the hypothesis that the latter may be rather more under the influence of environmental variables, such as social class and family size. We can now look briefly at this hypothesis with fresh data by examining the influence of social class on language abilities in the singleton controls. This is done in Fig. 2.

The graph illustrates the ITPA profile of the 100 singleton controls who were of comparable age and background to the 200 twin subjects. Two features of this graph deserve mention. First, the clear superiority of middle class over working class children over the test as a whole; second, the finding that the gap between middle and working class children appears to be greatest on tests measuring the auditory-vocal channel — auditory decoding, auditory-vocal association, vocal enconding and auditory-vocal association and auditory-vocal sequencing. The gap is correspondingly smaller on the visual-motor tests — the very tests which yielded the highest heritabilities on the twin data.

Finally, we can compare the total ITPA language scores with those reported by other workers both for general intelligence and for educational attainment. The median h^2 for all the studies of general intelligence summarised by Erlenmeyer-Kimling and Jarvik (1963) 11 years ago is 68; this is much higher than the values suggested by Burt (1966) for educational attainment — these range between 6 for reading and 22 for arithmetic. Thus, language abilities at 44% fall somewhere between the values obtained from intelligence tests on the one hand and tests of school attainment on the other.

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