

The nature of cognitive dysfunction in school-children with epilepsy

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The literature on cognitive dysfunction in children with epilepsy is scattered and diverse in its nature. A review of it [1] indicates at least four types of reports. Some consist mainly of impressions. These are an important source of ideas, but insufficient in themselves and not necessarily in agreement with each other. Other reports are more empirically derived but are based on relatively crude ratings, usually by teachers or parents. In other accounts, measurements have been made of the performance of children on laboratory or formal psychological tests, or of school attainments.

These various reports leave certain fundamental issues unresolved. The meaning of some of the central concepts remains confused. The same term may cover different types of behaviour not necessarily closely correlated. Both “inattentiveness” [2] and “poor memory” [3] are of this type. Another problem is that, although laboratory or formal psychological tests may be convenient to use, their predictive value for real life behaviour has rarely (if ever) been satisfactorily demonstrated. The need for “real life” measures of dysfunction in adults has recently been recognized in cognitive psychology [4–6]. These studies have emphasized the use of appropriately constructed questionnaires.

An additional problem, which runs through behavioural studies in epilepsy, is that many different factors may affect the behaviour of the epileptic child. Type of epilepsy, drug treatment, emotional state, home and school environment, and even the child’s sex may all be relevant [1].

These factors may operate in combination and their relative effects are often difficult to disentangle.

The present study addresses all three types of problem. It is an attempt to clarify the type of cognitive dysfunction in children with epilepsy by means of a measure of behaviour in the real life situation of the classroom. It is also concerned with assessing the relevance to such behaviour of some of the confounding factors just mentioned. The details of this study will be published elsewhere (Bennett-Levy & Stores, in preparation).

Present study: Methods and procedure

1. Construction and evaluation of a cognitive dysfunction questionnaire

On the basis of prolonged discussions with teachers and direct observation of children’s behaviour in the classroom, 41 items of behaviour were selected as apparently relevant to learning difficulties, other than low intelligence. The questionnaire was completed by 40 teachers for 196 randomly selected normal children, between the ages of six and 13 years, all attending local ordinary schools. None of the children had a neurological disorder. Teachers were asked to rate each child on every item using a five-point scale.

A principle components factor analysis on the results showed the questionnaire to be composed of five factors which together accounted for 75 per cent of the variance. From the nature of the items loading highly on each factor, the factors have been la-

belled (in terms of the mental functions which might be defective to produce learning difficulties) as *Concentration* (56.5 % of the variance); *Processing*, that is, mental processing of information underlying memory, for example, (8.1 %); *Alertness* (4.0 %); and *Confidence*, (that is, in one's own ability) (2.9 %). A fifth factor consisting of only one item was discarded for the present purposes. Over a six-week period, the test-retest reliability of these factors, and the mean reliability of individual items, ranged between 0.78 and 0.94 ($p < 0.0001$). Teachers' ratings on this questionnaire were, therefore, highly consistent over time.

2. Questionnaire completed for children with epilepsy

Scores on the questionnaire were obtained for 42 children with epilepsy attending either the Park Hospital Epilepsy or EEG Service. Their age range was again six to 13 years. As all were attending ordinary schools, their intelligence was within the normal range. None had serious behaviour problems.

3. Assessment of attainment levels

Teachers' ratings on a four point scale of *Reading, Mathematics and Spelling* were obtained for each epileptic and non-epileptic child. From these a *Total Attainments Score* was derived for each child. The teacher ratings of Reading were shown to be in very close agreement with the reading levels measured by means of the British Ability Scale Word Reading Test [7] indicating that their ratings of reading ability were highly accurate. It was assumed that their ratings of other attainments were similarly correct.

4. Matching of epileptic and normal children

(a) Each of the 42 epileptic children were matched for sex and age with the next child on the school register in the same class. Questionnaire and attainment scores were obtained for the matched controls.

(b) Each of the 42 epileptic children were

matched for sex, age, and overall attainment level with another child in the same class. Questionnaire and attainment scores were also obtained from this new set of matched control children.

It was demonstrated that the matching in both (a) and (b) was very close.

Results

1. Questionnaire, factor scores, and attainment ratings in normal children

Highly significant negative correlations were obtained between each factor and the attainment scores. Thus, children with poor educational attainments were seen by their teachers as having poor concentration in class, as being slow to process information, as not being alert and often demanding of teachers' attention because of lack of confidence.

2. Factor scores and attainments of epileptic and normal controls matched for sex and age

Again, highly significant findings indicated that teachers perceive epileptic children as having poor concentration and mental processing, and as being less alert than their matched classmates. However, they also rated epileptic children as having poorer overall attainments. The poorest attainment was in mathematics.

The question arose whether teachers' judgements about epileptic children's cognitive failure (usually expressed in terms of "inattentiveness") were actually based on their perception of these children's poor attainments. To answer this point the following comparison was made.

3. Comparison of factor scores in epileptic children and controls matched for sex, age, and attainments

It was possible to match the two groups very closely in all three respects using the Total Attainment Scores. The results are shown in Table 1. Each factor score is the sum of the five-point scale scores (1 to 5) of the items with a loading on the factor greater than 0.5.

These findings indicate that, even when epileptic children are matched for educational attainments, although they are no longer thought by their teachers to concentrate less, to process information less well, or to lack confidence, they are seen as less alert.

4. Factors associated with reduced alertness

As sex differences in various psychological aspects of childhood epilepsy appear to be prominent [8], the boys (n=24) and girls (n=18) making up the present epileptic group were compared with sex and age-matched normal children. The epileptic boys were judged by their teachers as more lacking in concentration, more impaired in processing information, as being less alert and as having lower attainment than normal boys. Epileptic girls were only judged to show more processing impairment and to be less alert than their normal counterparts. However, when matching included attainments, the only significant difference in both girls and boys with epilepsy and their controls was that the epileptic children were less alert. This feature seemed to characterize children with epilepsy irrespective of sex.

The possible relevance of the *type of epilepsy* was considered by comparing those children whose seizures were clinically and

electrographically partial in type (n=20) with those whose seizures were generalized (n=12). Those with mixed or uncertain types of seizures were omitted. The only significant difference was that children in the partial group were judged to be less confident.

Drug effects is an obvious possible explanation of the apparently characteristic lack of alertness of the children with epilepsy [9]. For this part of the analysis, information was available on only 39 of the 42 epileptic children. Those having any form of antiepileptic drug treatment (n=25) had significantly worse concentration, poorer processing ability, and were less alert, as well as having lower attainments, than those not taking treatment after a period of at least two months (n=14). Whereas those taking either valproate or a combination of drugs (n=12), grouped together because of small numbers, showed the same pattern of deficits as the total group of children taking drugs, the children taking carbamazepine alone (n=13) showed differences from the non-treatment group only in having lower attainment ratings. When the very small group on valproate alone was considered (n=5), they similarly appeared to be no different from the non-treatment group, except for having lower attainments. Perhaps most interesting of all, epileptic children no longer on treatment were the same as their normal controls in all respects except for being significantly less alert.

Table 1. Comparison of mean factor scores* of epileptic and non-epileptic children matched for sex, age, and attainments

Factor**	Epileptic Children (n=42)	Matched Controls (n=42)	t	p
Concentration	44.0	38.8	1.34	NS
Processing	32.9	29.2	1.20	NS
Alertness	12.9	9.4	3.31	<0.001
Confidence	4.1	4.0	0.50	NS

* Each factor score is the sum of the five-point scale scores of the items loading highly on the factor.

** The factors are labelled in terms of the functions which might be defective to produce learning difficulties.

Discussion

It has been possible to devise a reliable questionnaire for the assessment by teachers of real-life (classroom) cognitive dysfunction in children. Factor analysis indicates that such cognitive dysfunction consists mainly of poor concentration; less potent factors being impaired processing ability, impaired alertness and lack of confidence. All these factors are associated with poor educational progress as perceived by teachers.

Teachers perceive epileptic children as having all these deficits significantly more

often than sex and age-matched normal school-children and as having poorer school attainments. Teachers' judgements of the cognitive behaviour of epileptic children are not wholly influenced by their perceived lower attainments, because when epileptic children are compared with non-epileptic children closely matched for sex, age and also attainments, they are still judged to be significantly less alert.

This apparently characteristic feature of lowered alertness is seen in both boys and girls with epilepsy. It is not associated with type of seizure or drug treatment. Indeed, epileptic children having no longer taken treatment for some time are still characterized by not being as alert as normal children.

The ways in which this type of study might be improved include validating more completely the teachers' judgements of each child's attainments. In the present study this was done for Reading, where a very high level of agreement was shown between teachers' ratings of this subject and children's scores on the British Ability Scale Word Reading Test. A similarly high level of agreement was assumed for the other subjects. The relevance of the type of

epilepsy and drug treatment could be more fully assessed if larger numbers of epileptic children were investigated.

However, the results of the study are consistent in suggesting that the particular type of attentional disorder, which here has been called impaired alertness, is perhaps a fundamental characteristic of children with epilepsy. This seems to be due possibly to some type of internal deficit (not obviously attributable to drugs) rather than to distraction by outside events. Indeed, there is evidence that the performance of epileptic children may be improved by stimulation which is distracting and harmful to the performance of normal children [10].

An essential next step will be to define more closely the nature of this lack of alertness by close examination of the behavioural items from which the factor is derived, and from careful first-hand observations of such behaviour in the classroom.

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