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ABSTRACT

A series of three experiments was conducted for the purposes of (1) clarifying problems of previous research on the relationship between working memory capacity and performance on figural analogy tasks, and (2) exploring developmental issues concerning executive strategies, working memory capacity, and perceptual processing. Directly manipulating the amount of available memory capacity a subject has while solving figural analogy problems, the first experiment required 29 fifth-grade children in Ontario, Canada to solve nondegenerate and semidegenerate figural analogy problems while counting backwards aloud by ones from 10 to 0. The second experiment investigated the possibility that children with a low level of working memory capacity who are unable to solve a high-level problem may lack necessary task-specific perceptual skills or cognitive operations. A random sample of 44 children selected from junior-kindergarten, kindergarten, and first-grade classes were presented with a series of nondegenerate figural analogy problems, broken down into prerequisite tasks. The third experiment tested the possibility that failure of subjects to solve such problems was due to lack of understanding of the nature of the conjunctive response concept underlying the bidimensional comparison strategy. A total of 24 first-grade children were administered pretest, treatment, and posttest sets of pictures of people and/or geometric figural analogy problems. Subjects were read names of features required for a correct conjunctive response. Treatment also consisted of a verbal facilitation procedure. Results indicate that young children have difficulty applying analogical reasoning to figural problems because of insufficient working memory capacity after carrying out the encoding elements of the task and because of perceptual encoding errors. (RH)

Some Prerequisites in Learning to Solve Figural Analogy Problems.

by James Wagner

For presentation at the Annual Meeting of the American Educational Research Association, Montreal, Quebec, Canada 1983.

One of the more interesting observations that have been made with regard to the development of analogical reasoning ability is that somewhere between the ages of 4 and 7, children show a dramatic increase in the number of correct responses they give when solving figural analogy problems (Inhelder and Piaget, 1964; Jacobs and Vandeventer, 1971; Parker and Day, 1971; Resnick, Seigel and Kresh, 1971). This shift in performance, depending on how one measures it, has been attributed to (a) the development of a cognitive operation for multiplicative classification (Inhelder and Piaget, 1964), (b) the ability of the child to perceive the features and feature relationships in a figural analogy problem (Jacobs and Vanderventer, 1971; Odom, Aster and Cunningham, 1975, 1980; Parker and Day, 1971; Parker, Rieff and Sperr, 1971), (c) the ability of the child to process feature relationships exhaustively (Sternberg and Rifkin, 1979), and (d) the development of the child's working memory capacity (Bereiter and Scardamalia, 1979; Wagner, 1981).

The theory of cognitive development proposed by Case (1978), however, suggests that these factors should not be regarded as competing hypotheses. Case (1974, 1978) argues that cognitive development is a function of the interaction between a child's available operational working memory capacity and the working memory load required by the executive processing strategies which are inherent in the algorithms of tasks such as the Genevan conservation tasks. For example, Case (1978) argues that the unidimensional comparison strategy is an executive strategy which requires that the child hold two chunks of information in working memory while comparing them. A child who has acquired this strategy then, is capable of comparing two beakers which vary in height and colour, by abstracting and comparing (tall) and (short) in working memory and responding by indicating which is the shortest. Case (1978) and Case, Kurland and Goldberg (1982) argue that a child who can only make such a comparison along one dimension at a time, is subject to this limit because his/her remaining attentional capacity is being used in encoding the features (tall) and (short) and in retrieving the comparison routine.

Within the framework of this theory, Wagner (1981) proposed that the working memory load of figural analogy problems might account for the difficulties young children have with such problems. Employing Sternberg's (1977) model of analogical reasoning the following predictions were made:

Figural analogy type (Sternberg, 1977)	Structure	Executive stragegy (Case, 1978)	Working memory load
Degenerate	A:A::A:A	Isolated centration	(1)
Semidegenerate	A:B::A:B	Unidimensional comparison	(2)
Nondegenerate(a)*	A:B::C:D	Bidimensional comparison	(3)
Nondegenerate(b)*	A:B::C:D	Bidimensional comparison with quantification	(4)

These predictions were tested by training children from each working memory capacity level on each type of figural analogy problem. The results indicated that inspite of training, children with a working memory capacity of less than (3) were unable to achieve the criterion of three correct problems in a row on nondegenerate (a) and nondegenerate(b) problems. The data from the study also suggested that the degenerate problem structure has an M-demand (working memory load) of (1) and that the semidegenerate problem structure has an M-demand of (2) or (1) depending on whether the subject employs the Infer A ->B operation or a simpler match D ->B strategy. The data was less clear with regard to the nondegenerate (b) type of problem, however. Although this structure was clearly more difficult than the nondegenerate (a) problem, the limited number of subjects with a working memory capacity of (4) plus the observation that 50% of the subjects with a working memory capacity of (3) achieved criterion, made it difficult to draw any firm conclusions. In addition, it is important to note that contrary to the findings

*Nondegenerate (a) figural analogies consisted of problems with 1 to 3 feature transformations between the A->B terms and 1 feature transformation between the A->C terms. Nondegenerate (b) problems consisted of 2 feature transformations between the A->B terms and 2 feature transformations between the A->C terms.

of Bereiter and Scardamalia (1979) and Mullholand, Pellegrino and Glaser (1980), no association was found between the number of feature transformations in a figural analogy problem and its M-demand in this study.

Although the subjects in the Wagner(1981) study were trained in solving figural analogy problems, it is possible that the younger subjects in particular, may have failed to correctly identify the features and feature transformations in those instances in which they selected an incorrect response alternative. In addition, although this study demonstrated that there is a reliable relationship between a subject's working memory capacity and his/her performance on the figural analogy task, attentional capacity was not experimentally manipulated in order to study its effect on figural analogy problem solving performance. The following experiments were designed to overcome these problems as well as address the issue of the relationship between the development of executive strategies, the development of working memory capacity, and the development of accurate and exhaustive perceptual processing.

Experiment 1

If, as was suggested by the Wagner (1981) study, figural analogies require a working memory capacity of (3), then subjects with a working memory capacity of (4) or more should show less interference in terms of figural analogy problem solving when required to perform a concurrent task, than subjects with a working memory capacity of (3). Similarly, subjects with a working memory capacity of (3) should be able to perform a concurrent processing task with little or no performance decrement when solving semidegenerate figural analogy problems.

These hypotheses were tested by asking grade five children to solve non-degenerate and semidegenerate figural analogy problems while counting backwards, aloud, from 10 to 0, by ones. Although it is difficult to assess precisely how much attentional capacity a task like this requires in a dual processing context, pilot study data suggested that for ten year-olds, counting backwards requires attention but does not use up all of the subject's available working memory capacity.

The subjects then, were 29 grade five children (Mean C.A.=10.69) randomly selected from an elementary school in a middle class suburb of St. Catharines, Ontario, Canada. The procedure entailed first, independently assessing each child's working memory capacity. This was done by using the Mr. Cucumber and Count the Spots tests developed for children by Case and Kurland (1976).(1) Following this, each subject was individually administered three sets of geometric figural analogies. The first set consisted of six semidegenerate problems, the second of two (1x1), two (2x1), and two (3x1) nondegenerate (a) problems, and the third of six (2x2) nondegenerate (b) problems. (2) Feedback and positive reinforcement was given after each trial and no counting was required. In the dual task condition which was administered after a 15 minute rest, each subject was first given practice in counting backwards and in counting backwards while solving 3 degenerate figural analogy problems. Three sets of figural analogy problems structured in the same manner as the sets employed in the single task condition were then administered. The subjects were instructed to begin counting when a given problem was presented and to stop counting when they had located and pointed to a response choice or when they reached 0. In addition, the counting was paced by a metronome set for a 1.5 second beat. Items in which the counting slowed or stopped or in which the subject reached 0 without responding were not included in the scoring and new items were administered in their place.

Five comparisons were made between the single and dual task conditions using repeated measures analyses of variance with significance set at the .01 level. The results of these analyses are presented in Tables 1 and 2. As can be

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(1) These tests are different from the normal short-term memory task in that the subject must perform several encoding or counting operations in order to obtain a product to be held in short-term store. These operations tend to limit the amount of time the subject has for rehearsal or chunking strategies and as a result working memory scores are not only lower than short-term scores but also may be closer to the actual processing capacity available in problem solving tasks.

(2) The (2x2) nondegenrate (b) problems were employed as a seperate class of stimuli because of the uncertainty with regard to their M-demand.

Table 1

Semidegenerate Figural Analogies

M. Score Group	Means	Mean Square Error	D.F.	F. Ratio
3 and 4				
Single task	5.5	2.777778	17,1	6.53846
Dual task	4.94444			

Table 2

Nondegenerate (a) Figural Analogies

M. Score Group	Means	Mean Square Error	D.F.	F. Ratio
3				
Single task	4.058823	10.617647	16,1	8.99678999
Dual task	2.941176			
4				
Single task	3.857142	5.142857	13,1	1.91803
Dual task	3.0000			

Table 2 (cont'd)

Nondegenerate (b) Figural Analogies

M. Score Group	Means	Mean Square Error	D.F.	F. Ratio
3				
Single task	2.588235	5.76470599	16,1	2.69416
Dual task	1.764705			
4				
Single task	3.285714	12.892857	13,1	6.54533
Dual task	1.928571			

- Insert Tables 1 and 2 about here.-

seen the data generally support the hypothesis that working memory capacity is employed in solving nondegenerate analogies. Specifically, subjects with a working memory capacity of (3) or (4) showed little decrement in performance when required to count backwards while solving semidegenerate problems.[(1)] This is consistent with the hypothesis that semidegenerate figural analogies have an M-demand of (2) or less. On the other hand, subjects with a working memory capacity of (3) showed a clear and significant decrement in performance in the dual task condition on the (1x1) (2x1) (3x1) nondegenerate problems. Notice too, that this was not the case for subjects with a working memory capacity of (4). This is consistent with the hypothesis that the (1x1) (2x1)(3x1) nondegenerate figural analogy problem has an M-demand (working memory demand) of (3). The evidence with regard to (2x2) nondegenerate figural analogies is less clear. Consistent with Wagner's (1981) observations, this type of problem appears to be more difficult than the (1x1) (2x1) (3x1) structure. However, it is not clear whether or not the (2x2) problem requires a working memory capacity of (4). The performance of the subjects with an M-Score (working memory score) of (3) suggests that this type of problem may have an M-demand greater than (3) in that these subjects solved very few (2x2) problems in the single task condition. However, the decrement in performance in the dual task condition for subjects with an M. Score of (4) was not significant at the .01 level.[(2)] It may be that, although the (2x2) structure places some additional demand on a subject's central processing capacity compared to the (1x1) (2x1) (3x1) problems, this demand is less than the equivalent of (1) unit on the Case and Kurland (1976)

(1) As can be seen in Tables 1 and 2, there was a small decrement in performance in the counting condition. This difference was significant at the .05 level, suggesting a small but consistent effect.

(2) This difference was significant at the .06 level, however.

tests of working memory. For example, the additional A->C feature transformation in the (2x2) structure may be applied after the subject has identified a response alternative on the basis of one A->B and one A->C transformation.

Experiment 2

Although the amount of available working memory capacity a subject has while solving figural analogy problems was directly manipulated in Experiment 1, it is still possible that the child with a working memory capacity of (2) who is unable to solve the nondegnerate (a) problem may lack the prerequisite perceptual skills or the prerequisite cognitive operations for this type of analogical reasoning. This possibility was tested in Experiment 2.

A random sample of 44 children was selected from junior-kindergarten, kindergarten and grade one of 3 Metro Toronto schools. Each subject was first assessed individually on the Mr. Cucumber Test (Case and Kurland, 1976) of working memory capacity. Following this, each subject was presented with a series of non-degenerate (a) and (b) figural analogy problems broken down into prerequisite tasks which were administered in the following order:

(1) (a) a nondegenerate figural analogy problem.

(2) (a) a semidegenerate figural analogy problem requiring an Infer A->B operation from (1).

(2) (b) a semidegenerate figural analogy problem requiring a Map A->C operation from (1).

(3) a series of visual discrimination tasks requiring the identification of the perceptual features in the A->B, A->C feature differences and similarities from (1).

(1) (b) a repeated administration of the figural analogy problem used in (1).

In other words, each figural analogy problem was broken down into a series of tasks designed to represent subsets of Sternberg's (1977) algorithm. In this respect it is important to note that the stimuli used in the second and third tasks were taken from the figural analogy problem used in the first task for each series of tasks. This is illustrated in Figures 1 to 5. Employing this framework, each subject was administered two (1x1), two (2x1), two (3x1), and two (2x2) figural analogies, each with its three pre-requisite tasks.

- Insert Figures 1 to 5 about here -

It was predicted that the errors on these tasks would be in the following order of magnitude; (1)(a)(b) > (2)(a)(b) > (3). This prediction was based on the hypothesized complexity (Sternberg, 1977) and M-demand of the algorithms underlying each task. It was also predicted that success on a task which was higher in terms of complexity and M-demand (e.g. closer to 1.) would result in success on all of the tasks which were below it in the hierarchy (e.g. 2-3). Figure 6 illustrates the overall structure of this hierarchy of tasks.

- Insert Figure 6 about here -

These predictions were confirmed by Guttman scaling procedures (see Tables 3, 4 and 5) and by an analysis of the relationship between successful performance on each type of task and the working memory scores of the subjects (see Table 6). Moreover, both types of analyses confirmed the predicted order of difficulty in the hierarchy. It is also important to note that there were a large number of cases (44) in which subjects succeeded on all of the prerequisite tasks but were unable to solve the nondegenerate figural analogy problem in task (1)(a) and (b). A majority of these subjects, however, did not have a working memory span of (3).

- Insert Tables 3 to 6 about here -

Figure 1

The People Picture Nondegenerate Analogy

(Referred to as the Aha. Task in This Experiment)

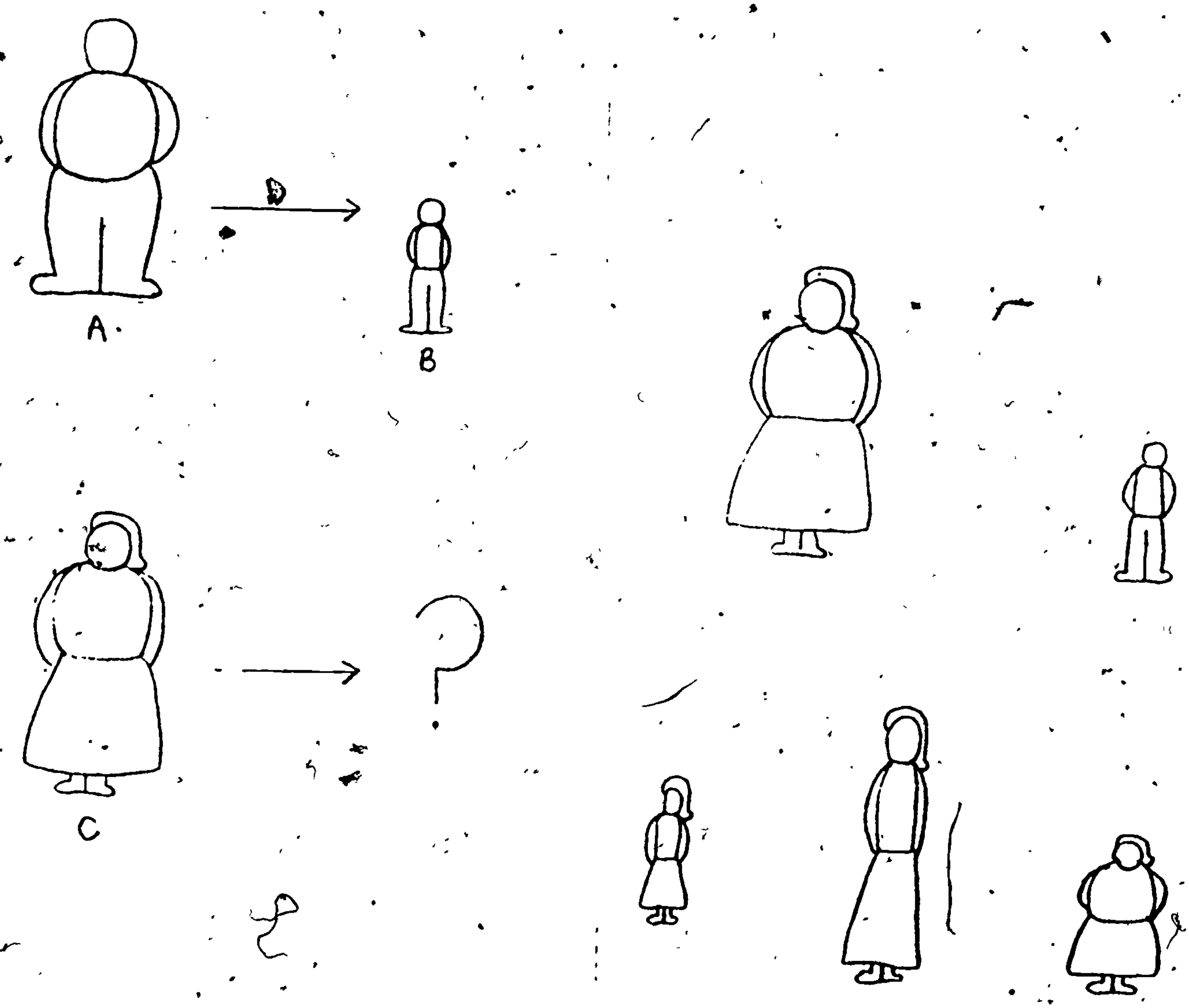


Figure 2

The Infer A → B Prerequisite Task

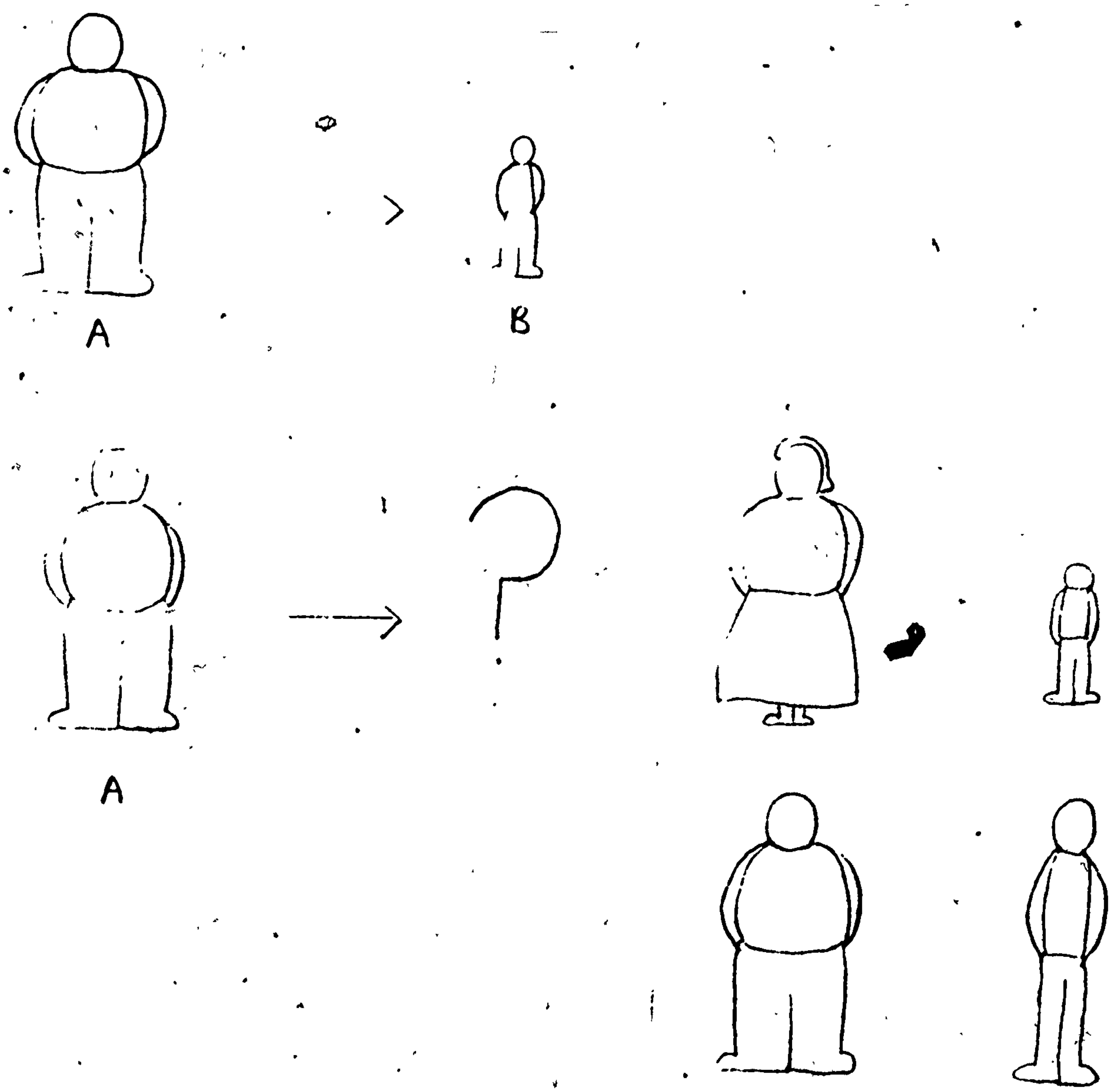
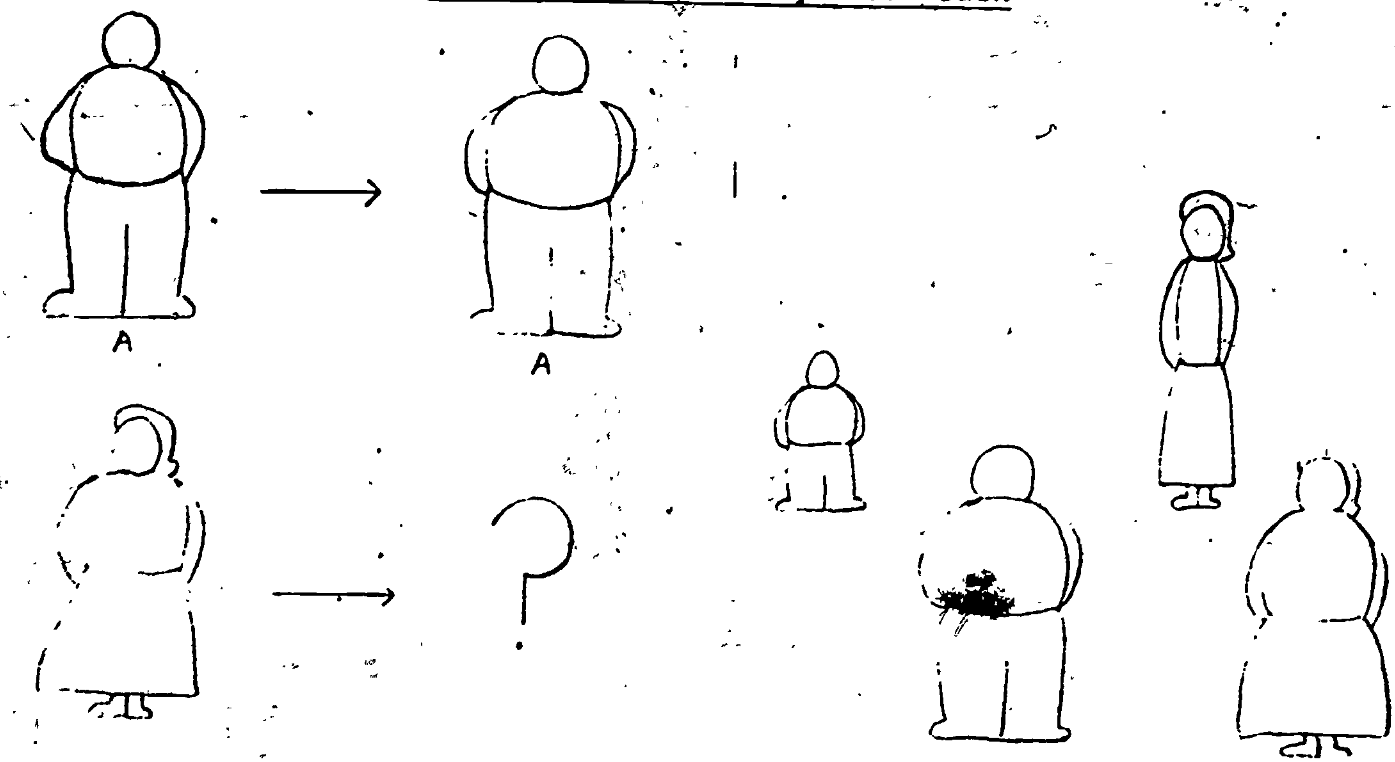


Figure 3

The Map A → C Prerequisite Task



Note: The procedures for the prerequisite encoding tasks involved asking the subject to put his/her left hand index finger on the figure marked R. The child was then asked to point to the figure on the right side (with his/her right hand) which was most *like* the one marked R. In the case of encoding differences, the subject, of course, was asked to point to the figure that was most *different* from R. In each case, the right hand figures were selected so that the distractor was incorrect in terms of only one critical feature similarity or difference. It was reasoned that the subject would have to process all of the critical similarities or differences between these stimuli if he/she was to avoid selecting the distractor.

Figure 4

Encode A/B Similarities

Prerequisite Task

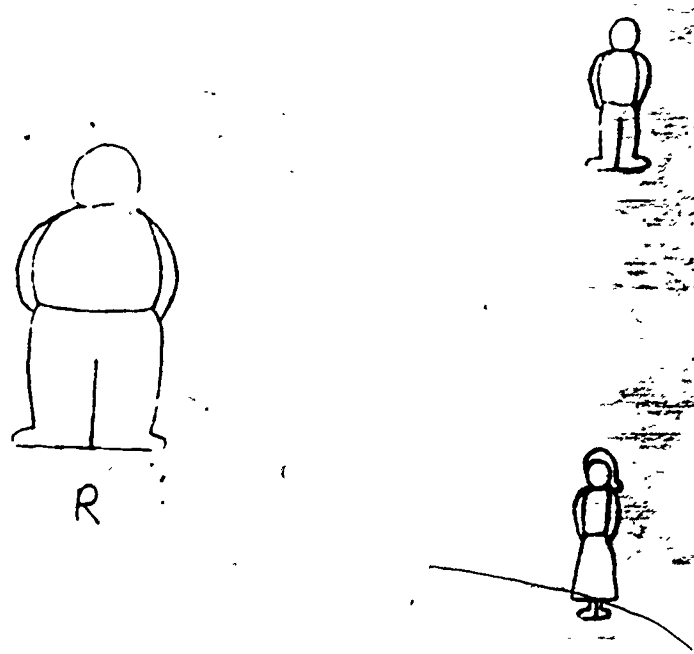
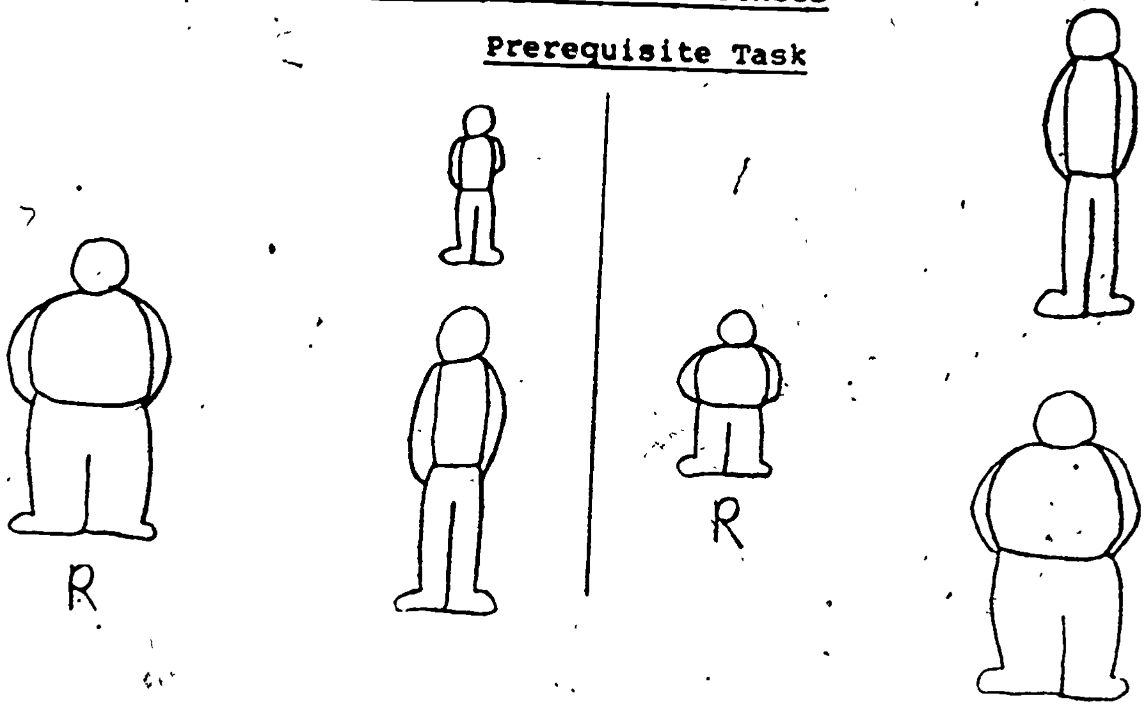


Figure 5

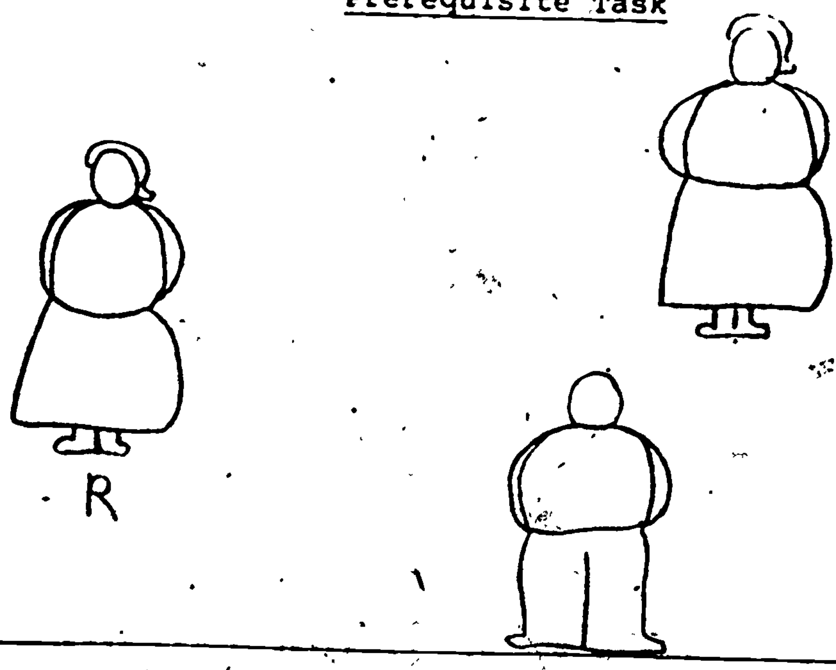
Encode A / B Differences (1)

Prerequisite Task



Encode A / C Differences

Prerequisite Task



(1) Each of the critical feature differences between A and B (of Figure 1) were tested separately.

Figure 6

Hierarchy of Prerequisite Tasks for Nondegenerate Figural Analogies

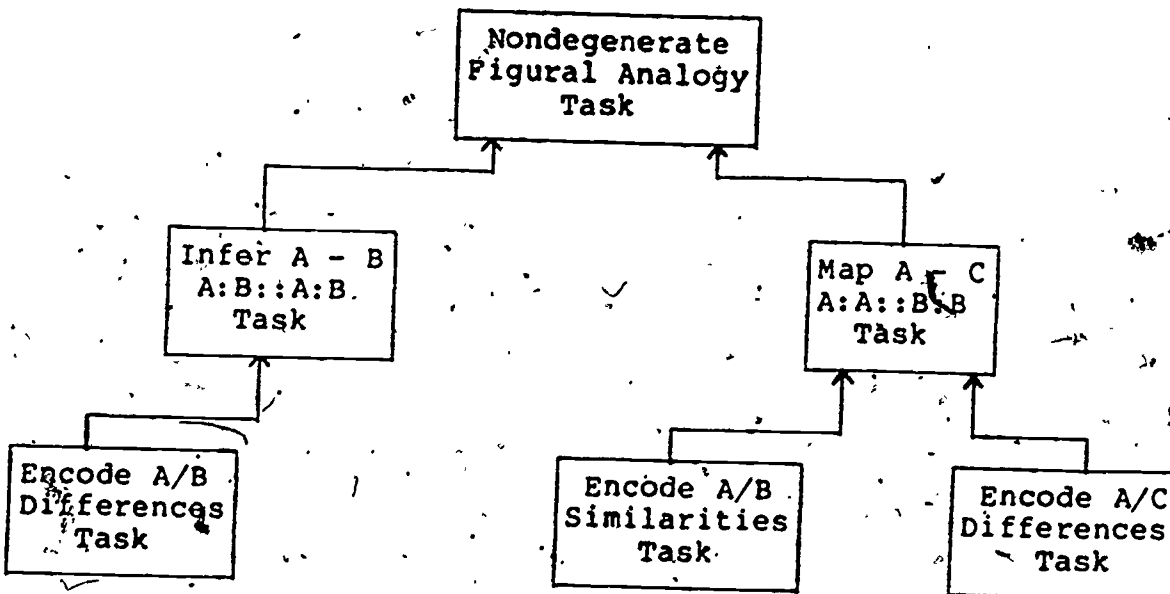


Table 3

Response Scale A; the Ana. Task, the Infer A - B Task, the Encode A/B Differences Task

		Ana. Task		Infer A → B Task		Encode A/B Differences Task	
	Response	0	1	0	1	0	1
Scale Type	3	0	66	0	66	0	66
	2	73	19	12	80	7	85
	1	97	1	80	18	19	79
	0	48	0	48	0	48	0
	Sums	218	86	140	164	74	230

Response Scale A Correlation Coefficients (Yules Q)

	Ana. Task	Infer A → B Task	Encode A/B Differences Task
Ana Task	1.0000		
Infer A - B Task	0.7737	1.0000	
Encode A/B Diff. Task	0.6179	0.4992	1.0000
Scale/Item (Biserial Corr.)	0.5267	.4999	0.3689

Coefficient of reproducibility = .9260
Coefficient of scalability = .7231

Table 5
Guttman Scaling of the Ana. Task, the Map A - C Task, and the Encode A/B Similarities Task

		Ana. Task		Map A → C Task		Encode A/B Sim. Task	
	Response	0	1	0	1	0	1
Scale Type	3	0	69	0	69	0	69
	2	127	13	10	130	3	137
	1	75	4	60	19	23	56
	0	16	0	16	0	16	0
	Sums	218	86	86	218	42	262

Coefficient of reproducibility = 0.9211
Coefficient of scalability = 0.6636

Table 21 Inter-Item Correlations (Yule's Q)

	Ana. Task	Map A → C	Encode A/B Sim. Tasks
Ana Task			
Map A - C Task	0.4334		
Encode A/B Sim. Task	0.3668	0.4594	
Scale/Item (Biserial Corr.)	0.2410	0.3009	0.2812

Table 4
Guttman Scaling of the Ana. Task, the Map A - C Task, and the Encode A/C Differences Task

		Ana. Task		Map A → C Task		Encode A/B Sim. Task	
	Response	0	1	0	1	0	1
Scale Type	3	0	72	0	72	0	72
	2	138	13	13	138	0	151
	1	64	1	57	8	9	56
	0	16	0	16	0	16	0
	Sums	218	86	86	218	25	279

Coefficient of reproducibility = 0.9211
Coefficient of scalability = 0.6636

Table 22 Inter-Item Correlations (Yule's Q)

	Ana. Task	Map A → C Task	Encode A/C Diff. Tasks
Ana Task			
Map A - C Task	0.4344		
Encode A/C Diff. Task	0.8263	0.7322	
Scale/Item (Biserial Corr.)	0.2715	0.3485	0.5031

Table 6

Mean Correct on Nondegenerate Analogy Prerequisite Tasks

M-Score Group	Ana.	Infer A → B	Map A → C	Encode A/B (D.)	Encode A/B (S.)	Encode A/C (D.)
3 n = 9	62.5% 5.0	83.4% 6.67	91.25% 7.3	100.0% 8.0	95% 7.6	100.0% 8.0
2 n = 17	53.25% 4.26	72.75% 5.82	84.5% 6.76	80.125% 6.41	85.25% 6.82	97.75% 7.82
1 n = 18	14.375% 1.15	31.25% 2.5	57.62% 4.61	70.75% 5.66	81.25% 6.5	82.625% 6.61

Means based on 8 trials per task

It is conceivable, however, that the failure of these subjects to solve the nondegenerate figural analogy problems was not the result of a limited working memory capacity but rather, was caused by a failure to understand the nature of the conjunctive response concept underlying the bidimensional comparison strategy. In other words, although these children were able to perform successfully all of the operations in the nondegenerate algorithm when these operations were embedded in familiar tasks, they did not realize that the products of the Infer A- B and Map A- C operations had to be conjoined on one response alternative. This possibility was tested in Experiment 3.

Experiment 3

Twenty four grade one children were randomly selected from an elementary school in St. Catharines, Ontario, Canada. As in Experiments 1 and 2, each child was first pretested on the Mr. Cucumber and Count the Spot working memory tests (Case and Kurland, 1976). Following this each subject was individually administered (1) a pretest set of people picture (Sternberg, 1977) figural analogy problems, (2) a treatment set of geometric figural analogy problems, and (3) a posttest set of people picture and geometric figural analogy problems. Each set consisted of (a) six (1x1) nondegenerate (a) problems and (b) two (2x1), two (3x1), and two (2x2) nondegenerate problems, and was administered in this order. The (1x1) figural analogy problems were administered first as a separate unit in order to give each child the opportunity to learn and consolidate the bidimensional comparison strategy on problems with the least number of feature transformations. In all three conditions after the subject selected a response alternative for a problem, he/she was asked to name all of the A → B and A → C feature transformations in the problem. Following this the experimenter gave the subject a 2 x 6" card with the names of the features required for a correct conjunctive response on it. The experimenter then read these names to the child while he/she searched for and selected a response alternative. These procedures were carried out regardless of whether or not the subject made a correct response while solving the problem.

The treatment in this experiment also consisted of a verbal facilitation procedure. In this case the experimenter verbalized the second feature in either the A->B or A->C feature relationships while the subject was attempting to solve the problem. Half of the subjects received verbal prompting on the A->C feature transformations while the other half received verbal prompting on the A->B feature transformation. Cards with the feature names on them were not used here. However, the experimenter repeated the verbal prompting until a response alternative was selected. In addition, each subject received verbal feedback on the correctness of his/her response choices for every other problem in pretest and treatment conditions.

The following predictions were made. First, if the subjects did not understand the nature of the conjunctive concept underlying the response required in figural analogy problems then it was reasonable to expect that there would be a correlation between performance in solving figural analogy problems and performance in locating the correct response alternative when the subjects were read the features that had to be conjoined. In other words, errors on the figural analogy problems were expected to be correlated with errors on the conjunctive response locating task. If on the other hand, the development of available working memory capacity was the problem, then subjects were expected to select the wrong response alternative to a figural analogy problem even when they responded correctly in the conjunctive response locating task. Second, it was predicted that if the child's problem was one of learning to employ the bidimensional comparison strategy as opposed to the M-demand of this strategy, then performance should improve and reach criterion in the treatment condition and should remain at this level in the posttest condition. If on the other hand, the child was having difficulty retaining information in working memory, it was expected that performance would decline back to pretest levels in the posttest condition. Third, it was predicted that if the number of feature transformations in a problem added to its difficulty in terms of additional processing time and the potential for error when the child was attempting to learn to employ the the bidimensional comparison strategy, then children might learn to apply this executive strategy first to the (1x1) type of problem.

The results are presented in Tables 7 and 8. First, as can be seen, there was no correlation between the subjects' ability to respond correctly to the conjunctive response locating task and his/her performance on a given figural analogy problem. This is particularly evident when one makes this comparison across all three conditions. In general, these subjects were able to locate the correct response alternative on the basis of being given the features that had to be conjoined. Second, the results of the repeated measures analyses of variance clearly point to the working memory hypothesis in terms of the effect of the treatment. The working memory hypothesis is further supported by the fact that these analyses were based only on those problems in which the subject was able to answer all of the A->B and A->C feature transformation questions correctly. Third, there was no support for the notion that the additional feature transformations in the (2x1), (3x1) and (2x2) problems made these problems more difficult than the (1x1) structure. This effect may have been masked to a certain degree, however, by the experimental procedure of always administering the (1x1) problems first. Therefore, it was decided to compare the performance of the subjects who received assistance on the A->C transformations with those who received assistance on the A->B transformations. It was reasoned that there should be a difference between these two groups on the (2x1) and (3x1) problems because of the difference in the number of A->B transformations. In brief, the subjects receiving assistance on A- B transformations were expected to do better if children find it difficult to meet the exhaustive processing requirements of such problems. Again, no differences were found.

- Insert Tables 7 to 9 here -

In concluding then, it seems clear that Case's (1978) theory of cognitive development can best account for these results. A major problem young children face in learning to reason by analogy on figural problems is that the attentional or working memory capacity they have available after carrying out the encoding requirements of this type of task is not sufficient to coordinate the information from both domains. However, one should not conclude that this is the only problem facing the six year old. As can be seen in Table 9, there was a significant difference between the number of problems these subjects missed as a result of perceptual encoding errors (inferred from the post problem solving feature labelling task) and the number of problems they missed as a result of working memory loss (those problems which were solved incorrectly inspite of correct performance on the feature labelling task). Thus, as Sternberg and Rifkin (1979) suggest, young children also experience major encoding problems.

Table 7

Conjunctive Response Locating Task

(1x1) Problems	Pretest Mean	Treatment Mean	Posttest Mean
Figural Anal.	3.391304	1.260869	3.130434
Conj. Response	5.856123	5.893716	5.765312

(2x1)(3x1)(2x2) Problems	Pretest Mean	Treatment Mean	Posttest Mean
Figural Anal.	3.0	1.565217	3.217391
Conj. Response	4.981763	5.126389	5.573212

Table 8

Verbal Facilitation in One Domain

Type of Problems	Means	Mean Square Error	D.F.	F. Ratio
(1x1)				
Pretest Treatment	3.391304 1.260869	52.195652	22,1	49.27425
Pretest Posttest	3.391304 3.130434	.782608999	22,1	.33616
Treatment Posttest	1.260869 3.130434	40.195652	22,1	28.24861

Type of Problems	Means	Mean Square Error	D.F.	F. Ratio
(2x1)(3x1)(2x2)				
Pretest Treatment	3.0 1.565217	23.673913	22,1	12.75179
Pretest Posttest	3.0 3.217391	.543478	22,1	.47909
Treatment Posttest	1.565217 3.217291	31.391203	22,1	18.36301

Table 9

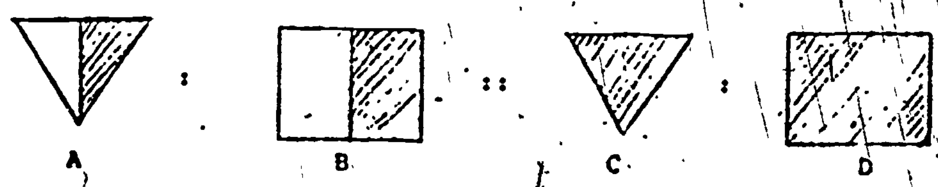
Feature Transformations

Posttest	Means	Mean Square Error	D.F.	F.Ratio
(1x1) Problems	3.130434	.086956999	22,1	.04259
(2x1)(3x1)(2x2) Problems	3.217391			

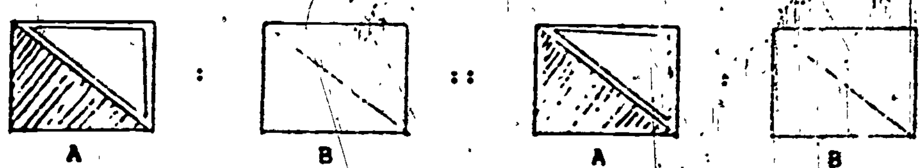
Encoding and Working Memory

Posttest	Means	Mean Square Error	D.F.	F.Ratio
Encoding + W.M. Errors	4.217391	11.5	22,1	12.04762
W.M. Errors	3.217391			

Appendix I



The Nondegenerate Analogy



The Semidegenerate Analogy

The Degenerate Analogy

After Sternberg (1977)

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