A neurobehavioural study in preschool children

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SUMMARY

The focus in this study is on relationships between neurological findings and free-field behaviour in preschool children. The study was triggered by the problem of learning and behaviour disorders in children, which are supposed to be related to a non-optimal condition of the nervous system and which are described in the literature under headings such as "minimal brain dysfunction (M.B.D.)" or "special learning disorders". There is much confusion and controversy as to the exact kinds of neurobehavioural relationships and their etiology. There is a dearth of experimental studies but a wealth of impressionistic descriptions.

This study differs in two important respects from previous studies in the M.B.D. area,

1. concerning the group studied: generally M.B.D. studies concern school-aged children in whom behavioural and/or learning problems have already developed. This did not apply to the preschool children included in this study.
2. concerning the method of direct observation and quantitative analyses of free-field behaviour that was applied: this method has not been used previously in relation to the M.B.D. problem nor on such a large scale in other human studies. In consequence in this study many problems related to data collection and processing had to be solved.

The general problem of the study is stated in chapter 2 as follows: What are the relationships between neurological findings and "free-field" behaviour, directly observed in variously structured environments, in a group of preschool aged children with a variety of minor neurological dysfunctions but without serious neurological handicaps and not selected because of behavioural problems?

In the introductory chapter the wide interest in the M.B.D. problem is traced back to converging developments in education, psychology, and medical thinking during the last half century. Child centered didactical methods and the development of specific approaches for children with limitations in their learning abilities went parallel to a rapid development of refined psychodiagnostic tools and basic theoretical insights on

connections between somatic and mental aspects of the development. In neuropsychology the C.N.S. became considered as an integrated, differentiated system in which diffuse damage would lead to general deficits in the behavioural organization. Further, findings in relation to aphasia in adults and sequelae of brain damage in children together with the idea of a continuum of the degrees of damage led to the conception of a neurological background for adaptational problems in children.

Despite this widespread interest it is pointed out that progress in the study of M.B.D. was slow. This is attributed partly to differences in refinement and standardization of methods in the different disciplines. Many studies show fallacies and these are briefly indicated.

The method of free-field observation in stylized environments seems to be particularly suitable for the study of M.B.D.-types of behaviour. This method is applied in this study and its possibilities and limitations are discussed in chapter 3. The method allows for,

a. an objective and analytic study of complex behavioural phenomena,
b. the study of behaviour patterns which closely resemble those important for adaptation in "natural" environments,
c. the study in young children of behavioural aspects which are basically important in the child's future adaptation in formal and less formal situations (e.g. home, school).

With allowance for its limitations, which are related to restrictions in the method of registration, the choice of behavioural categories, the necessary reduction in the data, etc. it is suggested that the method of free-field observation may provide important information about the background of children's adaptational problems.

In chapter 4 the group, design, and measures used in the study are described. The study concerns 150 preschool children (age range 4;11 - 5;5 years) none of whom presented serious neurological disorders. Main criteria for selection were full-term delivery and completeness of obstetrical and neonatal neurological data. All children had a re-assessment at preschool age. Apart from the neurological examination and the free-field observation, data were collected about the social background, the behaviour in home and school situations, and the psychological and medical history of the child. In addition, a number of experiments were carried our. In this report only a limited part of

the material is discussed, namely that directly related to connections between neurological findings at the age of five and free-field behaviour.

To avoid the difficult discrimination between neurologically normal and abnormal, an optimality concept, devised by Prechtl, was applied. Behaviour was related to two sorts of neurological measures,

a. a general optimality score. On the basis of this "overall" score children were classified in three groups, with low, intermediate, and high neurological scores respectively. In a preliminary analysis, behaviour in these three groups was compared for boys and girls separately.
b. measures for six neurological functional categories, defined on the basis of clinical criteria and statistical evidence, and labelled as "sensorimotor", "posture", "coordination", "choreiform movements", "maturation of functions", and "maturation of responses". Free-field behaviour was studied in relation to these measures in the final analysis.

Observations took place in a specially designed playing room. Behaviour was video-recorded through a one-way screen and from a corner of the room and analysed from video recordings by two cooperating observers. Children were observed in six differently structured environments, always in the same sequence:

1. together with mother in the novel empty room (3 minutes)
2. alone in the empty room for the first time (3 minutes)
3. with blocks and a passive observer (10 minutes)
4. alone in the empty room for the second time (3 minutes)
5. alone with a variety of toys (15 minutes) and
6. alone with one "non-motivating" toy (5 minutes).

These environments were selected because they differed with respect to a number of aspects important for the structuring of the behaviour at preschool age: the novelty of the environment, the presence of a social figure, and the amount and variety of material.

Behaviour was described in terms of predefined categories, partly derived from systems by Hutt, Berkson and McGrew, and partly developed in pilot and preliminary analyses to this study. These categories allowed for a detailed description of the behaviour of the child in relation to the social environment (mother, observer), the physical environ-

ment (fixtures in the room, play material), and the own body. Aspects of the motor, visual, and verbal activity were scored. The procedures of registration, observation, scoring, and coding of behaviour were standardized as much as possible.

Having discussed a number of pilot studies, focussing on optimalizing of observational conditions and categorization of behaviour, preliminary studies are described in chapter 5 concerning the reliability of the application of behavioural categories in the observation, and the reliability of the coding procedure.

To estimate the reliability of the scoring procedure two analyses were carried out,
an interscorer reliability estimation (video recordings scored by two observers, independent of each other),
an estimation of the score-rescore agreement (video recordings scored by two cooperating observers on two occasions, six weeks apart).
Score-rescore agreement is in general slightly higher than interscorer-agreement, a difference which, it is suggested, may be explained by the possible communication between observers during the scoring procedure. In general it was found that measures are sufficiently high for a study in which groups of children are compared, most coefficients reaching values of .80 or higher. Reliability is particularly high in the categories concerning motor and play activity. The estimation of the intercoder reliability gives coefficients in the range of .80 to .98.

Prior to the investigation of neurobehavioural relationships, the structure of the behaviour was explored (chapter 6). A comprehensive analysis of the behaviour rather than a preselection of specific "key variables" was used.

The purpose of this analysis of the structure was:

a. to ascertain relationships between behavioural categories in order to avoid overinterpretation of differences on isolated elements of the behaviour, and
b. to reduce the data by combining categories in behaviour patterns on the basis of known relationships.

Behavioural categories used in the video analyses were included in "behaviour patterns" on the basis of statistical data and a number of other criteria, such as the environmental orientation of the behaviour,

the comparability of the composition of patterns in different observational conditions, the relevance of the behaviour in relation to neurological findings, etc.

In the empty room conditions the following patterns were distinguished: room exploration, passive waiting, body-oriented activity, one-way screen reactions, close contact, verbal contact, and visual contact with mother. In the play conditions the following patterns were distinguished: low and high level play, exploratory play, no play activity, gross body activity, body-oriented behaviour, and room-oriented behaviour.

Relationships between behavioural categories within and across observational conditions are discussed. As might be expected, because of the large number of alternatives in the behaviour repertoire, correlations between separate behavioural categories are generally low. Higher correlations were found between a number of "behaviour patterns" when they occurred in the same observational condition. Across the six observational conditions relationships between such patterns are weak.

Neurobehavioural relationships were studied by means of a method of profile analysis. Results are given in chapter 7. Scores for behaviour patterns and for the six neurological categories were introduced in these analyses. They were carried out separately for boys and girls and for each of the observational conditions. Prior to this analysis, two preliminary studies were carried out:

a. one on sex differences in the behaviour, irrespective of neurological condition,
b. one on behavioural differences between groups with low, intermediate, and high neurological optimality scores.

The main results, reported in detail elsewhere, are the following:

a. In boys more exploratory activity and verbal behaviour was observed in the condition "together with mother in the novel room", while in girls more body-oriented behaviours were observed in all empty room conditions. Boys showed more gross body activity in all play conditions. Differences in the level of play activity between sexes are negligible. Some slight indications that the higher incidence of neurological dysfunctions in boys is one of the determinants of behavioural differences between sexes requires further analysis.
b. Neurological variables exerted a stronger effect on behaviour in boys

than in girls, and different observational conditions discriminated between neurological groups in boys and girls. In boys the condition "with one non-motivating toy", in girls the condition "together with mother in the empty room" seemed to be most sensitive.

In the final profile analysis groups of children were identified characterized by specific combinations of neurological and behavioural scores. The main results are the following:
Behaviour patterns associated with low neurological scores were similar in boys and girls in some observational conditions, different in others. Similar findings included high exploration in the novel room and low exploration when the environment had become familiar. Contrasting results were obtained when a variety of toys were available, where boys with low neurological scores played at a higher level than boys with high scores.

There were some sex differences found in the neurobehavioural associations, depending on the situational context.

In boys differences in"sensorimotor" and "postural" optimality scores were most closely related to differences in free-field behaviour, while "maturation of responses" had no effect. In girls "maturation of functions", "maturation of responses", and "sensorimotor" contributed most to the neurobehavioural discriminations, "choreiform movements" and "posture" least.

Choreiform dyskinesia only affected the behavioural organization in boys in conditions with non-attractive toys.

Differences in social background were only found in the Blocks condition between the two groups of boys. There were slight differences in age between some neurobehavioural groups in both sexes.

In chapter 8 the main results are discussed in the light of free-field observations in brain damaged children and experimental studies in animals. Relatively strong reactions to novelty, observed in neurologically non-optimal preschool girls are to some extent comparable with phenomena seen in unequivocally brain damaged children and in animals with lesions in hippocampus or pre-frontal areas.

The rapid decrease in exploration in preschool children with unfavourable neurological scores is in strong contrast to the slow "habituation" observed by Hutt, Hutt and Ounsted in severely brain damaged

children. These differences may relate to motivational factors in our preschool group and cognitive deficits in the brain damaged children.

These findings of differences in neurobehavioural relationships found in different environments, are in sharp contrast to the invariability of the behaviour of children with brain defects, reported by the Hutt's and Ounsted.

General points made in the discussion concern,

- the necessity of specifying situational context and behaviour in reporting neurobehavioural relationships (there is a variety of associations between neurological categories and behaviour),
- the importance of comprehensive and differentiated neurological assessments: pooling "soft signs" implies loss of valuable information,
- the necessity of taking into account the fact that objectively similar environments may be differently perceived by different children,
- some changing opinions about the "structural basis" of M.B.D.-like behaviours,
- the controversies in the "choreiformity" literature, which are traced back to the specific connection of that neurological condition to adaptive behaviour in boys in non-stimulating situations.

The view is expressed that in girls the aspect of "dysmaturity", in boys that of "neurological dysfunction" may be most prominent in the typical M.B.D. child.

Finally, the relevance of the findings for the early detection and proper guidance of children at risk is briefly outlined. The observation and quantitative analysis of free-field behaviour is considered to be a promising method in the study of a variety of clinical and developmental problems.