



## Lateralization of verbal ability in pre-psychotic children

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### Abstract

Deficits in lateralization have been reported in handedness, language and anatomical asymmetry in schizophrenia, but the relationship between these anomalies has been unclear. Extending earlier work demonstrating that degrees of lateralization are related to verbal ability in the general population, we here investigate the relationship in children who later developed psychosis. Using data from a box-marking test and an index of receptive verbal ability in the UK National Child Development study, we constructed three-dimensional plots of verbal ability in relation to left- and right-hand skill at the age of 11 years, and compared the performance of 34 children who by age 28 had developed schizophrenia and 21 who had developed affective psychosis with 12,782 in the total population. In the total population, verbal skill is decreased in those who are close to the L=R line. Children premorbid for schizophrenia are less lateralized and their verbal skill is lower than predicted by their hand skill, with a similar trend in children premorbid for affective psychosis. Thus pre-psychotic children deviate from the general population in the trajectory of lateralization of words. The findings are consistent with the concept that in psychosis at some critical stage in development there is a failure of lateralization of the components of language.

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### 1. Introduction

There is a long history of interest in the role of lateralization in relation to psychosis. After Wigan (1844) presented his thesis on *A New View of Insanity — The Duality of Mind*, Wigan and Crichton-Browne suggested in relation to his post-mortem

studies “it seemed not improbable that the cortical centres which are last organised, which are the most highly evolved and voluntary, and which are supposed to be localised on the left side of the brain, might suffer first in insanity” (Crichton-Browne, 1879). In 1861 Broca (1861) presented his case that language is lateralized to the left hemisphere, and this apparently was already known to Dax (1865). These findings are relevant to the thesis that language is the species-defining characteristic of *Homo sapiens* (Mueller, 1873; Chomsky, 1985; Bickerton, 1990).

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Following the report of Flor-Henry (1969) that schizophrenic psychoses of temporal lobe epilepsy are associated with a focus on the left side, there have been a number of studies suggesting anomalies of lateralization for handedness (Gur, 1979; Green et al., 1989), and of anatomical (Crow, 1990; DeLisi et al., 1997; Petty, 1999) and electrophysiological (Flor-Henry, 1983) asymmetry. There is also a large literature on abnormalities in the use of language by individuals suffering from psychosis (e.g. Chaika, 1990; Sims, 1995; DeLisi, 2001). In a recent meta-analysis of handedness, language lateralization and anatomical asymmetry, Sommer et al. (2001) concluded that there was strong evidence for decreased cerebral lateralization in schizophrenia. However, the relationship between these components and their relationship to the disease process is obscure.

We have previously demonstrated that lateralization is a determinant of verbal and other abilities in the general population (Crow et al., 1998). In a cohort of children in the UK National Child Development study, those who were less lateralized had acquired fewer words at age 11 years. These relationships are most readily appreciated in three-dimensional figures in which verbal performance is shown as a mean value in relation to left- and right-hand skill plotted on separate axes (Leask and Crow, 2001b), a form of presentation that avoids some difficulties associated with the widely used laterality indices (Leask and Crow, 1998). Here we extend this approach to illustrate the position in this three-dimensional space relative to the population as a whole of children who later developed schizophrenic and affective psychoses. Some of the findings have been previously published in abstract form (Leask and Crow, 2001a, 2002).

## 2. Methods

### 2.1. Subjects

In the National Child Development Study, a cohort of all births in the United Kingdom 3–9th March 1958, 12,782 individuals were examined at school at the age of 11 on tests of verbal and other abilities. Consent was sought from individual cohort members in later sweeps, and ethical approval obtained from all

responsible regional ethical committees involved in the case-finding exercise.

### 2.2. Tests

Children were assessed for manual dexterity. The subject had to mark as many boxes in a grid of 200 as he or she could, in a minute, using the right hand, and then the left hand (cf. Tapley and Bryden, 1985). Word acquisition was assessed using the verbal subscale of the General Ability Test (Douglas, 1964), a test of receptive vocabulary: the child provided from a list of four possible alternatives the fourth in a logical, semantic or phonological sequence of four words.

### 2.3. Diagnoses

Cohort members with diagnoses of psychotic illness by the age of 28 were divided into two groups, schizophrenia or affective psychosis, for the purposes of this analysis. The procedure whereby individuals who developed psychotic illness as adults were identified in the cohort has been described (Done et al., 1994). Here we included as suffering from a schizophrenic illness those who were diagnosed by narrow criteria, i.e., the presence of ‘nuclear’ (or ‘First Rank’) symptoms elicited by the Present State Examination.

### 2.4. Data analysis

In comparing verbal skill with asymmetry of hand skill, we avoid the use of a laterality index by treating right- and left-hand skill as separate variables. Fig. 1 presents a scatterplot of right- and left-hand skill at the box-marking task in the general population at age 11.

We next calculate a local mean verbal performance at each point on this plane of hand skill, generating a 3D surface of mean verbal skill versus hand skill (Fig. 2). From Fig. 1 it can be seen that cases are not uniformly distributed; therefore the figure is censored at the edges where case density drops off. Further details of this approach can be found in Leask and Crow (2001b). Fig. 2 resembles a river valley, with increasing verbal ability associated with greater lateralization either to the left or to the right and relative deficits close to equal hand skill. The deficit is present

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