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ABSTRACT

Two studies on cognitive performance in mentally retarded children are reported. In the first study, the Bayley Scales of Infant Development were administered to 56 mentally retarded children, aged 2 to 6, to determine the possibility of discerning subsets of items that form a developmental pattern of interrelated subscales, using the SCAMMO scale analysis. Three partially interrelated subscales emerged in the Motor Scale and five subscales in the Mental Scale, suggesting that mentally retarded children may follow a variety of possible developmental paths or partial paths that exhibit logical and/or psychological consistency and structure. The second study investigated Down Syndrome children's problem-solving strategies within a developmentally oriented theoretical framework. Four children aged 9-13 were required to reconstruct a lane of four slanted blocks in a motorway form board. Analysis showed that the Down Syndrome children may exhibit systematic problem-solving behavior in a complex multistep task and an increase of its efficiency due to active forms of regulation. However, the children showed perseverative tendencies, and their error monitoring routines were slow to develop. (Author/JDD)

COGNITIVE DEVELOPMENT IN MENTALLY HANDICAPPED CHILDREN *)

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Abstract

Two studies on cognitive performances in mentally retarded children, mostly Down syndrome children, are reported. In the first study, Bayley Mental and Motor Scales results of 56 retarded children between two and six years but below mental age of 30 months were subjected to an item analysis procedure suggested by Mokken and derived from scalogram analysis. Three partially interrelated subscales emerged in the Motor Scale and five scales in the Mental Scale suggesting that mentally retarded children may follow a variety of possible developmental paths or partial paths that exhibit logical and/or psychological consistency and structure. In the second study, a complex concrete problem solving task, namely the correct insertion of a lane of four slanted blocks into a form board inproduced as a slanted motorway, had to be solved repeatedly by four Down syndrome children of school age. The microanalysis at the level of elementary operations and block related action sequences showed that DS children may exhibit systematic problem solving behavior and an increase in its efficiency due to active forms of regulation.

Zusammenfassung

Zwei Untersuchungen zur kognitiven Entwicklung bei geistig behinderten, meist Down-Syndrom-Kindern, werden vorgestellt. In der ersten Untersuchung wurden die Bayley-Test-Ergebnisse von 56 retardierten zwei- bis sechsjährigen Kindern mit einem Entwicklungsalter von unter 30 Monaten einer Itemanalyse unterzogen, und zwar nach einem von Mokken vorgeschlagenen Verfahren, das aus der Skalogrammanalyse abgeleitet ist. In der Motorskala des Bayley-Tests ergaben sich drei, in der Mentalen Skala fünf teilweise unabhängige Subskalen. Sie legen nahe, daß sich geistig behinderte Kleinkinder entlang einer Mehrzahl verschiedener Entwicklungspfade entwickeln, die ihrerseits sowohl logische als auch/oder psychologische Struktur und Konsistenz aufweisen. In der zweiten Untersuchung erhielten vier Down-Syndrom-Kinder im Schulalter mehrfach eine komplexere Problemlöseaufgabe, in der sie vier abgeschrägte Blöcke in eine als "Autobahn" vorgestellte abfallende Fläche einfügen sollten. Die Mikroanalyse auf der Ebene elementarer Operationen und blockbezogener Handlungssequenzen legt den Schluß nahe, daß Down-Syndrom-Kinder systematisches Problemlöseverhalten zeigen, das mit Wiederholung unter Nutzung aktiver Regulationsweisen effizienter wird.

Two studies are reported on in this paper. Firstly, an analysis of Bayley Scale data obtained with a sample of mentally handicapped children is presented. The method of analysis employed is the Scammo-technique introduced by Mokken (1971). Secondly, parts of a pilot observational study concerning constructive and regulatory aspects of problem solving strategies in children with Down syndrome is discussed.

Study 1

Albeit employing rather different methods of data collection and analysis, both studies address a developmental interpretation of the type of mental handicap that ensues from the condition known as Down syndrome. It would appear that children with Down syndrome take a course of mental development that is rather similar to, but slower than the course of development of normally developing children. The development of Down syndrome children levels off early, but the sequence of developmental milestones that they do pass through which is thought to be the same as for "normal" children (Weisz & Yeates 1981, Weisz & Zigler 1979). We hypothesized that this apparent identity of developmental sequence as well as its retardation may also be observed in microgenetic processes as they occur in the solution of problems. While it may be obvious that the retardation of development is itself in need of being explained, we will not try to address this question in the present paper (Rauh 1983 a, b).

The Bayley Scales of Infant Development have been widely used as normative assessment instruments for infants and for retarded young children up to a mental age of 30 months. Although with respect to the development of nonretarded infants, the Bayley Scales' item pool is a fair sample of accumulated everyday and scientific knowledge about age-graded achievements and performances, not much research seems to have been done on the Bayley Scales in populations of mentally handicapped children, especially not beyond the chronological age of 30 month.

In the construction of the scales, emphasis has been placed on their psychometric properties independent of item content. The selection of items was not guided by any particular developmental theory. However, there have been some attempts to uncover hidden structures, i.e. to identify subsets of items that form developmental sequences (e.g.McCall et al., 1977; Kohen-Raz, 1967).

In this study the Bayley Scales were administered to 56 mentally retarded children between two and six years of age, 27 being children with Down syndrome (Jähnichen 1979, Henning & Rauh 1982). All children were recruited from early intervention programs, all were cared for at home, and all were free of spastic or epileptic symptoms or major visual or hearing deficiencies. The children were tested in a clinical fashion so as to maximize motivation and to obtain a fair picture of their abilities.

We were interested in determining whether in this sample of subjects it was possible to discern subsets of items of the Bayley Scales that form a developmental pattern of interrelated subscales. This we wanted to do both for the Mental and the Motor Scale.

The statistical method of analysis chosen, the SCAMMO scale analysis by Mokken (1971), is a probabilistic elaboration of scalogram analysis. In Scammo-analysis, a search process looks for those items that satisfy statistical criteria for prerequisite sequences. These may include logical sequences, for instance, that knowing three words implies knowing two words, as well as psychological relationships, for instance, that "Puts 9 cubes in a cup" is a prerequisite for "Completes pink board", which again is a prerequisite for "Pegs placed in 42 seconds". SCAMMO-analysis also allows one to look at development as a complex pattern of interwoven sequences.

This may be demonstrated with the **Motor Scale**. In the "official" scoring of the Motor Scale all items are used to derive a summary index, the "Psychomotor Development Index". However, SCAMMO-analysis shows that there are about five achievements at the highest difficulty level which, although of equal difficulty, are not strongly interrelated. They are:

Item 79: Hops on one foot, 2 or more hops.
Item 76: Distance jump, 14-24 inches (35-60 cm).
Item 80: Walks down stairs: alternative forward foot.
Item 74: Walks board: alternates steps part way.
Item 75: Keeps foot on line, 10 feet (300 cm).

Each of these achievements has a different "history". (**Figure 1**). All are based on the developmental sequence of standing up, getting down, and standing with balance, as well as the progression from stepping to walking where the development of walking itself forms a series. Good balance (item 57) seems to be especially important for later jumping, whereas careful monitoring of one's own feet while walking on a line (item 61) or standing on a board (item 55) are prerequisites for highly directed walking on a board or a line. Walking staircases seems to include good balance on one foot (item 60) as well as highly monitored stepping forward. This pattern of item sequences shows that some children may be better in highly monitored walking, others in jumping (and risk taking!). But at certain times in development, achievements in one area may positively influence those in another area.

In the **mental domain** four scalable subsets of items of the Bayley Mental Scale were identified. At the lower end of the Bayley Mental Scale two Scammo-scales emerged. These are the following:

Subscale I comprises items the successful mastery of which is dependent on the understanding of simple gestures or the copying of those gestures, or the correct acting out of simple commands, e.g. showing one's shoes or other pieces of cloth-

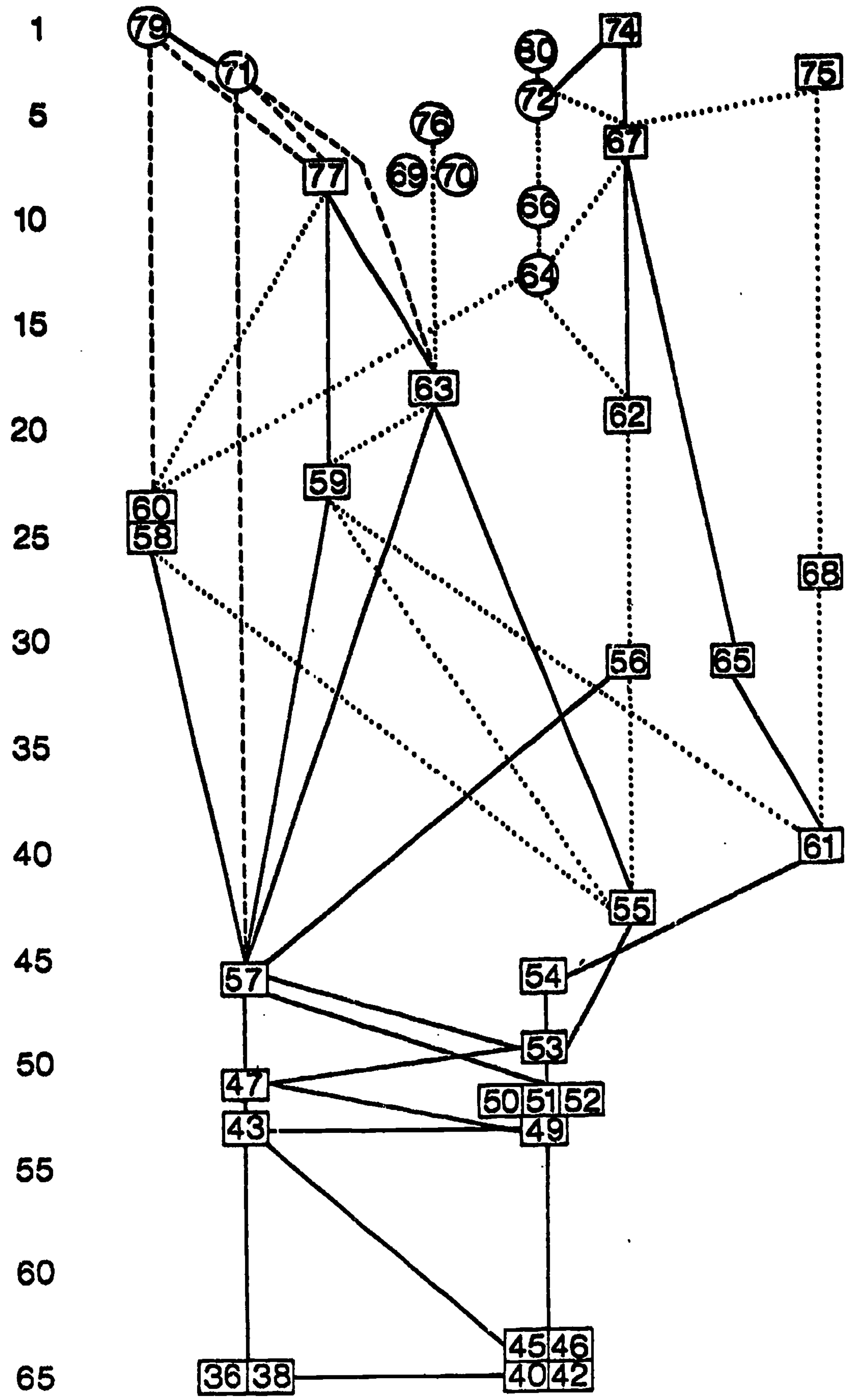

Figure 1: Sequences and branchings of Bayley Motor items in mentally handicapped children

Legend:

Ordinate: Number of children who solved the particular item indicated by its item number in a quare or a circle.

Lines: Scalogram-type relations between items. Dashed and dotted lines: weaker relations between items with some few errors.

ing, stopping an ongoing action, putting three or more cubes into a cup, and attempting to imitate some scribble.

Subscale II comprises items which seem to require that two objects are put into some relationship or that two actions are ordered sequentially. Examples are "Closes round box", "Gets toy with a stick", "Unwraps cube". Apparently, within a certain period of development the execution of interrelated actions of this kind is of so much interest to the child that not much instruction is needed to elicit those actions beyond the mere opportunity to act.

The remaining two SCAMMO-scales comprise a large number of items from the top end of the Bayley Mental Scale.

Subscale III relates to the development of more complex forms of action. Each item of this scale appears to constitute a task that the child can only solve by anticipating the completion of the task and by executing a series of component actions. Typical examples are "Puts all nine blocks into the cup", "Puts all pegs into the board", and "Puts all forms into the formboard".

Subscale IV is comprised of items that require the identification, the discrimination, and the naming of objects and pictures as well as the comprehension of linguistic symbols. The respective abilities appear to be among the major precursors of the symbolic use of language.

Thus,the analysis of their response patterns on the Bayley Scales, both Mental and Motor, shows that mentally retarded children may follow a variety of possible developmental paths or partial paths, respectively, that exhibit logical and/or psychological consistency and structure.

We do not know whether the same set of subscales would be obtained with nonretarded children. It is plausible, however, that task comprehension and length and complexity of action are among the criteria of differentiation.

We intend to replicate this analysis with a larger set of data from Australian and Canadian children with Down syndrome. We will then test alternative models of the structure and sequence of developmental progression.

Study 2

The objective of the second study was to investigate Down syndrome children's strategies of problem solving within a developmentally oriented theoretical framework. It was considered that problem solving may be regarded as a function of the interaction between the individual and a task domain, similar to the way that development may be considered as a function of the interaction of the individual and a world of physical objects and social others. Specifically, we were trying to find out whether particular construction strategies, error monitoring routines, and correction procedures would be discernible in the task related activities of our subjects. Furthermore, we hoped to gain some insight into the kind of conceptual base from which those strategies are generated.

Four children with Down syndrome, two boys and two girls between ages 9-0 and 13-6, participated in the study (Diesch 1984). The task presented to them required the reconstruction of a sloping "motorway" or a lane of this motorway, respectively. The motorway is shown in its intact state in Figure 2. This task was previously used by us in a study of cognitive development of four year old nonretarded children (Schmid-Schönbein et al., 1983). At the beginning of each trial, the motorway or one of its lanes was destroyed and the subject was asked to reconstruct it. Only the results from the task condition where the subject had to reconstruct just one of the lanes are reported here. Each subject was tested three times at intervals of five to eight days. The number of trials presented on

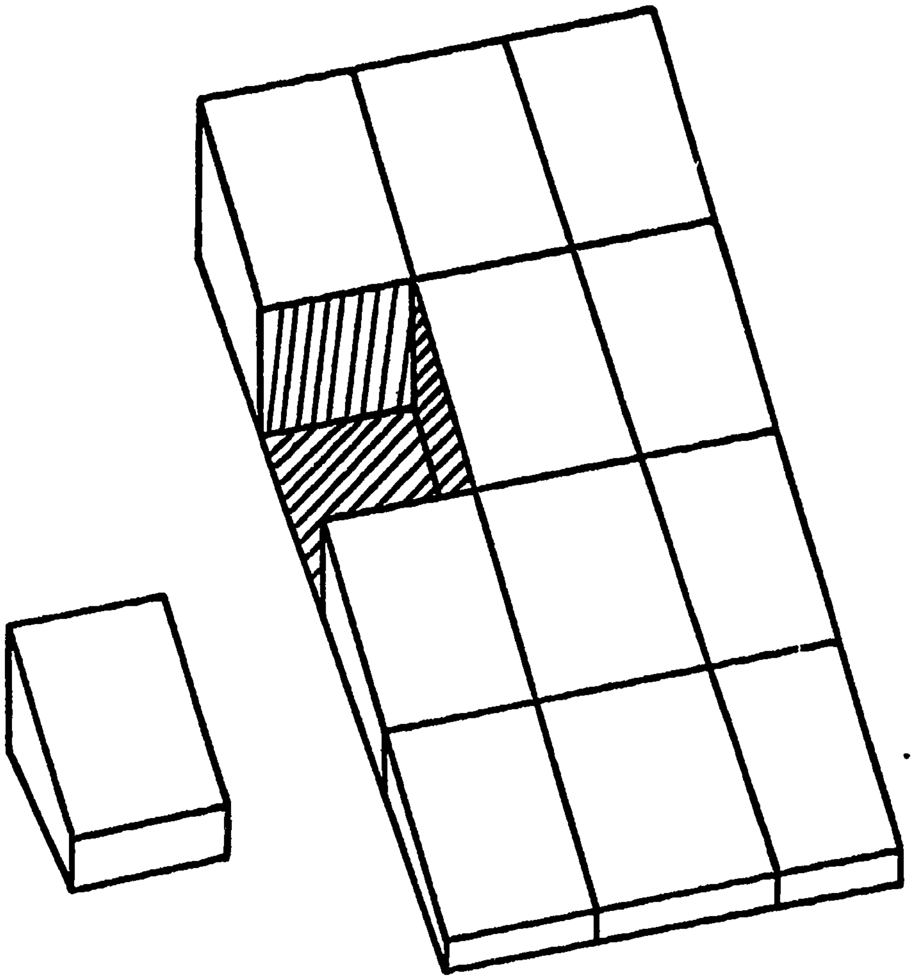

Figure 2: The "motorway" (28 x 15 cm)

each occasion varied between one and four, depending both on the performance and the cooperation of the subject. All task presentations were recorded on video tape.

The analysis of the material obtained in this way started with the transcription of video tapes. A notational system was developed whereby all task-related activities of the subjects were described in terms of "elementary operations". Elementary operations effect a change of either the location and/or the orientation of a motorway element or block. They may be characterized by their source and goal positions and orientations. Complex units of action were determined of and recorded as coordinations of elementary operations. For instance, a complex unit of action that occurred frequently is the block centered action sequence (henceforth BCAS). A block centered action sequence was defined as an uninterrupted sequence of elementary operations carried out with one block.

In the analysis of the results thus obtained, the development both of global and local action success as well as the efficiency and persistence of action was investigated. Global action success refers to whether or not the task is successfully completed, and local action success to whether or not a BCAS is terminated by the correct placement of the block involved. In the case of the task being successfully completed in a particular trial, the number of elementary operations performed may be regarded as an indicator of the efficiency of action. If, however, the task is not successfully completed, this measure may be said to reflect persistence.

Because three of the subjects were able to reconstruct the lane every time they attempted to solve the task, global action success did not prove to be an informative measure. However, local action success, that is to say the ratio of successful BCASs to all BCASs during a trial, and the efficiency of action seem to have changed for at least some of the Ss during the period of investigation (Figures 3 and 4). However, the results are less conclusive than one might want them to be.

It could be argued that a more sensitive measure of progress would be provided by the correlation between the measure of local action success and the measure of efficiency/persistence. A negative correlation would indicate that performance changes across trials were due to increasing efficiency, and a positive correlation that change was due to increasing persistence. The correlations obtained were in fact negative for three of the four subjects,namely for those which never failed to complete the task, and positive for only one of

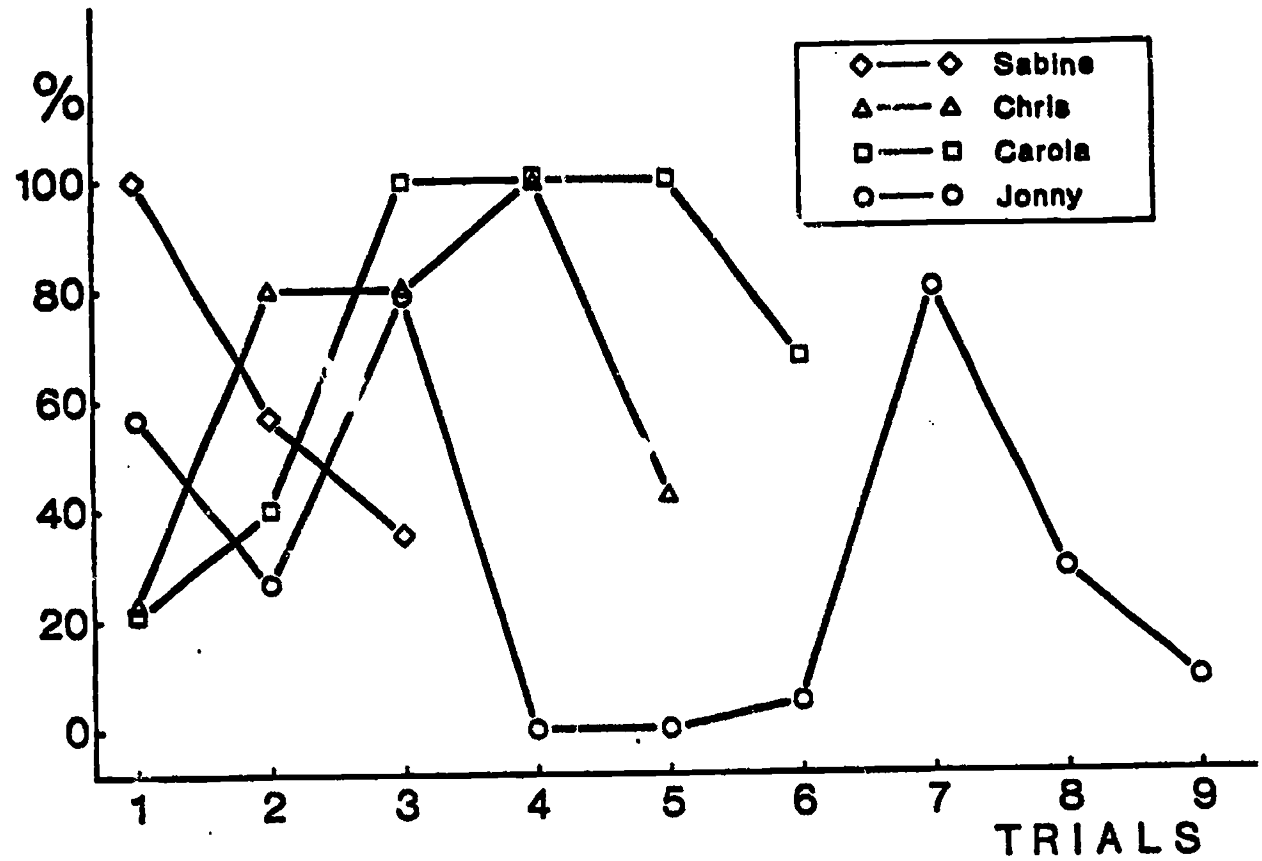

Figure 3: Percent of correct block-centered action sequences per trial

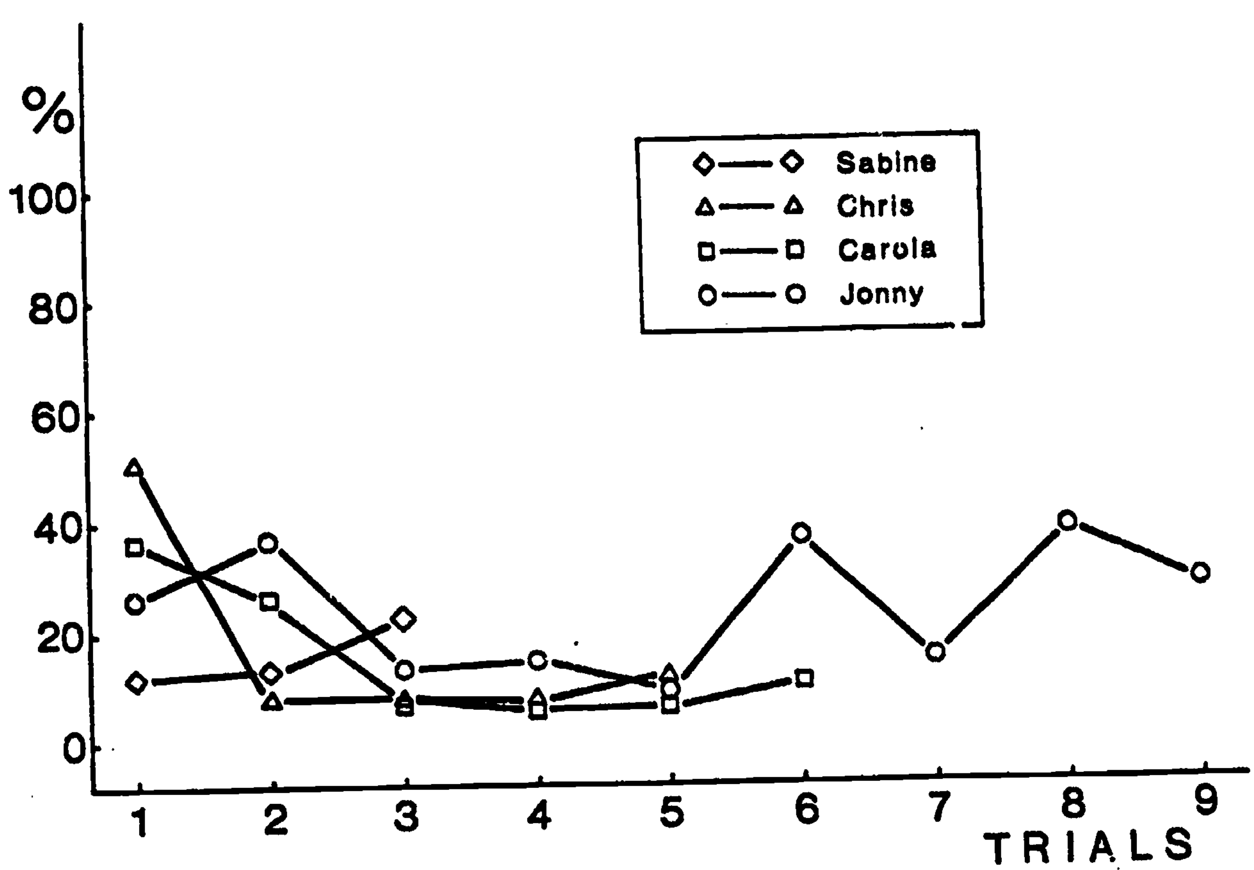

Figure 4: Number of elementary operations per trial

them, that is the one whose performance was unstable throughout the period of investigation.

Basically, the reconstruction of the motorway amounts to the correct reinsertion into the board of the four blocks removed from it. If errors of placement and orientation are not taken into account, then with four blocks and four positions to be filled there are 24 possible sequences of insertion. However, an analysis of first order transitions of the subjects' insertion sequences revealed that their block placement strategies are highly constrained. In particular, the subjects virtually never placed a block onto a board position that was not partially bound by either the boundary of the board or other blocks already reinserted. Thus, the constraints on the subjects' construction procedure may be described by a simple rule: "While there is a block yet to be placed: Insert a block into that board position that is furthest towards the front of the board or into that board position that is furthest towards the back of the board." The subjects did not seem to recognize the existence of the middle positions. When they had selected a block that was too large for the frontmost position or too small for the backmost position, respectively, they preferred to put it back onto the table rather than to slide it onto its appropriate middle position. When they were not free to select the particular block they wanted to insert next, they refused to place blocks which would have had to be placed onto a middle position. When being questioned, they denied that there was a possible position for such blocks. Presumably, the psychologically functional cues for the subjects were discontinuities in the field of action and relationships of spatial neighbourhood rather than position within a (Euclidean) coordinate system.

The selection of blocks to be placed was apparently guided by factors such as the relative distance between the subject's hand and the block and the size of the block relative to the size of the preceding block rather than the mental coordination of block-sizes and target positions.

A comparison of the corrective actions, i.e. displacement and rotation, elicited by position errors on the one hand and orientation errors on the other showed that the type of correction was related to the kind of error it was intended to correct. However, this correlation was far from perfect. In particular, blocks which accidentally were rotated by an angle of 180 degrees around the vertical apparently were often perceived as blocks which were incorrectly placed. From this and from the observation that errors of orientation involving rotations around spatial axes other than the vertical hardly ever occurred it may be inferred that for the subjects the psychologically functional cues relating to orientation were the location (top, side, etc.), the alignment (with neighbouring lanes), and the direction of the incline of the slanted surface of a block (towards the front/the back of the board), rather than angles of rotation, and that those features were hierarchically ordered for them.

Corrective action may either be elicited by the chance detection of errors or by monitoring routines which are preplanned as part of the overall plan of action and later systematically applied to the results of action. If error correction was an active process, then BCASs terminating in some kind of error would be expected to be of about the same average length, measured in terms of the number of elementary operations, as BCASs terminating with the removal of the block from the board. However, if error correction was a passive process, then the former type of BCAS would be expected to be shorter, on the average, than the latter type. The latter result was obtained for the first half of all trials and the former result for the second half. Thus, active error correction apparently developed over time. (In order to avoid a spurious confirmation of the passive error detection hypothesis, the elementary operation of removal was not counted in the comparison of the two types of BCAS.)

These analyses show that, under appropriate conditions of testing, children with Down syndrome may exhibit systematic problem solving behaviour in a complex multistep task and an increase of its efficiency due to active forms of regulation. However, the children which we studied apparently experienced great difficulty in coordinating the size feature and the position feature in the action of placement. Their strategies of block selection and insertion may be regarded as an attempt to vary as little as possible the size and the position of the block involved in successive BCASs, or alternatively, as a sign of perseverative tendencies. Their error monitoring routines were slow to develop. It remains to be determined, whether this is due to attentional deficits or rather to a lack of metacognitive knowledge.

References:

Diesch, E. 1984. Konstruktive und regulatorische Aspekte des Problemlösens bei Kindern mit Down-Syndrom. Final Report, DFG-Project, No. Ra 373/1-1 und 373/1-2.

Henning, H.-J., Rauh, H. 1982. Methoden zur Analyse differentieller Entwicklungssequenzen. In: Oerter, R. (Ed.): Bericht über die 5. Tagung Entwicklungspsychologie, September 1981. Augsburg: Dokumentation der Universität Augsburg, p. 29 - 35.

Jähnichen, E. 1979. Diagnose der kognitiven Entwicklung bei geistigbehinderten Kindern im Vorschulalter: Überprüfung der Brauchbarkeit der Bayley Scales als Entwicklungsskala. M.A. Thesis in Education. University of Bielefeld, unpubl.

Kohen-Raz, R. 1967. Scalogram analysis of some developmental sequences of infant behavior as measured by the Bayley Infant Scale of Mental Development. Genetic Psychology Monographs, 76, 3-21.

McCall, R., Eichhorn, D.H., & Hogarty, P.S. 1977. Transitions in early mental development. Monographs of the Society for Research in Child Development, 42 (3), Serial No. 171.

Mokken, R.J. 1971. A theory and procedure of scale analysis. Mouton: The Hague.

Rauh, H. 1983a. Entwicklungspsychologische Analyse geistiger Behinderung. In: Lüer, G. (Ed.), Bericht über den 33. Kongreß der Deutschen Gesellschaft für Psychologie in Mainz 1982. Göttingen: Hogrefe, p. 508-514.

Rauh, H. 1983b; Analyse geistiger Behinderung im Rahmen der Piagetschen Theorie. In: Montada, L., Reusser, K., & Steiner, G. (Eds.): Kognition und Handeln. Stuttgart: Klett-Cotta, p. 114-126.

Schmid-Schönbein, C., Thiel, T., Rauh, H. 1983. Entwicklung kognitiver Strukturen als Äquilibrationsprozeß. Final Report to Stiftung Volkswagenwerk.

Weisz, J.R. & Yeates, K.O. 1981. Cognitive development in retarded and non-retarded persons: Piagetian tests of the similar structure hypothesis. Psychological Bulletin, 90, 153-178.

Weisz, J.R. & Zigler, E. 1979. Cognitive development in retarded and non retarded persons: Piagetian tests of the similar sequence hypothesis. Psychological Bulletin, 86, 831-851.