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Dynamic testing in practice : shall I give you a hint?

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CHAPTER 2

Dynamic assessment and a reversal task:

A contribution to needs-based

assessment

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Abstract

The aim of this explorative study is to examine whether a dynamic test and an additional reversal task provide valuable information about children's general cognitive performances, which could be especially useful for planning educational interventions. The Analogical Reasoning Learning Test (ARLT) was administered to 26 young children, receiving special education services, followed by a newly developed reversal task in which the child was requested to construct analogy problems for the examiner. Results demonstrated additional information about the children's cognitive performance (compared to the static test) and the ability to construct problems, which indicated a transfer of the trained problem-solving strategies to the construction of problems in the reversal task. Qualitative analyses of the reversal task revealed additional information about individual strategies and verbalization. This combination of tasks could provide the first steps towards measures that could provide directions for (educational) interventions.

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Introduction

In their daily classroom environment, teachers are used to attuning their instruction to the specific needs of individual children. The resulting variety of instruction may differ, for example in the amount of emotional or motivational support a child needs, or in the specific curriculum adaptations needed. When children with learning difficulties are involved, their specific needs can be rather complex and the most suitable intervention may not be simple to decipher. For this reason teachers, in agreement with the child's parents, frequently call upon the help of an educational psychologist to carry out an assessment to guide the planning of their educational interventions.

The present study therefore focuses on the contribution of dynamic assessment including a reversal task to the guidance of (educational) interventions. The search for the best fitting treatment and tackling of the problem behavior actually takes place in the final phase of the whole psycho-diagnostic process (Resing, Ruijsenaars en Bosma, 2002). In this cyclic process (De Bruyn, Pameijer, Ruijsenaars & Van Aarle, 2003) the diagnostician first formulates a diagnostic question. Then, he or she specifies the degree and interaction of the problems which form the basis of hypotheses to be tested in order to explain factors playing a role in evoking or maintaining these problems. Test results and other information will then be interpreted, concluding a report about the nature of the problems. Finally, consultation takes place, during which alternative explanations are considered and appropriate interventions or treatments are determined.

An intervention model based on this diagnostic cycle, is the needs-based assessment model (Pameijer & Van Beukering, 2004; Pameijer, 2006). The intention of the model is to find and integrate important relations between problems and complaints and to consider for every new case, or referral, which hypotheses, tests and measures could be used to answer the diagnostic questions and will lead to appropriate interventions corresponding to the educational needs of the child. This approach is

Chapter 2

different from the procedure sometimes used of administering standard batteries of tests, or procedures intended for classification or labeling.

Although consultation, educational planning and advice have always been part of school psychologists' agenda's, traditional tests diagnosticians choose in the psycho-diagnostic process following a referral, often appear not to be very suitable for planning interventions. Assessment is frequently carried out with the purpose of classifying or labeling children (e.g., Timms & Elliott, 2006), to clarify the present learning difficulties or to evaluate a child's cognitive ability often with the final aim of assisting in the decision making processes of allocating resources or school placement (e.g., Elliot, 2000; Lauchlan, 2001; Resing, 1997).

Most of the traditional tests for determining the intellectual or cognitive abilities of children with learning difficulties lack specific implications for starting points for instruction (e.g., Lidz, 1992, Resing 2001, Tzuriel, 2000a), and manuals of these tests prescribe standard instructions, a neutral testing attitude, and no feedback. The result of testing often is a quantitative score reflecting the number of items the child has answered correctly and the rank order of the child's performance related to peer group scores. These test scores, interpreted in terms of abilities and disabilities and strong versus weak aspects of the child's functioning, also provide ample opportunities for analyzing the child's learning and problem solving processes (e.g., Elliott, 2000, Resing et al., 2002). The scores themselves provide information about learning only in a very indirect way (Day, Engelhardt, Maxwell & Bolig, 1997).

Inspired by, among others, Binet's definition of intelligence as "the ability to learn", various dynamic assessment measures have been developed, which all at least have in common that instruction and feedback to solve cognitive tasks are integrated in the testing process (Lidz & Elliott, 2000; Resing et al., 2002). The amount of hints given during testing is sometimes fixed, sometimes adapted to an individual's performance, whereas in other test procedures different needs for various types of hints seem to resemble individual learning routes (see for a detailed comparison Resing et al., 2002). Some of these tests have incorporated structured and fixed protocols of hints, ranging from general to task specific, for example the Analogical Reasoning Learning Test

(Büchel & Hessels-Schlatter, 2001) or the Learning Potential test for Inductive Reasoning (Resing 1997, 2000), which make a qualitative analysis of the type of hints needed possible. In studies of Campione and Brown (1987) and Resing (1990, 1997, 2000) the intervention or teaching phase consists of a structured protocol of hints, which measures the minimal number of hints a child needs to solve a problem independently, instead of attempting to maximize tasks performance. Such tests provide information concerning both the amount of hinting a child needs and the type of help from which the child profits. Resing et al. (2002) have stated that both the need for instruction and the hint structure used in dynamic testing can provide additional information about children's learning processes and can provide guidance for interventions and educational planning.

In contrast, studies following a more dynamic assessment approach, for example Feuerstein, Rand & Hoffman (1979), Tzuriel (2000a), Lidz & Jepsen (2000), use individualized mediation as an intervention, which goes beyond hints. Elliot (2000, 2003) and Lidz (1992) pointed out that there is actually a gap between the extent to which dynamic assessment can result in meaningful recommendations for educational purposes and the need and wish for more standardized, psychometrically founded approaches to dynamic assessment. So far, these two aims of dynamic assessment appear hard to combine.

In this exploratory study we tried to find a match between the prerequisite of standardized dynamic assessment procedures and the aim of generating practical recommendations. We made use of a standardized dynamic assessment procedure to obtain an indication of the learning potential of a child, followed by a newly developed reversal task, which should both provide additional quantitative and qualitative information about specific utilized strategies utilized by the learner, as well as provision of evidence for transfer of the training and hint procedure.

Tasks that are frequently used in both static and dynamic assessment are analogical reasoning tasks. The most commonly used analogy is the classical type $A:B :: C:D$, in which the relation between A and B must be inferred and has to be equivalent to the relation between C and D (Goswami, 1992; Sternberg, 1985). These

Chapter 2

classical analogies can be composed as either conceptual or perceptual analogies. According to Lifshitz et al. (2005) conceptual analogies are based on semantic relationships, for example functional, part-whole or categorical (e.g. Feuerstein et al., 1979; Resing, 1990; Sternberg & Nigro, 1980). The solution of a conceptual analogy requires consideration of one characteristic, whereas perceptual analogies are composed of perceptual components such as color and shape, and require consideration of two or more characteristics to solve the analogy. While perceptual analogies can be solved by visual comparison of the components and inductive reasoning, the possible relations in a conceptual analogy are various (Resing, 1990) and therefore considered as more abstract (Lifshitz et al., 2005). Studies with young children demonstrated that perceptual analogies were easier to learn than conceptual analogies (Tzuriel & Galinka, 2000), yet for adolescents with intellectual disabilities perceptual analogies appeared to be more complex to solve, probably because of the number of dimensions to be considered (Lifshitz et al., 2005).

The purpose of the reversal task used in this study was to stimulate and invoke children to demonstrate their understanding of inductive reasoning. We no longer just asked children to solve analogies but to take more active roles by constructing analogies similar to the analogy problems taught by the examiner during dynamic assessment. The constructed analogy problems were to be solved by the examiner and the child had to provide the instruction. The assumption behind the construction and use of the reversal task was that the child would be enabled by transferring the trained principles of solving analogies to a new situation. The idea is that solving a given problem and picking out the correct answer is very different from constructing a problem and explaining the process of solving the problem to someone else, although the same problems are involved. The latter process requires a more profound knowledge of the problem-solving process and the verbal ability to explain the principles of problem solving to someone else.

The development of the reversal task was inspired by a few studies in which children were asked to construct and/or to instruct someone else. Tzuriel and Galinka (2000) developed the dynamic Children's Conceptual and Perceptual Analogical Modifiability test (CCPAM), which compares children's ability to solve and to construct

analogies; children receive mediation during problem solving and structured prompts during the construction of analogies. Kohnstamm (1967) reported a task in which the child was asked to construct inductive reasoning problems, specifically inclusion problems. In order to prove how well children understood the principle of inclusion problems, they were offered new materials and asked to both formulate correct inclusion questions and construct inclusion problems for the examiner. To check if the child understood how to solve inductive reasoning problems, the examiner provoked corrections by the child of the examiner either by giving a wrong answer or by asking for clarification (see Kohnstamm, 1967).

Although the encouragement to explain or clarify the correct answer or requests for provisions of the reasons behind an answer stimulates young children to search for the cause of events, young children appear to be less likely than older ones to explain their reasons or answers spontaneously (Siegler, 1995). He demonstrated that kindergarten children benefited from requests to explain another person's reasoning, that is, that of the older and more knowledgeable examiner. Trying to see the situation from the other person's perspective appeared to enhance the child's learning process. During a dynamic assessment procedure, a child is often asked or trained to clarify the characteristics of an analogy. However, it is unusual, even within the dynamic assessment context, to ask the child to assume full responsibility for the role as teacher. In the Application Cognitive Function Scale (Lidz & Jepsen, 2000; a curriculum-based dynamic assessment for use with young children) the child was also requested to take the perspective of teacher and the child's ability to share thinking with another person was emphasized. During testing, the child was asked to take the role of examiner, and to instruct the former examiner – playing the child now – to draw a picture. In this case, the focus was on the child's ability to adapt communication to express awareness of the needs of another.

In using our reversal task, we were expecting, by assigning the role of teacher to the child, that this role, combined with provoking questions from the examiner, would reveal further understanding of the child's analogical problem solving.

Chapter 2

Explaining the principles of analogical problem solving to someone else in the reversal task requires transfer of the principles learned in the prior training. Resing (1990) discerned several forms of transfer, based on the work of Klauer (1989), who differentiated between, among other things, formal and material transfer. In the reversal task, the procedure of how to guide or help the examiner through the problem-solving process could be interpreted as formal transfer, that is, knowing the sequence of problem solving. The ability to construct the analogy problem might indicate transfer on a more declarative knowledge level, that is, material transfer; in this case the child applies the knowledge that an analogy consists of four elements that relate to each other.

This exploratory study focused on the question of which diagnostic information could be derived from the combination of a static and a dynamic testing procedure, including role-reversal, given to young children and whether dynamically gathered information on the general cognitive performance of children, measured with an analogical reasoning task, had additional value in the final phase of the psychodiagnostic process. Specifically, this study explored the relationship between the dynamic testing procedure and the reversal task. We expected that measures of learning potential would have a stronger relationship with the ability to construct an analogy than scores on an intelligence test. Further, we examined how several qualitative observations, for example the type of instruction and exchange of pictures, obtained by administering the reversal task, would contribute to the dynamic assessment results.

Method

Participants

Twenty-six children took part in this study. All children were recruited from special education schools¹ in the Netherlands. Five children (three boys and two girls, age range

¹ In the Netherlands special education is split up into different types in accordance with the level of learning difficulties. One category is special education for children with mild to moderate learning

77 to 89 months, $M = 82$ months; Mean IQ = 58.6) went to schools for children with severe learning difficulties, and 21 children (17 boys and four girls, range 68 to 98 months, $M = 80$ months; Mean IQ = 82.4) went to schools for children with mild to moderate learning difficulties. Schools were selected based on their willingness to participate. Parental consent for participation, permission to use video recording and access to IQ scores was obtained. For all children Dutch was the primary language spoken at home.

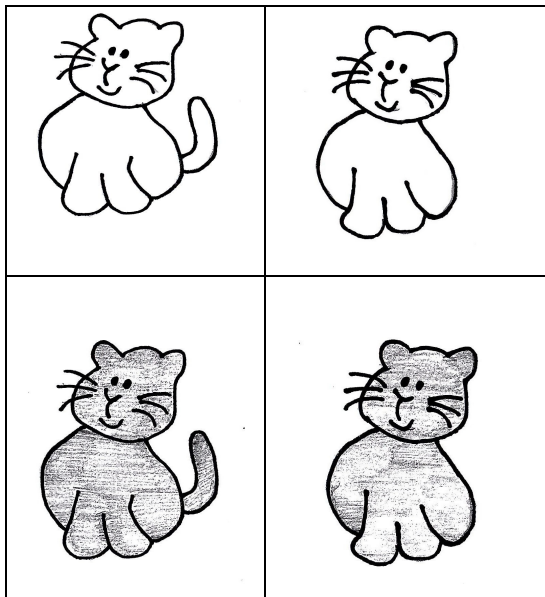


Figure 2.1 Example of analogy similar to the ARLT

Materials

Analogical Reasoning Learning Test. The Analogical Reasoning Learning Test (Büchel & Hessels-Schlatter, 2001; Hessels-Schlatter, 2002a, 2002b) has been developed to assess the learning potential of children and young adults with moderate to severe mental retardation. The items of the ARLT consist of perceptual analogies in a 2 x 2 matrix format with colored pictures on wooden blocks which fit in a matrix frame (see Figure 2.1). Two dimensions play a role in solving the items: the elements A-B relate to each

difficulties and another category schools concerns the education of children with severe learning difficulties (IQ below 60).

Chapter 2

other by one dimension and the elements A-C relate to each other as well by another dimension. The solution D should be a combination of both of these dimensions.

Administration of the ARLT consists of three phases: a pre-learning phase, a learning phase, in which a training of analogies is given with predetermined hints and feedback, and a maintenance and transfer phase, in which no help and only simple feedback is given. Based on the score of this latter phase, the child's learning potential can be computed and categorized in terms of the result of dynamic testing as 'high', 'moderate', or 'low' responding to intervention children.

Reversal task. The reversal task used in this study has been constructed to stimulate and invoke children to demonstrate their understanding of inductive reasoning by constructing an analogical problem and explaining the process of problem solving to the examiner. In the present study, the reversal task has been constructed additionally to reflect the ARLT. Four items, identical to and already presented in the ARLT, 'ice creams', 'trucks', 'dogs' and 'combs', were used to construct the task. Table 2.2 shows the four items and the transformations being trained in the ARLT. The core attributes for solving the chosen items could be categorized as differences (form, color or size) or presence (addition or omission). For two items (trucks and dogs) another attribute could be chosen for constructing an analogy (see last column of Figure 2.2). For both items this attribute was depicted in some of the alternatives to choose from, but was not explicitly practiced or pointed out in the ARLT training. The item 'combs' has a higher complexity level, because three transformations have to be considered.

Procedure

Intelligence scores were collected from the children's files at school. After the ARLT English manual (Büchel & Hessels-Schlatter, 2001) was translated into Dutch, the ARLT and reversal task were administered by third year psychology students who had received training, including feedback, on administering the ARLT. All training and test sessions were administered within two weeks. During the sessions scoring sheets were filled in by the examiner and all sessions were recorded on audiotape and typed out verbatim, in order to check the amount of feedback given during training and the scoring

of the items. The reversal task was administered one or two weeks after finishing the ARLT by the same examiner who had given this training. In most cases a second examiner was silently present to operate the video camera, in order to make a detailed observation and scoring possible. The examiner was instructed to take a more passive role than in a normal testing situation, by, for example, sitting back a little and not being too quick to prompt or encourage the children. The reversal task was introduced by telling the child that the task was different from previous ARLT sessions and that this time he or she would be the teacher and the examiner would be the child. Next, the request was made to construct an analogical problem ('a puzzle like we did before') for the examiner to solve. The examiner handed the necessary number of pictures and the wooden matrix form to the child and waited for response. The examiner took the role of pupil, by choosing an alternative, and by asking for help, or clarification.

Item	ARLT phase	transformations of attributes practiced in the ARLT			Extra/ new attribute
		Attributes 1	Attributes 2	Attributes 3	
Ice cream (4 blocks)	Learning phase; maintenanc e phase	<i>Difference:</i> Presented in glass or crust	<i>Existence</i> <i>Addition of</i> <i>chocolate</i>		
Trucks (9 blocks)	Learning phase	<i>(Difference</i> <i>in) direction:</i> Driving direction	<i>Existence</i> Addition of a wagon		<i>Difference:</i> low or high wagon
Dogs (9 blocks)	Learning phase	<i>Difference in</i> color white, spotted,	<i>Existence</i> Omission of tail		<i>Difference:</i> color grey
Combs (11 blocks)	Transfer Phase	<i>Difference in</i> <i>size</i> Big or small	<i>Existence</i> omission of teeth	<i>Difference :</i> color (purple/red or blue)	

Figure 2.2 Items of the reversal task per ARLT phase and type of transformation practiced

Chapter 2

To guide the children through the task, several general prompts could be given, for instance, if the child completed the analogy: 'leave one box open, so that I can choose the answer'; if the child did not give any instructions after constructing the analogy puzzle the examiner would say: 'can you tell me what to do?'; asking for clarification or help: 'I don't understand, could you tell me why this is the right answer?' In order to check for understanding and to encourage explanation of the displayed dimensions, the examiner deliberately picked out wrong alternatives and asked for clarification when a correct or incorrect answer was approved by the child.

To introduce the concept of constructing the analogy and taking the role of teacher, the item 'ice cream' was presented first. Because this item had already been practiced twice, we expected that children would be somewhat familiar with the pictures and analogy. To enhance the focus on the procedure of constructing the analogy and instructing the examiner, only the pictures of the analogy, matching the analogy provided in the ARLT were handed to the child. For the next two items, 'trucks' and 'dogs', all nine pictures were provided and the child could choose which ones should form the analogy and which would remain as alternative. The last item, 'combs', consisted of 11 pictures and included, as shown in Figure 2.2, three possible aspects.

Scoring. The ARLT was scored according to the test manual and the child's learning potential was categorized into one of the three 'status categories' based on the total score of the third phase. The reversal task was scored both quantitatively and qualitatively based on the video recording and the scoring sheet. The first author and an observer, not involved in the administration, independently watched the videos and determined scores by following an observation scheme, which is described below, for every item and every child. Both observers recorded their interpretation of the observed elements and responses of each child, and recorded the instructions verbatim, in addition to explanations of dimension and additional comments. All recordings of the observers were compared and differences in interpretation were discussed to obtain consensus. In three cases the specific video under discussion was reviewed to promote assignment of the observation to a category. The observation scheme of the reversal task focused on both the process of analogy construction and the process of instructing

and explaining to the examiner. The observation categories could be divided into quantitative and qualitative information.

Quantitative recordings were scored as dichotomous or categorized variables (present/absent or correct/partial correct/incorrect) and added up for all items, whereas qualitative recordings offered detailed information about type of action, behavior or expression demonstrated. Scores on the item 'ice cream' have not been analyzed. The following variables were quantitatively scored: choice of the pictures as a deliberate or random act; the moment at which the examiner handed the pictures to the child and especially the child's next action, and selecting the pictures for the analogy problem were observed; spontaneous composition of analogy problems consisting of three elements; the problem should be displayed as three pictures in the matrix, and several alternatives. Change of some or more pictures during the process; this was scored 'present' if the child did exchange pictures from the analogy problem and the initial alternatives. Correct analogy (scores): this was scored 'present' if the complete analogy, including the approved solution, formed a correct analogy. Dimensional analogies, in which one transformation was displayed horizontally or vertically and the other transformations dimensionally, were scored as partial correct.

- a) Spontaneous perspective taking; this was scored 'present' if the child took the 'viewing' perspective of the other into account, demonstrated by turning the pictures or matrix towards the other.
- b) Description or explanation of all transformations displayed; this was scored 'present' if the child described all attributes or transformations, one transformation or none during the construction and problem-solving processes of the analogy.

In the qualitative recordings more detailed observations were made, to gather information about what type of behavior happened, the response to a hint, or the sort of explanation that was provided. Four categories (the composition of the analogy problem, the act of change, the instructions given and the transformations or attributes described), have been analyzed in detail, and the observation categories recorded are displayed in Figure 2.3.

Results

Based on their dynamic test scores after administrating the ARLT, all children were categorized into three learning potential groups: 12 children with high responsiveness, 9 children with medium responsiveness and 5 children with low responsiveness to intervention. Table 2.1 provides an overview of the characteristics of these three groups. A Kruskal-Wallis test with correction for tied ranks was conducted to evaluate differences among the three status groups on median change in both IQ, and in age. The results revealed no significant effects for either IQ, for age.

Qualitative observations	
<u>Type of composition:</u> <ul style="list-style-type: none"> • 3, 4 or 2 pictures • response to a hint 	<u>Occurrence of change:</u> <ul style="list-style-type: none"> • child initiated, spontaneous • in response to instruction to or question from the examiner • after description of aspects
<u>Type of instruction provided:</u> <ul style="list-style-type: none"> • simple • compared with pointing • providing the correct answer • with description of attributes of the analogy • meta-cognitive level 	<u>Description of transformation</u> <ul style="list-style-type: none"> • response to a wrong answer • all transformations or attributes • partially (one transformation) • new attribute • not corresponding • irrelevant

Figure 2.3 Qualitative observations

In order to answer the question whether the reversal task contributed additional information to the dynamic assessment scores, the recorded observations of the reversal task were analyzed both quantitatively and qualitatively; the quantitative analyses are presented here. Firstly, in the process of constructing analogy problems we differentiated between the presence of deliberate versus random choices of the

pictures. About 65% of all children made a deliberate choice for each of the three analogy items, whereas only two children (7.7%) picked pictures randomly for all three items. These results indicate that the majority of children were task-oriented at the start of constructing the analogy problem. Further, we observed whether children were able to compose an analogy-problem, consisting of three elements (A, B and C), in the 2x2 matrix with only one place open for element D. Of all the children 30.8% were able to do so spontaneously, whereas 43.9% needed one or two hints “to leave a box open” and 15.4% needed this prompt during the construction of all the analogies.

Then, the act of changing a picture of the analogy problem has been observed during both analogy construction and instruction given by the child. The results demonstrated that 34.6% of the children did not change any of the pictures – they just put them in place in the 2x2 matrix - and most children (57.7%) changed pictures only once or twice. A small percentage (7.7%) consistently changed the pictures in all three tasks.

Table 2.1 Characteristics of learning potential status groups

	Responsiveness to intervention		
	High (N=12)	Moderate (N=9)	Low (N=5)
Boys	10	8	2
Girls	2	1	3
School type:			
Moderate Learning Difficulties	10	8	3
Severe Learning Difficulties	2	1	2
Age (months: M/ <i>SD</i>)	83.3/ 7.8	75.1/ 6.9	82.8/ 5.9
IQ (M/ <i>SD</i>)	80.1/13.6	79.0/ 9.1	70.4/24.5
IQ range	56-112	71-100	49-108
ARLT score ^a (M/ <i>SD</i>)	16.0/ 2.6	8.7/ 1.2	3.0/ 2.0

^a Maximum ARLT score is 20

Next, the ability of the children to construct a correct analogy was examined. About one third of the children participating in the study were able to construct a correct analogy problem for all items, one third were not at all able to do so or made only once a partial

analogy². The other third of the group consisted of children who made two or three partial analogies and one or two correct analogies. It was expected that measures of learning potential (ARLT status scores) would have a stronger relationship with the ability to construct analogies than the scores on an intelligence test. The connection between children’s learning potential status and their reversal task score appeared to be strong ($r_s = .70, p < .001$), whereas the relationship between IQ scores and scores on the reversal task score was less strong and non-significant ($r_s = .31, p = .13$). When the ability to construct correct analogies was examined for each status group separately, children with the high responsiveness status constructed the most correct analogies (83.3%), and children with a moderate or low responsiveness status had more problems in constructing correct analogies, but nevertheless obtained correct scores in respectively 25.9 % and 26.7% of the cases. In Figure 2.4 the percentages of all correct (score of 6), at least one correct (score of 2 to 5) and a partially correct analogy (score of 1) are displayed per status group.

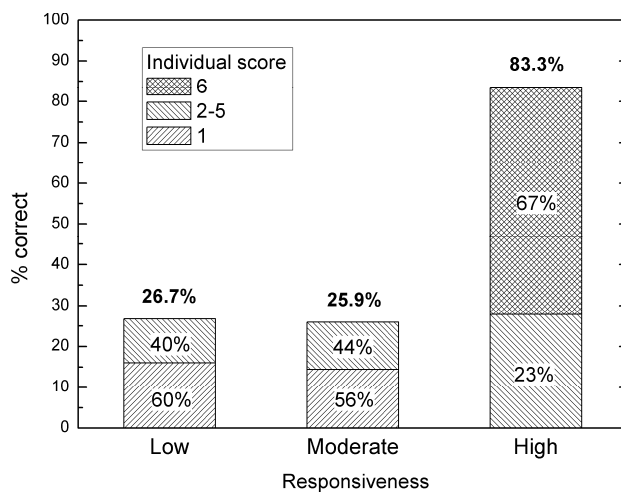
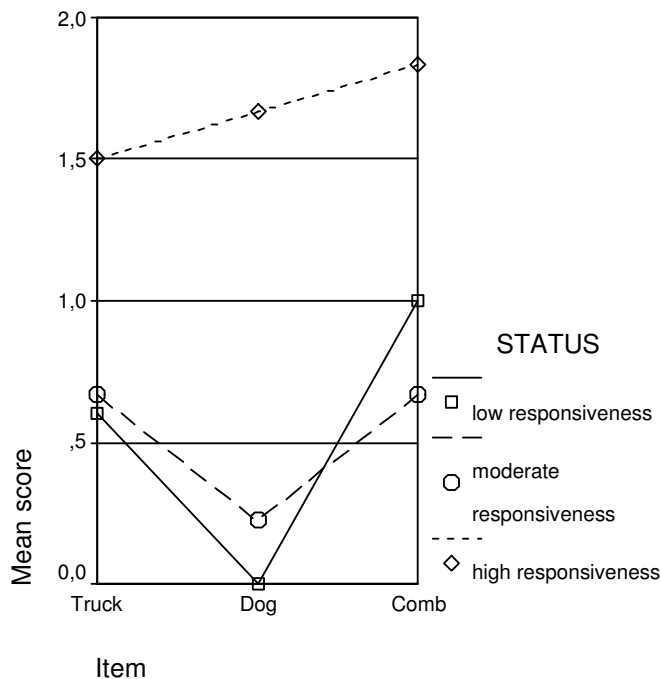


Figure 2.4. Percentage correct scores for every status group

² A partial or diagonal analogy consist of one relation between two elements displayed horizontally or vertically (e.g., A-B or A-C), and one relation diagonally (e.g., A-D or B-C).

A one-way between subjects ANOVA was conducted with the factor being the total construction score and the independent variable being the learning potential status to evaluate differences between status groups. The one-way ANOVA indicated a significant effect for status, $F(1,23) = 14.07$, $p \leq .01$. Pair-wise comparison showed significant differences ($p \leq .001$) between the low responsiveness and the high responsiveness group and between the moderate responsiveness and high responsiveness group ($p < .001$). However, these results should be taken cautiously, because of the small numbers in each group. Figure 2.5 displays the mean scores per status group.



2.5. Estimated mean scores per item split in status group

After the child had constructed an analogy, he or she was supposed to instruct and help the examiner to solve this analogy. In this ‘teaching’ process, it was recorded if the child ‘took perspective’: turning the pictures or the matrix towards the examiner, so that the person would be able to view the pictures well. The results showed that 30.8% of the children were able to take perspective in only one item spontaneously, and did so

Chapter 2

only after a prompt from the examiner in the other two items, whereas 69.2% of the children needed this prompt for all items of which half of them (34.6%) responded positively to this hint. Apparently, taking perspective was not a natural reaction: none of the children were able to show perspective taking spontaneously during two or more items.

The number of transformations - as displayed in the analogy- explained by the child to the examiner, during the process of instructing or in response to a clarification question, differed considerably. Some of the children (30.4%) were not at all able to explain transformations of the items, 34.6% of the children described only one transformation of each item, whereas the remaining children (28.6%) were able to describe or explain all transformations of at least one of three items. In three cases (11.5%) the child received so much help from the examiner that the number of described aspects could not be scored at all.

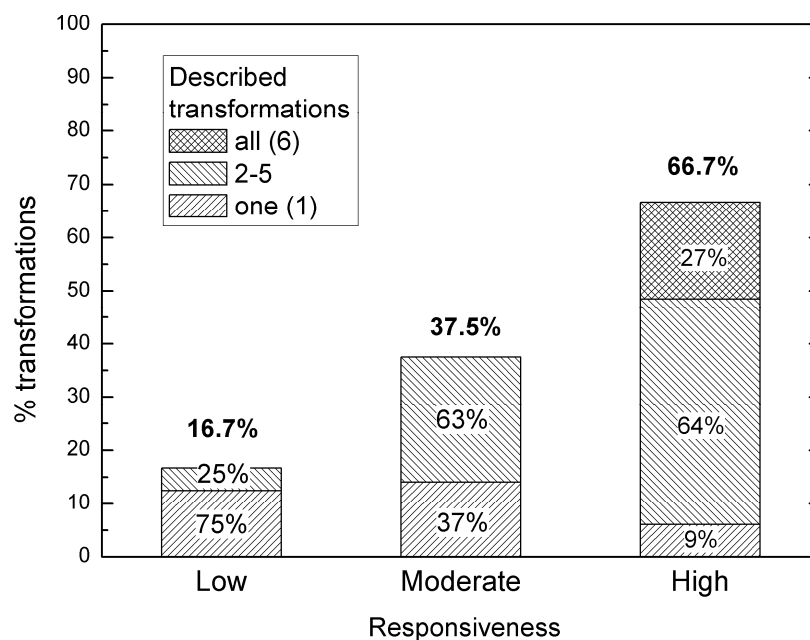


Figure 2.6. Percentage of total described transformation per status group

IQ was not significant in relation to learning potential status ($r_s = .36, p = .073$), but was significant in relation to the number of described transformations ($r_s = .65, p \leq .001$). The number of described transformations correlated also significantly with the ability to construct a correct analogy on the reversal task ($r_s = .41, p = .038$).

Children from the high responsiveness group described the highest number of transformations (66.7%), followed by the moderate responsiveness group (37.5%). In Figure 2.6 the percentage of the total number of described transformations has been displayed per status group.

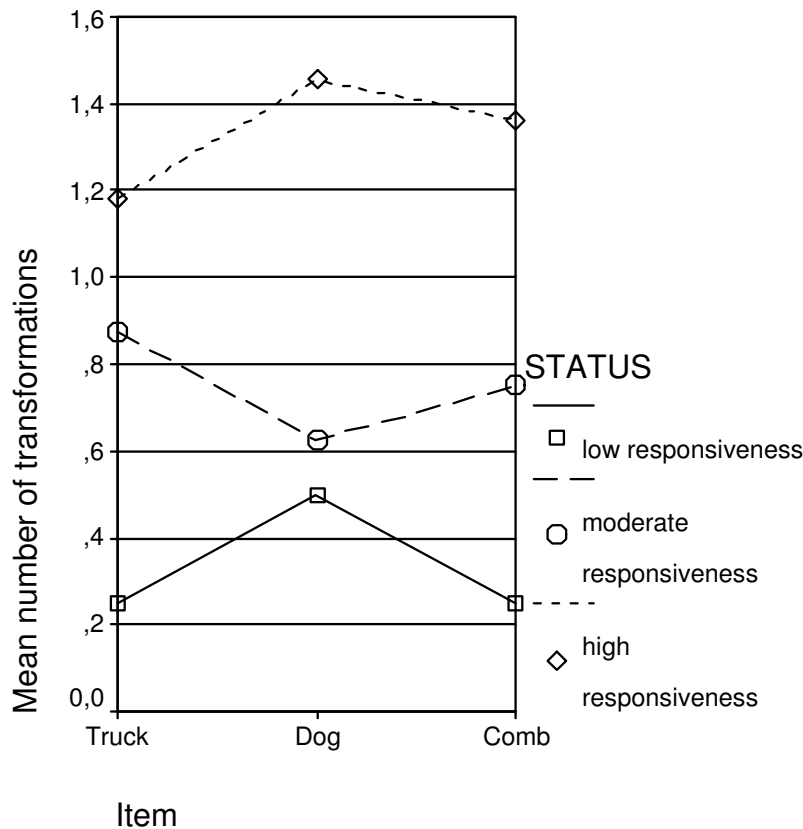


Figure 2.7. Estimated means of described transformations per item for each status group

To evaluate the differences between status groups regarding the total number of described transformations, a one-way between subjects ANOVA was computed with the

Chapter 2

number of described transformations as the factor and the independent variable being the learning potential status. The results for the ANOVA indicated a significant effect for status, $F(1,20) = 4.35$, $p=.027$. Pair-wise comparison indicated a significant difference ($p=.04$) only between the low responsiveness and the high responsiveness group. The results should be considered with caution, because of the small number of participants. The mean scores per status groups are displayed in Figure 2.7.

The qualitative results presented here conform to the overview given in Table 2.2. Observations of the construction of analogy problems revealed that children did not always construct an analogy of three elements (ABC and one open box in the matrix), they also constructed combinations of four pictures (ABCD), or displayed only two pictures (AB or AC). Analyzing the reasons for filling up all four boxes of the matrix, revealed various 'variants/categories': completion of the whole matrix, but spontaneously putting the answer D between the alternatives; completing the whole matrix and waiting yet responding quickly to a prompt to leave one box open by taking the answer D out; and completing the whole matrix, yet not responding to the prompt to leave one box open, and four pictures remained or were just moved from one box to another.

One of the reasons for displaying only two pictures was explained by a girl, who displayed two pictures on the third item, whereas she displayed three pictures on the previous items. She responded to the prompt to leave one box open: "but this is an extra difficult one for you!" Her reasoning seemed accurate: she knew exactly which other two pictures had to be picked out to complete the analogy but wanted to know if the examiner could find the correct answers. After constructing the analogy problems the children were supposed to teach the examiner how to solve the problem. The recorded instructions, given spontaneously or in response to a prompt, could be categorized into five types: simple, shown/pointed, correct answer, description of transformations or attributes, and self-regulating. In Table 2.2 examples of all instruction types are shown.

As was shown in the quantitative analyses above, children often exchanged one or more pictures of the constructed analogy. Analysis of the observations revealed

various instances of changing a picture: Exchanging pictures randomly during the construction of the analogy problem, in response to a prompt to leave a box open or change happened because the child was not satisfied (for example, a child muttered: “No” and changed a picture). Or change was caused by limited choice of pictures, triggered by an instruction to the examiner or by a request for help from the examiner.

Table 2.2. Types of instruction given by children during the reversal task

Simple:

“Choose”

“Pick one”

“Tell me, then”

Shown/Pointed

“You have to find this one (points to empty box)”.

“Which one? This one, this one, this one...” (Pointed to the alternatives one by one)

“You have to see which one belongs there (empty box)”.

Gave away the answer by pointing to the alternative:

“It is this one”

“That one with no tail and spots”

Description of attributes or transformation:

“I shall explain: from tail- no tail and spots-no spots”

“See, this one lacks teeth (comb)”

“This one goes that way, and that one goes that way (trucks)”

Meta-cognitive

“Just like just before”

“The same as you we did before”

Finally, change was triggered by the description or explanation of a transformation or an attribute of the analogy. In the last two instances, by giving instruction or by verbally describing the transformation(s) of the constructed analogy, the child’s focus was directed to the displayed transformations and the child might have realized that a transformation was not correctly displayed. A final qualitative analysis was conducted on the recorded observations of the described attributes of the transformations in the

constructed analogy. These descriptions were often given in response to a request to clarify the correct answer or in response to a wrong answer given by the examiner, see examples in Table 2.3.

Discussion

The goal of the present study was to explore the value and usefulness of information gathered with different kinds of dynamic assessment measures, the Analogical Reasoning Learning Test (ARLT) and a newly developed Reversal Task, when determining the general cognitive performance of children. A second purpose was to explore the value of this information in the final phase of the psycho-diagnostic process.

One main finding of this first study with dynamic assessment, in addition to intelligence testing, was that the levels of learning potential (“high”, “moderate” and “low” responsiveness to intervention) based on the results on the ARLT, did not necessarily correspond with the reported IQ of the children. Children’s IQ in the category “high” responsiveness, who profited from instruction, varied, for example, from far below average to average IQ’s, and similar ranges were found for both the “moderate” and “low” responsiveness groups. These findings are consistent with those reported by, for example, Resing (1990, 1997, 2000) , Hessels (1997, 2000) and Campione & Brown (1987), who demonstrated that the classification of children in terms of their general cognitive abilities based on the dynamic assessment was different from classifications based on IQ, and support one of the purposes of dynamic assessment. For children identified with severe learning disabilities, as in this study, these findings indicate that some children have actually higher learning potential than expected based on their IQ score and may thrive when educationally challenged. In contrast, some children with moderate learning disabilities hardly profited from training, and will need additional and intensive instruction to promote modest progression in learning.

Although the scores of the ARLT distinguished among three learning ability categories, these categories were based on post test scores only, and did not take into

account the level of analogical reasoning prior to the test. Therefore, the degree of responsiveness did not necessarily indicate the accurate performance level: children who were able to reason analogically prior to the test were indistinguishable from children who could not or hardly do so.

Table 2.3. Examples of children’s descriptions of attributes or transformations during the reversal task

Reactions to a wrong answer from the examiner:

Item “Trucks”: “No!” Now they bump into each other!

Item “Combs”: “No, because this one is red

Then This one? “No, for then it goes big and big

This one? “Yes”

All transformations described:

Item “Dogs”: (while pointing)

“These with tail and this one and this one without tail and these are grey and these have spots”

One transformation described

Often the analogy contained more than one transformation, but there were quite a number of children that did mention only one.

Item “Trucks”: “this one goes this way and that one that way”

(addition of wagon is not mentioned)

New aspect described

Within the item “Trucks” a child pointed to a different attribute, the presence of an empty wagon or a full wagon, which was not practiced in the ARLT training, for example:

“Because this one has two wagons with a roof and these two wagons without a roof (empty) and this one goes this way and that one goes that way”

Not corresponding

Children mentioned aspects that did not correspond with the created analogy. For example, while referring to an analogy (“item Combs”) consisting of the transformations colour and size, a boy clarified the correct answer as:

“With this one you can not comb, with this one you can. This one is the broken one”

Irrelevant:

Children explained the analogy without describing any correct transformations:

“A dog needs to be white”

“This is the same”

“These are all brushes”

Chapter 2

The reversal task reflected our findings. Children with either lower (low responsiveness) or moderate learning potential demonstrated comparable abilities in constructing correct analogy problems or in explaining the transformations in the analogy. Highly responsive children stood out by demonstrating higher abilities in constructing and explaining analogy problems compared to the other two groups.

Although describing attributes and transformations was emphasized in the dynamic assessment training, unexpectedly, no significant relationship was found between the number of descriptions and learning potential status. However, descriptions in the ARLT training were intended to facilitate problem solving, for example, directing attention, but the children were not asked to explain the analogy afterwards, which might explain the present findings.

The role of the static measure, reported IQ, in constructing and explaining analogies was different from the dynamic measures. Although a relationship between the ability to construct analogies and IQ could not be found in this preliminary study, a strong relationship between the number of described transformations in the analogy and IQ scores was found. Since describing or explaining (parts of) a problem requires certain verbal skills, this relationship was not surprising.

Another finding was that the majority of children demonstrated the ability to construct an analogy problem on the reversal task. Apparently, children were able to transfer the problem solving strategies practiced in the teaching phase of the ARLT to the process of constructing analogies, which could be considered as material transfer (e.g., Klauer, 1989). Kohnstamm (1967) also observed this ability in children who were asked to construct inclusion problems, especially when similar materials were offered.

Formal transfer, transfer of procedural knowledge, was also observed during the reversal task, when children instructed or explained to the examiner how to solve the analogy. Yet children showed individual variations in instructions or explanations and most children only responded to a prompt or question from the examiner, which indicates that they knew the principles of problem solving, but did not always spontaneously explain them, as was also noted by Siegler (1995) as well as Tunteler and Resing (2007).

For school psychologists completing a psycho-diagnostic process, the results of dynamic assessment could provide additional and valuable information about children's learning potential, compared to IQ. The results suggest that there is more to describing children's learning ability than is provided by traditional tests of intelligence. Moreover, the reversal task adds insights into the ability to transfer trained problem solving skills to the construction of problems and explanation of the problem solving process to someone else. Together these measures provide directions for recommendations about the level of instruction and educational challenge a child needs.

Children in this study, even those with more severe learning problems, appear actually to be able to learn abstract inductive reasoning and problem solving from specific, step by step instructions and frequent feedback, indicating that instructions and learning goals could (sometimes) be raised above the concrete level, facilitated with concrete materials.

The observations of children's performances on the reversal task also provided information about individual learning characteristics, which could guide the recommendations even further. The child's task approach and processing in constructing an analogy problem could be observed as well as information about the child's understanding of the task demonstrated during the process of "teaching". It appeared possible, for example, to assess whether children were goal or task oriented by observing their choice of pictures and the composition of the analogy. When a child deliberately chose pictures and composed a problem of three elements (ABC), either spontaneously or after a hint, the child appeared to know what was expected from him or her. It was also possible to identify children who needed visualization of the complete (ABCD) analogy, instead of adding the D element mentally.

The process of teaching someone else how to solve an analogy problem might reveal a child's understanding of the analogical problem solving process (Kohnstamm, 1967), for example, by the elaborateness of the instruction or explanation provided, which indicates the presence of transfer of the prior learned principles. It might also reflect how well the child understands the needs of the other person, by giving hints or instructions and by taking the other person's perspective. This last skill is very useful in a

Chapter 2

cooperative learning setting. Alternatively, the request to play the role of teacher might have complicated the construction of the analogy, because it might have worked as a distraction during the construction of the analogy problem. Especially, a wrong answer or a request for clarification from the examiner -playing child-, could have confused the child's reasoning.

The present study has been conducted with a small number of children, and very low numbers of specific subgroups, especially girls and children with severe learning disabilities. Nevertheless, we would like to conclude that the dynamic assessment procedure, combined with our newly developed reversal task, provides additional information about general cognitive performance as well as individual learning characteristics, which could contribute to decisions and implementations made by diagnosticians. Dynamic assessment, including both a classification of learning potential and qualitative, child-specific information, could be the very beginning of a bridge between assessment and (educational) interventions.