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ABSTRACT

The purpose of the study was to determine whether particular aspects of movement control influenced the performance of 2-year-old children on a standard developmental test, and thus influenced assessments of intellectual progress based on that test. Six cerebral-palsied (CP) children were compared with six children not suffering motor system dyscontrol (NCP) on a brick tower-building task. Results showed that the most competent CP child achieved the same level as the least competent NCP child. Two distinct sub-groups were found within the CP group--one which achieved acceptable age-related performance with slightly lower levels of control than the NCP group and another which showed very low levels of control especially in digital manipulation of the test objects. (Author/JDD)

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Movement Control in Cerebral Palsied Children During a Developmental Test

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Abstract

The purpose of this study was to determine whether particular aspects of seated movement control influenced the performance of two year old children on a standard developmental test. The actions of six cerebral palsied children (CP) and six children not suffering motor system dyscontrol (NCP) were recorded on video-tape whilst they undertook a brick-tower building task. Performance was measured by number of bricks into a tower without time constraint. Movement control was gauged using an observational framework based upon five components essential to manipulation and transportation of the test objects. The performance of the criterion groups was clearly different with the most competent CP child achieving the same level as the least competent NCP child. All NCP children showed very sound movement control so further detailed analysis was carried out on the records of the CP group. This revealed two distinct sub-groups, one which achieved acceptable age-related performance with slightly lower levels of control than the NCP group and another which showed very low levels of control especially in digital manipulation of the test objects.

Following the UK Education Act (1981) standard assessment procedures are used to produce a statement of special education need for school placement. Such assessments may begin before the child reaches two years of age in order to provide: early developmental records, check progress, detect problems and, if necessary, initiate appropriate intervention such as physical, occupational or speech therapy and early nursery or school placement.

Many standard developmental tests in use purport to determine intellectual progress when performance is often heavily dependent on precise and accurate movement control, for example, the Griffiths Mental Developmental Scales, (Griffiths, 1970). By the age of 18 months children have usually developed sound postural control and are able to manipulate suitable objects and tools quite skilfully (Gallahue, 1982). At this age a child would normally be expected to stack three/four bricks into a tower having recognised the task from either previous experience or demonstration (Holle, 1981). This achievement requires well co-ordinated control of head, trunk and upper limbs coupled with reasonably fine motor control of the fingers to provide either a good palmar grasp or opposition pincer movements of the thumb with the index, middle or ring digits to hold, transport and release an object precisely(Rosenbloom and Horton,1971). Clearly children with motor system dyscontrol are hampered because although they may appreciate what is to be achieved, the recognised objective cannot be attained. This situation calls into question the accuracy/validity of the assessment procedure and was the stimulus for this investigation.

The purpose was to determine which aspects of movement control influence the performance of cerebral palsied children on a standard developmental test. It was considered that a motion analysis of appropriate video-taped recordings of their movement behaviour (and that of children likely to succeed in the task) whilst they performed the test would achieve this objective.

Method

Subjects

Six children (mean age 24.6 ± 6.1 months) with moderate degrees of cerebral palsy (CP) were selected from a larger, similar group treated by the first author at a child development centre in the North West of England. The sample was drawn from a population in which most of the signs of cerebral palsy (diplegia, hemiplegia, quadriplegia, spasticity ataxia, athetosis, hypotonia) were present and the children selected suffered from one or more of the variations, moderate in that they were all able to move unaided and use their upper and lower limbs to some extent.

A further group of six children of a similar age (mean age 24.5 ± 2.7 months) and home background were chosen to serve as a comparison sample which was representative of a population free from motor system disorder (NCP).

Setting and Equipment

A testing and observation room was set up to provide an accurate replication of the conditions in which most educational assessments are carried out. This was a comfortable room without distracting noise or display material. The room contained a table and chair appropriate to the size of the children, the chair was structured such that each child was reasonably well supported, could place their feet flat on the floor and move their upper limbs freely.

A video camera was placed 3.5 metres in front of the table and a second 2.5 metres lateral-right to the table. The cameras were gen-locked and fed through a mixer to a video-tape recorder-monitor system which was placed out of view of the children. The test materials were a six shape form board, a four shape posting box, a bead threading device and coloured stacking bricks. These were kept out of sight and introduced by the researchers who sat to the left/front of the table.

Procedure

The children were accompanied by one or both parents and attended by pre-arranged appointment. Each child was brought to the table by a parent who remained close-by and in view throughout the procedure. The test objects (four tasks) were placed on the table in turn, the task explained when the test was introduced and the children were encouraged to attempt the tests. There was no time limit, each test was terminated when it was evident that the child's limit had been reached. The children's movements were recorded from when the test material was introduced until the test was terminated. Both lateral and anterior viewpoints of the movements simultaneously displayed in split screen format were then available for analysis.

Analysis of Movement Control

An observational framework was designed to enable the analysis of the video-tape records. This was developed from a pilot study in which one child from each of the criterion groups was video-taped whilst they carried out a series of similar tests. The movements used by the children during the brick/tower building test (selected for its close resemblance to everyday manipulative behaviour) were carefully reviewed by using a frame by frame editing function on the video-tape recorder (National Panasonic VD5800 - PS). This showed that task performance when seated was sub-served by five inter-related movement control components. These were: head control (HC), trunk control (TC), upper limb control (ULC), prehension and grip (G), lower limb control (LLC). Each control component was scaled from 0 - 9 with control descriptions for each level which represented dyscontrol at one extreme and effective control at the other. Inter-rater reliability for use of the framework was high(r=.90). Full details of the framework and its derivation are to be published in a separate article.

Results

Two sets of measures were devised for the developmental test and both were taken by scanning the video-tape records. These were task performance scores for each subject measured in number of bricks successfully balanced to make a tower and movement control scores for each subject for each of the five components of movement control included in the observational framework which has been outlined. In order to be awarded an appropriate control score, CP subjects were required to display a given level of control for 75% of the time taken to complete the task. This criterion was not necessary for the children in the NCP group.

The task performance scores for each group were so clearly different that formal statistical analysis was unnecessary: the most competent performer in the CP group achieved the same level as the least competent performer in the NCP group, each child completing a tower of six bricks.

The overall level of movement control for each group was compared using rank mean values which were 19.44 for the CP group and 50.37 for the NCP group. The correlation between movement control and task performance was r = .881 ($p<.05$). As the NCP group demonstrated the highest level of control (with a single exception) on all the components of the framework used, attention in the remaining analysis was centred on the control characteristics of the CP group. The similarity in control of each subject for each of the five components of control was compared by computing rank order correlations and proceeding from these values to an elementary linkage analysis (McQuitty, 1957). This revealed two sub-group clusters within the CP group, namely subjects G-J-M and subjects H-K-L. Both the control and performance of the sub-group G-J-M was clearly superior to that of H-K-L. These results are illustrated in profile form in Figure 1 and show the control variable 'grip' to be at a particularly low level for all members of that sub-group.

Fig. 1 about here

Discussion

The results of the study confirmed that dyscontrol and performance on the brick stacking task to be positively associated. This finding supports the view-point that care should be taken in drawing inferences pertaining to intellectual competence from the results of this test because of its heavy dependence on precise movement control.

The observational framework used to analyse the video-tapes of the children's movements whilst they carried out the tasks permitted the source of dyscontrol in the CP group to be more precisely identified. In effect, three of that group achieved a performance level expected of children aged two years. This group consisted of two more mildly affected children and another who was diplegic and had reasonably sound seated upper body control. The remaining three children in the CP group were more severely affected in that they too suffered moderate to severe spastic quadriplegia and the other ataxic quadriplegia with some athetoid movements of the upper limbs. The analysis showed that these children experienced particular difficulties with grip and release of the objects which was probably the main contributory factor in their poor performance.

It is concluded that video - motion analysis of this kind is useful in the appraisal of movement control difficulties. Such a system of appraisal is of value in assessing the locus of dyscontrol which prevents the production of important action and can usefully supplement normal observation. It is seen to be of particular value in establishing the validity of developmental assessment procedures which require sound motor control. The information gained in this way is helpful in making accurate assessments of exceptional children and in determining appropriate remedial therapy more precisely especially in situations where team decisions are necessary.

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Annotations for Fig.1

1. Vertical Axis (left side)

MOVEMENT CONTROL RATING
(Mean Values)

2. Vertical Axis (right side)

NUMBER OF BRICKS STACKED
(mean)

3. Horizontal Axis

CONTROL CATEGORY

4. Legend

■ Non-Cerebral Palsied

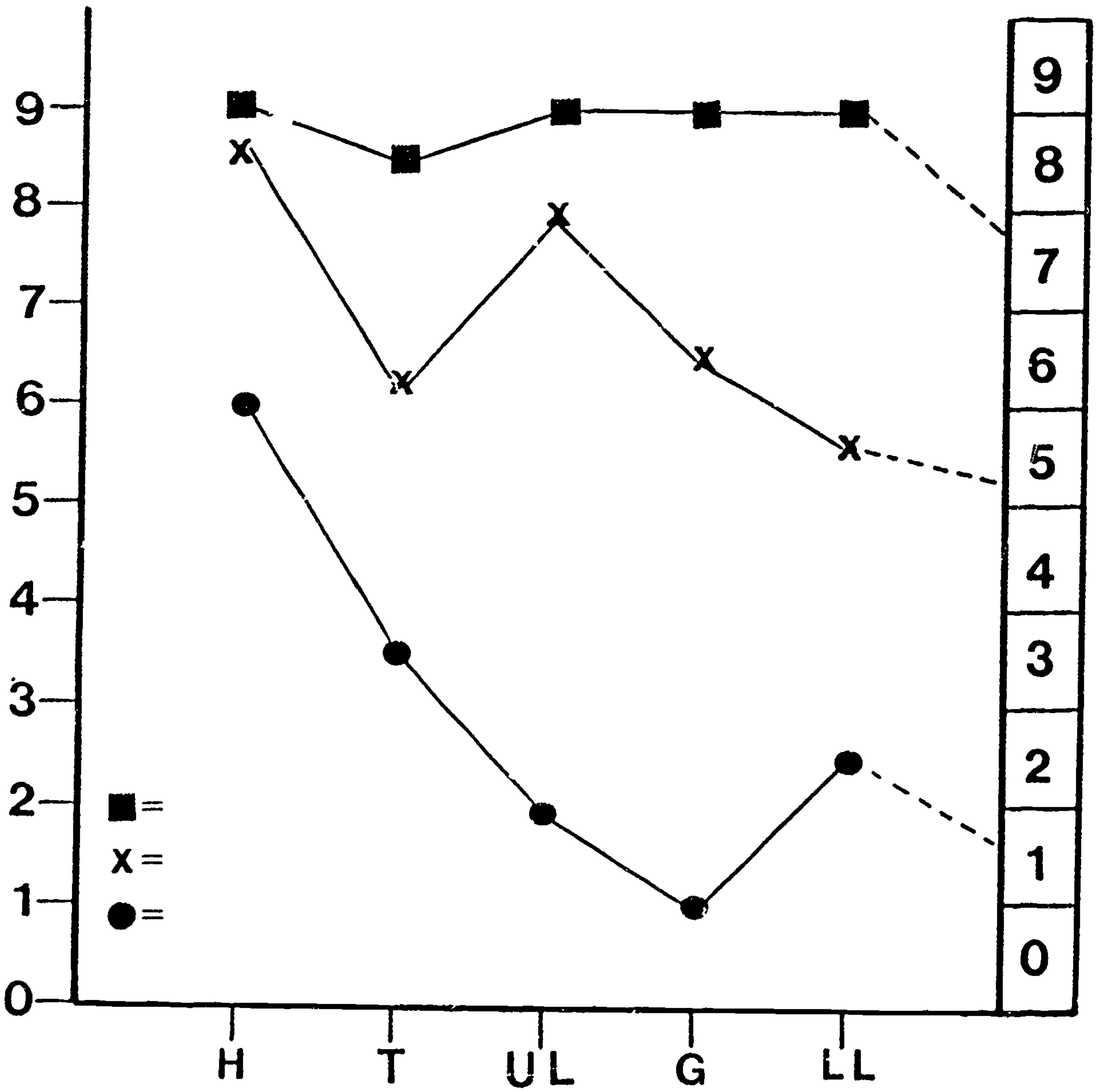
✕ Cerebral Palsied(sub-group 1)

● Cerebral Palsied(sub-group 2)

5. Title

Fig.1 MOVEMENT CONTROL PROFILES OF CEREBRAL PALSIED AND NON-CEREBRAL PALSIED TWO YEAR OLDS DURING A BRICK STACKING TASK.

The profiles show control ratings as derived from an observational framework for 5 control categories:- Head(H),Trunk(T),Upper Limbs(L),Grip(G) and Lower Limbs(L) and the performance level achieved on the task.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