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ABSTRACT

The instructional components of mediation, a teaching technique used in dynamic assessment, were evaluated with 100 four-year-old children attending daycare or preschools in London, Ontario. The effects of familiarization with task materials, task-specific rule teaching, and elaborated feedback were assessed using a pretest-posttest design. Children trained on the Stencil Design Test using various combinations of the mediation components were compared to each other and to a non-instructed control group. Analyses of covariance on posttest measures with type of instruction as the independent variable and pretest scores as the covariate revealed that feedback was the most effective component of the mediation procedure. Performance on the Stencil Design Test and near transfer performance on the Animal Stencil Test was significantly better than performance of non-instructed control children whenever feedback was included in instruction on the Stencil Design Test. There was no transfer to the Animal House Coding Task of the Wechsler Preschool and Primary Scales of Intelligence, or to the Conceptual Grouping subtest of the McCarthy Scales of Children's Abilities. Results were discussed in terms of the importance of understanding the nature of the instruction provided in dynamic assessment. (Author/JAZ)

Instructional Components of Mediational Dynamic Assessment

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Abstract

The instructional components of mediation, a teaching technique used in dynamic assessment, were evaluated with 100 four year old children attending daycare or preschools in London, Ontario. The effects of familiarization with task materials, task-specific rule teaching, and elaborated feedback were assessed using a pretest-posttest design. Children trained on the Stencil Design Test (Arthur, 1947) using various combinations of the mediation components were compared to each other and to a non-instructed control group. Analyses of covariance on posttest measures with type of instruction as the independent variable and pretest scores as the covariate revealed that feedback was the most effective component of the mediation procedure. Performance on the Stencil Design Test and near transfer performance on the Animal Stencil Test (Burns, 1985) was significantly better than performance of non-instructed control children whenever feedback was included in instruction on the Stencil Design Test. There was no transfer to the Animal House Coding Task of the Wechsler Preschool and Primary Scales of Intelligence (Wechsler, 1967) or to the Conceptual Grouping subtest of the McCarthy Scales of Children's Abilities (McCarthy, 1972). Results were discussed in terms of the importance of understanding the nature of the instruction provided in dynamic assessment.

Instructional Components of

Mediational Dynamic Assessment

Psychologists have long been concerned with how to assess cognitive capacity in children. Traditional assessments emphasize measurement of the current level of knowledge (Bransford, Delclos, Vye, Burns, & Hasselbring, in press; Brown & Ferrara, 1980, Haywood, Filler, Shifman, & Chatelanat, 1975; Resnick, 1979). These assessments are "static" in the sense that they do not assess the ability to change the current level of knowledge. In contrast, recent assessment techniques have incorporated instruction and measured the ability to profit from such instruction. These assessments are termed "dynamic" and are currently being validated as diagnostic and prescriptive tools to augment traditional psychometrics (Bransford, Delclos, Vye, Burns, & Hasselbring, 1986).

The focus of the present research is to investigate the nature of the instruction provided in one form of dynamic assessment, mediational dynamic assessment. However, before discussing the specifics of the research, a presentation of the concept of dynamic assessment and the available validation research will be provided.

<u>Dissatisfactions with Traditional Assessment Techniques</u>

While they may be one of psychology's greatest successes, traditional assessment techniques have been criticized on several grounds. Most arguments focus on one of two problems: (a) using the tests to predict

future learning, and (b) using the tests to derive instructional prescriptions. One criticism is that traditional preschool measures have not proven to be very reliable predictors of young children's later performance (Brown & Ferrara, 1980; Lidz, 1983; Simner, 1983). It has been suggested that this may due to the discontinuity of preschool measures and later measures of cognitive abilities (Brown & Ferrara, 1980). Whatever the reason, this is a serious criticism given current interest in early identification of learning difficulties.

A second criticism related to the predictive functioning of static tests is that they measure only products of past learning (Brown & Ferrare, 1980; Haywood, 1977). A child from a disadvantaged background may perform poorly on static tests and be classified as mentally retarded. Such a classification could result from either a true learning difficulty or from inadequate learning experience. In the latter case, the diagnosis would be an invalid indication of the learning capacity of the child.

A third criticism of static assessment measures is that they do not yield prescriptive instructional information. Resnick (1979), for example, cites the need for tests which monitor the effects of instruction and which adapt to the needs of individual children. One approach to the diagnosis of individual problems in learning has been the differential diagnosis - prescriptive teaching model. Standard diagnostic tools are used to identify specific learning problems and instructional recommendations are made based on this diagnostic information. Unfortunately, this approach has been criticized on the grounds that the diagnostic measures and the teaching prescriptions are largely invalid (Arter & Jenkins, 1979). There is still an important need, therefore, for measures and methods that provide instructional prescriptions.

These criticisms of traditional assessment suggest the need for reliable measures of learning ability, which do not rely exclusively on past opportunity to learn and, perhaps more importantly, yield valid prescriptive information. The ultimate goal of dynamic assessment procedures is to fulfill this need.

Examples of Approaches to Dynamic Assessment

Three major approaches to dynamic assessment - the learning potential procedure (Budoff & Friedman, 1964); the zone of proximal development procedure (Brown & Ferrara, 1980; Brown & French, 1979; Campione, Brown, Ferrara, Jones & Steinberg, 1983); and the learning potential assessment device (Feuerstein, Rand, & Hoffman, 1979) will be briefly discussed to show how different researchers conceptualize dynamic assessment. The three approaches each attempt to measure learning ability but differ in: a) theoretical orientation; b) purpose of assessment; c) tasks used in the assessment and; d) type of instruction employed.

Budoff and colleagues developed the learning potential procedure to identify children who had been misclassified as mentally retarded (Budoff, 1967; Budoff & Friedman, 1964; Budoff, Meskin, & Harrison, 1971). The assumption is that those who can improve performance during learning potential assessment are "educationally" but not "mentally" retarded. This procedure emphasizes the importance of using non-verbal assessment tasks to capitalize on the abilities of children who have likely not been exposed to a rich verbal milieu. The learning potential procedure utilizes non-verbal tasks such as the Kohs blocks and Ravens Progressive matrices.

Brown, Campione, and colleagues developed the zone of proximal development procedure, the graduated prompt method, to identify children at risk for academic failure (Brown & Ferrara, 1980; Brown & French, 1979). These researchers have attempted to improve classification by developing a measure of learning ability that can effectively supplement the predictive power of static measures. Instruction consists of a standardized set of hints or prompts, graduated in explicitness. A more explicit hint is provided each time the child fails to provide a correct solution. Vygotsky's (1978) theory of sociocultural cognitive development forms the theoretical basis of this procedure. The prompting procedure is an attempt to measure "the zone of proximal development", which Vygotsky (1978) defined as:

> the distance between the actual developmental level as determined by independent problem solving and the level of potential development

> as determined through problem solving under adult guidance or in collaboration with more capable peers (p.86)

The width of the zone is operationalized in terms of learning speed, that is, the number of prompts required to reach a predetermined performance criterion. This is a departure from the other two dynamic approaches which measure the amount of improvement following instruction. The procedure has been developed for use with the letter series completion task and the Ravens Progressive matrices and work is currently being conducted on tasks in the curriculum areas of mathematics and reading.

The learning potential assessment device (LPAD) was developed originally by Reuven Feuerstein in Israel (Feuerstein et al. 1979). He developed his procedures after working with culturally diverse groups of immigrants. Many of these people scored poorly on static measures. The LPAD was designed to derive a measure of learning potential. Many of the immigrants were considered "culturally deprived", that is, they had received inadequate mediated learning experience. According to Feuerstien, "mediated learning experience" is essential to cognitive development in that it enables learning from direct experience. Feuerstein et al. (1979) defined mediated learning as:

> the interactional processes between the developing human organism and an experienced intentioned adult, who, by interposing himself between the child and external sources of stimulation, "mediates" the world to the child by framing, selecting, focusing, and feeding back environmental experiences in such a way to produce in him appropriate learning sets and habits (p.71)

The LPAD is a non-standardized clinical device in which instruction is based on the principles of mediation as specified by Feuerstein. The assessment is designed to identify deficient cognitive functions and to measure responsiveness to remediation. The cognitive functions diagnosed in the LPAD are basic learning skills that are established over the course of adequate mediated learning and, thus, are assumed deficient in those deprived of adequate mediation

Feuerstein's theoretical approach has influenced the development of a dynamic approach by American psychologists (Burns, Haywood, Delclos, & Siewert, 1985; Vye, Burns, Delclos, & Bransford, in press). This approach is known as mediational assessment. Proponents of this approach have modified the LPAD assessment to be a brief scripted instructional procedure. Details of the mediational instruction will be provided shortly, as they are the focus of the present research.

<u>Validation of Dynamic Assessment</u>

Dynamic procedures are in the process of being validated but at present there is not an abundance of data on this issue. What follows is a discussion of the available validation research.

In an attempt to relate dynamic measures to static measures of cognitive ability, Brown & Ferrara (1980) correlated dynamic learning speed and transfer measures with IQ of third and fifth grade children. Learning speed was measured in terms of the number of standardized prompts required to reach a criterion on the letter series completion task and transfer in terms of performance on a similar but more difficult letter series completion task. IQ predicted learning speed and transfer for two thirds of the children. In other words, most high IQ children required few prompts to learn the task (high learning speed) and transferred learning to new letter series tasks, while most of the average IQ children required more prompts to learn the task and did not transfer to similar tasks as well. However, approximately one third of the children did not fit into this categorization, i.e. IQ did not predict learning speed or transfer. Furthermore, learning speed and transfer did not correlate positively for one third of the children - there were fast learners who did not transfer well and slow learners who transferred well.

Vye et al. (Study A, in press) gave graduated prompting to 44 four to six year old mentally handicapped children (IQ less than 70) on a perceptual performance task, the Stencil Design Test (Arthur, 1947). Children's independent performance on the Stencil Design Test following graduated prompt instruction did not correlate significantly with McCarthy General Cognitive Index. Subscale McCarthy Perceptual performance scores were moderately and significantly correlated with the dynamic measure, but not to an extent that the dynamic performance would be totally predictable from the static measure. Static classification would not have predicted

the amount of learning evidenced by these children.

The lack of correlation between dynamic measures and static measures may demonstrate increased sensitivity of dynamic measures to individual differences in learning ability. However, unreliability of either the IQ or the dynamic measures could produce the same results. Concurrent and predictive validity data are needed to resolve this issue. The following is a discussion of validation research that suggests that the unreliability hypothesis is not tenable and that dynamic measures provide valuable information about learning ability. Bryant (1982) investigated the relationship between static cognitive ability measures and learning and transfer measures using the graduated prompt method of instruction. Four to six year old children were trained to do a matrix task. The static measures predicted gain scores - improvement in performance following instruction. However, hierarchical regression analysis showed that the dynamic training and transfer measures significantly increased predictability of gain scores. In other words, two dynamic measures - learning speed and transfer - increased the ability of static measures to predict learning.

Budoff et al. (1971) demonstrated the predictive validity of the learning potential measure in the non-verbal domain. Seventy educable mentally retarded and 26 regular class grade 7 to 9 children matched for chronological age were assigned learning potential status using the Kohs blocks. Learning potential was operationalized in terms of overall score on the Kohs blocks and the amount of improvement following instruction on the task. Half of the EMR children and all of the regular class children were given non-verbal instruction on electricity principles. All children were matched for knowledge of electricity prior to instruction. Learning potential status was a better predictor of the ability to profit from instruction than either IQ or class placement. Learning potential status predicted learning of electricity principles even when IQ was used as a covariate. The dynamic measure was a valid predictor of learning in an educational setting.

Delclos, Burns, & Kulewicz (1985) investigated the role of mediational dynamic procedures on teacher expectations of handicapped children. Sixty teachers viewed videotapes of children in a static assessment, followed by a second assessment session which was either static or dynamic. Teachers who viewed the dynamic session after the static assessment rated the children as generally more competent than did teachers who viewed the same children in two static assessment sessions. This finding has important implications given that teacher expectancy may affect the quality of instruction teachers offer children. Exposing teachers to the child in a situation which emphasized the child's abilities rather than the child's weaknesses had a positive effect on teacher expectancy.

Using single subject methodology, Vye et al. (in press) provide an initial demonstration of how mediational assessment can be used as a prescriptive tool with multiply handicapped preschool children. A delayed time series design with three children was used. Following baselines on the criterion measure (Stencil Design Test), children received a session of mediational assessment. Children's behaviour during the session was coded using a scale designed to identify behaviours associated with successful task performance (Burns et al. 1985). Observation revealed lack of behaviours indicative of efficient strategic processing, such as visual scanning and self correction (Burns et al. 1985). Subsequent sessions of mediation instruction were then tailored to remediate the specific deficits of the children. Performance on the trained task and on transfer measures improved when mediation was tailored to meet the needs of the individual children.

The Effects of Different Types of Instruction

The research discussed above suggests that dynamic procedures may provide important assessment information. The available data indicate that dynamic measures predict learning in new situations, influence teacher expectations about children's future learning and may be useful for developing prescriptive information.

One issue that has been addressed is the nature of the instruction provided during the assessment. Burns (1985) compared the graduated prompt and mediational methods of instruction to static assessment on the Stencil Design Test using a sample of three to five year old children who were either mildly mentally retarded or at risk for academic failure. Mediation and graduated prompting resulted in equivalent learning of the trained task but different degrees of transfer. Transfer of learning from the Stencil Design Test was measured on the Animal House subtest of the Wechsler Preschool and Primary Scales of Intelligence (WPPSI). The mediation method resulted in greater transfer than the graduated prompt method. Although there was no experimental control for the amount of time exposed to test materials, the correlation between training time and later performance was not significant.

Burns' results suggest that different instructional procedures may produce different estimates of learning ability, and point to the need for a more precise understanding of the effective instructional components of the various procedures. The present study examines the components of the mediational method of instruction.

The mediation procedure consists of three instructional components - familiarization with materials, task-specific rule teaching, and feedback on performance. Feuerstein considered familiarization essential because it orients children to the relevant task dimensions. Children with deficient cognitive functioning often do not know which dimensions of the task to attend to. Familiarization also provides the

examiner the opportunity to discover the child's knowledge of labels of task materials so that the child and examiner can communicate more efficiently.

Task specific rule-teaching was deemed important by Feuerstein because lower functioning children are less likely to have been exposed to such tasks in the past and need precise information for task completion.

Feedback, the third component of the mediation procedure, was included for several reasons. Feedback reinforces correct attempts at a task and may encourage more accurate attempts. It may also give the child a better understanding of the previously taught task-specific rules. Feuerstein assumes that practice with feedback results in reflective thinking by the child.

These three components have been included in the mediational assessment scripts (Bransford et al. 1986; Burns et al. 1985; Vye et al. in press). In these procedures the child is first familiarized with the task materials with attention being directed to the relevant dimensions of task materials. Following familiarization, the child is taught the rules for task completion in an interactive format. After demonstrating comprehension of the rules, the child attempts practice items of the particular assessment task. Detailed feedback is provided after the child indicates that she has completed the practice item. The child is given a review of what she had done correctly or incorrectly with attention being given to the previously-taught rules.

Several studies have been conducted which have looked at the effectiveness of instructional components similar to familiarization, rule-teaching and feedback (Carlson & Wiedl, 1978; Pressley, Levin, & Ghatala, 1984; Siegler & Liebert, 1972; Spiker, Cantor, & Klouda, 1985). Spiker et al. (1985, experiment 3) studied 40 five to seven year old childrens' ability to perform multidimensional reasoning tasks. These tasks involved the comparison of stimuli on the dimensions of colour and form. They assessed the effects of providing labels to the stimulus dimensions, pretraining on a sample task, and giving feedback as to the correctness of responses. Ten children were given standard task instructions which included the use of labels of stimuli. Ten children were given standard instructions (with labels) plus feedback following responses, 10 children were given a sample easy task with feedback on it plus feedback on subsequent tasks without the use of labels and finally, 10 children were given pretraining (practice task), labels, and feedback. Feedback alone was as effective at improving task performance after the first task as was pretraining and feedback or pretraining, feedback and the use of labels. These results suggested that preliminary task exposure with feedback was sufficient to improve reasoning on a discrimination task above that produced by standard task instructions which simply tell the child what is expected of them.

Siegler & Liebert (1972) assessed the effects of presenting rules and giving simple feedback on the acquisition of liquid quantity conservation on 40 five to six year old children using a factorial design. Pretesting showed that the children were not conservers prior to training. Training consisted of 18 trials on a liquid quantity conservation task in which children received some combination of rules and feedback. Rule teaching involved telling the child the appropriate rule following the child's response to each trial. Feedback consisted of telling the child whether the response was correct or incorrect and asking the child the reason for the response. The child was also told whether the reason was correct. Posttest liquid conservation tasks six to eight days after training showed additive effects of rules and feedback. Seventy per cent of the children presented the rules and given feedback became conservers, compared to 40% of the children given rules only and 30% of the children given feedback only.

Pressley et al. (1984, experiment 5) found that feedback improved memory strategy selection in 11-13 year old children. Two associative strategies for learning new foreign vocabulary were described to 86 children: 1) repetition, a strategy which proved to be inefficient in this study; and 2) the keyword method, an effective elaborative method which involves the use of associative imagery. The experimenter told half of the children that he thought repetition was the better method. Sixteen children who had heard this recommendation and 16 children who had not, were then asked to choose which strategy they would use to study a list of 10 vocabulary items.

Most children chose to use repetition if repetition had been recommended to them. More children chose the elaboration strategy if no recommendation had been made by the experimenter.

Another 16 children who had heard the recommendation and 16 who had not, studied 24 items for a practice test using both strategies. Following the practice test these children were asked to choose a strategy to study for a test. Again, children chose the repetition strategy if it had been recommended, even though more items had been recalled on the practice when the elaboration strategy had been used during study. Children complied with the experimenter's recommendation even after practice using a more efficient strategy.

Finally, 16 children who had been given the repetition recommendation and 16 who had not, were given feedback following the practice test. The children were told the total number of items they had recalled correctly, the number of correct elaboration items and the number of correct repetition items (half of the items had been studied using each strategy). The use of elaboration had resulted in better recall. Children were asked to make a strategy choice following feedback information. This time children chose elaboration as the strategy to study for the test, regardless of the

experimenter's recommendation. Precise feedback information was necessary for the children to demonstrate their knowledge of the superiority of the elaboration method.

Carlson & Wiedl (1976) have developed an approach to testing which they refer to as "testing-the-limits" (Carlson & Wiedl, 1978; Dillon & Carlson, 1978). It does not involve training separate from the actual testing as do most dynamic approaches. Rather, it involves variations of the testing procedure itself and repeated testing. Carlson & Wiedl (1978) compared several approaches to testing with 108 eight to twelve year old children with learning difficulties. The task used was the Raven Coloured Progressive Matrices, puzzle and booklet forms. The six testing conditions were: 1) standard - sample problem with no feedback or further instructions; 2) verbalization by the child during and after problem solution; 3) verbalization by the child after solution; 4) simple feedback - telling the child if the response was correct or incorrect 5) elaborated feedback - explanation of why the response was correct or incorrect; and 6) elaborated feedback and verbalization by the child during and after problem solution. Conditions 5 and 6 (elaborated feedback and verbalization) were most effective at improving problem solving on Raven items which Carlson & Wiedl identified as problem solving items through factor analysis.

These studies suggested that feedback would be an effective instructional component of the mediational method (Carlson & Wiedl, 1978; Pressley et al. 1984; Siegler & Liebert, 1972; Spiker et al. 1985). It was also expected that teaching task-relevant rules in an interactive atmosphere, involving verbalization by the child, would increase learning (Carlson & Wiedl, 1978; Siegler & Liebert, 1972). It was unknown how effective the familiarization aspect of mediation would be. Spiker et al. (1985) found that providing labels to task materials was not helpful in improving problem solving which would suggest that familiarization would not be a very effective instructional component. However, familiarization in the mediation procedure does much more than provide labels to task materials.

Method

Subjects

One hundred children enrolled in 15 preschools and daycare facilities in London, Ontario participated. The mean age of the children was 53 months with a range of 47 to 60 months.

Equal numbers of children were assigned to each of five experimental conditions. Assignment to groups was random with the restriction that the number was approximately balanced across groups for each setting.

Materials

The tests used as both pre- and post-instructional measures were:

1. An adaptation of the Stencil Design Test I of the

Arthur Point Scale of Performance Tests (Arthur, 1947). The Stencil Design Test presents children with 18 coloured cards. Twelve of the cards have geometrical shapes cut out of them and six cards are solid. The child's task is to reproduce model designs by placing cut-out cards on top of a solid card. Children received 3 two-card items and 5 three-card model items (see Appendix A for a complete description of the test items). This test was scored as the number of designs reproduced completely accurately, for a maximum score of eight. The Stencil Design Test was chosen as the criterion task because it has been used in past research on mediational dynamic assessment (Burns 1985; Burns et al. 1985) and, thus, a mediation instructional script was available for the test (Burns et al. 1985).

2 The Animal Stencil Test - this test is a version of the Stencil Design Test. It uses animal shape cut-outs instead of geometrical shapes (Burns, 1985). The test consisted of 3 two-card items and 5 three-card items (see Appendix B for a description of both the materials of the test and the specific test items). The test was scored as number of designs reproduced accurately, with a maximum score of eight. This test was considered a near transfer task because of its direct similarity to the Stencil Design Test

3. The Animal House subtest of the Wechsler Preschool and Primary Scale of Intelligence (Wechsler, 1967). The child is presented with four colour-coded animals, the

colour coding being indicated by cylindrical markers placed beneath the animals. The child's task is to colour code 20 of these animals. The test was scored in terms of errors, omissions, and time taken to complete the task (Wechsler, 1967). The maximum score was 70. This test has been used as a far transfer task in earlier studies (Burns, 1985). It was selected because it is a perceptual performance task and appears to share some component processes with the Stencil Design Test (e.g. referral to a model, colour and shape discrimination, and sequential ordering of behaviours).

4. The Conceptual Grouping subtest of the McCarthy Scales of Children's Abilities (McCarthy, 1972) - this test was chosen as a far transfer task because it requires knowledge of some of the concepts trained during the familiarization component of the mediational procedure. These include colour, shape and size discrimination. The child is given 12 red, yellow, and blue circles of two different sizes. Early test items require the child to identify and group blocks according to colour, shape, or size. Later items require the child to complete analogies of pairs of blocks by noticing the dimension on which items of a pair differ. This test was scored as outlined by McCarthy (1972) in terms of the number of correct responses for a maximum score of 12.

Procedure

Children were tested individually and all sessions were videotaped. Each child was tested in two 30 to 45

minute sessions. During the first session, pretest scores on the Stencil Design Test, Animal Stencil Test, Animal House and Conceptual Grouping subtests were recorded. The second session consisted of the instructional phase in which instruction was given on the Stencil Design Test. The four tests administered during the first session were repeated following instruction. All tests were administered in random order during both sessions.

The Instructional Phase

The mediational instruction script for the Stencil Design Test is an adaptation of a script developed by Burns et al. (1985). The Burns et al. mediation script was developed for use with two-card items only (i.e. one cut-out and one solid). Pilot testing revealed that the population of four year old children of the present study could reproduce these two-card items with little difficulty. The task was therefore modified to include three-card items (two cut-outs and one solid card). The mediation script was modified to incorporate training of the three-card items (see Appendix C for the modified version of the mediation script as used in this study).

Children in the four treatment groups received instruction on the Stencil Design Test during the second session. Each treatment group received some variation of the mediation procedure as described in Appendix C. One group of children was instructed using the full mediation procedure. The three other groups received a combination of two of the three instructional components task-specific rules and feedback on performance, familiarization and feedback, or familiarization and task-specific rules.

Children in the control group were given exposure to the Stencil Design Test materials without any instruction. This exposure was in the form of a game designed to hold the child's attention without providing instruction as outlined by the mediation procedure. The experimenter hid one of a second set of Stencil Design Test cards in an envelope and the child's task was to guess which of the 18 cards was in the envelope. If the child became bored with this format, the child and experimenter exchanged roles.

To control for exposure time to the Stencil Design Test materials, children in the two-component groups played the control game for the length of time required to train the missing component. The timing of the three components was calculated by averaging the amount of time needed by five randomly chosen pilot subjects. The full mediation procedure took an average of 22 minutes to complete so the control subjects played the exposure control game for 22 minutes. Familiarization took an average of 4.5 minutes, rule-teaching 12 minutes and feedback 5.5 minutes This procedure preceded instruction for each of the two-component groups

Reliability

Tester adherence to the outlined mediation procedure

was calculated on the basis of percent accuracy in fulfilling tester criteria. Tester criteria were determined by subdividing the mediation procedure into each of the specific instructions to be followed by the experimenter (see Appendix D) An unbiased observer calculated per cent accuracy scores by scoring videotapes of the instructional phase for 25 percent of the subjects Tester accuracy was measured in terms of the percentage of appropriate criteria completed during instruction less the number of inappropriate instructions, i e criteria of a component the subject was not supposed to receive Subjects were eliminated if the tester accuracy was less than 85%

Results

Tester adherence to the mediation procedure for the 25 scored sessions ranged from 92 to 100% with a mean of 97 2%. Tester accuracy was 100% for the control children, i e they did not inadvertently receive any mediation instruction

Dependent measures consisted of pre- and posttest measures on the Stencil Design Test, Animal Stencil Test, Animal House subtest, and the Conceptual Grouping subtest Oneway analyses of variance were conducted on the four pretest measures to test for group differences prior to instruction Instructional group was the factor used in these analyses. The means and standard deviations of pretest and posttest measures are presented in Table 1. The group effect was not significant for any pretest measure at the .05 level of significance (Stencil Design Test, $F(1,94) = .49$; Animal Stencil Test, $F(1,94) = 0.79$; Animal House, $F(1,94) = 2.10$; and Conceptual Grouping, $F(1,94) = 0.30$). Thus, prior to instruction the groups did not differ on the four dependent measures. The grand mean on the Stencil Design pretest was 1.83 and on the Animal Stencils was 2.17. The grand means on the Animal House and Conceptual Grouping were 33.32 and and 7.0, respectively. These scores were within the normal range for the two tests for which norms were available (Animal House and Conceptual Grouping subtests).

Oneway analyses of covariance with instructional group as the independent variable were conducted on the four posttest measures. Pretest measures were used as the covariate in each analysis. The regression of pretest measure on each of the posttest measures was significant (for Stencil Design Test, $F(1,94) = 69.47$, $p < .001$; for Animal Stencil Test, $F(1,94) = 71.50$, $p < .001$; for Animal House; $F(1.94) = 103.41$, $p < .001$; and for Conceptual Grouping, $F(1,94) = 56\ ,4.$ $p < .001$). These results verify the importance of conducting the analysis of covariance, in order to remove the variability in posttest scores that is attributable to pretest scores.

Adjusted posttest means and results of ANCOVA and

Table 1

Group Means and Standard Deviations of Pretest and Posttest Measures

		Full	RFe	FaFe	FaR	Control
Stencil Design Test	pre	1.70 (2.23)	1.45 (2 48)	2.25 (2.43)	1.55 (2.35)	2.20 (2.38)
	Post	4.40 (2.26)	5.05 (2.14)	5.30 (1.87)	3.65 (2.50)	3.10 (2.81)
Animal Stencil Test	pre	1.75 (2.49)	1.45 (2.37)	2.55 (2.67)	2.40 (3.00)	2.70 (3.03)
	Post	5.55 (2.39)	5.20 (2.65)	5.40 (2.98)	4.20 (3.25)	3.35 (3.30)
Animal House	Pre	32.30 (13.08)	29.35 (13.32)	35.60 (14.43)	39.45 (10.08)	29.90 (13.66)
	Post	39.65 (13.82)	40.50 (13.45)	43.75 (9.30)	42.55 (7.09)	41.55 (12.98)
Conceptual Grouping	pre	7.10 (1.45)	6.65 (1.95)	7.25 (1.86)	6.90 (1.94)	7.10 (2.17)
	Post	7.10 (2 00)	6.65 (2.74)	7.60 (2.39)	7.20 (1.85)	7.55 (1.67)

Note. Instructional group labels are abbreviated. RFe denotes rules and feedback, FaFe familiarization and feedback and FaR familiarization and rules. Standard deviations are in parentheses.

tests of means are presented in Table 2. The ANCOVA showed a significant effect of instructional group on the Stencil Design Test ($F(4,94)=6.15$, $p<.001$) and on the Animal Stencil Test ($F(4,94)= 6.35$, $p<.001$). The Animal House and Conceptual Grouping subtests did not show group effects ($F(4,94)= 1.34$ and $F(4,94)= .42$, respectively). Tukey's HSD tests of means were conducted on posttest Stencil Design and Animal Stencil Test means, adjusted for pretest covariation. The critical difference for the Stencil Design Test was 1 56 ($\alpha = .05$). Adjusted posttest means for the full (M= 4 48), rules and feedback (M= 5.30) and familiarization and feedback (M= 5.03) groups did not differ significantly from each other and all three were significantly different from the control mean (M= 2.86). The adjusted familiarization and rules mean (M= 3.83) did not differ significantly from any of the four means.

The pattern of results was identical for the Animal Stencil Test. The Tukey's HSD critical difference was 1.91 ($\alpha = .05$). Adjusted posttest means for the full (M= 5.66), rules and feedback (M= 5 73) and familiarization and feedback (M= 5.12) groups did not significantly differ from each other and all three were significantly greater than the adjusted control group mean (M= 2.96). The familiarization and rules group mean (M= 4.03) did not differ significantly from any of the other group means.

Table 2

Tests of Adjusted Group Means and Standard Deviations of Posttest Measures

	Full	RFe	FaFe	FaR	Control
Stencil Design Test	4 48a (2.26)	5.30a (2.14)	5 03a (1.87)	3.83ab (2.50)	2.86b (2.81)
Animal Stencil Test	5 86a (2.39)	5.73a (2.65)	5.12a (2.98)	4.03ab (3.25)	2.96b (3.30)
Animal House	40.31 (13.82)	43.08 (13.45)	42.27 (9.30)	38.56 (7.09)	43.78 (12.98)
Conceptual Grouping	7.03 (2.00)	6.89 (2.74)	7.43 (2.39)	7.27 (1.85)	7.48 (1.67)

Note 1. Instructional group labels are abbreviated. RFe denotes rules and feedback, FaFe familiarization and feedback and FaR familiarization and rules.

Note 2. Posttest means were adjusted for pretest covariation. Means designated by different subscripts within any row are significantly different at the $p<.05$ level according to Tukey's HSD tests of means. Standard deviations are in parentheses.

Initial trends in the data may have biased later testing. If this had occurred, it would be possible that results of children tested after the trends became apparent would be a magnification of the trends. To test for such experimenter bias, separate oneway ANCOVAs were conducted on the first and second 50 children. These ANCOVAs were a replication of the original ANCOVAs based on all 100 children For all four posttest measures, pretest measures predicted posttest measures with a significance of $p<.001$. The group effect on the Stencil Design Test was similar for both the first and second 50 children ($F(4,94)= 2.94$, $p<.031$ and $F(4,94= 2.86$, $p<.034$, respectively). There was a significant group effect on the Animal Stencil Test for the first 50 children ($F(4,94)= 4.62$, $p< 003$) but not for the second 50 children ($F(4,94)= 1.64$, $p=.18$). The Animal House subtest showed similar non-significant results for both the first and second 50 children ($F(4,94)= 1\ 22$, and $F(4,94)= \ 87$, respectively). Similar results were found for the first and second 50 children on the Conceptual Grouping subtest ($F(4,94)= .42$ and $F(4,94)= \ 77$, respectively. The results of these ANCOVAs suggest that experimenter bias did not magnify initial trends.

To test the possibility that instructional groups differed on the actual amount of time exposed to the Stencil Design Test materials during the instructional phase, a oneway ANOVA was conducted on the duration of

instructional phase. There was a significant group effect ($F(4,95)= 3\ 37$, $p< 01$). Tukey's HSD tests of means revealed that the control group ($M= 22.0$ minutes) was exposed to the materials for more time than either the full group ($M= 16\ 3$ minutes) or the familiarization and rules group ($M= 17\ 3$ minutes). The mean exposure time for the rules and feedback group was 18.6 minutes and 18 9 minutes for the familiarization and feedback group. Although there was a significant difference in the amount of time groups were exposured to the task materials, the direction of this difference was in favour of the controls

Discussion

The mediation method of instruction was effective at improving perceptual performance scores. Children taught using the full mediation method evidenced learning on the trained task and a near transfer task as compared to non-taught control children

Feedback appears to have been the most effective instructional component of the mediation procedure. Performance on the Stencil Design Test was significantly better for all three groups of children given detailed feedback on practice items during training. It cannot, of course, be concluded that feedback alone was effective in improving perceptual performance because feedback was always given in combination with some other instructional component(s). However, feedback was the common element of the three groups which performed at higher levels than the non-instructed control group. The only group not given feedback - the familiarization and rules group - did not perform at a higher level than the control group following instruction. Children who were taught using familiarization and rules resulted in performance intermediate to the three groups given feedback and the control group, indicating that being familiarized with materials and given task-specific rules may have improved performance but that giving the child verbal feedback after practice was more beneficial.

The three groups which received feedback did not differ from each other on the posttest. Feedback improved performance on the Stencil Design Test regardless of which other instructional component(s) the children were given.

Learning transferred to the Animal Stencil Test, with the identical pattern of results as the Stencil Design Test. This was probably due to the fact that the rules for both tasks are the same, with the tasks differing only in the nature of the cut-out shapes. However, interaction with the children indicated that they did discriminate the Animal Stencil Test from the Stencil Design Test. The transfer was not simply an artifact of children not discriminating the two tasks.

Results on the Animal House subtest indicated no transfer of training. There was improvement from pretest

to posttest by all groups with no significant group differences on either the pretest or posttest. The lack of transfer of training is in contrast to those of Burns (1985) who showed transfer to the Animal House following mediational dynamic assessment. However, children in the present study made few errors on the Animal House. Increased scores on the posttest were most often a result of increased speed rather than reduced errors This may be in contrast to children in Burns' study. Her sample consisted of at-risk and mentally retarded preschoolers who are likely to have made errors. The present lack of transfer to the Animal House may have resulted from the lack of emphasis on speed during mediational instruction on the Stencil Design Test.

There was also no evidence of transfer to the Conceptual Grouping subtest. There were no significant differences between groups on either the pretest or posttest and very little improvement following instruction Mediation training on a perceptual performance task and previous experience with the test did not improve Conceptual Grouping scores

The Conceptual Grouping subtest requires the child to differentiate colours, sizes, and shapes of geometrical figures and to solve analogies involving the geometrical shapes. The mediation procedure did not involve teaching of analogies but shape, colour, and size discrimination was an inherent aspect of the familiarization component of the mediation procedure. However, it is possible that there was no transfer to the Conceptual Grouping since familiarization was not a particularly effective instructional component. Also, the overall scores on the pretest indicated that the children successfully discriminated colour, shape and size but had difficulty with the test items requiring use of analogies. The knowledge the children required to improve their scores, was not a part of the mediation procedure.

An alternate explanation for the lack of transfer to the Animal House and Conceptual Grouping subtests is that pretest scores on both tests were at the upper end of the four-year range of the standardization samples. The mean chronological age of the children in this study was 53 months and mean performance at a 57 month age level on both the Animal House and Conceptual Grouping subtests. The lack of transfer may be an artifact of the difficulty of improving already accelerated performance.

Despite the lack of transfer to the Animal House and Conceptual Grouping subtests, performance on the trained task and on a near transfer task improved whenever feedback was included in the training Why was feedback so effective at enhancing perceptual performance? One explanation is that feedback may have improved metacognitive functions (Pressley et al. 1984). The feedback phase of mediation training gave the child the opportunity to practise the task while being provided verbal information regarding the accuracy of responses. Feedback regarding correct aspects of task completion may have reinforced the child's knowledge of the task. The child may have questioned those task behaviours which were inaccurate according to the tester's feedback. In other words, feedback may have increased the child's monitoring of strategies specific to the Stencil Design Test This probably resulted in more efficient strategies for completion of the task and, hence, improved performance on the Stencil Design Test and on a near transfer task

Results of this study were consistent with those of Spiker et al. (1985) who showed that experience with a task and feedback were sufficient to produce high levels of performance on a reasoning task. Siegler & Liebert (1972) demonstrated additivity of teaching relevant rules and providing simple feedback on a liquid quantity task. This finding was not completely supported by the present study, as evidenced by performance of the familiarization and feedback group who improved as much as either of the groups that received both rules and feedback.

The results of this study demonstrate the important contribution of feedback to the effectiveness of the mediation procedure. A replication of this study with an intellectually handicapped population would increase the generality of this conclusion since this is the population for which dynamic methods are being developed

(Vye et al. in press). However, this study demonstrated the appropriate methodology for the identification of instructional components of multi-component teaching methods and gave a clear demonstration of the effectiveness of giving feedback to preschool children.

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Appendix A

Stencil Design Test Items

Item Number	Solid	Middle Cut-Out	Top Cut-Out
1	1	n/a	11
2	3	n/a	12
3	6	10	7
4	2	18	8
5	1	16	10
6	3	13	15
7	6	10	14
8	5	n/a	18

Appendix B

Animal Stencil Test

Stencil Number	Description
1	blue solid
2	yellow solid
3	red solid
4	green solid
5	white solid
6	black solid
7	small red bird
8	large green cat
9	white elephant
10	large black dog
11	small white teddy bear
12	large blue bird
13	small yellow dog
14	small blue cat
15	small black squirrel
16	large white squirrel
17	large red teddy bear
18	white giraffe

Test Item	Solid	Middle Cut-Out	Top Cut-Out
1	4	n/a	16
2	2	n/a	10
3	6	11	17
4	2	7	9
5	4	7	10
6	1	11	8
7	6	14	17
8	6	n/a	7

Appendix C

MEDIATION PROCEDURE FOR STENCIL DESIGN TEST

I. Familiarizing the child with materials and relevant dimensions

1. Point out cut-outs (I cut them out).

2. Label shapes. If there is any resistance or difficulty learning labels, tell the child the label, but go quickly to finding shapes that match and say FIND ALL THE CARDS LIKE THIS. Comment on the lack of labels in a report, but do not get bogged down - the matching encourages comparative behaviour while establishing shape as a relevant feature.

3. Point out solids (NOT CUT OUTS - NO HOLES). Note all are in bottom row, near child.

4. Label colours (see notes for label shapes).

5. Have child COUNT THE SOLIDS. Focus here is not on the ability to count, but on the child's conceptualization of 'solid' or 'not cut-out'. If child counts correctly to 6, then the distinction is being made.

WARNING
If child cannot count all the solids, you need more work on the preceding concepts.

6. Compare 2 circles (big,small)/ 2 white squares (straight,crooked)/ 2 blue cards (solid, cut-out)/ 2 yellow cards (solid, cut-out).

7. At some point, put solid and cut-out back in wrong place - again to gauge whether the discrimination is being made.

WARNING
If child cannot see that you put the solid and cut-out back in wrong place - you need more work on the preceding concepts.

II. Teaching the rules for combining stencils.

1. Demonstrate what happens when a green circle is placed on a yellow solid. Point out 2 colours, made from 1 + 1.

2. Change solids, showing that the inside colour changes by changing solids. Allow child to try 1 or 2 colour changes. Emphasize that it is solid that is changing.

WARNING
If child cannot change the colour of the solid, you need more work on the preceding concepts.

3. Use white solid with green circle. Change cut-outs (don't reproduce any of the upcoming designs). Show that outside colour changes by changing cut-outs.

4. Put solid on top of cut-out and establish necessary order rule and reason.

5. Insert green cross between red solid and white square. Point out that more than one cut-out may be used but only one solid.

6. Have child change solid colour twice. Note that middle colour changes by changing solid.

7. Have child change middle cut-out twice. Note that the middle shape changes.

8. Demonstrate what happens when a middle cut-out is hidden by a larger top cut-out.

9. Have child change top cut-out twice. Note that the top shape changes.

10. Establish rule: One solid card an bottom, with two cut-outs on top. Solid colour is in the middle. Replace all stencils.

11. Have child reproduce the two-stencil sample (white solid, blue "X"). Discuss how a picture is made of the stencils, pointing out that there are 2 colours in the picture but only one on each of the cards.

12. If necessary, teach search pattern over cut-outs and solids. Have child say: "Is it this one?"

13. When reproduction is made, encourage checking back to the model. Go over what is right and what is wrong about the reproduction.

WARNING

If the child's reproduction is wrong, you need more work on the preceding concepts. Refer to any errors made enroute to a correct answer (spontaneous corrections) and discuss why they were wrong. Alternate the correct one and the wrong one. Always end with the correct solution.

14. Repeat steps 11 and 12 with the 3-stencil sample: white solid , blue "X", red octagon.

III. Feedback

1. Ask child to reproduce each of the three training models. Go over what is right and what is wrong about the reproductions.

Training items:

Solid	Middle cut-out	Top cut-out
2	n/a	13
4	14	9
5	13	7

Appendix D

Mediation Tester Criteria

N= NEEDED U=USED

Familiarization		N	U
Point to cut-outs			
I cut them out			
Label shapes	a		
	b		
	c		
	d		
	e		
	f		
	g		
	h		
	i		
	j		
	k		
	l		
Match a shape			
Point out solids			
Note on bottom row			
Label colours	a		
	b		
	c		
	d		
	e		
	f		
Count solids			

	N	U
Repeat if can't count		
Compare two circles (big/small)		
two white squares (crooked/straight)		
two blue cards (solid,cut-out)		
two yellow cards (solid,cut-out)		
Put cards back in wrong place		
Go back if can't see cards in wrong place		
Rules		
Demonstrate green circle, yellow solid		
Change solids (at least twice)		
Go back if can't change solids		
Change cut-outs - outside changes		
Put solid on top		
Est. rule: cut-out on top to see solid in middle		
Demonstrate red solid, green cross, white square		
Change solids (at least twice)		
Change middle cut-out twice - middle shape changes		
Demonstrate what happens when middle cut-out is hidden		
Change top cut-out once - top shape changes		
Introduce 2-card sample design		
Tell how model made		
Teach search pattern		
Ask child to make one like model		
Check model go over correct		
go over incorrect		
Introduce 3-card sample		
Tell how model made		

	N	U
Ask child to make one like model		
Check model go over correct		
go over incorrect		
Feedback		
Item 1 go over correct		
go over incorrect		
go over spontaneous corrections		
Item 2 go over correct		
go over incorrect		
go over spontaneous corrections		
Item 3 go over correct		
go over incorrect		
go over spontaneous corrections		