Developmental Characteristics of Block-Designing Constructive Activities of Mentally Retarded Children : An Approach from Developmental Neuropsychological View Point

知的障害児における積木模様構成活動の発達的特徴：発達神経心理学的観点からのアプローチ

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脳損傷者の構成活動に関するLuriaらの研究に示唆を受けた我々は、「コース立方体テスト」事態における知的障害児の構成活動を、「解決できなかった課題を解決に導くにはいかなる援助を与える必要があるか」の観点から、解析を試みてきた。その結果、以下のことが明らかになった。1）知的障害児のパフォーマンスレベル（教示以外の援助がない事態での成績）は、一般に、MAの増加と共に高まる傾向にあるが、個人差が大きい。同一MAレベルの普通児と比較してみると、約70%の者が普通児の示す範囲内に位置し、必ずしも低いレベルにあるとは言えない。2）知的障害児では、解決不能であった課題を解決するためには、空間的な分析・操作の成分に向けた援助だけでなく、活動全体を企画・制御する操作成分に向けた援助まで必要とする者が、CA、MAレベルにかかわりなく多い（普通児では、後者の援助まで必要とする者は、6～11歳 70名中、一人も存在しなかった）。3）また、同一MAレベルにある場合でも、異なるタイプの援助を異なる程度に必要とすることが多い。その様相に従って分類を試みたところ、以下の5タイプに分けることができた；同一MAレベルの普通児と差異のないタイプ（47%）、同一MAレベルの知的障害児に比べかなり低い成績を示し、必要とする援助の量も多いタイプ（16%）、空間的分析・操作成分に対する援助が有効なタイプ（4%）、企画・制御成分に対する援助が有効なタイプ（2%）、分類不能（33%）。以上の結果は、知的障害あるいは発達障害の診断に、「必要な援助の量と質」の観点を含むべきであることを示唆するものである。

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1. Introduction

The purpose of this study is to reveal the general and individual characteristics of constructive activities of Mentally Retarded Children. We adopt "Kohs' Block-Design Test" in order to analyze their constructive activities.

"Kohs' Block-Design Test" is well-known as one of the types of the so-called "performance test" which measures intelligence. The immediate purpose of this test is to examine whether the subject is able to construct the presented design (See Fig.1) with 4 (task-1 to -9), 9 (task-10 and -11), or 16 (task-12 to -17) blocks or not. Each of the blocks has 4 "one-color sides" and 2 "two-color sides" divided on the diagonal.

A. R. Luria and L. S. Tsvetkova (1964) used this test to analyze the disturbance of constructive activity in local brain injuries, and found out the followings ;

1) Both of the lesions of the parieto-occipital part of the brain and of frontal lobes resulted in any disturbance of constructive activity.
2) But the characteristics of both of the disturbances were different from each other.
3) Rightly, in order to compensate each of the disturbances it was necessary to make the different type of restoration programs.

we learned two salutary lessons from their study ;

1) A constructive activity has two major components. One is involved in spatial analyzing and/or operating, another is in planning and/or controlling.
2) It is suggestive for us interested in education of mentally retarded children that Luria et al. adopt methods which examine what kind of assistance each subject needs to resolve the failed task(s).

These led us to organization of the series of tests in our studies.

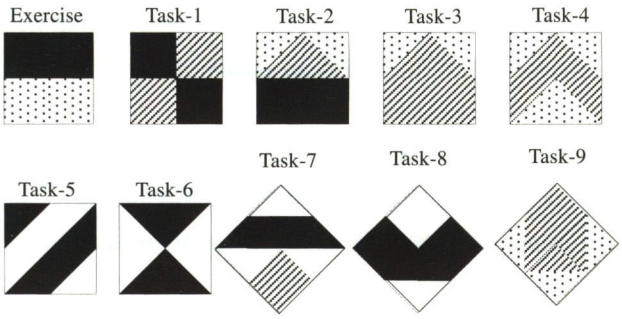

Fig.1 Examples of designs used as models.

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2. Method

1)Participants

70 normal children and 46 mentally retarded children participated in our study (See Table 1 and Table 2).

2)Procedures

We presented the children the following tasks in order to examine not only the children's performance levels without any assistance (in Test 1) but also what kind of assistance each subject needs to resolve the failed tasks(s) (in Test 2).

Table 1 Normal participants

Grade	CA-Range	Number
Preschool	6:00−6:05	10
1	6:06−6:11	10
2	7:06−7:11	10
3	8:06−8:11	10
4	9:06−9:11	10
5	10:06−6:11	10
6	11:06−11:11	10
		Total=70

Table 2 Mentally retarded participants

No	Name	C A	M A	No	Name	C A	M A	No	Name	C A	M A
1	AE	13:00	6:00	21	Ksu	14:10	7:05	41	KeS	15:08	10:01
2	AT	12:08	6:00	22	SS	17:02	7:07	42	Tka	19:08	10:02
3	SE	14:01	6:00	23	HS	16:01	7:09	43	TYo	16:07	10:05
4	TC	15:04	6:01	24	JA	14:10	8:00	44	NG	16:03	10:09
5	JO	16:03	6:02	25	Msa	15:07	8:01	45	KeSu	16:08	11:00
6	YC	14:10	6:02	26	YH	14:04	8:04	46	Tot	15:07	11:06
7	SI	17:06	6:04	27	Ksu	15:00	8:05				
8	HF	15:00	6:05	28	SH	14:07	8:09				
9	HO	13:07	6:06	29	MK	18:03	8:09				
10	MS	13:01	6:07	30	TaT	14:09	8:09				
11	YA	14:07	6:07	31	TY	16:04	8:11				
12	KH	18:06	6:08	32	THa	16:00	9:00				
13	TK	14:06	6:08	33	YS	16:00	9:00				
14	ED	13:06	6:09	34	SI	16:01	9:00				
15	JS	18:03	6:11	35	TH	15:00	9:00				
16	YI	18:06	7:00	36	SM	13:07	9:02				
17	HE	14:05	7:00	37	TS	15:10	9:02				
18	SK	18:01	7:01	38	KK	16:09	9:03				
19	EK	16:06	7:04	39	TT	14:03	9:04				
20	NS	13:11	7:04	40	MiS	14:11	10:00				

i) Test-1

First of all, we presented the series of tasks (See Fig.1) according to the established manual (Ohwaki,1966). Here, we didn't give any assistance except for necessary instructions. The task presentations were stopped when subjects failed to solve two tasks consecutively, and proceeded to the next stage, Test-2.

ii) Test-2

Making a pause (at least one week), we asked subjects to construct the models (designs of tasks not solved in Test-1) under experimenter's some assistance. Test-2 has four steps of assistance; Assist-1, -2, -3, and -4. The task presentations in Test-2 were also stopped when subjects failed to solve two tasks consecutively, and proceeded to the next step. The assistance to be given are as follows (See Fig.2) ;

Assist-1

The models used here are enlarged so as to be equal to the actual dimension. And then, laying blocks one by one on the model, experimenter tell subjects that the model-dimension is equal to the constructed as a whole. Thereby subjects may, at least, not need to convert the model-size into the actual size, and are lightened of loads on spatial analysis of the presented model.

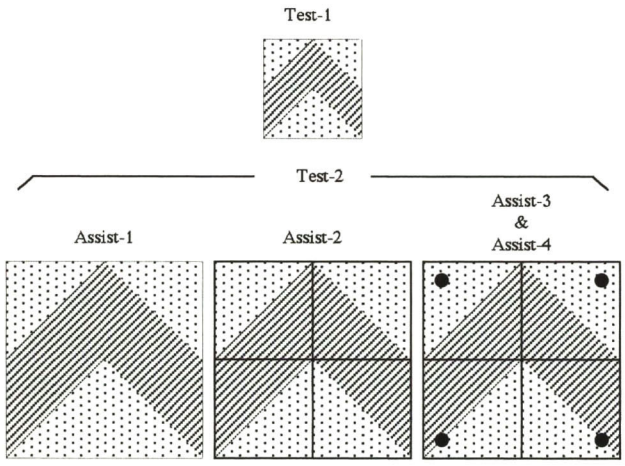

Fig.2 Examples of models in Test-1 and Test-2.(in the cases of Task-4)

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Assist-2

Two lines are drawn on the models to be presented (designs of tasks not solved at Assist-1) so as to be divided into the construction elements. And then, subjects are asked to numerate construction elements on the presented model. Thereby, it may come to be easy for subjects to overcome their immediate perceptual impression received from the presented model and to translate it into the construction elements.

Assist-3

A mark as a guide to spatial orientation is put on each construction element to be constructed with two-color side. Likewise, each block is also put the mark. And then, the experimenter instructs subjects how to utilize the marks in their construction, using demonstrations jointly. Thereby, it may come to be easy for subjects to orientate each two-color side spatially.

Assist-4

The models used here are the same as Assist-3. At this step, the experimenter points out one by one what S should do at each node in the process of construction. That's why subjects may not need to plan and /or control their construction and only need to carry out the operations pointed out by the experimenter.

In sum, Assist-1, Assist-2, and Assist-3 are means of assistance focused on spatial analyzing and/or operating, Assist-4 is on planning and/or controlling.

3. Results and Discussion (1)

1) To what extent can children construct by themselves ?

a) In case of normal children

Fig.3 shows the performance level (the highest Task-Number resolved successfully) of each normal child in Test-1, that is, without any assistance.

Each of the performance levels tends to be upward by degrees with chronological age, although individual

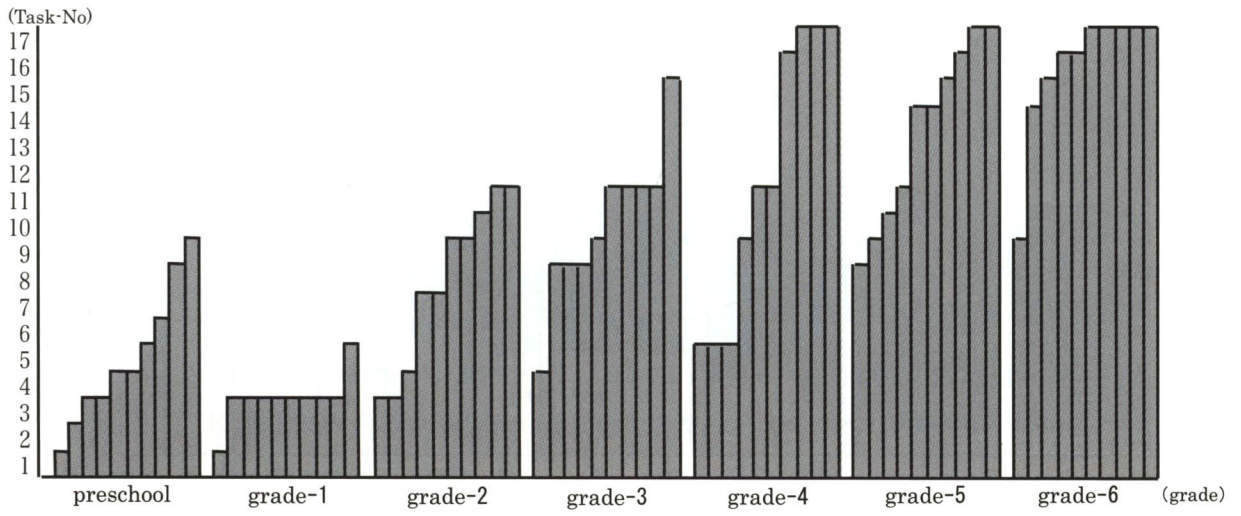

Fig.3 Performance levels of normal children in Test-1

difference in each group is large. And, It should be noted that 7 out of 10 grade-4 children and 9 out of 10 grade-5 resolved task-9 or above. This suggests that by these ages most of normal children come to accomplish all the types of construction with 4 elements.

Incidentally, the performance levels in most of groups tended to be higher in comparison with the norms standardized by S. C. Kohs (1920). For example, even in preschool children group, there was the child who resolved task-9 successfully. In addition, according to "the manual", we had to give IQ=170 to 180 to a few of the children who are not peculiar in their classes. It might be necessary to reconsider whether Kohs' Block Design Test is a true test for measuring IQ or Mental Age or not.

b) In case of mentally retarded children

Fig.4 shows the distribution of performance levels of mentally retarded children in Test-1.

Each of the performance levels tends to be upward with mental age. But individual difference is large. Not a few children (for example, EK, JA, MK, THa, TS, KK, MiS, TYo, NG) showed rather lower levels.

In comparison with same-MA normal children, mentally retarded children are not necessarily lower than normal children. Because about 70% of them fell in the range of performance levels of same-MA normal children. Some of them(for example, JO, JS, KSu, TH, SM, TKa, and ToT) proved themselves to be on fairly higher levels even in comparison with same-MA normal children.

2) What kind of assistance do children need ?

a) In case of normal children

Fig.5 shows the individual performances of normal children in Test-2. Characteristically, most of the normal children (even in preschool group) didn't need so much of assistance in order to resolve the failed task. At least, nobody, among the normal children group, needed up to the Assist-4. These children are likely to come to accomplish 4-elements construction by fairly early age, if they are supported by the Assist-1, -2, or -3.

The above suggest that for normal children of 6 and over, the measure component serving to construct the designs of 4-elements is the operation for analyzing a given design into the elements of construction, at least the role of planning/controlling component is relatively smaller.

b) In case of mentally retarded children

Fig.6 shows the performances of mentally retarded

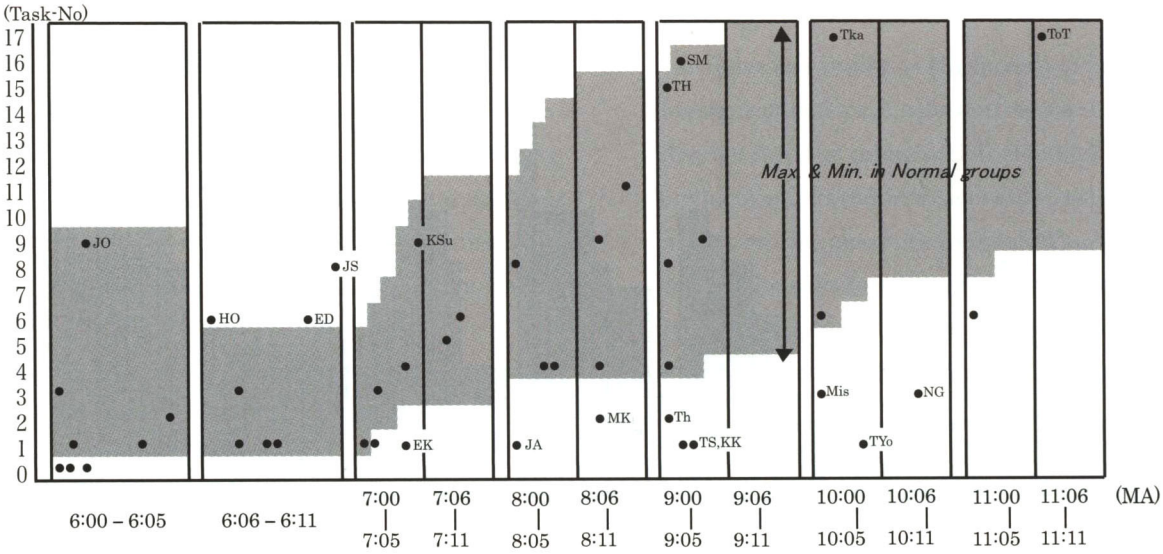

Fig.4 The performance levels of mentally retarded children in Test-1

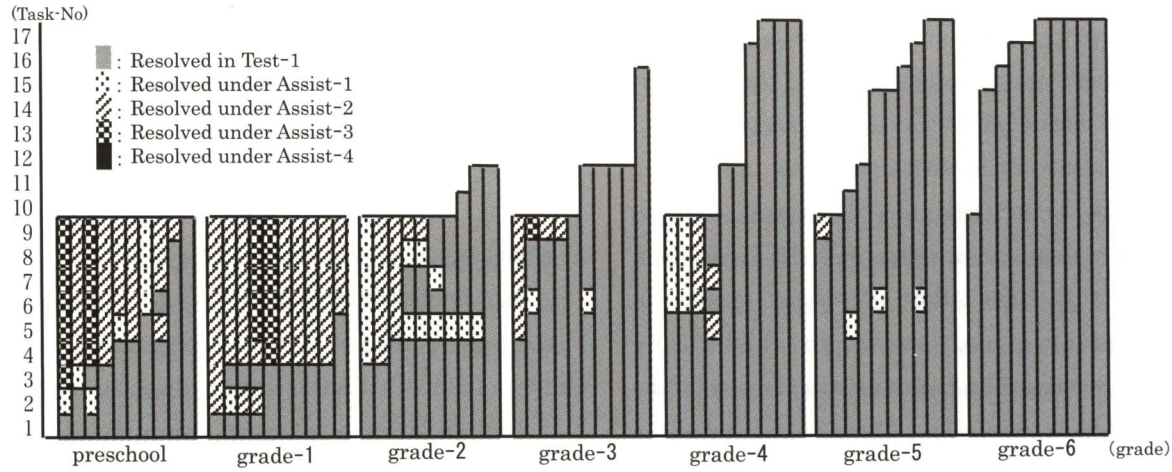

Fig.5 Performances of normal children in Test-2

children in test-2. At first, it deserves our attention that many of the children needed up to the Assist-4. 16 out of 46 mentally retarded children needed up to the Assist-4. This is likely to be one of the general characteristics of them, although this characteristic tends to be find in case of lower mental ages (It should be noted that a part of the children of higher mental ages, for example,THa, TS, MiS, and TYo, don't need up to the Assit-4 despite of showing the lower performance levels in Test-1).

The above suggest that in case of mentally retarded children, there are many children who are different quantitatively and/or qualitatively from the same-MA normal children concerning to the necessary assistance. And there also are children who need some specific or special type of assistance (This was already reported in detail somewhere else). For example, AE(MA=6:0) and MS(MA=6:7) needed, beyond the ordinary extent, the type of assistance focused on spatial analyzing and/or operating, and TC (MA=6:1) on planning and/or controlling.

3) What type of task do children stumble on ? (See Fig.5, Fig.6 and Fig.7)

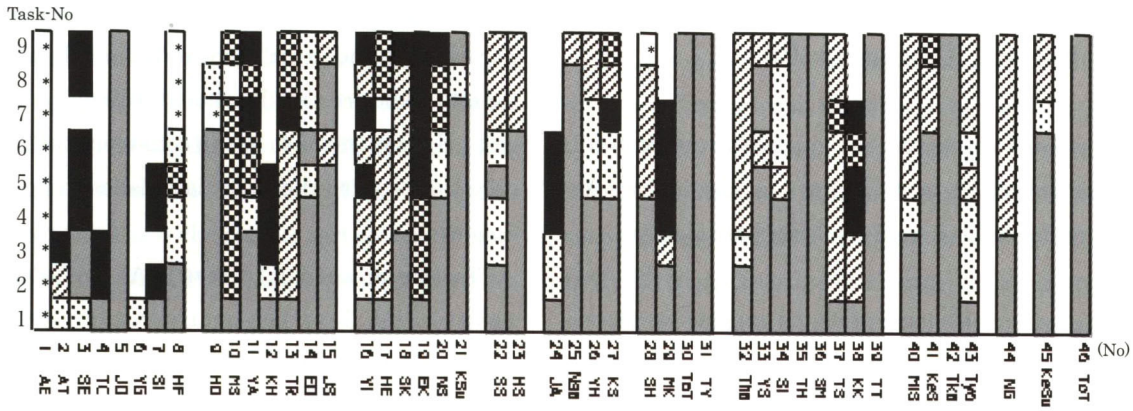

Fig.6 The performance levels of mentally retarded children in Test-2

: Resolved in Test-1
: Resolved under Assist-1
: Resolved under Assist-2
: Resolved under Assist-3
: Resolved under Assist-4
*: Resolved under Specialized assi
: Unresolved

It is one of the main characteristics for mentally retarded children that many of them stumble on the Task-2 and/or -7 in comparison with normal children. This had nothing to do with mental age.

The number of mentally retarded children who stumbled on the Task-2 in Test-1 reached to 15 out of 46 (33%), while only a minority of normal children under 7 years of age stumbled on this task. Incidentally, The Task-1 is a type of the tasks in which each of construction-elements corresponds with the direct perceptual impression of the design, while the Task-2 isn't such a type. In case of a latter type of task, children, at first, need to overcome their impression and divide the model into construction-elements in heart, and then to utilize 2-color sides to construct the model so as to be correspond with the impression. That is, the fact that many of them stumbled on the Task-2 suggests that not a few mentally retarded children need some type of assistance for making them overcome direct perceptual impression in comparison with normal (at least same-MA) children.

The number of mentally retarded children who stumbled on the Task-7 in Test-1 reached to 18 out of 46 (39%), while most of the normal children didn't stumble on this task. Incidentally, in this task-7 (and task-8 and-9), the models stand diagonally (See Fig.1). So children have to adjust to "leaning model". At least, operation of rotating the concerned coordinate system in heart may be necessary. Characteristically, 6 (HF, HO, HE, SK, SH, KeSu) out of 18 mentally retarded children who stumbled on this task showed dramatic changes in their constructional activities under a special type of assistance in which we gave them "Frame of reference" (See Fig.7) and made them fit each of cubes one by one into the frame. They changed their "trial & error" type of manipulation to "goal-directed or planful" type ; Behaving, as it were, in a hit-or-miss way at first, they came to select the necessary side of cube beforehand, then decided the direction, and finally set the cube. We have to give up more discussion on this fact because of being necessary to proceed additional experiments.

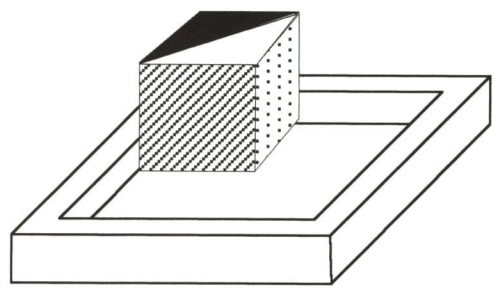

Fig.7 The frame of reference used in Task-7, -8 and -9

4. Results and Discussion (2)

Here, we will illustrate the 3 mentally retarded children who showed an interresting contrast in their developmental retardation of constructive activity.

1) The cases in which the assistance to spatial analyzing and/or operating worked effectively

Example-1 M.S. (m. CA=13:1, MA=6:7)

He tends to be exhausted and to be drowsy. So we had to stimulate him again and again.

It was the only Task-1 which he could solve by himself (See Fig.8). But it drew our attention that he was strategic. That is, at first, he gets all the necessary block-sides before starting to construct practically, thereafter, sets the blocks carefully (See Fig.9). That means that he has, preliminarily, analyzed the model and planned the process of construction.

However, when he proceeded to Task-2 which required to use 2-color sides as well, he ceased preliminary analyzing or planning and came to show a manner of "trial and error" manipulation. He also couldn't (or didn't) notice that he should utilize 2-color sides as well. He continued to try to construct the model with only 1-color sides and eventually failed in the next task-3 as well .

Then he proceeded to Test-2. At this stage, both of Assist-1 and -2 worked nearly in vain. It was the Assist-3 that worked most effectively on him. It was striking that this assistance made him change his manner of construction from "trial and error" to, so to speak, "goal-directed or planful" strategy ; He, at first, constructed the lower part of the design to be constructed with 1-color sides, and then the upper part with 2-color sides, paying attention to the mark on the model and blocks (It drew our attention that he divided the process of construction as a whole into two steps). He could solve up to the task-9 at this step.

Example-2 A.E. (f. CA=13:0, MA=6:0)

She chats well. She often talked fluently to us the occurrences in her school life. She listened to

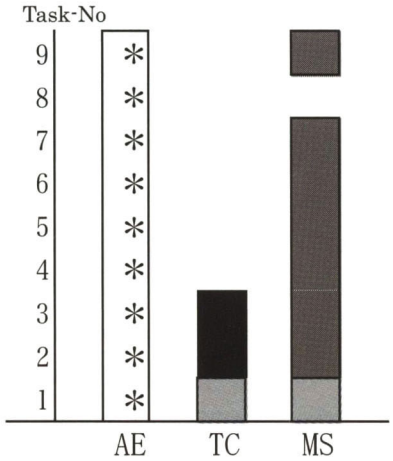

Fig.8 The stage or step where each MR could solve in each task.

: Resolved in Test-1
: Resolved under Assist-3
: Resolved under Assist-4
* : Resolved under Specialized assist
: Unresolved

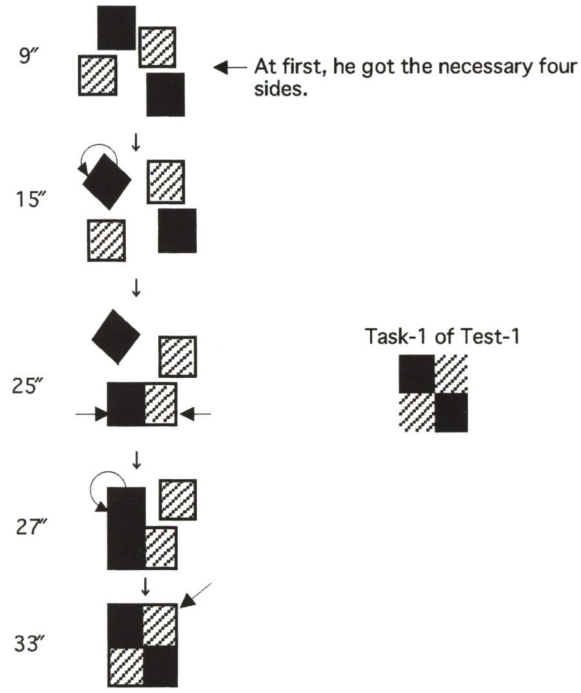

Fig.9 The process of cnstruction of MS in Task-1 of Test-1

experimenter's instructions, and even asked questions spontaneously if couldn't understand them well enough.

By contrast to M.S., she couldn't solve even Task-1 by herself. The Assist-1 didn't worked effectively in this task. It is nonsense to give Assist-2 for Task-1, because the model of task-1 is a checkered pattern. As for Assist-3, it is impossible for the same reason. Then we proceeded immediately to Assist-4. It was characteristic that she could choice the necessary sides, but often set them up at wrong position (e.g.  or ), and failed for the reason. Eventually, in spite of Assist-4 focused on the aspect of planning and/or controlling, we had to add the instructions concerned with spatial orientation (e.g. "Move it upward !") in order to make her complete the task. This Assist-4 worked in vain in the Task-2 as well.

Next, returning to the step of Assist-2, we asked her to solve Task-2. At this time, characteristically, she couldn't numerate correctly the construction elements on the presented model even after experimenter's instructions (M.S. was also unable to numerate correctly at first, but came to be able after experimenter's instructions). She numbered only according to the perceptual units (i.e. ). She could numerate only in the case of using the actual blocks as the models. Then, hypothesizing that the introduction of actual blocks may be useful to make her analyze the model, we tried to present the actual blocks as the model in order to make her solve. But she didn't get to solve. The next Assist-3 was also useless. That is, it was confirmed that all the assistance which had prepared at first had no effect on Task-2.

Then, we tried to present both of the model to be used in the Assist-3 (drawn on the cardboard) and the model of actual blocks in a row at the same time. This type of assist may be regarded as a modification of Assist-3. This modification worked effectively to make her solve all the tasks of four construction elements.

2) The case in which the assistance to planning and/or controlling worked effectively

Example-3 T.C. (m. CA=15:4, MA=6:1)

He is a man of few words contrastively to A.E.. He didn't even report that he had finished solving the given tasks, so far as he was not asked. He also trended to come to be drowsy. T.C. and M.S. were alike in this respect. However, M.S. could recovery the level of activity through experimenter's encouraging instructions, on the other hand T.C. couldn't so. So we couldn't present so many tasks to him.

Although he took much more time and his manner of construction was "trial and error", he could solve the Task-1 in Test-1 (See Fig.10). When he proceeded to Task-2 and -3, however, he came to be helpless.

In Test-2, it was not effective at all to give him Assist-1, -2, and -3. Characteristically, he didn't noticed how far he solved the given tasks. For example, in Assist-2 for Task-2, he came to be just before solution (he constructed as follows : ), but he didn 't (or couldn 't) noticed it, handled the block placed already correctly, put in a unnecessary correction, and failed at last. It should be noted that he failed the task not on the ground that he couldn't realize necessary operations appropriately, but on the ground that he couldn't

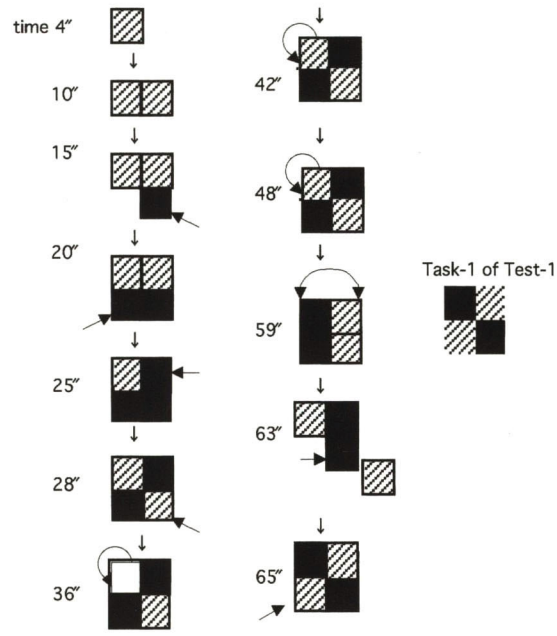

Fig.10 The Process of construction of TC in Task- 1 of Test-1

(or didn't) estimate that he had got the critical position. (We, latter on, tried to present him with the same situation as a special task. Then he could solve the task easily.)

It also should be noted that from the start, he was able to numerate correctly construction elements on divided designs. That suggested that he might find it less hard to analyze the presented designs into construction elements than M.S. and A.E., and at least, he might not depend on the actual block-model like A.E. did.

Then we presented the Assit-4 for this task, Task-2. Although he required experimenter's encouraging instructions, he could solve the next task-3 as well as this task, manipulating blocks one by one appropriately. Thus, it was Assist-4 that worked effectively on him.

Wishing to continue tests moreover, we had to stop on account of his problem pointed out at the beginning. But, we had chances enough to grasp what kind of assistance he needs essentially.

The above results show that M.S. and A.E. have more serious developmental problems in aspects of spatial analysis and/or operation, on the other hand, T.C. has of planning and/or controlling. In order to get the supporting evidences, we tried to present the following two sorts of tests to them : one is the test of "perception of direction (of hands on a clock)" ; another is of "programming (arranging checkers in a raw, for example in a following arranging form ; ●○○●○○)". In these tests as well, they showed differences similar to the above in performances and characteristics of errors. That may support that our interpretation of results is valid.

It is instructive finding that each of the mentally retarded children gaining nearly even MA-scores in a intelligence test required different type of assistance in order to solve the tasks which are beyond their performance level.

5. Summary

1. Although the individual difference in each group of the normal children is large, their performance levels without any assistance tend to be upward by degrees with chronological age. But the performance levels in most of groups tended to be higher in comparison with the norms standardized by S. C. Kohs (1920).

2. Mentally retarded children's performance levels without any assistance tend to be upward with mental age. But individual difference is large. Although not a few children showed rather lower levels, our mentally retarded children were not necessarily lower than normal children. Because about 70% of them fell in the range of performance levels of same-MA normal children.

3. Normal children even on rather lower performance levels in Test-1 don't need so much of assistance to resolve their failed tasks in comparison with mentally retarded children.

4. Many of the mentally retarded children needed up to the Assist-4 focused on planning and/or controlling, while Nobody among the normal children did up to the Assist.

5. Many of mentally retarded children stumble on the Task-2 in which each of the construction-elements begins not to be correspondent with the direct perceptual impression of the design, and/or on Task-7 in which the model begins to stand diagonally. This had nothing to do with mental age.

6. Mentally retarded children gaining nearly even MA-scores in a intelligence test required different type of assistance in order to solve the tasks which are beyond their performance level.

7. There may be 5 types of constructive activities of mentally retarded children ; Type-1s (47%) are not distinct from same-MA normal children ; Type-2s (16%) show relatively lower peformance-levels than the peers ; Type-3s (4%) show more gains with the assistance focused on spatial analyzing and/or operating ; Type-4s(2%) show more gains with the assistance focused on planning and/or controlling ; the others (33%) are not classifiable.

8. This study as a whole suggests that in order to connect the diagnostics of mentally retarded children with their education, it is important to examine what kind of assistance each mentally retarded child need and to characterize individually by the outcomes.

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