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ABSTRACT

The purpose of this study was to investigate the effects of hypothesis testing instructions compared to brief instructions on the speed of shift problem solution of grade school age subjects, in order to provide information on the development of hypothesis testing behavior in children and the sampling characteristics of hypothesis testing in these younger subjects. A second purpose was to apply models of analysis suggested by quantitative models of Concept Identification to the data from a traditional shift study with children, in order to provide some information regarding the processes which result in concept acquisition. Comparison of post-shift solution rates revealed that the effect of the detailed instructions was to decrease the difference between reversal (R) and non-reversal (NR) shifts in the predicted direction, and R shifts were still solved more quickly than NR shifts. Further analyses revealed that the data could not be accounted for by no-memory hypothesis sampling models. It is suggested that current developmental theories which can account for the relative difficulty of R and NR shifts be elaborated to quantitative models of children's concept learning. (Author/TA)

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INSTRUCTIONS AND PROBLEM SHIFTS:

THEIR IMPLICATIONS FOR THEORY IN CONCEPT LEARNING.

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Midwestern Psychological Association, May, 1971.

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INSTRUCTIONS AND PROBLEM SHIFTS: THEIR IMPLICATIONS FOR THEORY IN CONCEPT LEARNING.

Recent investigations (Erickson, 1971; Erickson, Block, and Rulon, 1970) of college age Ss acquisition of reversal and extradimensionsl shifts revealed that the relative difficulty of solving these problems was a function of the instructions given to Ss regarding the nature of the task. Specifically, if the instructions were very brief, simply telling Ss to discover some systematic relationship among the stimuli, then the traditional shift relationship was obtained, that is, reversal shifts were much easier to solve than extradimensionsl shifts. However, when Ss were given very explicit and detailed instructions regarding the task, pointing out the dimensions of the stimuli and explaining the nature of the rule for stimulus classification, then the relationship between the shift problems were reversed. Since the data from many concept identification experiments, in which great care is taken to insure that Ss understand the nature of the task, can be accounted for by hypothesis sampling models of concept identification (Bower and Trabasso, 1964), the results were interpreted in this context. It was suggested that when Ss re-sample from the pool of hypotheses after an error trial, that they tend to sample hypotheses from dimensions other than the dimension on which their most recent hypothesis was based.

The purpose of this study is to investigate the effects of hypotheses testing instructions compared to brief instructions (modeled after the instructions used by the Kendlers [Kendler and Kendler, 1959; Kendler, Kendler, and Wells, 1960]), on the speed of shift problem solution of much younger subjects, in order to provide information on the development of hypothesis testing behavior in children and the sampling characteristics of hypothesis testing in these younger Ss. A second purpose of the study is to apply methods of analysis suggested by quantitative models of Concept Identification (Suppes and Ginsberg, 1963), to the data from a traditional shift study with children, in order to provide some information regarding the processes which result in concept acquisition.

Method

Ninety-six randomly selected children from two age groups at a local elementary school in Pittsburgh were Ss in the experiment. The two ages represented were 7 and 8 year old Ss which were referred to as the young age group; and 10, 11, 12 year old Ss who were referred to as the old age group. The mean age of the young group was 7 years - 11 months and for the old group was 11 years - 7 months. Within these two age groups, half the Ss were assigned to a brief instruction condition and half to a detailed, hypothesis testing instruction condition. Within each age by instruction condition half the Ss received a reversal shift and half an extradimensional shift. The relevant stimulus dimension that a S received was completely counterbalenced across Ss in each cell. The design was completely randomized with 4 factors (Age x Instruction x Shift x Dimension) with two levels of each factor. There were six Ss per cell.

The experiment required that all Ss be given 1 hour to solve the first problem. However, due to computer scheduling, this sometimes was not the case.

The final data base consisted of the first 94 Ss run under the appropriate conditions who solved both problems and an additional two Ss who were the first Ss to solve the first problem in their cell assignment.

The stimuli were squares and circles colored red with either the top half colored white or the bottom half white as shown on page 1 of your handout. The four stimuli were photographed and mounted on slides.

Slide selection was computer controlled and the slides were back-projected onto a touch-sensitive screen. During every stimulus presentation 2 spots labeled "A" and "B" appeared below the stimulus. A touch applied to either spot "A" or "B" with sufficient pressure activated a feedback tone and told the S the computer received his response. For correct responses feedback was provided by the sounding of a second tone, a flashing light, and a bead was dispensed into a clear plastic cup positioned in front of the S below the screen. The beads could be exchanged for toys at the end of the experimental session. For incorrect responses, no more events occurred within the rest of the interval.

The four stimulus slides were presented in a random order in blocks of 4 subject to the restrictions that no slide could be presented twice in a row and that all 4 slides would be presented before the next block of trials. The sequence of events during a typical trial was as follows: (1) slide on; (2) S response with response feedback tone sounded concurrently; (3) (for correct responses only) - 2 seconds after the S's response the second feedback tone sounded, the light flashed and the bead was dispensed; (4) slide off. The stimulus remained on the screen until either 2 seconds after an incorrect response or 2 seconds after feedback on a correct response. The intertrial interval was 10 seconds.

All Ss were tested individually. The experimenter conducted each S into the experimental room and acquainted him with the apparatus. The experimenter explained the procedure to be used with a demonstration slide that had a blue triangle for the stimulus. The S was then read either a brief or detailed set of standardized instructions depending on his assigned condition. In general, the problem was presented as a labeling game in which Ss had to decide which stimuli were called "A" and which were called "B". The brief instructions were much like those of the Kendlers'. Ss were told: they would receive a bead for every correct response; they [illegible] one choice (A or B) [illegible] every trial; they should look at the figure when they responded; and they should try to get all correct responses in a row. Additionally Ss in the detailed instruction condition received information concerning the stimulus dimensions, and the values of the dimensions and the nature of the possible solutions. They were shown the set of the 4 stimuli, the differences were pointed out, and the rules were illustrated. Then Ss named the dimensions for the experimenter; if they expressed difficulty, they were prompted. They were told that one of several possible rules would govern the labeling of the stimuli and that they had to figure out which rule was being used. They would know that they had chosen the correct rule by getting all correct answers in a row. The experimenter then started the problem and left the room. Ss were terminated upon solving both problems or after one hour, whichever came first. Ss solved the first problem to a criterion of 10 correct responses in a row, then were immediately shifted to the second problem without any warning. The solution of the second problem had relevant dimensions that were either a reversal or a nonreversal of those in the first problem. The solution values ("A" and "B") for the second problem were selected after the S made a mandatory error on the first trial in the second problem - only for the nonreversal shift conditions. For the reversal shift the "A" and "B" values were merely switched. Ss then solved this second problem to the criterion of 10 successive correct responses.

The data from this study were analyzed under two criteria: one, a more stringent criterion was 10 consecutive correct responses in a row, the criterion used in this experiment to determine when to shift the problem solution. The data were also analyzed by applying a less stringent and more traditional criterion, that is, by considering a problem solved when Ss made 9 correct responses out of a block of 10 successive responses (Kendler, Kendler and Wells, 1960). With these two criteria, the major focus of analysis was the choice behavior on trials preceding a stringent, or a less stringent criterion. In almost all cases, the results of the analyses are similar for the two criteria with the exception of the stationarity analyses to be presented later.

Analyses of variance were performed on trials and errors to criterion in order to assess the effects of the four major variables. The results of the analyses were quite similar for errors and trials, and were similar under the application of either the stringent or the less stringent criteria. The major result of these analyses for the preshift problem was the fact that there were no main effects of age, instruction, relevant dimension, and shift; and that there were no strong two-way interactions among these variables, nor any four-way interaction. There was, however, a three-way interaction present in each analyses between shift, dimension, and age. Tables I and II in your handout shows the character of this interaction for errors and trials to criterion. As can be seen, the random assignment procedure was not successful in ensuring equivalent speed of learning for the two shift groups on the first problem, since reversal Ss solved the first problem faster. Further analyses of the interaction were done to determine if significant preshift differences existed for all combinations of shift and age; these analyses revealed that comparisons of speed of problem solution under reversal and extradimensional shifts could not unequivocally be made. The shift comparisons are confounded with the effects of either differential salience or speed of preshift solution which is in the same direction as the shift results, or both. Thus, shift comparisons on the basis of errors or trials to criterion obtained in this study cannot appropriately be made to the classic body of literature and theory of discrimination shifts, which requires that shift comparisons be unconfounded with the effects of dimensional dominance and preshift acquisition rate (Kendler and Kendler, 1962, 1968; Wolff, 1967). However, within the context of an hypothesis theory, which assumes that a dimension is sampled after every error trial and the design of the current study, the differential salience of the dimensions does not rule out the relevance of learning rate comparisons between preshift and postshift problems. Also, differences in preshift problem solving for the two shift groups do not invalidate the usefulness of information from postshift rate comparisons since, within the class of no-memory hypothesis sampling theories in which errors function as recurrent events, there is presumably no correlation between preshift and postshift problem solving rates (Bower and Trabasso, 1964).

Analyses of postshift performance revealed that both shift type and age significantly affected postshift performance with reversal shifts solved in fewer errors than extradimensional shifts, and younger Ss revealing more errors to solution than older Ss. Some interesting interactions were also observed and can be seen in Figures 2 and 3 of your handout. Figure 2 reveals that for the younger Ss, there is a very large difference in trials to criterion between the reversal shifts and the extradimensional shift, while this difference, although still significant, decreases with older Ss. The effect of instructions on shift behavior can be seen in Figure 3. The detailed instructions succeeded in reducing the differences between shifts, but the shifts were still significantly different for both instructional conditions. Thus, relative difficulty of shift type was maintained for both instructional conditions, but the size of the difference was reduced by the explicit instructions. The nature of the reduction was of the same form at both age levels, as can be seen in Figure 4 and 5 and was

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revealed in the statistical analysis as a three way-interaction between instructions, shift and age that was not significant. In summary, then, for the age groups studied herein, reversals and extradimensional shifts were significantly different, with an extradimensional shift being more difficult. Also, for a group of children ranging in age from 6 to 12 years old, more detailed, hypothesis testing instructions can reduce the relative difficulty of the two shifts.

The choice data from the preshift problem trials before the criterion run were analyzed for stationarity (Bower and Trabasso, 1964; Suppes and Ginsberg, 1963), and the results are presented in Figures 6 and 7. When trials to the stringent criterion are analyzed the detailed instructions led to significant departures from stationarity for both age groups, in contrast to the results usually observed with college Ss. The brief instructions led to stationary responding for both age groups. When the trials before a less stringent criterion are analyzed, the younger subjects receiving detailed instrucitons exhibited stationary responding before the trial of the last error. It is clear, then, that instructions affect the processes of concept acquisition but do not necessarily move it toward hypothesis testing accounts that predict stationary presolution responding.

Additional analyses of distributions of total errors to criterion for the two age groups solving under the detailed instructions provided further verification of this suggestion. Figures 8 and 9 show the observed distributions of total errors compared to the predictions of a no-memory process model in which the probability of sampling the correct hypothesis is 1/4. The data are also compared to the predicted error distributions from the Bower-Trabasso model. Both predictions do not compare well with the data and it is probably doubtful that any models predicting geometric distributions of errors could account for these preshift data.

Predictions of various statistics from the Bower-Trabasso model were also generated for these data and are compared to the data in tables III and IV. The closer fits usually obtained with this model to college S s data are not obtained here. The usual statistical tests associated with this and other hypothesis sampling models also revealed that the model does not fit the data well. Thus, the suggestion from these data is that the experimental conditions under which hypothesis testing behavior of the kind described by some current models of college S's behavior do not provide for the same behavior in children.

Because the learning rate in the preshift problem was too slow to compare well even to a no-memory model, then relative differences in shift difficulty will not be accounted for by adding memory processes of the form suggested by current models of adult hypothesis sampling behavior. Thus, probably the best theoretical direction in which to turn would involve a translation and elaboration of extant developmental theories of concept learning that can account for the shift results observed herein, into quantitative models. The models will make extensive and detailed predictions about aspects of the data other than over-all shift comparisons; and explicit assumptions about the nature of the processes involved in childrens' concept learning. Quantitative models which provide a good account of the data are basic to the solution of instructional optimization problems, and as such are a useful theoretical direction to pursue.

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REFERENCES

BOWER, G. and TRABASSO, T. Concept identification. In R. C. Atkinson (Ed.), Studies in Mathematical Psychology. Stanford: Stanford University Press, 1964. Pp. 32-96.

ERICKSON, J. R. Problem shifts and hypothesis behavior in concept identification. American Journal of Psychology, 1971, 84, 100-111.

ERICKSON, J.R., BLOCK K.K., and RULON, M.J. Some characteristics of hypothesis sampling in concept identification. Psychonomic Science, 1970, 20, 103-105.

KENDLER, H.H. and KENDLER, T.S. Vertical and horizontal processes in problem solving. Psychological Review, 1962, 69, 1-16.

KENDLER, H.H. and KENDLER, T.S. Mediation and conceptual behavior. In K. W. Spense and J. T. Spense (Eds.), The Psychology of Learning and Motivation: Advances in Research and Theory. Vol. 2. New York: Academic Press, 1968. Pp. 197-244.

KENDLER, T.S. and KENDLER, H.H. Reversal and nonreversal shifts in kindergarten children. Journal of Experimental Psychology, 1959, 58, 56-60.

KENDLER, T.S., KENDLER, H.H., and WELLS, D. Reversal and nonreversal shifts in nursery school children. Journal of Comparative and Physiological Psychology, 1960, 53, 83-88.

SUPPES, P. and GINSBERG, R. A fundamental property of all-or-none models, binomial distribution of responses prior to conditioning, with application to concept formation in children. Psychological Review, 1963, 70, 139-161.

WOLFF, J.L. Concept-shift and discrimination-reversal learning in humans. Psychological Bulletin, 1967, 68, 369-408.

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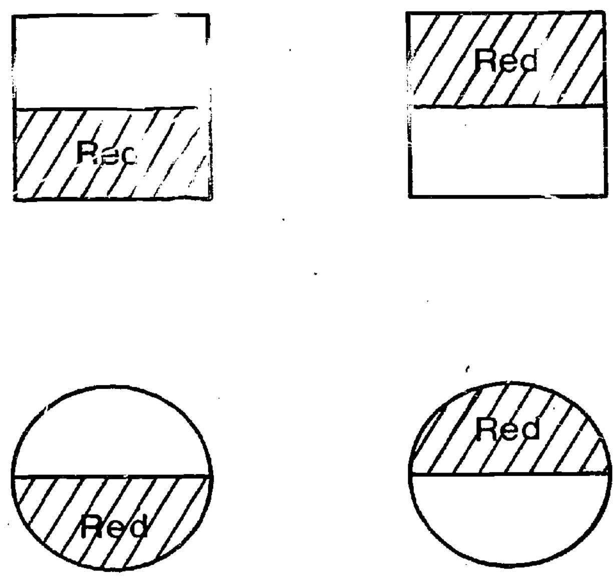

Figure 1: Stimuli Used In The Experiment.

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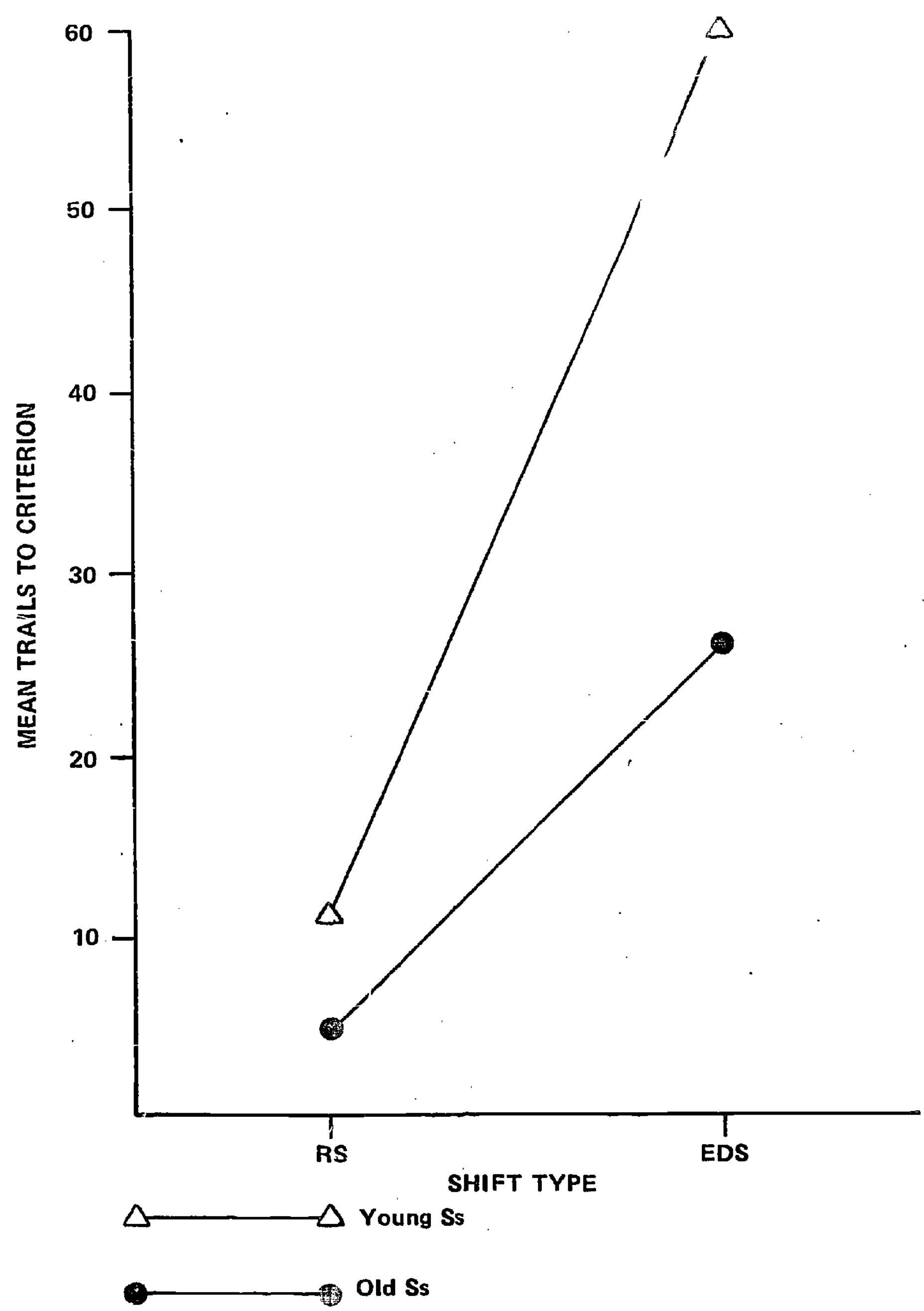

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Figure 2: Mean Trials To Criterion On Postshift Problem For Young And Old Ss (Stringent Criterion).

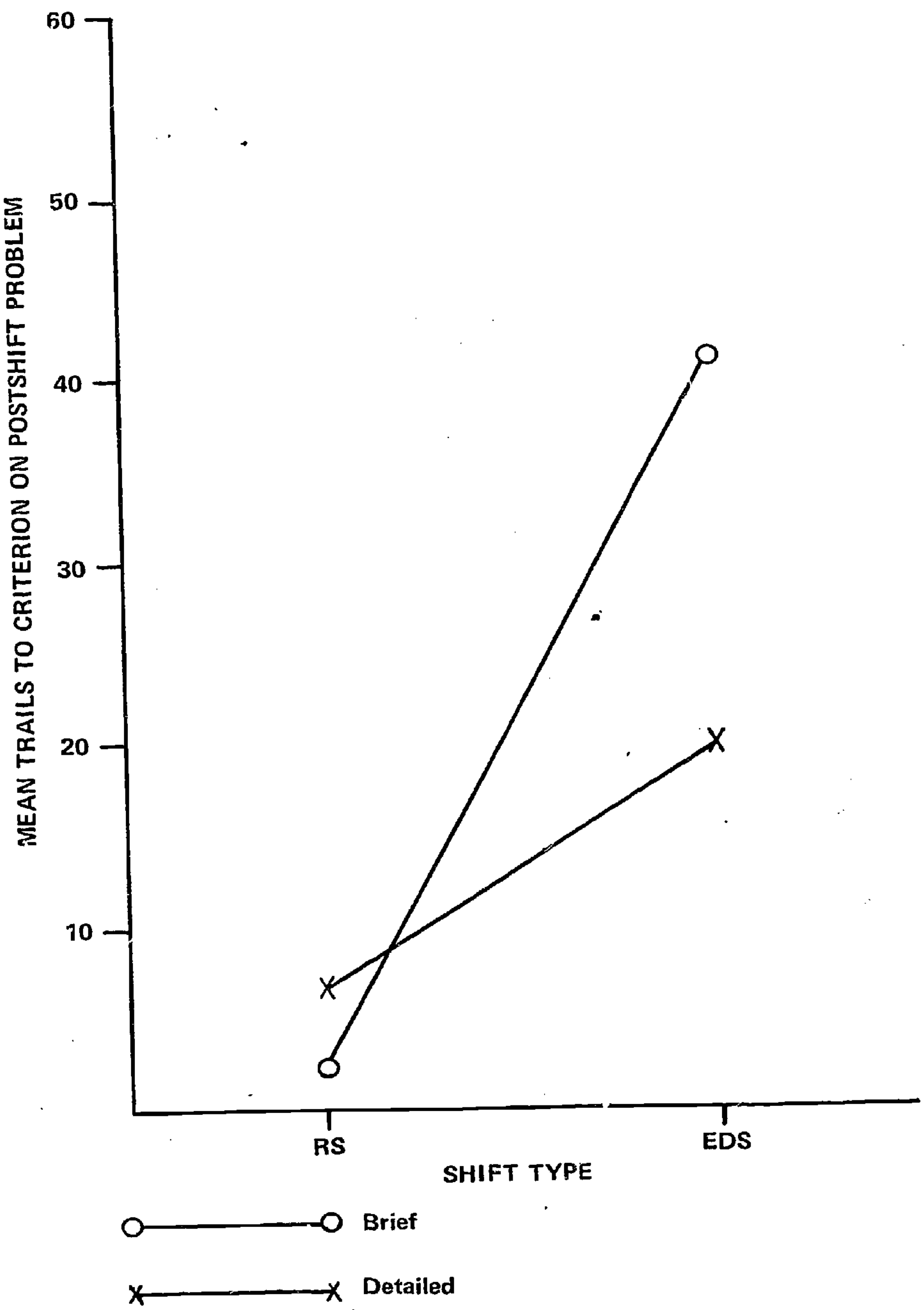

Figure 3: Mean Trials To Criterion On Postshift For Each Instruction Condition And Type Of Shift. Data Generated Under Less Stringent Criterion.

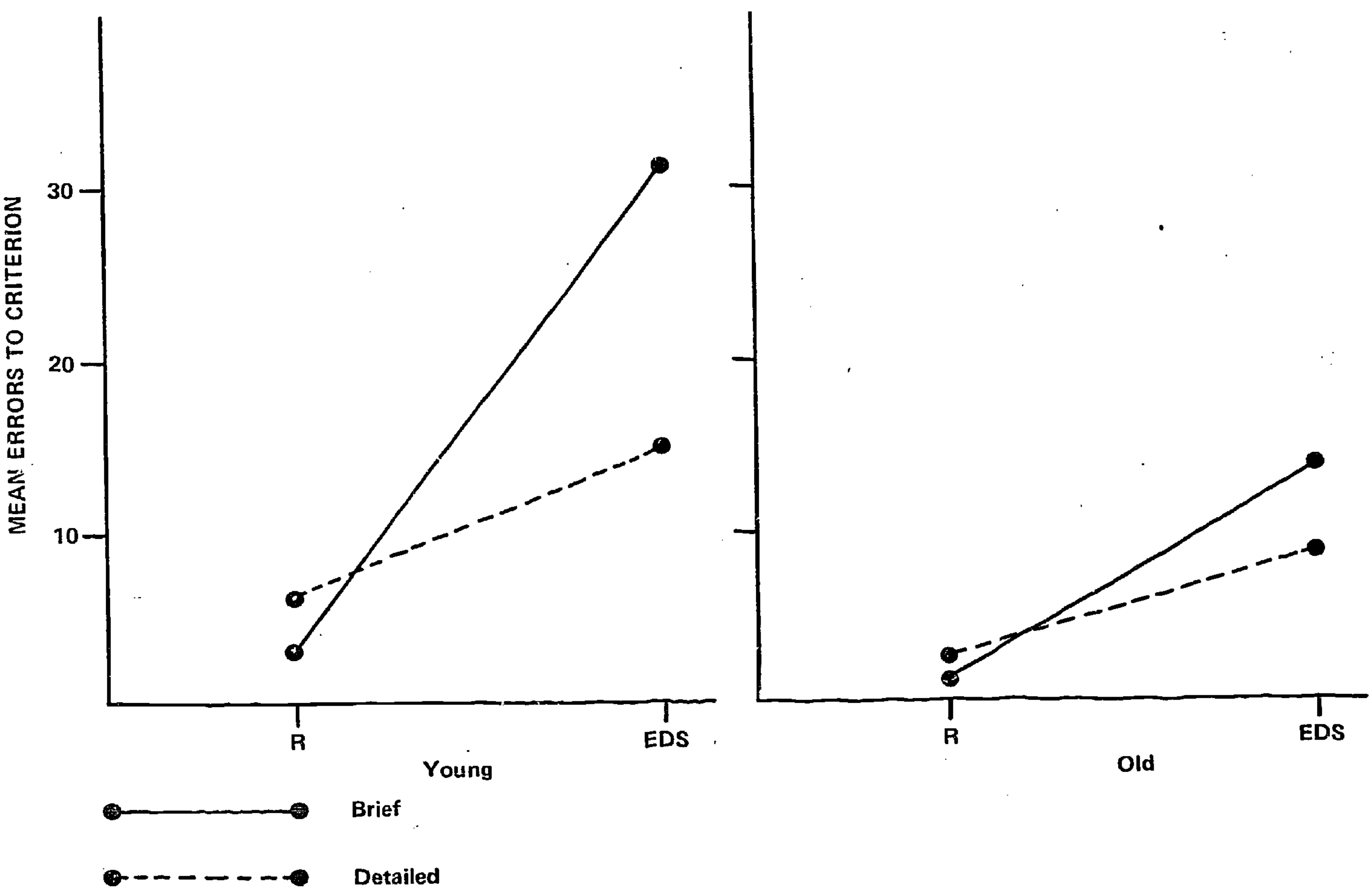

Figure 4: Mean Errors To Less Stringent Criterion On Postshift Problem For The Various Groups.

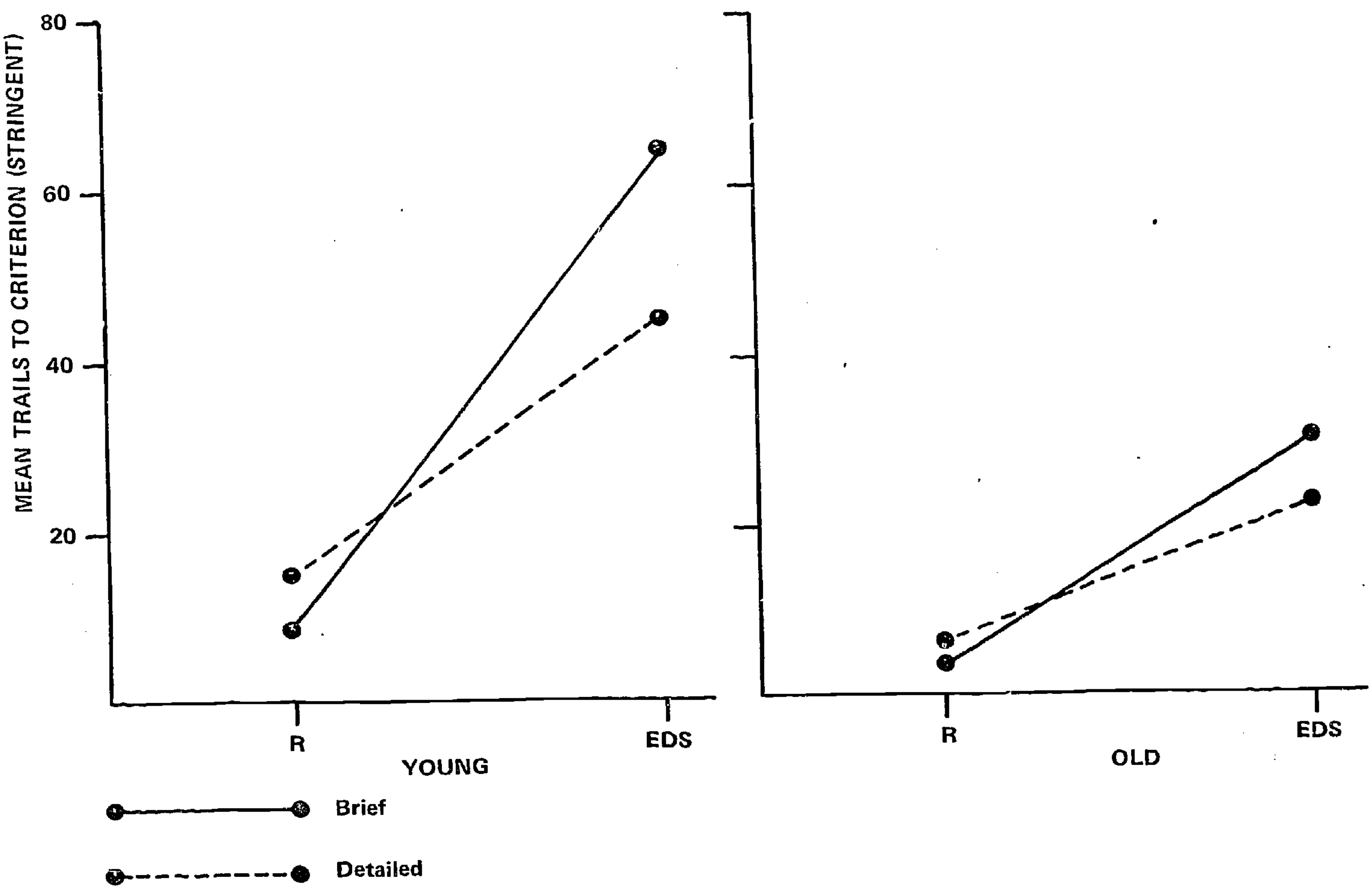

Figure 5: Mean Trials To Stringent Criterion On Postshift Problem For The Various Groups.

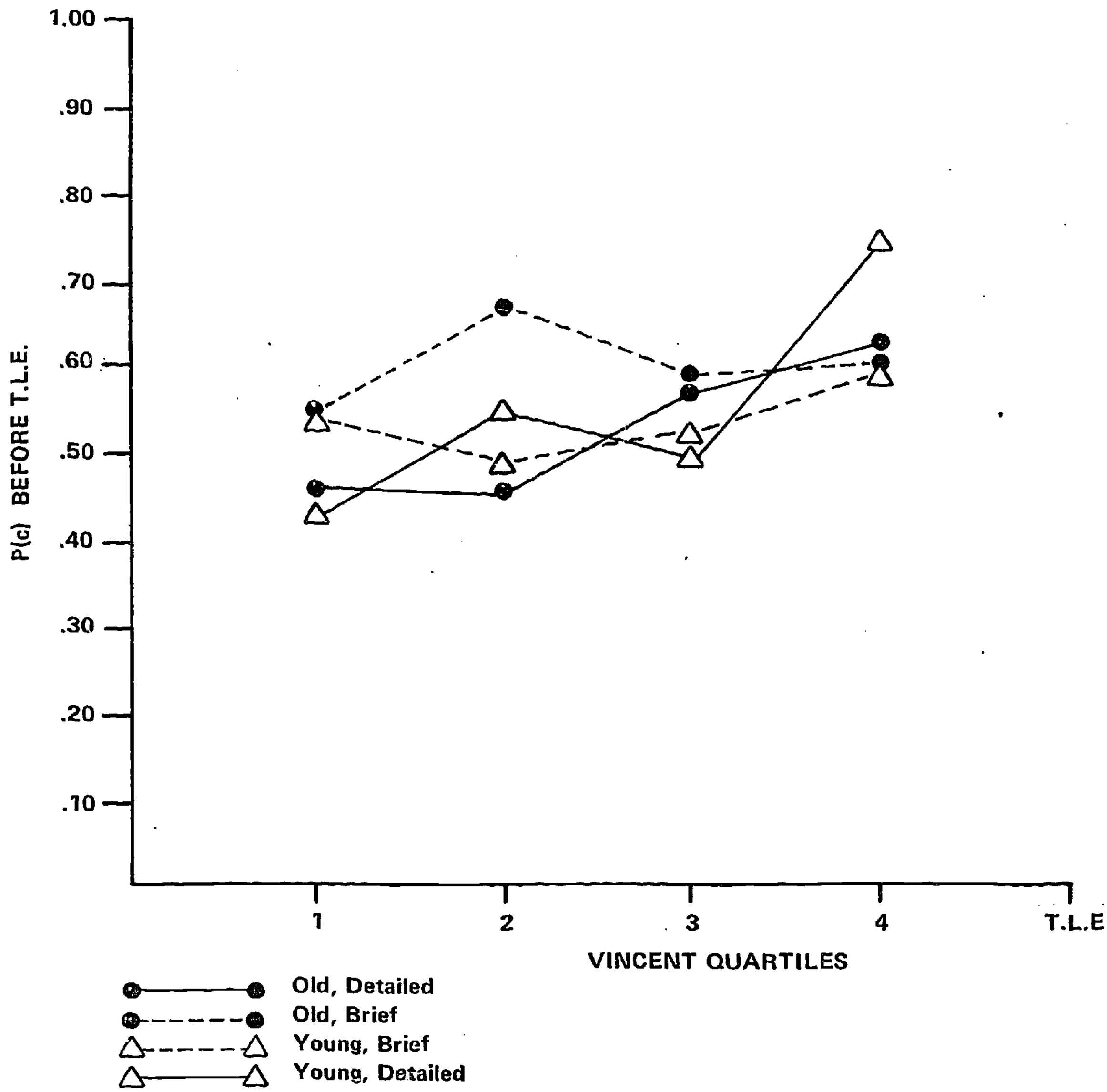

Figure 6: P(c) Before The T.L.E. Vincentized Into 4 Parts. Preshift Data With Stringent Criterion.

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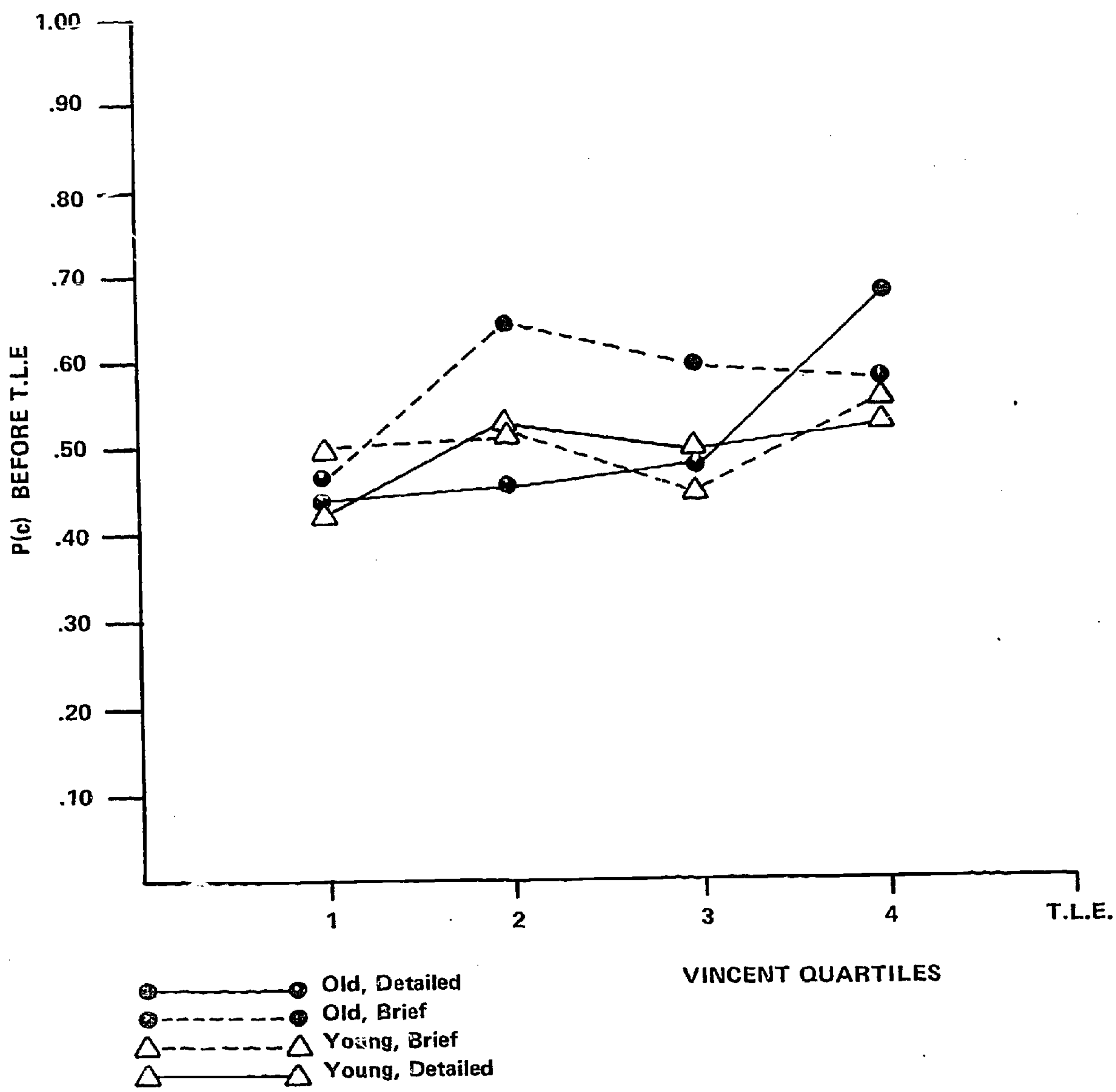

Figure 7: P(c) Before The T.L.E. Vincentized Into 4 Parts. Preshift Data With Less Stringent Criterion.

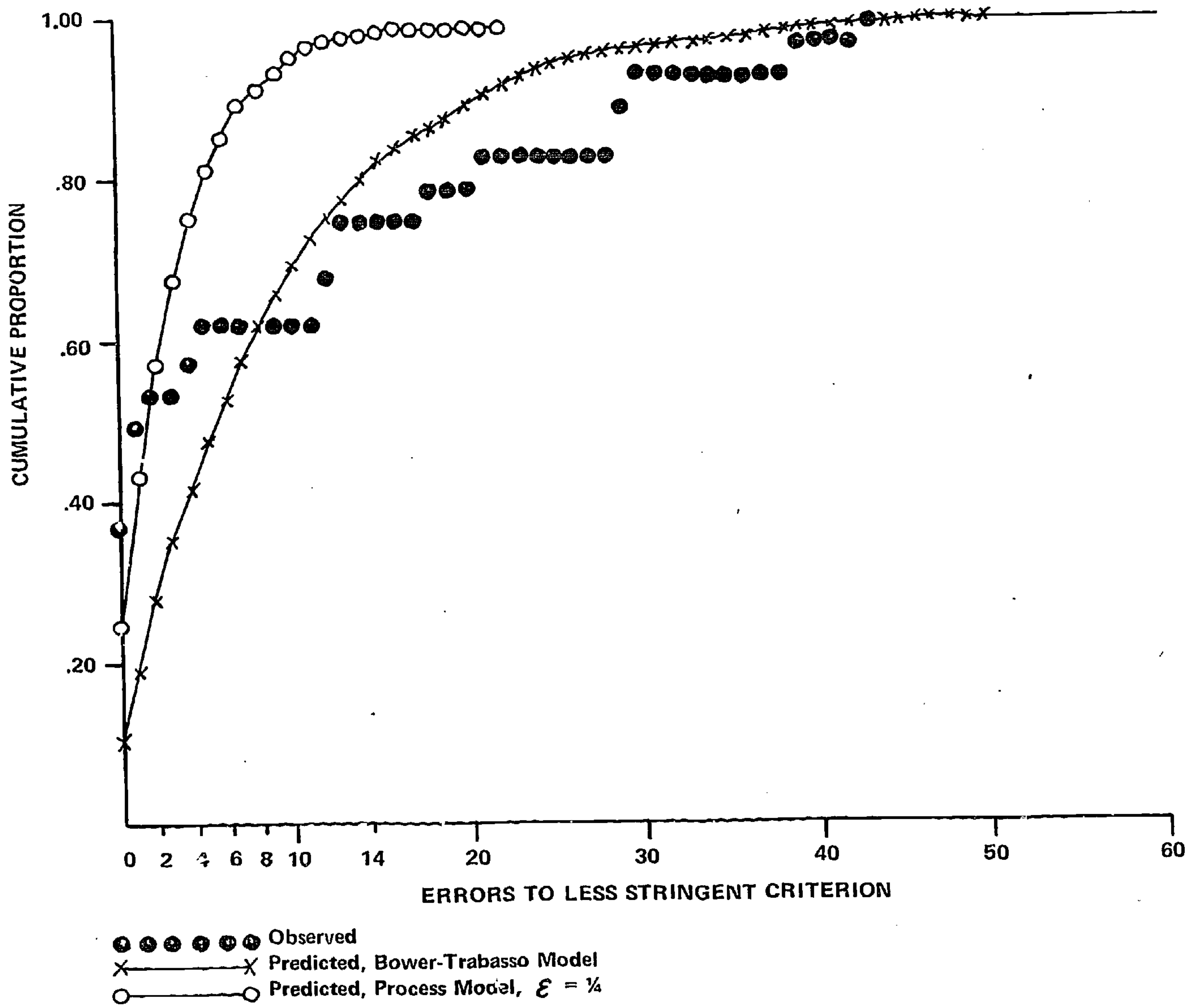

Figure 8: Cumulative Proportion Of Errors To Criterion For Young Ss, Detailed Instructions, Preshift Problem Under Less Stringent Criterion.

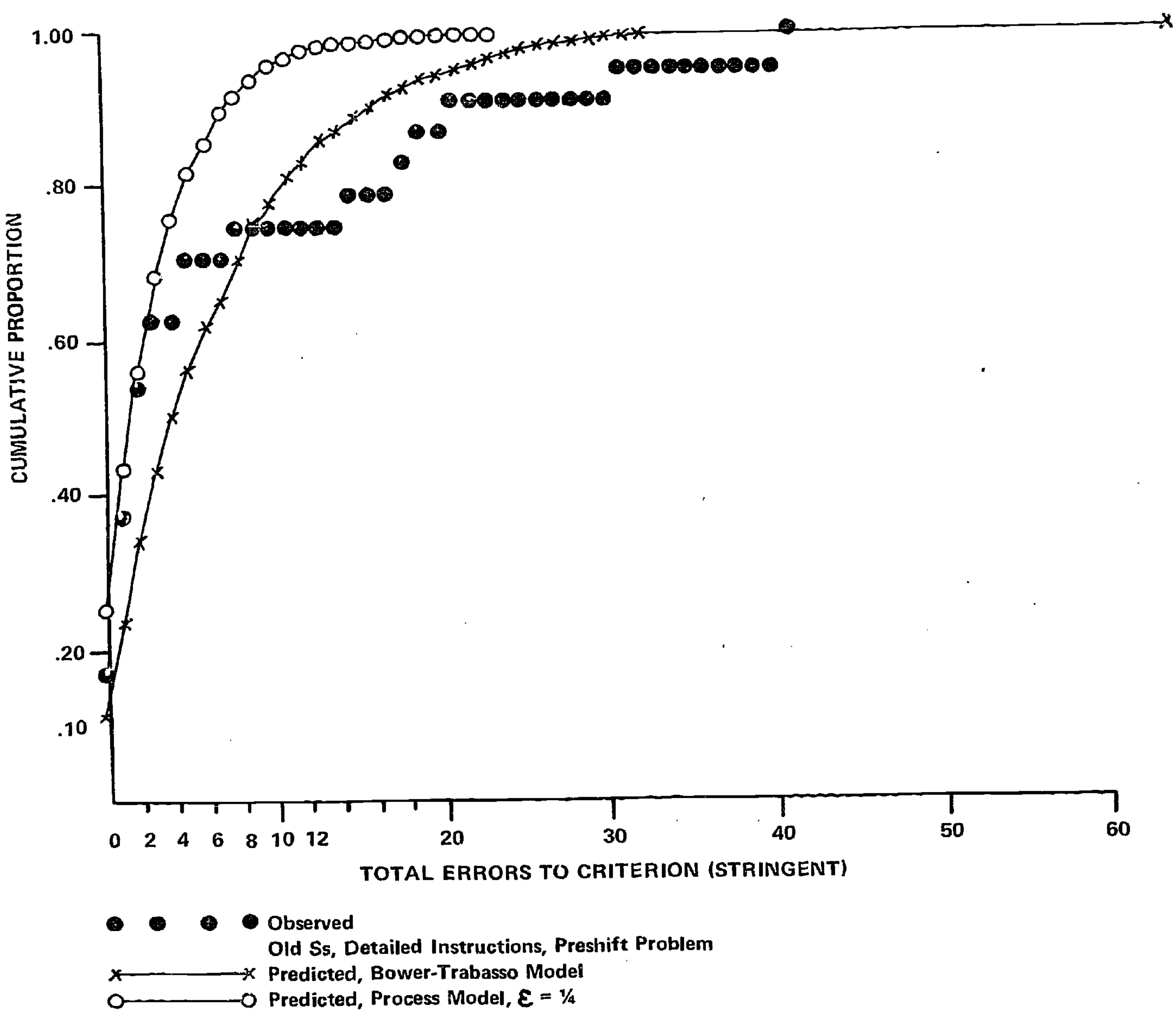

Figure 9: Cumulative Proportion Of Errors To Criterion For Old Ss, Detailed Instructions, Preshift Problem Under Less Stringent Criterion.

AGE

	YOUNG				OLD			
	R.D.* = FORM		R.D.* = TOP/BOTTOM		R.D.* = FORM		R.D.* = TOP/BOTTOM	
	STRINGENT	LESS STRINGENT	STRINGENT	LESS STRINGENT	STRINGENT	LESS STRINGENT	STRINGENT	LESS STRINGENT
SHIFT TYPE:								
REVERSAL	27.33	20.42	14.42	11.80	7.17	5.67	23.75	10.50
EXTRADIMENSIONAL	13.25	11.00	32.08	27.50	24.17	17.75	2.42	1.83

TABLE 1: Mean Trials To Criterion For The Various Groups On Preshift Problem.

STATISTIC	OBSERVED	PREDICTED
Mean Total Number Errors (T)		
VAR(T)	180.76	83.01
Trial Number Last Error (N)		
E(N)	18.58	17.88
VAR(N)	654.51	302.04
Number Successes Before Last Error (Z)		
E(Z)	8.58	8.26
VAR(Z)	161.56	76.51
Number Successes Between K, K + 1 Errors (H)		
E(H)	.93	.85
VAR(H)	1.62	1.59
K = 0	.52	.53
K = 1	.21	.24
K = 2	.15	.11
Number Errors Between K, K + 1 Successes		
K = 0		
E(JK)	1.08	.93
VAR(JK)	3.21	1.79
K = 1		
E(JK)	.41	.83
VAR(JK)	.77	1.68
K = 2		
E(JK)	.45	.74
VAR(JK)	.52	1.56
Mean Number Alternations	9.54	9.42
Mean Number Error Runs of Any Length	4.58	4.98
Mean Number Error Runs of Length K		
K = 1	2.79	2.58
K = 2	1.00	1.24
K = 3	.70	.60

TABLE 2: Data From Young Ss, Detailed Instructions Condition, Preshift Problem Compared To Predictions From Bower-Trabasso Model. Data Generated Under The Less Stringent Criterion.

STATISTIC	OBSERVED	PREDICTED
Mean Total Number Errors (T)		
VAR(T)	123.20	50.51
Trial Number Last Error (N)		
E(N)	15.17	14.84
VAR(N)	529.97	205.45
Number Successes Before Last Error (Z)		
E(Z)	7.37	7.21
VAR(Z)	147.46	59.30
Number Successes Between K, K + 1 Errors (H)		
E(H)	.99	.94
VAR(H)	2.12	1.84
K = 0	.53	.51
K = 1	.24	.24
K = 2	.07	.12
Number Errors Between K, K + 1 Successes		
K = 0		
E(JK)	1.04	.82
VAR(JK)	2.47	1.46
K = 1		
E(JK)	.63	.72
VAR(JK)	.94	1.36
K = 2		
E(JK)	.63	.72
VAR(JK)	.94	1.36
Mean Number Alternations	7.67	7.92
Mean Number Error Runs of Any Length	3.58	4.22
Mean Number Error Runs of Length K		
K = 1	2.00	2.33
K = 2	1.16	1.04
K = 3	.66	.46

TABLE 3: Data From Old Ss, Detailed Instructions Condition, Preshift Problem Compared To Predictions From Bower-Trabasso Model. The Data Generated Under The Stringent Criterion.

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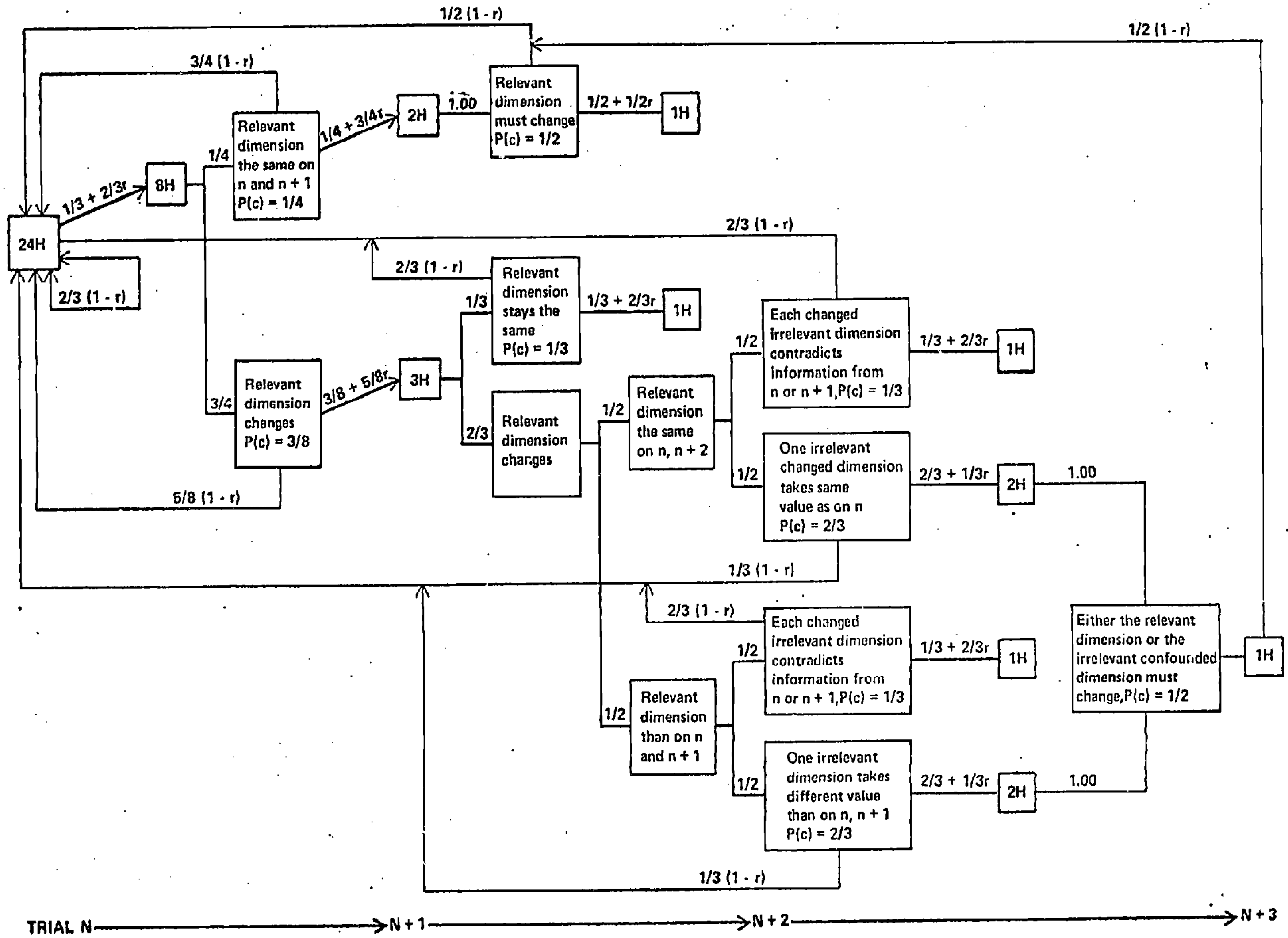
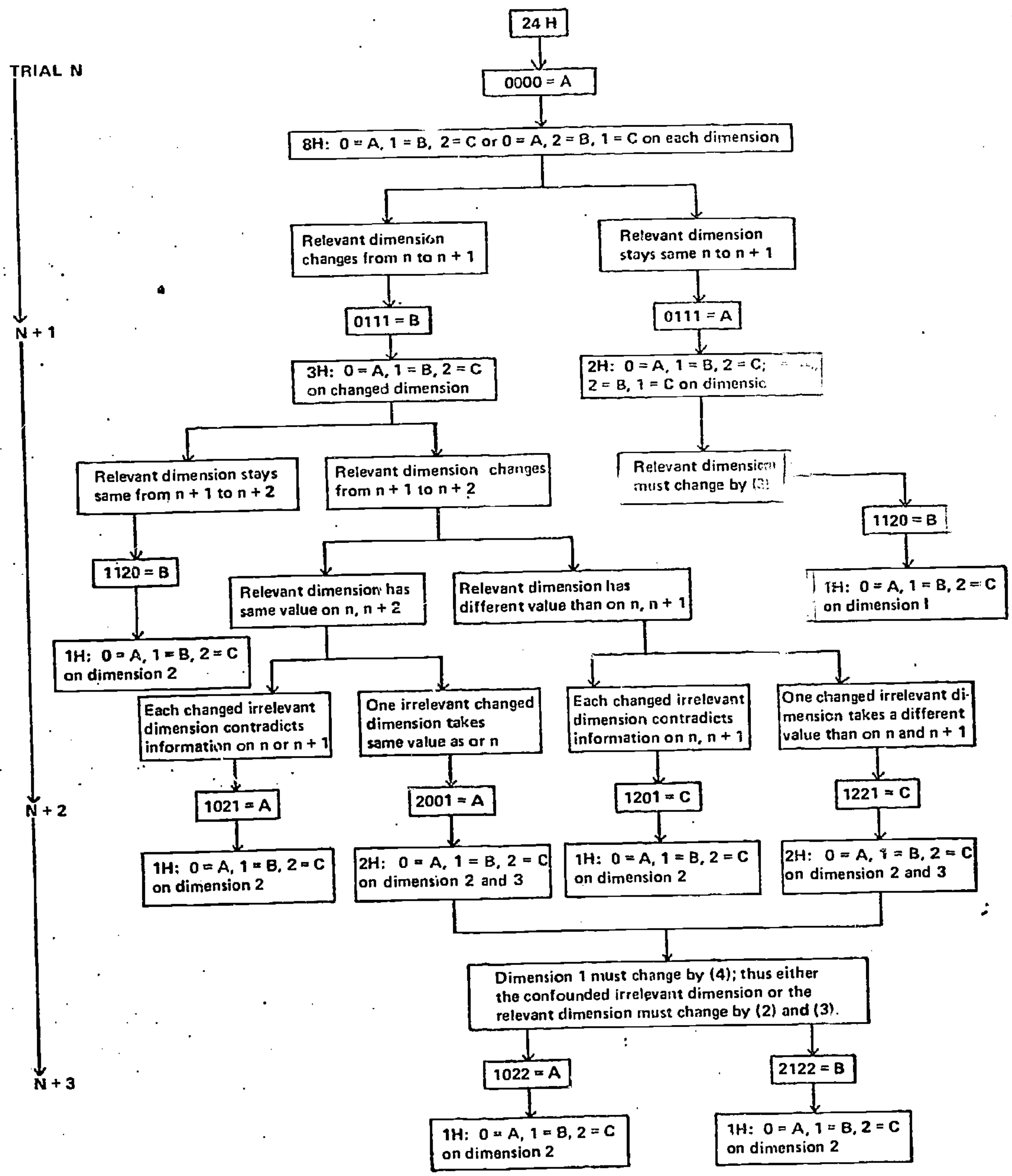

24H
1/3 + 2/3r
8H
1/4
Relevant dimension the same on n and n + 1 P(c) = 1/4
1/4 + 3/4r
2H
1.00
Relevant dimension must change P(c) = 1/2
1/2 + 1/2r
1H
1/2 (1 - r)
3/4 (1 - r)
3/4
Relevant dimension changes P(c) = 3/8
3/8 + 5/8r
3H
5/8 (1 - r)
2/3 (1 - r)
1/3
Relevant dimension stays the same P(c) = 1/3
1/3 + 2/3r
1H
2/3 (1 - r)
2/3
Relevant dimension changes
1/2
Relevant dimension the same on n, n + 2
1/2
Each changed irrelevant dimension contradicts information from n or n + 1, P(c) = 1/3
1/3 + 2/3r
1H
2/3 (1 - r)
1/2
One irrelevant changed dimension takes same value as on n P(c) = 2/3
2/3 + 1/3r
2H
1.00
1/3 (1 - r)
1/2
Relevant dimension than on n and n + 1
1/2
Each changed irrelevant dimension contradicts information from n or n + 1, P(c) = 1/3
1/3 + 2/3r
1H
2/3 (1 - r)
1/2
One irrelevant dimension takes different value than on n, n + 1 P(c) = 2/3
2/3 + 1/3r
2H
1.00
1/3 (1 - r)
Either the relevant dimension or the irrelevant confounded dimension must change, P(c) = 1/2
1H
1/2 (1 - r)
TRIAL N
N + 1
N + 2
N + 3


TRIAL N
N + 1
N + 2
N + 3
24 H
0000 = A
8H: 0 = A, 1 = B, 2 = C or 0 = A, 2 = B, 1 = C on each dimension
Relevant dimension changes from n to n + 1
Relevant dimension stays same n to n + 1
0111 = B
0111 = A
3H: 0 = A, 1 = B, 2 = C on changed dimension
2H: 0 = A, 1 = B, 2 = C;
2 = B, 1 = C on dimensic
Relevant dimension stays same from n + 1 to n + 2
Relevant dimension changes from n + 1 to n + 2
Relevant dimension must change by
1120 = B
1120 = B
1H: 0 = A, 1 = B, 2 = C on dimension 1
Relevant dimension has same value on n, n + 2
Relevant dimension has different value than on n, n + 1
1H: 0 = A, 1 = B, 2 = C on dimension 2
Each changed irrelevant dimension contradicts information on n or n + 1
One irrelevant changed dimension takes same value as or n
Each changed irrelevant dimension contradicts information on n, n + 1
One changed irrelevant dimension takes a different value than on n and n + 1
1021 = A
2001 = A
1201 = C
1221 = C
1H: 0 = A, 1 = B, 2 = C on dimension 2
2H: 0 = A, 1 = B, 2 = C on dimension 2 and 3
1H: 0 = A, 1 = B, 2 = C on dimension 2
2H: 0 = A, 1 = B, 2 = C on dimension 2 and 3
Dimension 1 must change by (4); thus either the confounded irrelevant dimension or the relevant dimension must change by (2) and (3).
1022 = A
2122 = B
1H: 0 = A, 1 = B, 2 = C on dimension 2
1H: 0 = A, 1 = B, 2 = C on dimension 2