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TURNBULL, SHARON KAY
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AND MEMORY SUPPORT IN CONCEPT ATTAINMENT.

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THE UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

LOCUS OF CONTROL, DEGREE OF SOCIAL CUEING, AND MEMORY SUPPORT IN CONCEPT ATTAINMENT

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

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Sharon Kay Turnbull

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LOCUS OF CONTROL, DEGREE OF SOCIAL CUEING,
AND MEMORY SUPPORT IN CONCEPT
ATTAINMENT

APPROVED BY

George W. Letchworth

Tillman J. Ragan

Michael Langenbach

William H. Graves

Kirby Gilliland

DISSERTATION COMMITTEE

A dwarf standing on the shoulders of a giant may see farther than the giant himself.

Didacus Stella, quoted by Robert Burton
Anatomy of Melancholy, 1621

I now pay tribute to the many giants who so willingly proffered their shoulders to this undertaking and its author. Some are singled out for their special contributions which were indispensable.

For their unfailing guidance to the places where "my eyes should learn, should read, should look," to paraphrase Shakespeare, the members of my doctoral committee, George Letchworth, Tillman Ragan, Michael Langenbach, Bill Graves, and Kirby Gilliland, have my appreciation. Special gratitude is due Tim Ragan whose enthusiasms and eclectic interests provided nourishment, and to George Letchworth who, as friend and chairman, provided assistance and encouragement sufficient to span an overabundant number of years and miles.

Thinking of St. Paul's words that "he that increaseth wisdom increaseth sorrow," I find myself unequal to the task of repaying my debt to my family. For the gifts of nature and nurture, I am especially grateful to my parents, Gerald and Kathleen Steelman, who are also counted among my friends.

My daughters and stepdaughter undertook, without complaint, many responsibilities of which they were not overly fond to enable me to work; Sarah deserves my gratitude for her humor and considerable patience, and Elizabeth for her encouragement and valuable library skills. Both proved to be mature beyond their limited years. And I am especially grateful to Andrea for her facility with the calculator during the early hours of the morning.

All these shared with me this labor. There is one other to whom my debt is enormous. It is to my husband, Jim, whose belief in me has enabled him to endure my preoccupation, mood swings, and neglect, that I dedicate this effort.

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One fundamental difference between behavioral and cognitive approaches to instruction has been the emphasis accorded to internal, mediational variables in the learning process. Yet concern with the cognitive mediation of overt behavior is evidenced in the social learning theory literature (Bandura, 1965; Rotter, Chance & Phares, 1972). Given that cognitive and other psychological processes are central factors in learning, a crucial question is raised: How is the effectiveness of instruction influenced by internal processes?

The investigation of cognitive and psychological variables in an instructional setting demands an attribute-treatment interaction approach to illuminate the complex interactions between individual differences and their associated internal processes, instructional conditions, and task demands. Three variables that seem especially relevant to this approach are locus of control, degree of social cueing in the instructional process, and the supplantation of memory processes.

Locus of Control

Locus of control is a mediational construct defined within the framework of Rotter's social learning theory as "a generalized expectancy regarding the degree to which a person's own behavior is seen to be the controlling factor in securing reinforcements" (Pines, 1973, p. 262). Individuals at the internal end of the locus of control continuum believe that the reinforcements they receive are primarily contingent upon their efforts, abilities, or characteristics. Externals tend to attribute the control of reinforcements to "luck, chance, fate, as under the control of powerful others" (Rotter, 1975, p. 276). Discussions of the internal versus external control dimension are often marked by a judgmental tone, with internality and its concomitant goal-directed behavior being highly valued. This view of locus of control as a personality trait is rejected by Rotter who argues against the use of the construct in terms of a typology, and favors an interpretation of locus of control as an individual difference which may be of considerable import in certain situational contexts (Rotter, Chance, & Phares, 1972).

Locus of Control and Cognitive Activity

Extensive research as reviewed by Rotter (1966) and others (Joe, 1971; Lefcourt, 1972) suggests a relationship between locus of control and cognitive activity, independent of the effects of intelligence and other general abilities. The locus of control construct suggests that internal individuals would be more alert and persistent in their encounters with information than externals. Numerous studies have verified their superiority in terms of information-seeking behavior (Seeman & Evans, 1962), attentiveness (Julian & Katz, 1968; Lefcourt, Lewis & Silverman, 1968), and covert organization of learning material (Wolk & DuCette, 1974; Pines, 1973).

Several investigators have concluded that internals make greater use of opportunities to seek and process information (Davis & Phares, 1967; Lefcourt & Wine, 1969; Phares, 1968) while externals are more influenced by the presence of social cues (Pines, 1973; Pines & Julian, 1972; Strickland, 1970). Pines (1973) suggests that externality is associated with a disposition toward information derived from social sources. On this basis, one would predict that instructional formats which provide social cueing would enhance the saliency of information for learners having external control orientations, while the performance of internals would be relatively unaffected or even impeded by the addition of social cueing.

Memory and covert organization of verbal material was studied by Pines (1973) in a test of the hypothesis that internals would exhibit greater retention and organization as a function of successive encounters with the learning material and of time available for recall. Finding support for this hypothesis, Pines posits that internals are better able to retrieve information from memory, or perhaps more willing to expend the necessary effort for retrieval.

Results from another area of investigation, that of self-evaluation and self-reinforcement, suggest a possible mechanism which might explain the rather consistent findings that externals are less proficient in the use of cognitive processes. Bellack (1972) investigated differential self-reinforcement behavior and found support for his hypothesis that externals, while utilizing the same evaluative criteria, demonstrated consistently lower self-evaluations, leading to fewer self-reinforcements. Bellack suggests that externals do not trust their own efforts and judgments and are dependent upon the input of others for the evaluation of their behavior. This notion is akin to Bruner, Goodnow, and Austin's (1956) identification of one type of "strategy error" in concept learning which they describe as a systematic response tendency leading the individual to indiscriminately treat cues as probabilistic. One aim of the present study is to assess the effect of locus of control on organization and memory processes, hypothesizing that the external, in the absence of social information, would require additional presentation of information before committing it to storage in memory.

The first general hypothesis was that individuals with an external locus of control are limited in their learning by a preference for social sources of information. This hypothesis is based on the assumption that different control orientations are associated with different dispositions toward information depending upon the nature of its source, with externals responsive primarily to information containing social cues and internals utilizing all relevant information regardless of its source. It is expected, however, that extensive social cueing could present a distractive condition for internals, resulting in decreased performance.

A second general hypothesis is that externals are deficient in their ability to remember and organize information. This suggests that the external, in the absence of social cues, would tend to discount the value of incoming information and, consequently, would require additional instances of that information before committing it to memory. The provision of external aids to memory, i.e., memory support, is expected to improve the performance of externals, while not affecting or even impeding the performance of internals.

This study was designed to address the question: Does a learner's locus of control interact with the degree of social cueing in instruction and with the supplantation of memory processes to produce differential performance on a task requiring the efficient use of memory and inferential processes?

Method

Subjects

All subjects were volunteers from elective nursing courses at a large southwestern university. The Rotter Internal-External Control Scale was administered to 52 students at the first class meeting, following an explanation by the experimenter that she was seeking subjects for a study of how instructional strategies might be optimized for the individual learner. The I-E Scale was again administered upon the subject's arrival for the experimental session as a control for statistical regression. Forty-eight subjects were selected; this sample was comprised of 42 females and 6 males, ranging in age from 18 to 43. On the basis of a median split using the scores resulting from the second administration, 24 subjects were assigned to an internal subgroup (M=4.29, SD=1.91) and 24 to an external subgroup (M=11.79, SD-2.42). Scores ranged from 1 to 17 with a median of 8.0, a mean of 8.04, and a standard deviation of 3.89. Assignment to treatment conditions within each locus of control group was randomized.

Task

The experimental task used was a conjunctive concept attainment task requiring the use of memory to retain inmation about both criterial and noncriterial attributes and the ability to make inferences and hypotheses correctly from the comparison of examples and nonexamples of the concept. The experimental task was administered via a microcomputer which presented the stimulus items and elicited subject responses, using a game-like format.

The task itself was an adaptation of a task described by Wickelgren and Cohen (1962) in their study of the use of artificial memory. The task is to identify the correct criterial attributes, and thereby the concept rule, following the presentation of examples and nonexamples of the concept, in as few trials as possible. The decision to adapt the task devised by Wickelgren and Cohen, which used eight-digit numbers as stimulus items, followed a pilot study in which it was noted that many subjects expressed "number anxiety" and many attempted arithmetical, rather than symbolic, operations with the stimulus items. The choice of the microcomputer as a delivery system offered advantages in terms of making the task more enjoyable and in facilitating data collection.

In the present study, stimulus items consisted of two rows of colored dots, each containing eight dots with four places comprising the criterial attributes of the concept. Each of the eight places is a stimulus dimension with ten possible color values, but defined so that only one value in those places designated as criterial attributes could be part of the concept. The concept used was blue in Place 2, pink in Place 4, green in Place 5, and blue in Place 8. The presentation schedule of examples was designed to allow optimal inference from a comparison of the bottom row of dots with the top row, an example of the concept which remained unchanged throughout all trials. The lower row was clearly designated as being either an example (positive instance) or a nonexample (negative instance) of the concept. The subject's task was to discover how many places, which places, and what colors in these places defined the concept. The subject was instructed to indicate hypotheses and inferences during each trial. The schedule of presentation was determined in advance and was the same for all subjects. Since the concept is attainable in nine trials, the remaining eleven trials were comprised of repeat presentations of the instances given in the first trials. Since all presentations involved rows differing in only one place, the subject's optimal response was to infer that the changed place between an example and a nonexample must be a criterial attribute and that the changed place between two examples of the concept cannot be a criterial attribute. Forming hypotheses, or provisional judgments, in these situations constitutes an inefficient concept attainment strategy. The number of presentations necessary before a subject will convert former hypotheses to inferences constitutes a reflection of trust in one's own judgment of the information provided.

Procedure

The procedure was designed as a 2 x 2 x 2 factorial design (Locus of Control x Social Cueing x Memory Support) conducted in two stages. The first stage consisted of the provision of different instructional models designed to teach the subject an efficient concept attainment strategy and to instruct the subject in the conduct of the experimental task. Models differed in the extent to which they provided social cueing, with a seven page paper containing minimal social cues used as an informational model and a twelve minute videotape of a "live" subject learning the process serving as the social model. Instructional materials were equated in regard to the level of terminology, average length of viewing/reading time, and amount of preprocessing (preorganization) of information, but varied in terms of social content such as friendly remarks and praise.

Following exposure to the instructional model, the subject was seated at a table in a small room, facing a television screen. The table contained a microcomputer which resembles an electric typewriter. The subject was shown how to use the computer's keyboard and rotary hand control for entering responses and told to summon the experimenter upon completion. After advancing the computer to the first presentation of stimulus items (Trial 1), the experimenter retired to an adjoining room. Stimulus items were presented by the computer and displayed on the television screen, automatically advancing to the next trial following the subject's response. Timing was therefore controlled by the subject.

The subject was required to respond in the following sequence for each trial:

1. Following comparison of the two rows of dots presented on the screen, to register the place selected as either a criterial or noncriterial attribute by rotating the dial on the hand control and depressing a button; or, alternately, to press P on the keyboard to pass to a new trial.

2. To type responses (Y or N) to these questions which appeared on the screen in the following order--"Is It Part Of The Rule? Y or N"; i.e., is the dot selected a criterial attribute? "Are You Sure? Y or N"; and, "Are You Ready To Guess The Rule? Y or N"; i.e. the total rule, all the criterial attributes.

3. When ready to guess the rule, to enter each part of the rule separately by using the hand control as before. If the rule was correctly guessed, the subject received a display reading "YOU GOT IT!!!!!!!!!!" If incorrect, the subject was presented with the next trial and the "game" continued. Up to twenty separate trials were presented using this procedure.

Half of the subjects in each group were provided with a visual display of their reasoning on previous trials during the task. This record, or memory support, was initially presented on the television screen as two sets of white dots.

After the subject indicated whether or not a given dot in the stimulus item was a criterial attribute, the corresponding white dot would either change to the appropriate color, if the subject had indicated that it was a criterial attribute, or would disappear from the screen, if selected as a noncriterial attribute. This change would appear in the row designated by the subject's expressed degree of certainty, i.e., "SURE" or "NOT SURE." Subjects in the condition without memory support received presentation of the stimulus items only.

Results

On the basis of previous studies reporting the frequency of incorrect usage of information from negative instances in concept attainment tasks (Bruner, et al., 1956; Wickelgren & Cohen, 1962), behaviors relating to the use of information derived from negative instances were chosen as being especially susceptible to change as a result of instruction. Five dependent variables reflecting the ability to remember, compare, and correctly utilize information about criterial attributes were utilized. These included: (a) number of trials to solution (overall performance), (b) number of inferences for negative instance trials, (c) number of hypotheses for negative instance trials, (d) number of trials with nonutilization of information, and (e) trial of first inference regarding negative instance. Since the problem is solvable in nine trials, data on the number of inferences and hypotheses would be confounded by the successive elimination of early solvers, so these measures were applied to the first trials only.

The data, summarized in Table 1, were analyzed using a 2 x 2 x 2 (locus of control x social cueing x memory support) multivariate analysis of variance on the five dependent variables: trials to solution, inferences, hypotheses, nonutilizations and first trial inference. The analysis yielded significant effects for the locus of control variable, $\underline{F}$ (5, 36) = 3.42, $\underline{p} < .02$. Although the remaining main and interaction effects did not attain significance, the first order interaction between locus of control and the extent of social cueing approached significance, $\underline{F}$ (5, 36) = 2.47, $\underline{p} < .0507$.

Univariate analyses revealed main effects for locus of control for inferences, $\underline{F}$ (1, 40) = 4.62, $p < .05$, and for hypotheses, $\underline{F}$ (1, 40) = 10.74, $\underline{p} < .01$, with internals exhibiting superior performance. An interaction between locus of control and the degree of social cueing was evidenced in the number of trials to solution, $\underline{F}$ (1, 40) = 8.48, $\underline{p} < .01$. Visual inspection of graphs (see Figures 15-24, Appendix R) based on cell means revealed the predicted superiority, on all five measures, for internals under the informational model condition with the performance of externals approaching that of internals under the social model condition. Although no main effects or first order interactions attained significance, results were in the desired direction with the performance of internals being relatively unaffected by the pro-

Table 1

Means and Standard Deviations for Each

Treatment Condition

Treatment	Internals		Externals	
	M	SD	M	SD
Variable: Trials to Solution				
Social, No Support	16.50	5.82	11.67	4.37
Social, Support	13.67	3.83	12.50	2.95
Informational, No Support	10.50	3.56	17.00	4.00
Informational, Support	12.33	4.76	14.33	4.59
Variable: Number of Inferences				
Social, No Support	3.83	1.47	4.50	1.22
Social, Support	4.00	1.26	2.33	1.86
Informational, No Support	4.67	0.52	2.83	2.48
Informational, Support	4.17	1.33	3.17	1.47
Variable: Number of Hypotheses				
Social, No Support	1.17	1.47	0.50	1.22
Social, Support	0.67	0.82	2.67	1.86
Informational, No Support	0.33	0.52	2.83	2.32
Informational, Support	0.33	0.52	2.00	1.79
Variable: First Trial Inference				
Social, No Support	2.00	2.45	2.17	3.37
Social, Support	1.67	1.03	2.17	1.17
Informational, No Support	1.33	0.82	3.67	3.93
Informational, Support	1.00	0.00	2.83	2.64
Variable: Non-Utilizations				
Social, No Support	0.67	0.82	0.00	0.00
Social, Support	0.33	0.52	0.17	0.41
Informational, No Support	0.33	0.52	1.00	2.00
Informational, Support	2.17	2.99	0.17	0.41

vision of memory support while the performance of externals improved. Significant three-way interactions were identified for the number of hypotheses, F (1, 40) = 4.35, $p < .05$, and for the number of nonutilizations, F (1, 40) = 4.16, $p < .05$. Inspection of graphs (see Figures 25-29) based on two-way interactions for each level of the third variable revealed disordinal profiles for internals and externals under the no memory support condition, but not under the memory support condition. As predicted, the performance of externals was improved by the provision of social cueing during instruction and memory support during task performance, and the performance of internals decreased under these conditions.

To assess the specific contributions of each of the independent variables, a series of individual comparisons was undertaken. Adjustment of error rate was accomplished by the use of Dunn's technique to control the probability of a Type II error at the .05 level per hypothesis, resulting in an alpha of .025 per comparison.

In order to investigate the hypothesis that the provision of social cueing in the instructional model would benefit the external's performance while interfering with the internal's performance, data were collapsed over the third dimension to provide a 2 (locus of control) x 2 (social cueing) design. The prediction that the performance of internals would exceed that of externals following an instructional presentation low in social cueing (informational model) received support in terms of the number of trials to solution, F (1, 40) = 5.80, $p < .025$, and the number of hypotheses, F (1, 40) = 12.30, $p < .01$. Support was not obtained, however, for the prediction that the performance of externals would exceed that of internals under the instructional condition high in social cueing. While differences between the two groups under the social model condition failed to achieve significance, inspection of the cell means reveals that with the provision of social cueing, the performance of externals approaches that of internals.

While the performance of internals generally exceeded that of externals without memory support, these differences were not found to be significant. The provision of memory support, however, did result in scores favoring externals in terms of the number of hypotheses, F (1, 40) = 9.53, $p < .01$.

Discussion

The purpose of this study was to explore the possible relationship between locus of control and its associated cognitive processes, and the effectiveness of selected instructional attributes, namely, the extent of social cueing and the provision of memory support to supplant the learner's memory processes.

The assumption that individuals who perceive their own behavior as the determining factor in securing reinforcements would be attentive to information which could prove to be of future value has been repeatedly substantiated by others. Of special interest was the assumption that for externals, who attribute their reinforcements to luck, fate, or other persons, the provision of social cueing in instruction would enhance learning through the stimulation of attentional or motivational processes. To the extent that social cueing functions as "noise" in the instruction message, it was predicted that the inclusion of social cueing would interfere with the performance of internals.

Results from this study support the notion that inclusion of social cueing in the instructional strategy enhances the learning of externals, while proving less efficacious than information alone for the internal. The obtained pattern of results suggest that, with minimal social cueing in the instructional format, the external learner is at a disadvantage. These data suggest that social stimuli may function as important cues to the external, stimulating attentional processes or providing an incentive condition for learning. For the internal, however, extensive social cueing may provide an undesirable distraction from the information contained in the instruction. These findings are consistent with Rotter's locus of control construct and with social learning theory (Rotter, 1966; Bandura, 1965) which accords considerable emphasis to the role of cognitive and other psychological processes in vicarious learning. In the sense that much school learning involves acquisition of information and skills from models (whether they be presented in live, mediated, or abstract verbal formats), an understanding of the social and psychological processes which govern learning is crucial to the improvement of instruction.

The second hypothesis predicted that the supplantation of memory processes through the use of an external aid to memory would compensate for the external's deficient memory processes. While the existence of such a deficiency has not been studied directly, the results of several studies (Pines, 1973; Pines & Julian, 1972; Wolk & DuCette, 1974) provide suggestive evidence that the external tends, in the absence of social validation, to avoid making strong judgments on the basis of available information and to have less adequate memory than externals on both intentional and incidental memory tasks. Current theory and research failed to provide substantial guidance concerning the likely effect of memory support on the performance of internals, but it was hypothesized that the provision of such support could serve as distractive stimuli, interfering with task performance. Limited support was found for this notion, with results generally suggesting that the provision of memory support neither impeded or enhanced the performance of internals. While the performance of externals was consistently better under memory support conditions, significant effects were identified only for the number of hypotheses.

Since significant results would have provided indirect evidence of the existence of a deficiency in memory processes for externals, the failure to find significant differences leaves this question unresolved. Should such a deficiency exist, as suggested by the direction of results, one plausible explanation may be found in an analysis of the cognitive demands involved in the experimental manipulation. It is not unlikely that an in-depth task analysis might reveal that, while simplifying the cognitive demands of the original task, the use of such a complex support system may have inadvertently introduced new demands of sufficient strength to offset the effects of the supplantation provided. Analysis of significant three-way interactions identified for the number of hypotheses and for the number of nonutilizations revealed the predicted pattern under the memory support condition, but not under the condition in which memory support was not available.

Although the present findings provide some support for the predicted relationship between locus of control, the degree of social cueing, and the supplantation of memory processes in a group of adult learners, the conditions of the experiment were not sufficient to allow generalization to other populations or other learning tasks. In particular, it was noted that the significant differences between internal and external groups on the first trial of inference and nonutilization variables may have been attenuated by the use of a game-like format which could conceivably encourage subjects to enter responses, even "wild guesses," rather than pass to the next round (nonutilization). Inspection of individual results indicated that nine subjects made inferences on early trials and then began reverting to hypotheses, presumably realizing that the "game" was not as easy as it originally appeared.

It is recommended that in a subsequent study of these variables the comparison groups be more highly differentiated in terms of locus of control, perhaps by the use of the upper and lower thirds of the distribution rather than a median split. That the effectiveness of instructional conditions differed for the individuals studied as a function of their locus of control implies the relevance of this construct as a learner characteristic having utility for the identification of psychological processes involved in learning as well as for the design and management of instruction.

Summary

This study investigated the hypothesis that the degree of social cueing and the supplantation of memory processes would differentially affect the performance of learners varying in locus of control on a computerized conjunctive concept attainment task. Specifically, it was hypothesized that instruction involving a high degree of social cueing would facilitate the performance of externals and function as a distractive condition for the internal learner, resulting in decreased performance. It was also hypothesized that the external, because of his tendency to avoid strong judgments, would not expend the necessary effort to commit information to long term memory, and that supplanting memory processes by providing an external aid to memory would compensate for this deficiency. The provision of memory support was expected to interfere with the performance of internals.

Forty-eight university nursing students were assigned on the basis of their scores on the Rotter Internal-External Control Scale to two treatment blocks, corresponding to internal and external control orientations, and randomly assigned in equal number to levels of the independent variables. The subjects received instruction in an efficient strategy for solving a concept attainment task, presented via a paper containing minimal social cueing or a videotape presentation of a "live" model which contained numerous social cues.

The subject received a conjunctive concept attainment task, designed as a video-game, either with or without the provision of memory support. Subjects in the no memory support condition received a display of the stimulus items only, while subjects in the memory support condition received an additional display which served as a cumulative record of their hypotheses and inferences on previous trials.

Five dependent variables were investigated: number of trials to solution, number of inferences and hypotheses regarding negative instances, first trial of inference regarding a negative instance, and number of nonutilizations. Statistical treatment of the data included a 2 (locus of control) x 2 (social cueing) x 2 (memory support) multivariate analysis of variance, followed by univariate factorial analyses and individual comparisons of cell means of special interest.

Predictions concerning the interaction between the learner's locus of control and the degree of social cueing were supported in terms of a borderline result in the multivariate analysis. Univariate analyses indicated that locus of control yielded significant effects on the number of inferences and hypotheses, with externals' performance increased and internals' decreased under the social cueing condition. Little support was found for the hypothesized relationship between locus of control and the provision of memory support. As expected, a significant effect for locus of control was demonstrated in favor on internals.

Results were interpreted as consistent with social learning theory, and as indicating that the locus of control variable serves as a learner characteristic of import to educators.

References

Bandura, A. Vicarious processes: a case of no-trial learning. In L. Berkowitz (Ed.), Advances in experimental social psychology (Vol. 2). New York: Academic Press, 1965.

Bellack, A. S. Internal vs. external locus of control and the use of self-reinforcement. Psychological Reports, 1972, 31, 723-733.

Bruner, J. S., Goodnow, J. J. & Austin, G. A. A study of thinking. New York: Wiley, 1956.

Davis, W. L. & Phares, E. J. Internal-external control as a determinant of information-seeking in a social influence situation. Journal of Personality, 1967, 35, 547-561.

Joe, V. C. Review of the internal-external control construct as a personality variable. Psychological Reports, 1974, 28, 619-640.

Julian, J. W., & Katz, S. B. Internal versus external control and the value of reinforcement. Journal of Personality and Social Psychology, 1968, 8, 89-94.

Lefcourt, H. M. Recent developments in the study of locus of control. In B. A. Maher (Ed.), Progress in experimental personality research (Vol. 6), 1972, 1-39.

Lefcourt, H. M., Lewis, L., & Silverman, I. W. Internal versus external control of reinforcement and attention in decision-making tasks. Journal of Personality, 1968, 36, 663-682.

Lefcourt, H. M., & Wine, J. Internal versus external control of reinforcement and the deployment of attention in experimental situations. Canadian Journal of Behavioral Science, 1969, 1, 167-181.

Phares, E. J. Differential utilization of information as a function of internal-external control. Journal of Personality, 1968, 36, 649-662.

Pines, H. An attributional analysis of locus of control orientation and source of informational dependence. Journal of Personality and Social Psychology, 1973, 26, 262-272.

Pines, H. A., & Julian, J. W. Effects of task and social demands on locus of control differences in information processing. Journal of Personality, 1972, 40, 407-416.

Rotter, J. B. Generalized expectancies for internal versus external control of reinforcement. Psychological Monographs, General and Applied, 1966, 80(1, Whole No. 609).

Rotter, J. B., Chance, J. E., & Phares, E. J. Applications of a social learning theory of personality. New York: Holt, Rinehart, & Winston, 1972.

Seeman, M., & Evans, J. W. Alienation and learning in a hospital setting. American Sociological Review, 1962, 27, 772-783.

Strickland, B. R. Individual differences in verbal conditioning, extinction and awareness. Journal of Personality, 1970, 38, 364-378.

Wickelgren, W. A., & Cohen, D. H. An artificial language and memory approach to concept attainment. *Psychological Reports*, 1962, *10*, 815-827.

Wolk, S., & DuCette, J. Intentional performance and incidental learning as a function of personality and task dimensions. *Journal of Personality and Social Psychology*, 1974, *29*, 90-101.

APPENDIX A

Prospectus

LOCUS OF CONTROL, DEGREE OF SOCIAL CUEING, AND MEMORY SUPPORT IN CONCEPT ATTAINMENT

An area of personality theory relevant to school learning is the locus of control construct. Locus of control is a mediational construct defined within the framework of Rotter's social learning theory as "a generalized expectancy regarding the degree to which a person's own behavior is seen to be the controlling factor in security reinforcements" (Pines, 1975, p. 262). It has been shown to be predictive of learner behavior in a number of varied situations and has been studied extensively in regard to cognitive activity, social influence, achievement behavior, reactions to social stimuli, deferment of gratification, response to success and failure, and self-control behavior (Joe, 1971; Lefcourt, 1972; Prociuk & Lussier, 1975).

The study of attribute-treatment interactions, i.e., the manner in which characteristics of the learner influence the learning process, is of considerable interest to behavioral scientists and educators. This investigation focuses upon the interaction between locus of control as a learner attribute, the degree of social cueing involved in the presentation of an instructional model, and the provision of external aids which supplant the learner's memory and organizational processes.

While studies of the relationship between locus of control and general learning-related behaviors have been numerous, there have been few attempts to examine the interaction between locus of control and specific instructional variables and their associated psychological processes, using an attribute-treatment approach. Results of this investigation could provide information which could be useful for the guidance of educational practice. The proposed study will attempt to identify those cognitive processes required in concept attainment tasks which are either interfered with or facilitated by the learner's locus of control. Current explanations of the effect of locus of control on these processes are inadequate for predictive purposes because they generally fail to specify the range of task and cognitive variables to which they apply.

Review of the Literature

The following review will summarize the relevant literature in these areas: attribute-treatment interactions, social learning theory, the locus of control construct and its relationship to learning-related behaviors, instructional models, and concept attainment.

Attribute-Treatment Interactions

The study of attribute-treatment interactions received its greatest impetus from the concern with individualized instruction which was prevalent during the 1960's. The central questions in this type of applied research were: Are different instructional conditions optimal for different learners? If so, how can we best match learners and instruction? The investigation of attribute-treatment interactions reflected the researcher's attempt to identify individual differences which could then be used to individualize instruction, with the ultimate goal of increased effectiveness and efficiency in instruction.

The term attribute-treatment interaction has been used to describe the expectation that different learners will perform optimally under different instructional conditions. The term aptitude-treatment interaction was previously used, but has been generally discarded in favor of the broader conception of learner characteristics implied by the term attribute. Attribute refers to any characteristic of the learner (whether trait, state, aptitude, or interest). Treatment refers to the organization of instructional materials or procedures. The notion of interaction implies an expectation of contrasting responses to the treatments by different learners depending upon their attributes.

Early efforts to identify learner attributes which could profitably be used to individualize instruction were generally discouraging. Cronbach and Snow (1969) provided one of the most extensive reviews of the field of attribute-treatment interaction research and concluded that

> Progress toward the goal of identifying and understanding ATI has been slight. . . . One reaction to this regrettable state of affairs would be to abandon ATI research on the grounds that such effects are nonexistent. We urge against this defeatist course. It is inconceivable to us that humans, differing in as many ways as they do, do not differ with respect to the educational treatment that fits each one best. (p. 139)

Cronbach and Snow note that one of the greatest problems in attribute-treatment interaction research is the failure to conceptualize the most important dimensions of the characteristics of learners and instruction. While a conceptual framework is viewed as a prerequisite for fruitful interactional research, Cronbach and Snow also argue that attribute-treatment research, by contributing to the development of a matrix of learning situations and learner characteristics, should assist in the development of a theory of instruction.

Others encourage the use of a third variable, the learning task, in interaction research (Hunt, 1975; Salomon, 1971). Cognitive-functional approaches such as these call for an analysis of the sequential psychological processes demanded by the learning task and of the cognitive processes required for adequate learning and subsequent performance of the task.

Salomon (1977) notes that there are at least two ways in which instructional strategies can affect relevant mental skills; they can either "call upon the skills" or "overtly supplant them" (p. 613). Instruction may then be viewed as preferential (where instructional attributes or task requirements are matched to the learner's preferred learning style) or compensatory (providing learners with the necessary mediators or organizers; i.e., the processes in which they are deficient).

Rhetts (1972) suggests that

> One of the reasons the previous work with specific abilities has not seemed to pay off may well be that the abilities under consideration in a given experiment had no known or strong inferential relation to the specific task the subject was asked to cope with. The task-analytic approach should increase the probability that treatment and attribute variables will show significant and replicable interactions. (p. 276)

The trend toward increasing attention to the analysis of task characteristics, specification of learner attributes in terms of required cognitive processes, and the development of treatments contrasted in terms of instructional attributes is evidenced in the recent research literature (Hunt, 1975; Meichenbaum, 1977; Pines & Julian, 1972; Salomon & Cohen, 1977).

The construction of a conceptual model, and its implied research paradigm, is an indispensable part of any attribute-treatment interaction study. Such a paradigm should include:

1. Measurement of the attribute. The initial level of the attribute variable must be assessed, by whatever valid and reliable means which are available, and individuals may then be assigned to groups on the basis of differences.

2. Selection of the dependent variables. Measures of overall task performance and mediating process variables should be selected on the basis of the theoretical expectation that they are likely to be affected by the learner attribute.

3. Selection of the experimental task. The task must permit measurement of the dependent variables and should yield itself to analysis with respect to its cognitive and psychological demands.

4. Development of contrasting treatments. Instructional materials and procedures must be designed which modify the cognitive processes which are believed to be affected by the attribute.

Salomon (1971) suggests that treatments may be contrasted on the basis of the way in which they modify cognitive processes. Salomon described three common approaches: remedial, compensatory, and preferential. The remedial approach involves the design of treatments which lead to the mastery of prerequisite objectives in which the learner is deficient, typically through the provision of more time or exposure to instruction. In the compensatory approach, treatments overtly provide (supplant) the needed cognitive processes for the learner, or act to neutralize the debilitating effects of certain psychological traits or states.

Treatments in the preferential approach, however, assume that the learner will perform best when working on learning activities whose characteristics are congruent or compatible with the learner's attributes. Preferential treatments are designed to capitalize on the learner's proficiency.

5. Determining the effectiveness of treatment. The extent to which the effects of the learner attribute vary as a function of the instructional treatment is the focus of an attribute-treatment interaction study. If the treatments provided are sufficiently strong, disordinal interactions should emerge based on the prediction that the low proficiency learner will benefit from treatment, while the more proficient learner will experience interference. If the expected results emerge, the instructional treatments, following further development and research, can be generalized and adapted to the requirements for classroom use.

Social Learning Theory

The locus of control construct has been related to a variety of theoretical frameworks including Adlerian theory of personality with its emphasis on mastery needs (Lefcourt, 1966), attribution theory (Pines, 1973), achievement motivation and Reisman's conceptualization of the inner-directed/outer-directed personality types (Rotter, 1966). However, the locus of control construct originated from Rotter's social learning theory. Consequently, it is most advantageous to examine the concept within this framework.

Social learning theory was developed within the behaviorist tradition in response to what was perceived as its failure to account for conditions that obtain in naturalistic conditions through the rigid "adherence to a relatively narrow range of learning principles and procedures" explicable by an operant conditioning model (Bandura, 1965, p. 2). Common to all behavioristic approaches is the notion that past experiences determine future behavior--the law of effect. In the operant paradigm, as typified by Skinner's behaviorism, learning is described as the acquisition of new response patterns as the result of differential reinforcement of an individual's emitted responses under specific stimulus conditions (Skinner, 1957).

Recognizing some of the limitations of this theory in explaining the complexities of human learning outside the laboratory setting, Miller and Dollard (1941) proposed a theory of social learning and imitation. According to this theory, individuals learn to match the behavior of models and to generalize these imitative responses to new models, different stimulus situations, and in response to different motivational states as a result of having been reinforced previously for matching behavior. Although this early attempt to bring social learning into the domain of behavioral psychology was in many respects simply an extension of the basic operant paradigm, it stimulated the search for broader formulations which would explain complex social learning phenomena such as attitudinal learning, vicarious learning, and symbolic learning.

The basic assumptions of social learning theory as outlined by Phares (1976) can be described as follows:

1. The concern of social learning theory is the interaction of individuals with their meaningful environments. Behavior must be analyzed in terms of situational and personological characteristics as well as stimulus conditions, responses and reinforcements. The subjective evaluation of stimulus properties is an important determiner of behavior.

2. Personological variables such as general traits are viewed as contributors to behavior. Emphasis is placed on learned attitudes, expectations, and values.

3. Social learning theory emphasizes the importance of situational variables. Behavior must be studied within its situational context.

4. Behavior is motivated, directed toward or away from some goal.

5. Finally, the "occurrence of a behavior . . . is determined not only by the nature or importance of goals or reinforcements but also by the person's anticipation or expectancy that these goals will occur" (Rotter, Chance & Phares, 1972, p. 11).

Specifically, social learning theory states that the probability of occurrence for any social behavior within an individual's response repertoire is a function of the expectancy of a given reinforcement following the specific response and the value of that reinforcement in the situation (Rotter, Chance, & Phares, 1972). Reinforcement is defined as anything having an effect on the occurrence, direction or kind of behavior. Value is defined as "the degree of preference for any reinforcement to occur if the possibilities of occurring were all equal" (Rotter, 1954, p. 107). Reinforcement value is related to learned needs; i.e., those acquired as secondary needs through early association with primary biological needs.

Expectancy, or the "probability held by the individual that a particular reinforcement will occur as a function of a specific behavior on his part in a specific situation" implies subjective assessment (Rotter, 1954, p. 107). Rotter compares generalized expectancy to Harlow's (1949) concept of higher-order learning skills--a set that certain types of problems can be solved by a certain approach, a propensity to adopt a similar approach across a wide range of situations, irrespective of the nature of the specific situation or reinforcements involved. Rotter delineates between situations which arouse specific expectancies because the individual has had prior experience in highly similar situations and novel situations which elicit generalized expectancies.

In summary, social learning theory attempts to explain the person's selection of specific responses from a larger repertoire in predicting behavior in a social setting. Although social learning theory evolved from associationistic and instrumental conditioning theories, it encompasses a wide range of behavior determinants including personality, motivation, and situational context. It was within this framework that Julian B. Rotter developed the concept of locus of control.

Locus of Control

Although the conceptualization of the locus of control construct is generally ascribed to the publication of Rotter's monograph on locus of control in 1966, precursors of the notion are found in the writings of Harlow in the 1940's, Piaget in the 1930's, Veblen in the 1890's, and even Shakespeare in the seventeenth century. Undoubtedly, thoughtful men have pondered the problems of fate, destiny, powerlessness, and control throughout the ages. The specific stimulus for the development of the locus of control construct, however, was a patient whom Rotter calls Karl S.

The psychotherapy of Karl S. was directed toward the goal of developing social skills in which he was deemed deficient. In spite of the fact that his therapy had succeeded in his developing these skills, which in turn led to the desired and expected reinforcements, Karl S. remained unhappy. He related that he could not feel better because he could not expect such success in the future because he believed his previous successes were due to his therapist and his good luck, rather than his own efforts.

To reconcile the discrepancy between the clinical evidence presented by Karl S. and the expectation that reinforcement should increase the expectancy of future reinforcement, Rotter formulated the locus of control construct as a specific example of a generalized expectancy. Locus of control is described as the degree to which a person believes in internal or external control of reinforcement, whether he believes that what happens to him is dependent upon his own behavior and thus under his own control (internal orientation) or is contingent upon fate, luck, powerful others, etc. (external orientation). Rotter's thesis is that locus of control is a personality dimension constituting an important motivational variable which can be used in the prediction of behavior. Rotter (1975) defined locus of control as follows:

> When a reinforcement is perceived by the subject as following some action of his own but not being contingent upon his action, then, in our culture, it is typically perceived as the result of luck, chance, fate, as under the control of powerful others, as unpredictable because of the great complexity of forces surrounding him. When the event is interpreted this way by an individual, we have labeled this a belief in *external* control. If the person perceives that the event is contingent upon his own behavior or his own relatively permanent characteristics, we have termed this a belief in *internal* control. (p. 276)

The expectancy in any specific situation is jointly determined by the expectancy that a reinforcement will occur as a function of previous reinforcement in a highly similar situation, and a variety of generalized expectancies, including locus of control (Phares, 1976).

Early attempts to assess the validity of the locus of control construct took two forms: demonstration of the experimental induction of situation-specific control expectancies and the development of an instrument which would be useful in scaling beliefs or general expectancies concerning locus of control; i.e., assessing expectancies on a continuum. Working at Ohio State University under the direction of Rotter, Phares developed a crude test of internal-external orientation as part of his doctoral dissertation. Subsequent revisions and reconstructions based on Phares' initial scale eventually resulted in the development of the instrument most widely used to assess control expectancy, the Rotter I-E Scale.

The earliest published studies of locus of control involved the experimental manipulation of expectancies through the use of tasks structured to encourage subjects to believe that success was determined either by chance or by skill (James & Rotter, 1958; Phares, 1957). In the Phares study it was noted that subjects under skill instructions (corresponding to internal orientations) changed expectancies more frequently and in the direction predicted by success or failure on previous trials. Chance (external) instructions led to unusual shifts in expectancy similar to the "gambler's fallacy," with increased expectancy of success following a run of failures. The James and Rotter study revealed that under chance instructions, the traditional superiority of partial reinforcement for increasing resistance to extinction was obtained; whereas, under skill conditions no difference was found between 100% and partial reinforcement. James and Rotter explained these findings on the basis of subjects' perceptions or attributions of causality. Subjects in the skill conditions persisted in the face of nonreinforcement, assuming that reinforcement had ceased as a result of a deficiency in their skill rather than as a result of a change in the rules governing reinforcement.

The publication of Rotter's monograph (1966) stimulated a wealth of research contributing to the further growth of Rotter's social learning theory and specifically to an understanding of the antecedents, correlates, and effects of locus of control. Reviews of the literature indicate the breadth of application of the locus of control construct in areas such as the following: (a) social class and ethnic group differences, (b) antecedents (familial and social) of internal-external attitudes, (c) achievement motivation, (d) personality correlates, (e) academic achievement, (f) alcoholism and drug abuse, (g) social influence, (h) interpersonal perception, (i) learning, (j) cognitive strategies and information processing, (k) measurement of locus of control, (l) socio-political activity, and (m) risk-taking behavior (Joe, 1971; Lefcourt, 1972; Phares, 1976; Prociuk & Lussier, 1975; Rotter, 1966). In an attempt to present a summarization of findings germane to the purpose of this study, a selective review of the literature will be organized around the empirical validation of locus of control as a personality variable, its relationship to achievement behavior, and its use as a cognitive variable.

<u>Locus of control as a personality variable</u>. Joe (1971), in a review of the literature pertaining to the construct validation of locus of control, notes a consistent pattern of findings. These findings characterize externals as being

relatively more anxious, aggressive, dogmatic, and less trustful and self-confident than internals, and as having lower needs for social approval. Joe cites numerous studies indicating the following behavioral correlates of internality: greater initiative and effort in attempts to control their environment (Phares, 1965; Seeman, 1963; Strickland, 1965); striving for achievement (Chance, cited in Rotter, Chance & Phares, 1972; Coleman, 1966; Crandall, Katkovsky, & Crandall, 1965); and resistance to subtle manipulation attempts (Strickland, 1970).

Several investigators have successfully predicted higher externality in cross-cultural and ethnic group comparisons. This supports the theoretical expectation that individuals from groups who are restricted by social barriers, or who are influenced by "passive" cultural traditions, e.g. Hindus, would exhibit highly external expectancies (Baron & Ganz, 1972; Lefcourt & Ladwig, 1965; Strickland, 1972).

<u>Locus of control and achievement behavior</u>. Another area of relevance to locus of control concerns the relationship between locus of control and achievement behavior. Several authors have suggested that the development of an internal control orientation might be explained as a phenomenological response to one's own intelligence or achievement, but Lefcourt (1966) argues against such an interpretation in favor of a view that locus of control may serve as

a mediating variable in the "pursuit of achievement."

The locus of control construct suggests a logical relationship with achievement behavior--individuals who do not believe their efforts and abilities are effective in securing reinforcements obviously should be handicapped in meeting the long-term demands of achievement-related goals. Investigations of this relationship have generally supported this view, but not without occasional contradictions which suggest that the relationship may not be as straightforward as it would seem. James (1965) found internality related to task persistence; Franklin (1963) reported that internal high school students spend more time doing homework; and other have presented findings supporting the hypothesis that internality is accompanied by a willingness to defer gratification (Bialer, 1961; Mischel, Zeiss & Zeiss, 1974). Achievement behavior, as measured by course grades, achievement test scores, and academic aspirations, has been found to be related to internality in numerous studies (Chance, cited in Rotter, Chance & Phares, 1972; Crandall, et al., 1965; Gurin, Gurin, Lao, & Beattie, 1969; Lao, 1970). Nevertheless, the straightforward interpretation of research findings in this area has been hampered by the frequent findings of sex differences in the relationship between control orientation and academic behavior. While studies have generally supported the correlation between internality and achievement in males, the results for females have been inconsistent (Brown & Strickland, 1972; Chance, cited in Rotter, Chance & Phares, 1972; Crandall, Katkovsky & Preston, 1962; Nowicki & Walker, 1973). An additional ambiguity is introduced by the substantial representation of external males in university student populations studied. This paradoxical occurrence is explained by Rotter (1966):

> Among college students and adults, particularly with males, there are more defensive externals or people who have arrived at an external view as a defense against failure but who were originally highly competitive. (p. 21)

This description of the defensive external male who behaves as an internal in academic situations is based on the assumption that, in the traditional academic setting, specific expectancies rather than generalized expectancies, such as locus of control, can be expected to play the major role.

Locus of control and instructional format. Studies exploring the possible interactions between students' locus of control and various instructional approaches have been minimal, and typically employ broad treatment conditions involving many instructional attributes. The findings of two such studies may be summarized as follows: participation in a personalized system of instruction course resulted in a change of locus of control toward internality (Johnson & Croft, 1975), and internality was predictive of both achievement and participation in an unstructured introductory psychology course (Eilersen, 1972).

Locus of control and cognition. The relationship between locus of control and cognitive activity has been extensively studied. The locus of control construct leads to the prediction that internal individuals would be more active, alert, and persistent in their encounters with information. Phares (1976) indicates that this hypothesis is the most consistently verified of all locus of control predictions. An early study by Seeman and Evans (1962) of the information-seeking behavior of patients hospitalized with tuberculosis indicated that internals requested more information, knew more about their conditions, and expressed less satisfaction with the amount of information received from hospital staff. These findings were replicated in a similar study (Seeman, 1963) measuring the amount of knowledge concerning prison rules and regulations in an inmate population.

In a study by Phares (1968), internals were found to have greater recall of information learned to criterion one week previously. Several studies of attentiveness revealed the superiority of internals' attentiveness to task-relevant information (Julian & Katz, 1968; Lefcourt, Lewis, & Silverman, 1968). Not surprisingly, internals have often been shown to be more effective in the utilization of information (DuCette & Wolk, 1973; Phares, 1968; Pines & Julian, cited in Pines, 1973).

Instructional Models

An instructional model can be defined as a concrete representation of the cues, processes, and outcomes involved in a person-environment interaction. Models are frequently used in education to provide guidance to enable the learner to reproduce the behavior modeled. Instructional models are presented in a variety of formats including live, written, or symbolic. The model is assumed to activate the learner to respond and to provide information concerning appropriate responses, the order in which they should occur, and expected outcomes.

According to Piaget (1962, 1976), imitation is internalized and leads to the development of mental images which are not replicas of the objects or events which they represent, but are rather general schema. Piaget carefully defines the schema as the meaning, or concept, and not only the object/event to which it applies. The use of internal schema, according to Piaget, develops gradually with age. Internalized representation (the reconstruction of the image independent of, or prior to, overt performance) becomes possible through the transformation of the object to schema and subsequent storage in memory. Piaget stresses the importance of language in the transmission and transformation (to schema) of models.

Bandura and his associates have focused their attention on the investigation of vicarious learning, using human models. Bandura (1965) cites evidence from informal observation that both live and symbolic models "are used extensively in social learning to short-circuit the acquisition process" (P. 2). In addition, Bandura argues that the vicarious learning process is essentially the same as that involved in any other associative learning, differing only in its employment of social cues. In summarizing a modeling study to test the hypothesis that symbolization (attaching verbal responses to the model's behavior) facilitates vicarious learning, Bandura (1965) made these observations:

> The degree of observational learning may also be partly governed by incentive-related sets which exert selective control over the type, intensity, and frequency of observing responses. . . . an incentive set may influence the amount of behavioral reproduction by either (1) augmenting and channeling the observing responses during acquisition, or (2) actuating deliberate, implicit rehearsal of matching responses immediately after exposure. (p. 12)

Bandura asserts that motivational conditions and prior training in discriminative observation are other subject variables which undoubtedly contribute to the vicarious learning process through their effects on attention.

Considerable evidence is provided in the research literature that a variety of observer characteristics, including personality variables, can affect the imitative process. Akamatsu and Thelen (1974), in a review of the research literature on observer characteristics, noted that the state variables of competence, arousal, and anxiety had been shown to affect imitation consistently across studies. Evidence concerning the effect of trait variables such as dependency, authoritarianism, and the need for social approval has been inconsistent. The authors suggest that the nature of the imitative task involved may affect the relationship between observer characteristics and imitation learning.

A similar notion is Gilmore's (1968) delineation of subtypes of imitative learning. Of particular interest are two subtypes: generalized learning type and the information-seeking type. In the generalized learning type, the learner assumes that rewards are contingent upon matching the behavior of the model irrespective of whether or not the model has been rewarded. Gilmore notes that a generalized learning style can be developed as a result of previous history of receiving reinforcements for matching a model's behavior. The information-seeking type of imitative learning is described by Gilmore as the imitation of a model's response for the purpose of gaining further information, comprehension, or understanding.

<u>Locus of control and the use of models</u>. There is a small body of research concerned with the relationship between locus of control and the vicarious learning process.

McColley and Thelen (1975) found significant differences between internals' and externals' imitative response under conditions of rewarded versus non-rewarded models, with externals imitating both equally and internals imitating the rewarded model more than the unrewarded. In addition, they reported a similar differential response to the perceived competency of the model. Primo (1973), however, in a study of the effects of locus of control in a vicarious learning situation, found that internals demonstrated "significantly greater attention to, awareness of, and utilization of vicariously presented, task-relevant information" than did externals. While these studies suggest the presence of different imitation learning processes, the respective contributions of various cognitive factors and learner characteristics remain unclear.

Pines (1973) examined the performance of internals and externals on a free recall memory task in the presence or absence of an observing audience. The externals' retention and covert organization of the learned material was facilitated by the presence of an observing audience, whereas the internals were benefited by having additional time available to organize the materials.

Several investigators have concluded that internals make greater use of direct opportunities to seek and process task-relevant information (Davis & Phares, 1967; Lefcourt & Winer, 1969; Phares, 1968; Seeman, 1963). A study by Pines and Julian (cited in Pines, 1973) indicated that externals and internals exhibited different levels of information-seeking behavior. Given tachistoscopic self-presentations of ambiguous photographs, internals sought less information the second time a photograph was presented. Externals' information seeking was not, however, affected by stimulus familiarity. Julian and Katz (1968) found that decision-time varied as a function of task difficulty for internals, but not for externals.

Wolk and DuCette (1974) concluded that internals are more "perceptually sensitive" as a result of their finding that internals performed consistently better on a task that involved both intentional and incidental learning. In a second experiment designed to replicate and extend this finding, they found that when explicit cues were given to attend to the incidental learning task, which in this case was story content, the correlation between intentional and incidental performance for the external was increased and not significantly different from that of internals; therefore, "it appears that the external does not make full use of his attentional system until stimuli are made more salient or prominent" (p. 99).

These findings are consistent with the hypothesis that the internal could be expected to utilize available opportunities to seek and process information while the external would be less likely to attend to or be influenced by the information itself and to be considerably more responsive to information containing social cues. These effects are best described by Pines (1973) as follows:

> Internal control orientation is likely to be associated with a disposition toward information obtained through one's own encounters with the environment--with physical reality--while an external control orientation is likely to be associated with a disposition toward information derived from the evaluations of responses of other persons--with social reality. (p. 263)

The potential validity of such an interpretation is suggested by Pines and Julian (1972) in their study of the effects of both task and social demands on the information processing activity of internals and externals. The major finding of this study was that externals appear more oriented toward the implicit social requirements inherent in the performance situation.

Memory and Organizational Processes

The organization of material for storage in and retrieval from memory and the retention of that information represent two cognitive processes assumed to underlie virtually all types of learning. Lindsay and Norman (1977) discuss three aspects of memory: the data base (information stored), interpretive mechanisms which operate on the data base, and a monitor which guides the interpretive mechanism. Interpretive processes require the analysis of information and its implications as well as its subsequent organization for storage in the memory. Retrieval of stored information depends primarily upon its organization during learning and the depth of processing it has received. Lindsay and Norman suggest

> the rule would appear to be that the more deeply the material is processed--the more effort used, the more processing makes use of associations between the items to be learned and knowledge already in the memory--the better will be the later retrieval of that item. (p. 355)

Ausubel (1978) outlines a theory of learning he calls assimilation theory. Central to this theory is the assumption that meaningful learning requires the incorporation of new concepts and information into an existing cognitive framework which is hierarchically organized. The use of advance organizers (introductory material at a high level of generality, inclusiveness and abstraction) as a means of effectively influencing cognitive structures to promote learning and retention has been demonstrated (Ausubel, 1960). Ausubel and Fitzgerald (1962) reported that when the learner's ability to form discriminations was low, verbal learning and retention could be enchanced by the use of organizers to provide stable subsuming concepts relevant to the new information. As it is generally assumed that the organization of information and its storage in memory are processes which occur simultaneously, the utilization of aids which record information in a preorganized manner (memory/organization support) should enhance performance on a learning task.

Locus of control and memory/organization processes. At the present time there is little direct evidence concerning the possible relationship between locus of control and memory and organizational processes. The frequent findings of superior performance by internals in a variety of problem-solving tasks are often interpreted in a global fashion; i.e., that internals "learn better" or "make more efficient use of available information." What are not known, but are merely suggested in a few studies, are the specific cognitive processes which might account for these differences.

Memory and covert organization of verbal material was studied by Pines (1973) in a test of the hypothesis that internals would exhibit greater retention and organization as a function of successive encounters with the learning material and of the time available for recall. Confirming this hypothesis, the internals exhibited a positively accelerated learning curve across trials on the measure of the subjects' imposition of organization on the stimulus words. Of additional interest is the finding that the provision of additional amounts of recall time increased the number of items recalled by internals across trials, which suggests that internals are better able to retrieve information from memory, or perhaps more willing to expend the necessary effort for the search. The latter explanation is suggested by the finding that externals' recall was greatly facilitated by the presence of an observing audience during the recall period.

In a study of the differential performance of internals and externals in three different tasks, DuCette and Wolk (1973) reported that internal subjects were more accurate in remembering and more quickly identified the rule from an ambiguous stimulus situation and used this rule to solve the problem.

Results from another area of investigation, that of self-evaluation and self-reinforcement, suggest a possible mechanism which might explain the rather consistent findings that externals are deficient in the use of cognitive processing. A consistent pattern of findings has emerged which indicates that externals are less effective than internals in their use of self-reinforcement (Baron & Ganz, 1972; Heaton & Duerfeldt, 1973; Strickland, 1973). Phares (1971) reported that externals tended to reduce the reinforcement value of tasks following failure experiences, presumably as a means of avoiding negative self-evaluation.

In a study designed to examine the merit of two alternate explanations for this differential self-reinforcement behavior, Bellack (1972) found that internals and externals utilized the same criterion or standard for the administration of overt self-reinforcement. Differential use of self-evaluation, with externals demonstrating consistently lower self-evaluations, was found to be responsible for differences in self-reinforcement. Self-evaluation was defined in this study as the subject's self-reported degree of certainty for each response. Bellack summarized his findings as follows:

> This finding contributes to an emerging picture of the external individual as one who does not trust his own efforts or judgments. He believes that his behavior is not effective in securing reinforcement and is dependent upon external input for evaluation of his behavior. . . . He does not risk making strong judgments in the absence of such input. (p. 165)

One could further hypothesize that the external individual, in the absence of social information, would require additional instances of that information before committing it to storage in memory. For example, in a task requiring the use of memory to retain and compare alternative solution strategies, externals should be less able than internals to remember which strategies previously led to failure, and thus to evaluate whether a given approach would ultimately lead to an impasse. If this is the case, then the use of external memory/organization supports should improve the external's ability to evaluate strategies and to avoid errors.

Concept Attainment

The capacity to conceptualize, or abstract, allows the individual to interact economically and effectively with the environment. To conceptualize is to "render discriminably different things equivalent . . . and to allow response to them in terms of their class membership rather than their uniqueness" (Bruner, Goodnow, & Austin, 1965, p. 1). Concepts are defined as the "abstracted and often cognitively structured classes of mental experiences learned by organisms in the course of their life history" (Carroll, 1964, p. 179).

Approaches to the theoretical issues involved with concept learning fall basically into two major divisions: those based in the cognitive-informational theories and those related to neo-behaviorism. In general, the cognitive theorists assert that thought is the product of inner organization and restructuring, while the neo-behaviorist views thought as the resultant product of previous learning in complex stimulus-response chains.

Concept learning in the behaviorist framework. The neo-behaviorist view presents a reformulation of early associationistic theories, based on simple stimulus-response mechanisms, to postulate the existence of internal stimuli and internal responses mediating thought. Kendler (1964) suggests the two theoretical approaches are not as divergent as they might seem and that they reflect "personal preference for models and language systems adopted to represent behavior instead of fundamental theoretical assumptions" (p. 229). Kendler goes on to suggest that cognitive theory's structures, plans, and strategies can be equated with internal stimuli that arise from complex chains of stimulus-response associations.

Inquiries into the nature of concept learning from a behaviorist framework can be traced to Hull's (1934) description of thinking as an intervening variable in the stimulus-response bond. An early investigation in this vein was Harlow's (1959) study of monkeys' learning when faced with discrimination problems, which led Harlow to postulate the existence of learning sets; i.e., learning how to learn. Harlow hypothesized that all concepts evolve from learning set formation through the simultaneous mechanisms of stimulus discrimination and generalization with increasingly efficient learning after extensive training on a wide range of problems belonging to a class.

More recent formulations of the concept learning process using a stimulus-response paradigm include Osgood's (1957) verbal mediating hypothesis and the Kendlers' (1962) model of problem solving. Osgood's mediational hypothesis suggests that meaning becomes attached to verbal symbols or signs as a result of a two stage process based on the traditional S-R bond: the first, decoding, is the association of signs with representational mediators; i.e., ideas or interpretations. The second stage, encoding, is the association of mediated self-stimulation with overt responses; i.e., the expression of ideas. The mediational hypothesis proposed by the Kendlers to account for the complexities involved in problem solving can be represented schematically as:

$$S\text{--}\boxed{r\cdot\cdot s}\text{--}R$$

with S = external stimulus, R = overt response, r = implicit response, and s = implicit cue. The implicit response (which can be viewed as thought as the product of the stimulus) then serves as the cue(s) for the overt response. There is growing support within behaviorist theorizing for the notion that much of human behavior is controlled by stimulation engendered by the individual himself and that one's own verbal responses are an important source of such self-stimulation (Michenbaum, 1975). It is well documented that the learning and transfer of concepts is facilitated by the use of verbal labels (Simon, cited in Wallace, 1967; Albert & Ehrenfreund, 1951; Freedman & Mednick, 1958).

<u>Concept learning from a cognitive-informational theory perspective</u>. Cognitive theories of learning focus on the inner mental states of the individual, with these states variously defined as cognitive structures (Ausubel, 1967), strategies (Bruner, et al., 1956), cognitive styles (Kagan, Rosman, Day, & Phillips, 1964), and images (Miller, Pribam, & Galanter, 1967). The notion of organized internal

hierarchies involving subordinate and superordinate conceptions occupies a central role in all cognitive theories. The use of computers to simulate the operations of human thought, especially problem solving, and the development of information theory as a means of explaining the processing and storage of information have further extended the contributions of cognitive theory to the study of concept learning.

Cognitive theories assume that thoughts are organized in the mind in a hierarchical fashion based on the level of their representation, with some concepts which are more broad and inclusive subsuming those less so via a process of ideational anchorages (Ausubel, Novak, & Hanesian, 1978). They are also concerned with the transformation of knowledge in the cognitive structure into action. The role of self-awareness in complex decision making and in learning is acknowledged, with the implication that conscious reflection upon the outcomes of actions and upon the causal links among acts and outcomes is of fundamental importance. The role of memory in thought is seen as critical. Memory is assumed to function in two distinct manners--as the source of data necessary for thought and as the source of guidance for the mental operations on the data (Lindsay & Norman, 1977). Information processing views of concept attainment stress the importance of memory as the task itself is seen to strain the limited capacity of short term memory to carry all the required information at one time. Two major solutions to the problem created by the limitations of short term memory are advanced: the use of external aids (notes, sketches, maps) to thought, and increasing the capacity and flexibility of long term memory through the use of abstraction, practice, and varied experience (Lindsay & Norman, 1977). In addition, cognitive and information theories suggest that the learning of complex material, and especially its efficient learning, require the use of appropriate organization within memory and the use of efficient operations or protocols for utilization of information, as in problem solving.

Because of the centrality ascribed to concept learning in the cognitive-informational theories, most of the investigations of concept attainment have been guided by this theoretical viewpoint. Concept formation and concept attainment are the two types of conceptual behavior which have been the focus of study. The term concept formation is generally reserved for the act of category formation or invention wherein a continuum emerges in response to specific stimuli or events, or through the combination of other such categories in the learner's repertoire. Concept attainment refers to the search for and testing of attributes which distinguish between members and non-members of a given category. Isaacs (1960) states that adult conceptualization typically involves concept attainment or the combinatorial form of concept formation, with concept formation appearing as the primary mode in infancy and early childhood. Although considerably more simplistic, this is not inconsistent with the Piagetian viewpoint of the evolution of concepts as described by Berlyne (1957).

Concept attainment can be described as the process of identifying attributes that are associated with two events, but distinguish them from a third. When a discriminable feature of an event is used to infer the class identity of another event, it is referred to as a criterial attribute.

Most concepts involve the simultaneous consideration of more than a single attribute, so it becomes necessary to distinguish between different types of concepts depending upon the way in which criterial attributes are combined to form the concept. A conjunctive concept is defined by the joint presence of the criterial attributes, e.g., a red square. A disjunctive concept is defined by its "either/or" quality, e.g., anything which is red <u>or</u> square. The relational concept is defined by a specifiable relationship between its attributes, e.g., having more numbers than letters. Obviously, the underlying rule is different for each type of concept, and the ability to identify and use the appropriate rule in solving the concept is an important prerequisite for concept attainment.

Bruner, Goodnow, and Austin (1956) describe the task of concept attainment as comprised of the following elements:

1. An array of instances (examples and non-examples of the concept) which can be characterized in terms of their attributes and/or the values of these attributes.

2. A tentative prediction (hypothesis) as to the attributes defining the concept.

3. A validation (confirming or disconfirming) of the hypothesis by the information contained in other instances.

4. The information provided by each hypothesis-test which limits the choice of criterial attributes.

5. The strategy employed to gain and retain information in memory.

6. The payoff, or consequences, of the decision regarding the nature of the concept.

Concept attainment tasks generally fall into two types of categories--those which require the use of selection strategies and those requiring reception strategies. In a situation where the individual is presented with a large array of positive and negative instances of the concept, the ideal strategy is one which involves the careful <u>selection</u> of those instances which contain the information needed to allow the most economical testing of attributes. More typical is the situation requiring the use of <u>reception</u> strategies which center upon the hypotheses formulated in response to a limited number of instances available for testing. Bruner and his colleagues described two main reception strategies commonly used in concept attainment tasks and cited the strengths and weaknesses of each. Knowledge of these strategies allows the explication of the learner's thought processes as he encounters negative and positive instances of the concept.

In the scanning strategy the learner begins by formulating an hypothesis about the nature of the concept based on a feature of the first example of the concept he receives. This hypothesis is then held until it is disconfirmed and a new hypothesis formulated which is consistent with the information encountered. Since the learner must notice and memorize all the characteristics of all previous instances for use when the present hypothesis fails, this strategy places considerable demand on his memory and inference capabilities.

The focusing strategy, however, makes little demand on the memory. The focuser uses the first example of the concept, encountered as a whole hypothesis, and changes only parts of this hypothesis as comparisons are made between this initial example (focus) and positive and negative examples encountered.

Locus of control and concept attainment. To date, there has been no reported studies of the possible relationship between locus of control and concept attainment. The several studies of reception strategies and common errors made in concept attainment tasks reported by Bruner, et al. (1956) suggest that much of the difficulty in concept attainment can be related to systematic behavior, which they call strategy error. One such error is attributed by the authors to the extent to which an individual is willing to trust and use cues as the basis for inferences about criterial attributes:

> One develops on the basis of past encounters with one's particular world an expectancy concerning the nature of classes of events. One may, by virtue of circumstances, develop a "gambling orientation" whereby cues tend to be treated as probabilistic . . . These deformations, though they may lead to inefficient behavior in particular problem-solving situations, may represent highly efficient strategies when viewed in the broader context of a person's normal life. (p. 240)

The authors note that the sources of these systematic response tendencies have yet to be identified, but the concept of a generalized control expectancy suggests that individual differences in locus of control might prove a fruitful area for investigation.

Proposed Study

The first general hypothesis proposed is that individuals with an external locus of control are limited in their learning by their preference for social sources of information. This hypothesis is based upon the assumption that different control orientations are associated with different dispositions toward information depending upon the nature of its source, with externals responsive primarily to information containing social cues and internals utilizing all relevant information regardless of its source.

A second general hypothesis is that externals are deficient in their ability to remember and organize information. This suggests that the external, in the absence of social cues, would tend to discount the value of incoming veridical information and, consequently, would require additional instances of that information before committing it to additional processing (organization) or storage in memory.

Research Problem

Does a learner's locus of control interact with the degree of social cueing in the instructional model and with the supplantation of memory processes to produce differential performance of a concept attainment task?

Research Hypotheses

Two major research hypotheses are proposed:

1. Within conditions of instructional model type,

internals' performance will exceed that of externals' performance under conditions without memory support as compared to memory support conditions. Specific comparisons will be made to test the following predictions:

1.1 The performance of internals is greater than the performance of externals under conditions of no memory support.

1.2 The performance of externals is greater than the performance of internals in the memory support condition.

2. Within conditions of memory support, the performance of internals will be superior to that of externals under the informational model as compared to the social model.

Specific comparisons will be made to test the following predictions:

2.1 The performance of internals is greater than the performance of externals under the informational model condition.

2.2 The performance of externals is greater than that of internals in the social model condition.

In summary, the performance of internals should exceed that of externals under conditions of informational model type and no memory support. The internal's performance should be hampered by social cueing and by memory support.

The external's performance, on the other hand, should be significantly improved by exposure to the social model and by the utilization of memory support, reaching the level of the internal's performance.

Although locus of control theory and previous research do not allow specific predictions, the following research questions will be addressed:

3. Across conditions of model type and memory support, internals will demonstrate performance superior to that of externals.
4. Within conditions of locus of control, subjects under the social model condition will perform better than subjects with the informational model without memory support as compared to the memory support condition.

Method

Subjects

Subjects will be selected from an initial pool of 100 female students enrolled in education courses offered by the University of Oklahoma, Norman, Oklahoma. Subjects will receive extra course credit for participation. Most subjects will be sophomores or juniors, ages approximately 18 to 20. A single sex approach will be employed with the gender used determined by the availability of subjects. The use of a single gender sample is necessitated by the frequent sex differences found on measures of control orientation and academic achievement (Joe, 1971; Lefcourt, 1966).

Subjects in the initial pool (N=100) will receive the Rotter I-E Scale, and arrangements will be made for subjects scoring within the upper and lower 27% of the distribution to participate in the experimental sessions (Cox, 1957).

Procedure

Prior to the experimental session, subjects will be dichotomized into Internal and External groups on the basis of their scores. The Rotter I-E Scale will be administered to these subjects a second time at the beginning of the experimental session and the three subjects from each group who score closest to the median will be eliminated from the study to minimize regression effects. Forty-eight subjects, an equal number from each group, will serve as subjects. A sample size of 48 was chosen to yield a power estimate of

.92 to detect differences of two standard deviations, with alpha set at .05 for the first-order interaction effect (Winer, 1971).

Following completion of the second administration of the I-E Scale, subjects will receive instruction in the use of negative information (information about criterial attributes gained from the comparison of an example and a non-example of the concept) in either an informational model or a social model format. Following the presentation, each subject will be asked to attempt a concept attainment task either with or without the use of memory support during task performance. Subjects within each level of the locus of control variable will be assigned randomly in equal numbers to each level of the treatment variables.

The Rotter I-E Scale

The Rotter I-E Scale (Appendix C) will be used to assess the control orientation of subjects. The test will be administered in a group setting and requires approximately 10 minutes to complete.

This scale is a 29-item measure which includes six filler items for the disguise of test purposes. The scale offers forced-choice type alternatives between internal and external control interpretations of various situations. An individual's score is the total number of external choices made.

Internal consistency estimates have been reported as follows:

.65 - .70 for male undergraduate psychology students in three samples

.70 - .79 for females in the same samples (Rotter, 1966)

.69 for 10th-12th graders (Franklin, 1963)

Test-retest reliability has been reported as follows:

.60 for males; .83 for females at one-month interval for undergraduate psychology students

.78 for male prisoners at one-month interval (Jessor, cited in Rotter, 1966)

.49 for males; .61 for females at two-month interval for undergraduate psychology students (Rotter, 1966)

Investigations regarding the relationship between locus of control and social desirability have resulted in contradictory findings. Strickland (1965) and Tolor (1967) found nonsignificant correlations between the I-E Scale and the Marlowe-Crowne Social Desirability Scale. However, Berzins, Ross, and Cohen (1970) found a correlation of -.23 ($p. < .05$) between the I-E Scale and the Edwards' social desirability scale, and Feather (1967) reported a -.42 ($p. < .01$) correlation with the Marlowe-Crowne Scale.

While internality was found to be positively related to intelligence in Bialer's (1961) comparison of normal and mentally retarded children, negligible correlations have been reported between intelligence and locus of control measures in university populations.

Scheduling of Experimental Sessions

The post-test only design when involving separate and individual experimental sessions requires careful attention to the random assignment of subjects to experimental sessions to minimize the possible effects of intersession history as a potential threat to internal validity. As the data collection in this study necessitates sessions over a one-week period, the influence of extraneous events remains a possibility. Randomization of experimental occasions is suggested by Campbell and Stanley (1963) as the "optimal" control for this problem.

Experimental events will be assigned to experimental sessions, using a table of random numbers. With 24 subjects in each level of the blocking variable, a list containing the numbers from one to 24 will be generated, with each number appearing in the order in which it was found in the table. These numbers, and their corresponding experimental sessions, will then be assigned to treatment conditions on a predetermined basis with the first number on the list assigned to the first experimental group, and so on, returning in cyclical fashion to the first group on the fifth numbers. This procedure insures the randomization of experimental sessions across time.

Treatment Conditions

Each subject will be exposed to two treatment conditions in stepwise fashion. First, she will receive instruction in the use of negative information in a concept attainment task presented via an informational or social model.

Informational model. The subject will be asked to read a brief and simple paper which describes the value of using non-examples (negative information) to determine criterial attributes, and which provides an example of the reasoning process in a concept attainment task. To further reduce social cueing, the paper will be written in the third person.

Social model. The subject will be asked to view a brief videotape of another "subject" (actually a confederate of the experimenter) working the same concept attainment task. The model "thinks out loud" the appropriate cognitive strategy.

Both the informational and social models will be equated in terms of time available to study, content, level of terminology, and the degree of preprocessing (i.e., the extent to which the model makes demands upon the learner to organize covertly the material presented).

Following the model presentation, the subjects will each be told that they are to perform a similar, but more complex, concept attainment task than the one presented in the model. Depending upon her initial assignment, the subject is then placed in one of the following conditions during her performance of the experimental task.

Memory support. The subject will be directed to record her hypotheses and inferences for each trial of the experimental task on separate scoring sheets which are placed on a memory board in front of her, providing a cumulative record of previous examples and non-examples and her previous inferences and hypotheses.

No memory support. The subject will be directed to record her inferences and hypotheses on separate scoring sheets during each trial in the series. These sheets are immediately placed face down, and are unavailable to the subject on later trials. The subject must therefore rely on her memory for recovering information about her reasoning on previous trials.

In order to avoid advance presentation of the list of instances *in toto*, instances for trials 2 through 18 will be uncovered one trial at a time by the subjects. Materials used in the memory support conditions are illustrated in Appendix D.

Levels of the memory support variable will be completely crossed with levels of the model type and locus of control variables to provide the eight treatment cells as outlined in the paradigm (Appendix E).

The Experimental Task

A conjunctive concept attainment task will be used which requires the use of memory to retain information about both criterial and noncriterial attributes and the ability to make inferences or hypotheses correctly from the comparison of examples and non-examples (Bruner et al., 1956; Smoke, 1933; Wickelgren & Cohen, 1962).

The experimental task is an adaptation of the conjunctive concept attainment task described by Wickelgren and Cohen (1962) in their study of the use of artificial memory. The task is to identify the correct criterial attributes, and thereby the concept, following the presentation of examples and non-examples of the concept, in as few trials as possible. The presentation will consist of numbers containing eight (8) digits with four (4) places comprising the criterial attributes of the concept. Each of the eight digits is a stimulus dimension with ten possible values, zero through nine. The concept will be defined so that only one value can be part of the concept.

The concept to be used is 6 in Place 2, 3 in Place 4, 8 in Place 5, and 6 in Place 8. The presentation schedule of examples is designed to allow optimal inference from a comparison of a given instance with the first instance, an example of the concept (Appendix G). Presentations may be categorized as either examples (positive instances) or non-examples (negative instances) of the concept. Either type may then be further classified as containing places whose values remain unchanged. The correctness of hypotheses and inferences made from each presentation depends upon the subject's ability to: (a) retrieve previous hypotheses and inferences from memory, (b) hypothesize that all unchanged places are probably part of the concept, (c) infer that the changed place between an example and a non-example is part of the concept, when the example and non-example differ in only one place, and (d) infer that changed places between two examples of the concept are not part of the concept. Definitions of optimal hypotheses and inferences for each stimulus situation are outlined in Appendix F.

In terms of task analysis, it should be noted that the informational unit is the place, and to attain the concept the subject must acquire two chunks (Miller, 1956) of information about each place--is it part of the concept, and if so, what is its correct value? The subject's task is to discover how many places, which places, and what values in these places define the concept. The subject will be instructed to indicate the hypotheses and inferences at the end of each trial. The schedule of presentation is determined in advance and will be the same for all subjects (Appendix G). The concept is attainable in ten trials. When subjects continue beyond the tenth trial, the remaining trials will be comprised of repeat presentations of the instances given in the first ten trials.

The number of presentations that are necessary before subjects will change their hypotheses to inferences constitutes a reflection of their trust in their own judgments of information provided.

Apparatus

The following equipment and materials will be used in this study: a three-page written model, a seven-minute black and white videotape, videotape playback equipment and monitor, memory board, and an album-type notebook containing presentations of the experimental task and scoring sheets. Descriptions of the apparatus to be used are provided in Appendix D.

Measures of the Dependent Variables

Two dependent variables have been selected for inclusion in this study: the ability to remember, compare and utilize information on a concept attainment task and skill in using information about criterial attributes correctly. These variables can logically be assumed to be susceptible to the influence of both the instructional treatment (model type) and provision of memory support during task performance.

Measures of the dependent variables are as follows:

1. Ability to remember, compare and utilize information on a concept attainment task; i.e., overall performance.

Measure: number of trials to solution

2. Skill in using information about criterial attributes correctly; i.e., use of negative information.

Measures:

a. Number of inferences for negative instance trials

b. Number of hypotheses for negative instance trials

c. Number of non-utilizations of changed place information

d. Mean trial for making first inference for negative instance trial.

Data on the first three measures of skill in using negative information will be counted for trials 1 through 10 only since the problem is solvable in ten trials, and data for further trials would be confounded by successive elimination of those who attain the concept early.

Measurement Procedure

Prior to beginning the experimental task each subject will receive written instructions describing the task and outlining the directions for use of the scoring sheets and memory board, if applicable. These instructions are included in Appendix H. Subjects are told they will be presented with a series of eight digit numbers, one at a time, with a statement as to which are examples and which are non-examples of the concept. They are instructed to record each of their inferences and hypotheses after each trial, and to record the complete concept in a separate space whenever they feel they know the complete concept. If they have failed to identify the correct concept, they are asked to continue. If, after twenty trials the concept has not been attained, the subject is instructed to make a final guess and the task is terminated.

In an effort to measure directly information processing, the experimenter manipulates the use of memory supports by the subjects under two experimental conditions. Subjects in the no support condition are directed to record their hypotheses and inferences on the scoring sheets after each trial, immediately placing them blank side up in the album. Having done this, they must rely on their memory for recovering information about previous reasoning. The subjects in the memory support condition are directed to record their responses on a scoring sheet which is then moved to the memory board to provide a record of previous reasoning. The scoring sheets are collected, and responses tabulated, upon the termination of the experimental trials.

<u>Design and Analysis</u>

An experimental post-test design (Campbell & Stanley, 1963) will be used, with 24 subjects from each control orientation classification randomly assigned in equal numbers to each of the treatment cells.

While selection of subjects was based upon their extremity on the locus of control measure, the use of this personality dimension as an independent variable, random assignment of subjects within blocks to experimental groups, and the use of a post-test only design provide control of statistical regression effects. The absence of a third comparison group representing intermediate levels of the control variable limits the overall generalizability of results to the total population of interest. Likewise, the use of female subjects, for reasons cited previously, drawn from a limited population (university undergraduates in education) further restricts the generalizability of findings. When viewed in the context of this study's contribution to the larger body of research and theory on locus of control and learning, these limits to external validity, although problematic, are of diminished concern.

For the major hypotheses, numbers one and two, a 2 (locus of control) x 2 (model support) x 2 (support) fixed effects multivariate analysis of variance will be employed to analyze the data, followed by individual univariate factorial analyses of variance. The multivariate test of significance to be used is the Wilk's Criterion. Significant interactions will be evaluated by means of graphs based on two-way summary tables. In view of the preferability of committing a Type I, rather than a Type II, error, the alpha level will be set of .05.

Testing of hypotheses numbers 1.1, 1.2, 2.1, and 2.2 will be accomplished by using an individual comparison technique to make comparisons among specific combinations of the four treatment conditions, collapsing across levels of the third variable.

The large number of comparisons involved mandate the use of a posteriori comparisons. Dunn's technique was selected for making comparisons between cell means. The Dunn's procedure offers the advantage of controlling error rate at the major hypothesis level without great sacrifice of power. Alpha per comparison is maintained at .025 by this procedure, with alpha per hypothesis at .05 and per experiment at .10.

In addition, research questions numbers 3 and 4 will be tested by the overall multiple analysis of variance procedure in terms of tests for main effect (locus of control) and a significant Model Sociality x Memory Support interaction, and followed by univariate analysis of variance.

References for Prospectus

Akamatsu, T. J. & Thelen, M. H. A review of the literature on observer characteristics and imitation. Developmental Psychology, 1974, 19, 38-46.

Albert, E. & Ehrenfreund, D. Transposition in children as a function of age. Journal of Experimental Psychology, 1951, 41, 30-38.

Ausubel, D. P. The use of advance organizers in the learning and retention of meaningful verbal material. Journal of Educational Psychology, 1960, 51, 267-272.

Ausubel, D. P. A cognitive-structure theory of school learning. In L. Seigel (Ed.), Instruction: Some contemporary viewpoints. San Francisco: Chandler, 1967, 207-257.

Ausubel, D. P. & Fitzgerald, D. Organizer, general background, and antecedent learning variables in sequential verbal learning. Journal of Educational Psychology, 1962, 53, 243-249.

Ausubel, D. P., Novak, J. D., & Hanesian, H. Educational psychology: A cognitive view. New York: Holt, Rinehart, and Winston, 1978.

Bandura, A. Vicarious processes: a case of no-trial learning. In L. Berkowitz (Ed.), Advances in experimental social psychology (Vol. 2). New York: Academic Press, 1965.

Baron, R. M. & Ganz, R. Effects of locus of control and type of feedback on the task performance of lower class black children. Journal of Personality and Social Psychology, 1972, 21, 124-130.

Bellack, A. S. Internal vs. external locus of control and the use of self-reinforcement. Psychological Reports, 1972, 31, 723-733.

Bellack, A. S. Self-evaluation, self-reinforcement, and locus of control. Journal of Research in Personality, 1975, 9, 158-167.

Bellack, A. S., & Tillman, W. Effects of task and experimenter feedback on the self-reinforcement behavior of internals and externals. Journal of Consulting and Clinical Psychology, 1974(3), 42, 330-336.

Berlyne, D. E. Structure and direction in thinking. New York: Wiley, 1965.

Berzins, J., Ross, W. F., & Cohen, D. I. Skill versus chance activity preferences as alternate measures of locus of control: An attempted cross-validation. Journal of Consulting and Clinical Psychology, 1970, 35, 18-20.

Bialer, I. Conceptualization of success and failure in mentally retarded and normal children. Journal of Personality, 1961, 29, 303-320.

Brown, J. C. & Strickland, B. R. Belief in internal-external control of reinforcement and participation in college activities. Journal of Consulting and Clinical Psychology, 1972, 38, 148.

Bruner, J. S., Goodnow, J. J. & Austin, G. A. A study of thinking. New York: Wiley, 1956.

Campbell, D. T. & Stanley, J. C. Experimental and quasi-experimental designs for research. Chicago: McNally, 1963.

Carroll, J. B. Words, meanings, and concepts. Harvard Educational Review, 1964, 34, 178-202.

Coleman, J. S., Campbell, E. Q., Hobson, C. J., McPartland, J., Mood, A. M., Weinfeld, F. D. & York, R. L. Equality of educational opportunity. Washington, D. C.: U. S. Government Printing Office, 1966.

Cox, D. R. A note on grouping. Journal of the American Statistical Association, 1957, 52, 543-547.

Crandall, V. C., Katkovsky, W., & Crandall, V. J. Children's beliefs in their control of reinforcements in intellectual academic behaviors. Child Development, 1965, 36, 91-109.

Crandall, V. J., Katkovsky, W., & Preston, A. Motivational and ability determinants of young children's intellectual academic achievement situations. Child Development, 1962, 33, 643-661.

Cronbach, L. J. & Snow, R. E. Individual differences in learning ability as a function of instructional variables. Stanford: Stanford University, 1969.

Davis, W. L. & Phares, E. J. Internal-external control as a determinant of information-seeking in a social influence situation. Journal of Personality, 1967, 35, 547-561.

Ducette, J. & Wolk, S. Cognitive and motivational correlates of generalized expectancies for control. Journal of Personality and Social Psychology, 1973, 26, 420-426.

Eilerson, H. J. Locus of control and achievement and participation in structured and unstructured introductory psychology courses. (Doctoral dissertation, University of Washington, 1972). Dissertation Abstracts International, 1972, 33, 2164-A. (University Microfilms No. 72-28, 593)

Feather, N. T. Some personality correlates of external control. Australian Journal of Psychology, 1967, 19, 253-260.

Franklin, R. D. Youth's expectancies about internal versus external control of reinforcement related to N variables. (Doctoral dissertation, Purdue University, 1963). Dissertation Abstracts, 1963, 24, 1684. (University Microfilms No. 63-6493)

Freedman, J. L. & Mednick, S. A. Ease of attainment of concepts as a function of response dominance variance. Journal of Experimental Psychology, 1958, 55, 463-466.

Gilmore, J. B. Toward an understanding of imitation. In E. C. Simmel, R. A. Hoppe, & G. A. Milton (Eds.), Social facilitation and imitative behavior. Boston: Allyn & Bacon, 1968.

Gurin, P., Gurin, G., Lao, R. C., & Beattie, M. Internal-external control in the motivational dynamics of Negro youth. Journal of Social Issues, 1969, 25, 29-53.

Harlow, H. F. The formation of learning sets. Psychological Review, 1949, 56, 51-65.

Heaton, R. C. & Duerfeldt, P. H. The relationship between self-esteem, self-reinforcement and the internal-external personality dimension. Journal of Genetic Psychology, 1973, 123, 3-13.

Hunt, D. E. Person-environment interaction: A challenge found wanting before it was tried. Review of Educational Research, 1975, 45(2), 209-230.

Isaacs, N. On a gap in the structure of our general psychology. Journal of Child Psychology and Psychiatry, 1960, 1, 73-86.

James, W. H. Internal versus external control of reinforcement as a basic variable in learning theory. (Doctoral dissertation, Ohio State University, 1957). Dissertation

Abstracts, 1957, 17(2), 2314. (University Microfilms No. 22, 797)

James, W. H., & Rotter, J. B. Partial and 100% reinforcement under chance and skill conditions. Journal of Experimental Psychology, 1958, 55, 397-403.

Joe, V. C. Review of the internal-external control construct as a personality variable. Psychological Reports, 1974, 28, 619-640.

Johnson, W. G. & Croft, R. G. F. Locus of control and participation in a personalized system of instruction course. Journal of Educational Psychology, 1975, 67(3), 416-421.

Julian, J. W., & Katz, S. B. Internal versus external control and the value of reinforcement. Journal of Personality and Social Psychology, 1968, 8, 89-94.

Kagan, J. B., Rosman, D., Day, J. A., & Phillips, W. Information processing in the child: Significance of analytic and reflective attitudes. Psychological Monographs, 1964, 78, 1-37.

Kanfer, F. H. Vicarious human reinforcement: A glimpse into the black box. In L. Krasner & L. P. Ullman (Eds.), Research in behavior modification. New York: Holt, 1965, 244-264.

Kendler, H. The concept of a concept. In A. W. Melton (Ed.), Categories of human learning. New York: Academic Press, 1964.

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

Lao, R. C. Internal-external control and competent and innovative behavior among Negro college students. Journal of Personality and Social Psychology, 1965, 2, 765-770.

Lefcourt, H. M. Internal versus external control of reinforcement: a review. Psychological Bulletin, 1966, 65, 206-220.

Lefcourt, H. M. Recent developments in the study of locus of control. In B. A. Maher (Ed.), Progress in experimental personality research (Vol. 6), 1972, 1-39.

Lefcourt, H. M., & Ladwig, G. W. The American Negro: A problem in expectancies. Journal of Personality and Social Psychology, 1967, 5, 377-380.

Lefcourt, H. M., Lewis, L., & Silverman, I. W. Internal versus external control of reinforcement and attention in decision-making tasks. Journal of Personality, 1968, 36, 663-682.

Lefcourt, H. M., & Wine, J. Internal versus external control of reinforcement and the deployment of attention in experimental situations. Canadian Journal of Behavioral Science, 1969, 1, 167-181.

Lindsay, P. H., & Norman, D. A. Human information processing. New York: Academic Press, 1977.

McColley, S. H., & Thelen, M. H. Imitation and locus of control. Journal of Research in Personality, 1975, 9(3), 211-216.

Meichenbaum, D. H. (Ed.). Cognitive behavior modification: An integrative approach. New York: Plenum, 1977.

Miller, G. A. The magical number seven, plus or minus two: Some limits on our capacity for processing information. Psychological Review, 1956, 63, 81-97.

Miller, G. A., Pribram, E., & Galanter, K. L. Images and plans. In John P. DeCecco (Ed.), The psychology of language, thought, and instruction. New York: Holt, Rinehart & Winston, 1967.

Miller, N. E. & Dollard, J. Social learning and imitation. New Haven: Yale University Press, 1941.

Mischel, W., Zeiss, R., & Zeiss, A. Internal-external control and persistence: Validation and implications of the Stanford preschool internal-external scale. Journal of Personality and Social Psychology, 1974, 29, 265-278.

Nowicki, S., Jr., & Walker, C. Achievement in relation to locus of control: Identification of a new source of variance. Journal of Genetic Psychology, 1973, 123, 63-71.

Osgood, C. E. The nature of meaning. In J. DeCecco (Ed.), The psychology of language, thought, and instruction.

Phares, E. J. Expectancy changes in skill and chance situations. Journal of Abnormal and Social Psychology, 1957, 54, 339-342.

Phares, E. J. Internal-external control as a determinant of amount of social influence exerted. Journal of Personality and Social Psychology, 1965, 2, 642-647.

Phares, E. J. Differential utilization of information as a function of internal-external control. Journal of Personality, 1968, 36, 649-662.

Phares, E. J. Internal-external control and the reduction of reinforcement value after failure. Journal of Consulting and Clinical Psychology, 1971, 37, 386-390.

Phares, E. J. Locus of control in personality. Morristown, N. J.: General Learning Press, 1976.

Piaget, J. Play, dreams, and imitation in childhood. New York: Horton, 1962.

Piaget, J. The place of memory and cognitive functions. In Sarah F. Campbell (Ed.), Piaget sampler. New York: Wiley, 1976.

Pines, H. An attributional analysis of locus of control orientation and source of informational dependence. Journal of Personality and Social Psychology, 1973, 26, 262-272.

Pines, H. A., & Julian, J. W. Effects of task and social demands on locus of control differences in information processing. Journal of Personality, 1972, 40, 407-416.

Primo, S. L. Locus of control of reinforcement as a cognitive characteristic of observers in a vicarious learning situation. (Doctoral dissertation, University of Pittsburgh, 1973). Dissertation Abstracts International, 1974, 35, 5205-B. (University Microfilms No. 74-8683)

Prociuk, T. J., & Lussier, R. J. Internal-external locus of control: An analysis and bibliography of two years of research (1973-1974). Psychological Reports, 1975, 37, 1323-1337.

Rhetts, J. E. Aptitude-treatment interactions in individualized instruction: A conceptual framework from the project plan. In L. Sperry (Ed.), Learning, performance, and individual differences: Essays and readings. Glenview, Illinois: Scott Foresman, 1972, 269-285.

Rotter, J. B. Social learning and clinical psychology. Englewood Cliffs, N. J.: Prentice-Hall, 1954.

Rotter, J. B. Generalized expectancies for internal versus external control of reinforcement. Psychological Monographs, General and Applied, 1966, 80(1, Whole No. 609).

Rotter, J. B. Some problems and misconceptions related to the construct of internal versus external locus of control of reinforcement. Journal of Consulting and Clinical Psychology, 1975, 43, 56-67.

Rotter, J. B., Chance, J. E., & Phares, E. J. Applications of a social learning theory of personality. New York: Holt, Rinehart, & Winston, 1972.

Salomon, G. Heuristic models for the generation of aptitude-treatment interaction hypotheses. Review of Educational Research, 1971, 42(3), 327-343.

Salomon, G., & Cohen, A. Television formats, mastery of mental skills, and the acquisition of knowledge. Journal of Educational Psychology, 1977, 69(5), 612-619.

Seeman, M. Alienation and social learning in a reformatory. American Journal of Sociology, 1963, 69, 270-284.

Seeman, M., & Evans, J. W. Alienation and learning in a hospital setting. American Sociological Review, 1962, 27, 772-783.

Skinner, B. F. Verbal behavior. New York: Appleton-Century-Crofts, 1957.

Smoke, K. L. Negative instances in concept learning. Journal of Experimental Psychology, 1933, 16, 583-588.

Strickland, B. R. The prediction of social action from a dimension of internal-external control. Journal of Social Psychology, 1965, 66, 353-358.

Strickland, B. R. Individual differences in verbal conditioning, extinction and awareness. Journal of Personality, 1970, 38, 364-378.

Strickland, B. R. Delay of gratification as a function of the role of the experimenter. Journal of Personality and Social Psychology, 1972, 22, 108-112.

Strickland, B. R. Delay of gratification and internal locus of control in children. Journal of Consulting and Clinical Psychology, 1973, 40(2), 338.

Tolor, A., & Reznikoff, M. Relation between insight, repression-sensitization, internal-external control, and death anxiety. Journal of Abnormal Psychology, 1967, 72, 426-430.

Unmacht, J. J., & Obitz, F. W. Verbal discrimination task performance as a function of self versus external reinforcement, I-E scale performance and subject versus experimenter determination of response. Journal of Psychology, 1974, 86, 139-148.

Wallace, J. G. Behaviourist approaches to the conceptual process. Concept growth and the education of the child. London: National Foundation for Educational Research in England and Wales, 1967.

Weiss, H., & Sherman, J. Internal-external control as a predictor of task effort and satisfaction subsequent to failure. Journal of Applied Psychology, 1973, 57(2), 132-136.

Wickelgren, W. A., & Cohen, D. H. An artificial language and memory approach to concept attainment. Psychological Reports, 1962, 10, 815-827.

Winer, B. J. Statistical principles in experimental design. New York: McGraw-Hill, 1971.

Wolk, S., & DuCette, J. The moderating effect of locus of control in relation to achievement-motivation variables. Journal of Personality, 1973, 41, 59-70.

Wolk, S., & DuCette, J. Intentional performance and incidental learning as a function of personality and task dimensions. Journal of Personality and Social Psychology, 1974, 29, 90-101.

APPENDIX B

The Pilot Study

The Pilot Study

Locus of control has been related to various learning related behaviors. However, little research has focused on the relationship between locus of control and specific psychological processes, such as those involved in the acquisition and performance of problem-solving skills.

This pilot study has two major purposes:

1. To provide evidence concerning the usefulness of the locus of control construct, as a learned attribute, in the study of the effect of selected instructional characteristics on the psychological processes involved in learning to perform a concept attainment task.

2. To refine instructional materials or procedures that would permit the researcher to explore the link between locus of control and the effectiveness of the selected instructional attributes.

Rotter Internal-External Scale

The Rotter Internal-External (I-E) Scale was chosen to measure the subjects' locus of control. The I-E Scale is easy to administer, complete, and score. It provides a measure of the generalized expectancy or belief that reinforcements are not contingent upon one's behavior or abilities. Reported reliability measures for the I-E Scale have been reasonably consistent with stability estimates for one to two month intervals ranging from .49 to .83 (Joe, 1974; Rotter, 1966). Discriminant validity estimates have indicated low correlations with variables such as intelligence, achievement motivation, and political liberalness. Evidence concerning possible sex differences and correlations with social desirability has been contradictory.

Analysis of test-retest scores of twelve subjects in the pilot study was accomplished by computing a product-moment correlation coefficient. A reliability estimate of .95 for a two week interval was obtained.

Assessment and Revision of Materials and Procedures

Immediately after each experimental session, subjects met with the investigator for a brief interview designed to assess the adequacy of the materials used and the instructions given during the session. Results accompanied by the questions taken from the interview schedule are summarized below.

"Would you please comment on the paper you read (or the videotape you saw)--was it clear or confusing? Did it give you enough information? Can you suggest improvements to make it more helpful?"

Comments on the written model:

It was very clear. (n=6)

It was clear, but I wish there had been more examples. (n=2)

You should have used number concepts. (n=2)

I thought I understood until I started the task, then I couldn't remember how to do it. (n=2, both externals)

Comments on the videotape:

It was clear and helpful (n=9)

It didn't make sense at first, but after awhile, I understood. (n=1)

You should have used an example with numbers. (n=3)

"How would you rank the videotape in terms of how social or personal it was . . . on a scale of 1 to 10? Did it seem friendly, enjoyable, relaxed?"

Number of Responses

Unsocial							4	4	3	1	Social
	1	2	3	4	5	6	7	8	9	10	

"How helpful were the instructions you received about how to do the task--did they tell you everything you needed to know?"

They were fine. (n=6)

I understood them when I read them, but I got confused later on and wasn't sure I was doing it right. (n=8)

They were too complicated; I had to spend too much time trying to figure out where to put my answers. (n=5)

They told me everything, but I had trouble remembering it. (n=3)

I think I misunderstood them. (n=1)

"Tell me what you thought about the task itself?"

It was impossible. (n=3)

I didn't have any trouble with it. (n=2)

Numbers are awful; couldn't you use letters or something. I have problems with numbers. (n=11)

I don't see how you can remember everything you're supposed to. (n=4)

It was frustrating, because I felt like I had the answer and then I got confused. (n=3)

I wanted to quit halfway through. (n=2)

It was fun; I like puzzles. (n=2)

Why can't we look back at the numbers? (n=3)

"Did you have any problems with the sheets you had to write your answers on?"

No (n=13)

Yes, there was too much you had to write, and I had trouble deciding what goes where. (n=6)

They took too much time. (n=3)

It was frustrating not to be able to look back and find out where you made the mistake. (n=2)

In addition to these appraisals, the interviewer and subject often reviewed the records made by the subjects during the task, to identify other problems. Several were noted. Many subjects utilized both the hypothesis and inference columns simultaneously, entering the appropriate conclusion in one column and the rest of the numbers present in the positive instance in the other column. This inevitably led to confusion on subsequent trials when the subject found it difficult to make sense of the large set of numbers recorded. In later sessions, a verbal instruction to avoid this procedure was given, and few subjects were noted to make this error. Another difficulty which was noted was the reluctance of many subjects (both internals and externals) to record a response as CERTAIN; six subjects managed to identify the concept correctly without having made the previous appropriate inferences. Explicit verbal instructions about this procedure were added in subsequent sessions.

Analysis of Results

The analysis of results was accomplished by using separate analysis of variance for each of the five dependent variables. Several research hypotheses and questions which are to be tested in the proposed study were investigated.

Two major research hypotheses were proposed:

1. Within conditions of model type, internals' performance will exceed that of externals' performance under conditions without memory/organization

support as compared to memory/organization support conditions. Specific comparisons will be made to test the following predictions:

1.1 The performance of internals is greater under conditions of memory/organization support than under no support conditions.

1.2 The performance of externals is greater under conditions of memory/organization support than under no support.

1.3 The performance of internals is greater than the performance of externals under conditions of no memory/organization support.

1.4 The performance of internals and externals is not significantly different in the memory/organization support condition.

2. Within conditions of memory/organization support, the performance of internals will be superior to that of externals under the informational model as compared to the social model.

   Specific comparisons will be made to test the following predictions:

   2.1 The performance of internals is not significantly different under conditions of informational and social models.

   2.2 The performance of externals is greater in the social model condition than it is in the informational model condition.

2.3 The performance of internals and externals is not significantly different in the social model condition.

Data from the pilot study was used to test the first hypothesis. This was accomplished by comparing internals (n=12) and externals (n=12) who had received instructional models varying in the degree of social cueing presented and two levels of memory support (present/absent) during the concept attainment task.

The data analysis was accomplished by comparing the internals and externals on five dependent variables:

1. Ability to remember, compare and utilize information on a concept attainment task; i.e., overall performance.

   Measure: number of trials to solution

2. Skill in using information about criterial attributes correctly; i.e., use of negative information.

   Measures:

   a. Number of inferences for negative instance trials

   b. Number of hypotheses for negative instance trials

   c. Number of non-utilizations of changed place information

   d. Mean trial for making first inference for negative instance trial.

Table A

Means and Standard Deviations of the Performance Measures by Locus of Control

Model:	Informational		Social	
Support:	Present	Absent	Present	Absent
Measure: Number of Trials to Solution				
Internals				
M	16.00	16.66	12.66	14.66
SD	4.32	4.71	2.77	4.10
Externals				
M	15.66	19.00	14.33	17.60
SD	4.22	.81	4.19	.48
Measure: Number of Inferences, Negative Instance Trials				
Internals				
M	2.66	3.66	3.33	4.00
SD	1.69	1.24	.93	1.72
Externals				
M	1.33	4.66	6.00	2.66
SD	.47	.47	1.63	1.63
Measure: Number of Hypotheses, Negative Instance Trials				
Internals				
M	3.00	1.66	2.33	4.33
SD	1.15	2.30	1.88	.53

Table A (cont'd.)

Model:	Informational		Social	
Support	Present	Absent	Present	Absent
Externals				
M	3.66	3.66	2.66	5.00
SD	1.24	1.88	2.05	0.00
Measure: Number of Non-Utilizations				
Internals				
M	3.00	3.00	5.00	3.00
SD	0.00	0.00	.99	0.00
Externals				
M	2.00	1.00	1.33	1.00
SD	1.41	0.00	.81	0.00
Measure: First Negative Trial Inference				
Internals				
M	2.00	2.00	2.00	2.00
SD	0.00	0.00	0.00	0.00
Externals				
M	5.33	9.00	2.00	9.33
SD	4.22	5.10	0.00	3.69

Additional analysis of the data was accomplished by visual inspection of graphs of the interactions.

A series of separate one-way analyses of variance were used to test the major research hypotheses. The use of a series of tests calls for the adjustment of alpha to control for error experimentwise. Given the exploratory nature of the pilot study, however, the experimenter chose to set alpha at .05 for each of the five analyses to facilitate the location of any existing differences.

Table B

Analysis of Variance of Number of Trials to Solution

Source	df	MS	F*
Locus of Control (LOC)	1	20.16	1.54
Memory/Organization Support (S)	1	32.66	2.50
Model Sociality (M)	1	24.00	1.83
LOC x S	1	4.17	.32
LOC x M	1	1.50	.11
M x S	1	.67	.03
LOC x M x S	1	.17	.01
Within	16	13.09	

*All tests were non-significant at alpha = .05

Table C

Analysis of Variance of Number of Inferences Following Presentation of Negative Instances, Trials 1-10

Source	df	MS	F*
Locus of Control (LOC)	1	1.5	.18
Memory/Organization Support (S)	1	2.66	.32
Model Sociality (M)	1	8.16	.98
LOC x S	1	4.17	.50
LOC x M	1	.67	.08
M x S	1	13.50	1.63
LOC x M x S	1	.67	.08
Within	16	8.28	

*All tests were non-significant at alpha = .05

Table D

Analysis of Variance of Numbers of Hypotheses Following Presentation of Negative Instances, Trials 1-10

Source	df	MS	F*
Locus of Control (LOC)	1	8.17	1.32
Memory/Organization Support (S)	1	1.50	.24
Model Sociality (M)	1	.67	.11
LOC x S	1	2.67	.43
LOC x M	1	.17	.03
M x S	1	1.50	.24
LOC x M x S	1	0.00	0.00
Within	16	6.17	

*All tests were non-significant at alpha = .05

Table E

Analysis of Variance of Non-Utilization of Information, Trials 1-10

Source	df	MS	F*
Locus of Control (LOC)	1	.17	.29
Memory/Organization Support (S)	1	1.50	2.59
Model Sociality (M)	1	0.00	0.00
LOC x S	1	.17	.29
LOC x M	1	.67	.39
M x S	1	0.00	0.00
LOC x M x S	1	.67	.39
Within	16	.58	

*All tests were non-significant at alpha = .05

Table F

Analysis of Variance of the Trial of First Inference Following Presentation of a Negative Instance

Source	df	MS	F
Between			
Locus of Control (LOC)	1	117.04	10.79**
Memory/Organization Support (S)	1	45.38	4.18*
Model Sociality (M)	1	5.04	.46
LOC x S	1	45.38	4.18*
LOC x M	1	3.38	.31
M x S	1	5.04	.46
LOC x M x S	1	5.04	.46
Within	16	10.85	

*$p < .10$

**$p < .01$

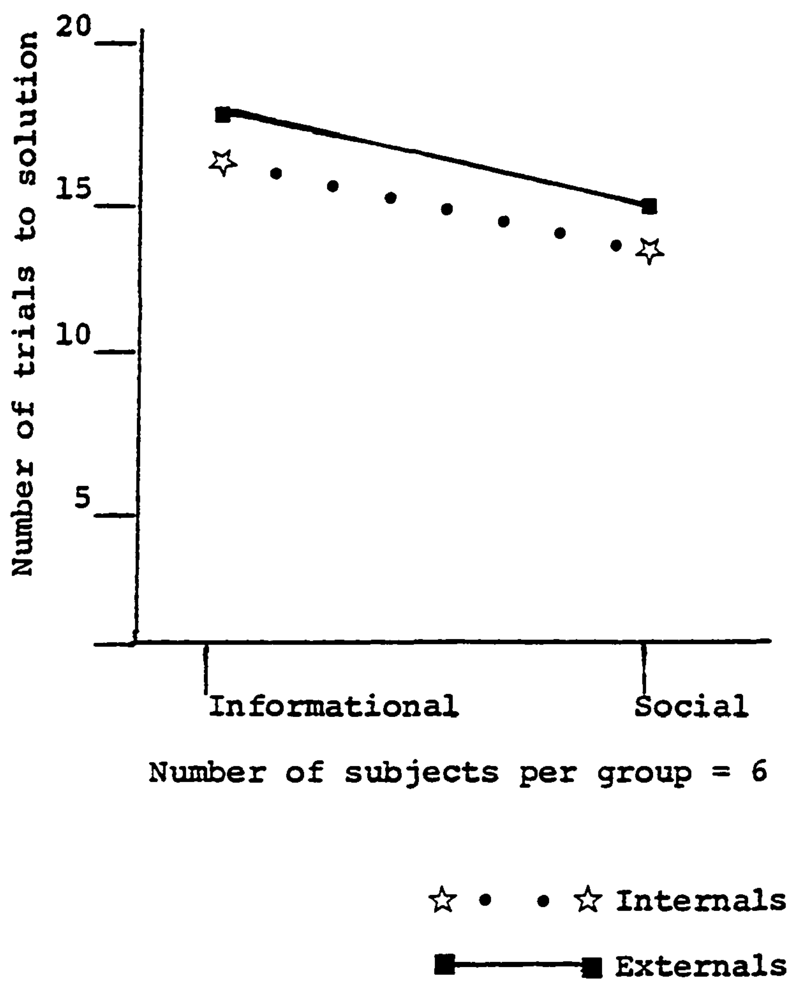
None of the main effects or interactions for the first four measures reached significance. The differences in the mean first trial for inferences about negative instance information were significant for the main effects of locus of control ($F(1,16)=10.79, p < .01$) and memory organization support ($F(1,16=4.18, p < .10$) and the locus of control and memory/organization support interaction ($F(1,16)=4.18, p < .10$).

Additional analysis of the dependent variables was accomplished by visual inspection of graphs of the interaction effects hypothesized. Inspection of the graphs reveals that results, while not reaching significance on the overall F test, were generally in the hypothesized direction. Figures 1 through 10 show the graphic representation of the interactions of interest for the five dependent variables.

Additional analyses of the cell means were accomplished using a multiple t test procedure to perform seven orthogonal comparisons with alpha set at .05 per comparison. Although this procedure inflates the probability of a type I error over the total experiment, the desirability of identifying any differences between the means led to the selection of this alpha level.

Figure 1

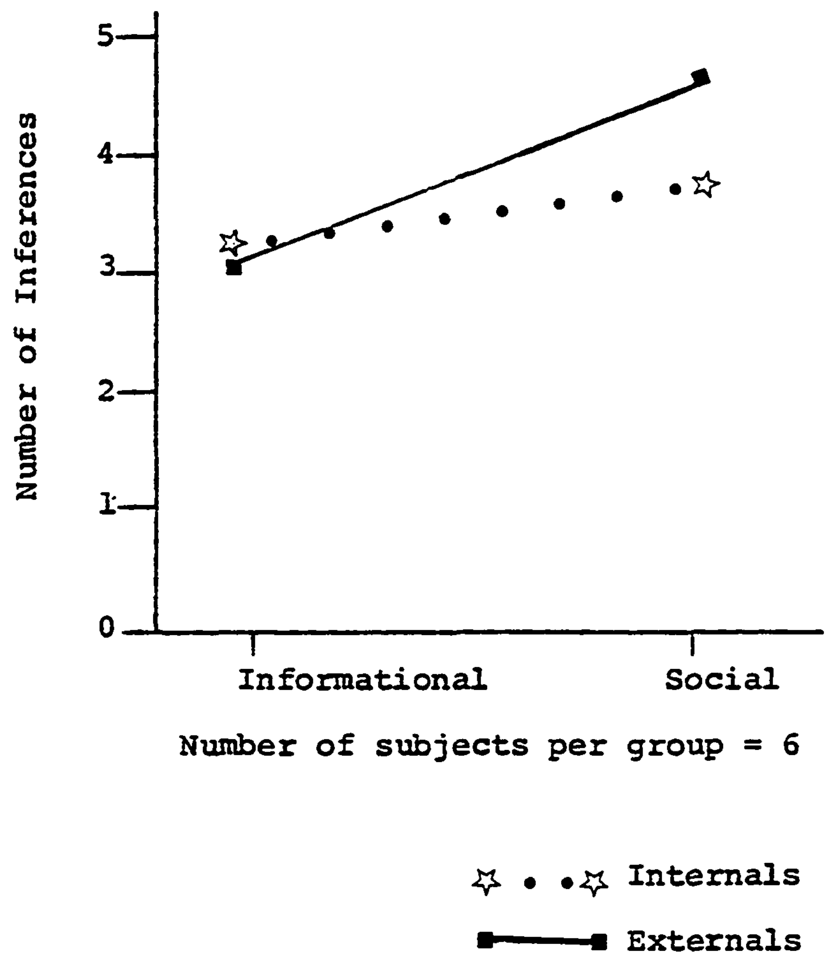
Number of Trials to Solution for Internals and Externals as a Function of Model Sociality[a]



[a]See Table B for analysis of variance.

Figure 2

Number of Inferences Regarding Negative Instances, Trials 1-10, for Internals and Externals as a Function of Model Sociality[a]



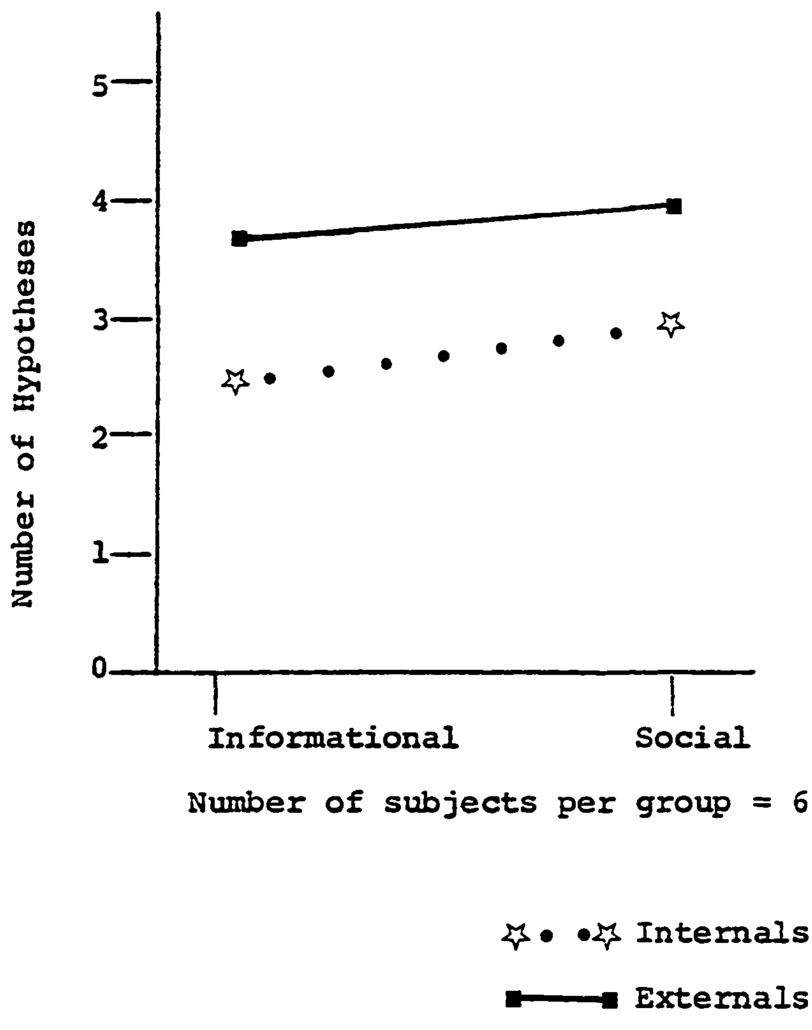
[a]See Table C for analysis of variance.

Figure 3

Number of Hypotheses Regarding Negative Instances,

Trials 1-10, for Internals and Externals as

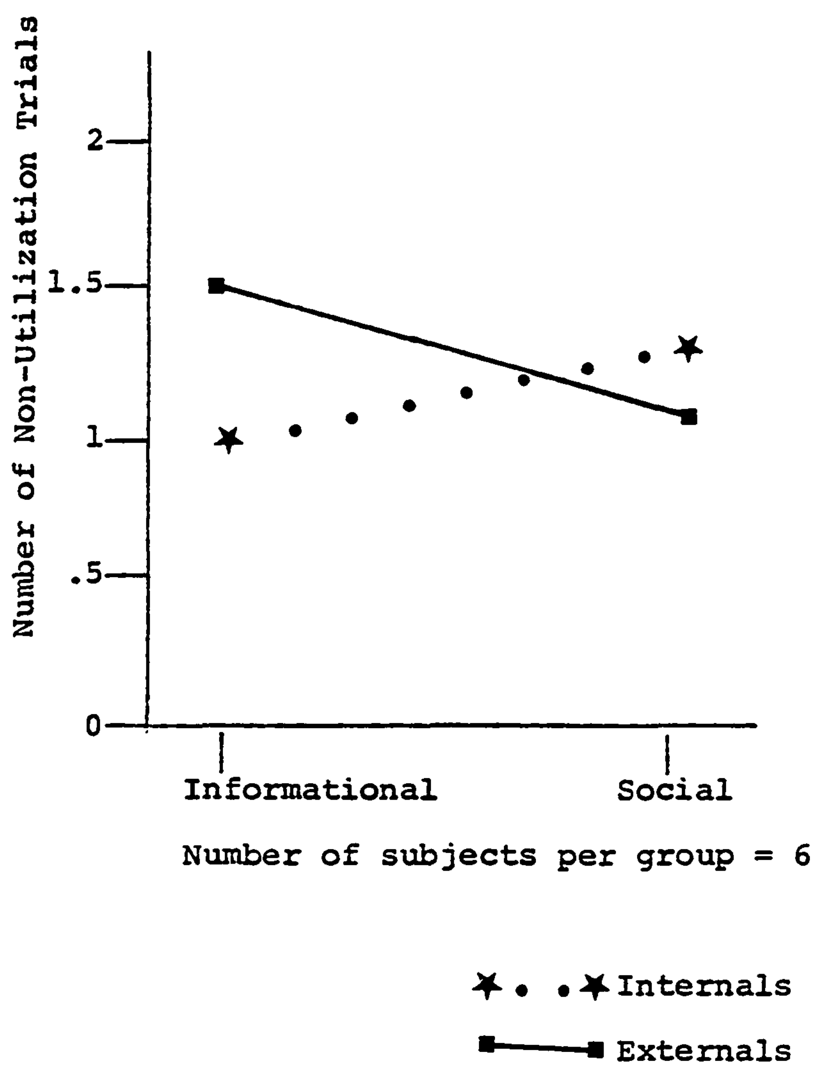
A Function of Model Sociality[a]



[a]See Table D for analysis of variance.

Figure 4

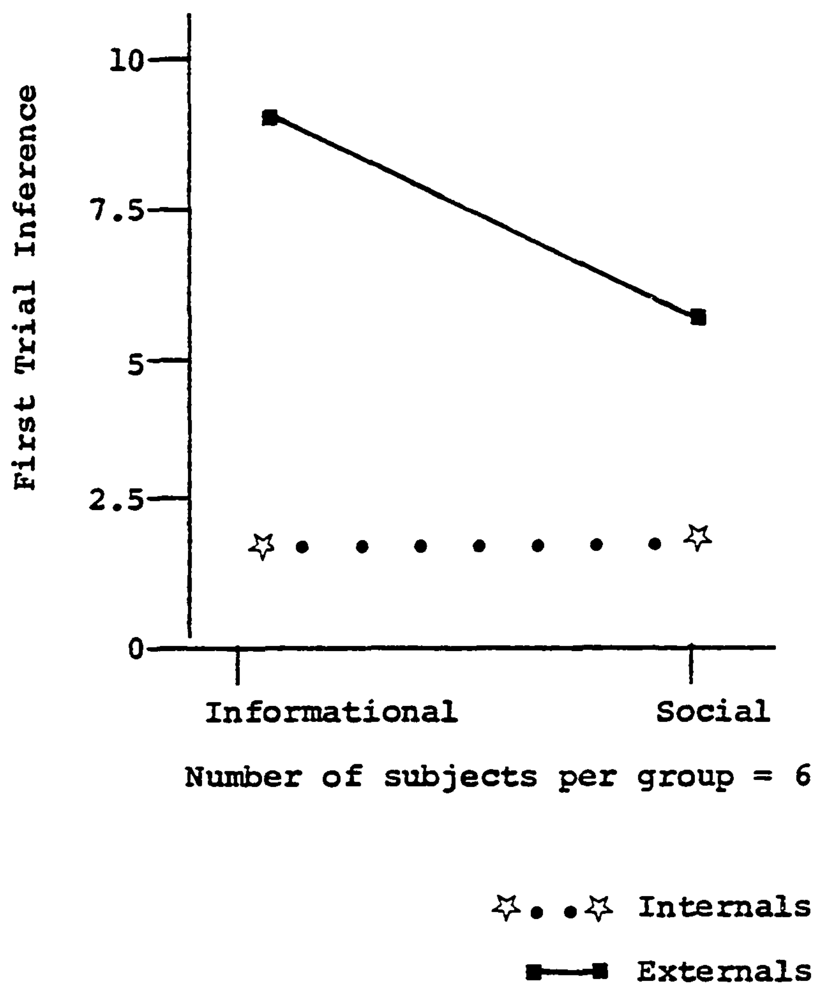
Number of Trials with Non-Utilization of Information for Internals and Externals as a Function of Model Sociality[a]



[a]See Table E for analysis of variance.

Figure 5

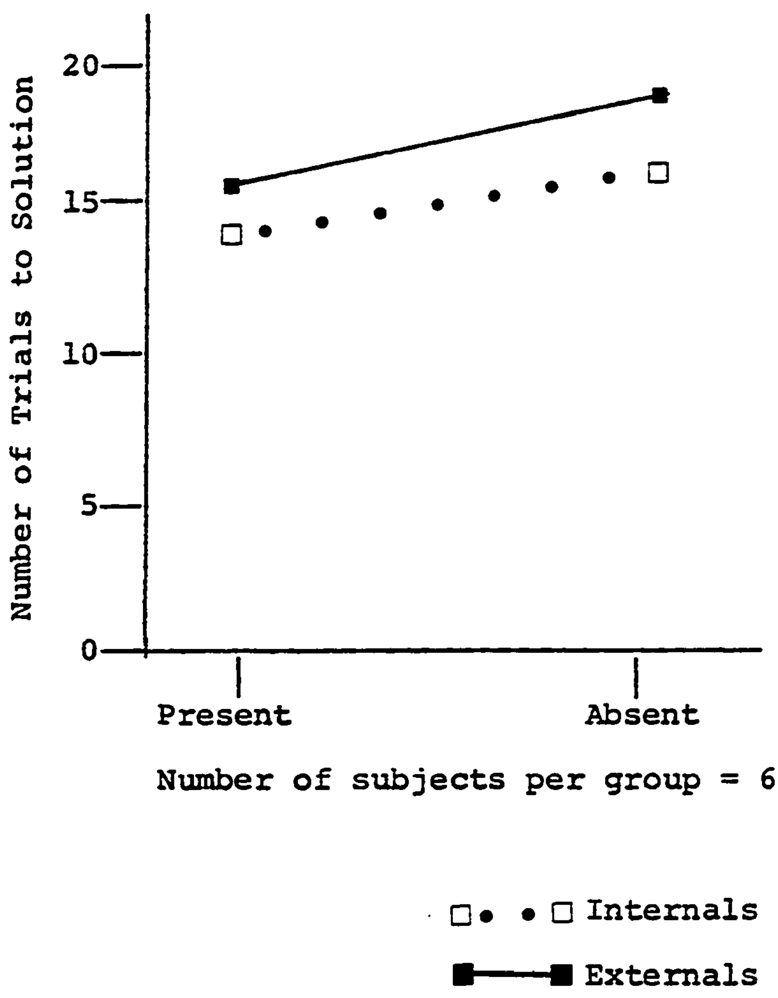
First Trial When Inference Regarding Negative Instance Was Made for Internals and Externals as a Function of Model Sociality[a]



[a]See Table F for analysis of variance.

Figure 6

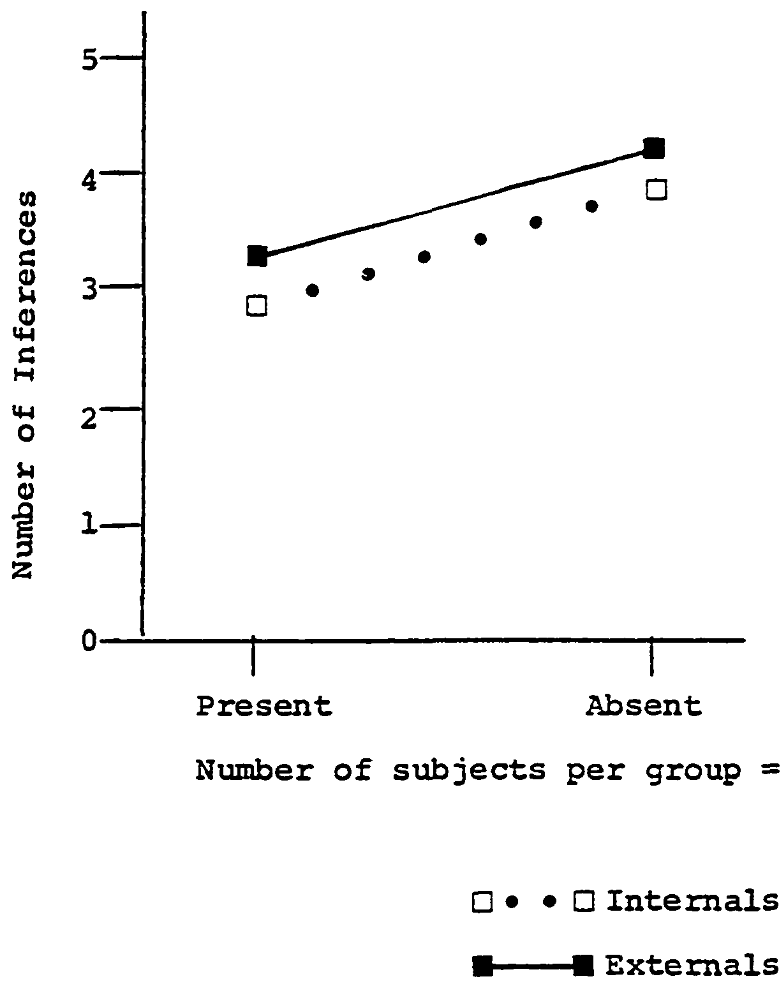
Number of Trials to Solution for Internals
And Externals as a Function of
Memory/Organization Support[a]



[a]See Table B for analysis of variance.

Figure 7

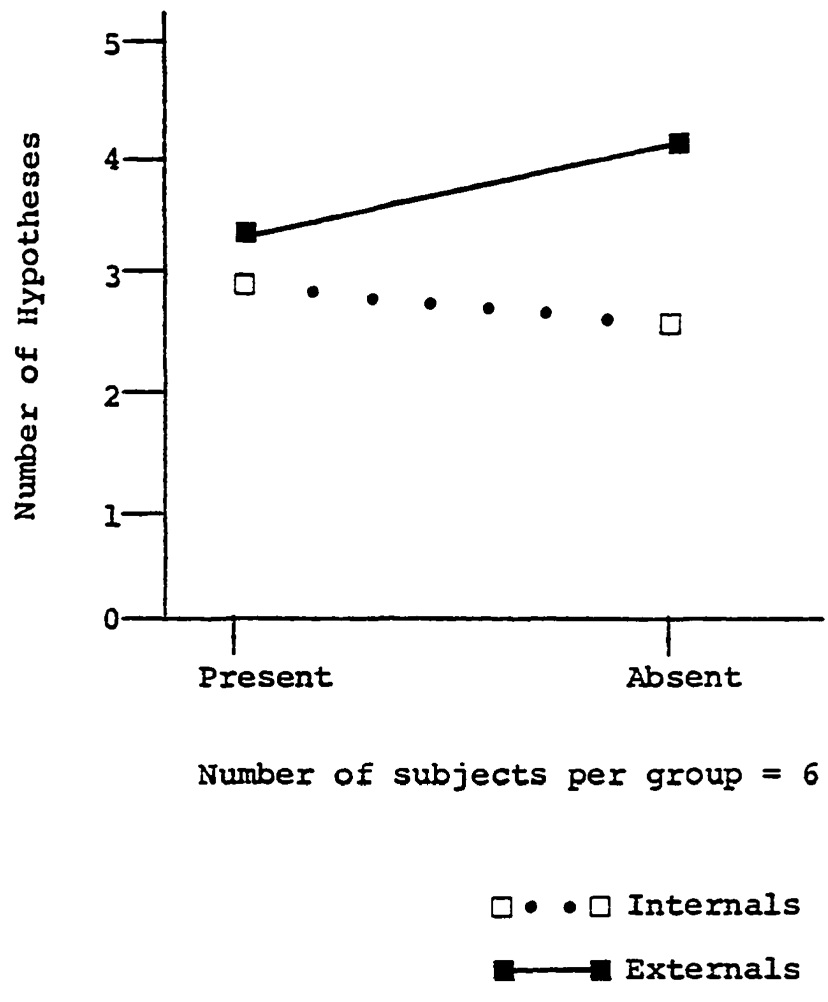
Number of Inferences Regarding Negative Instances, Trials 1-10, for Internals and Externals as A Function of Memory/Organization Support[a]



[a]See Table C for analysis of variance.

Figure 8

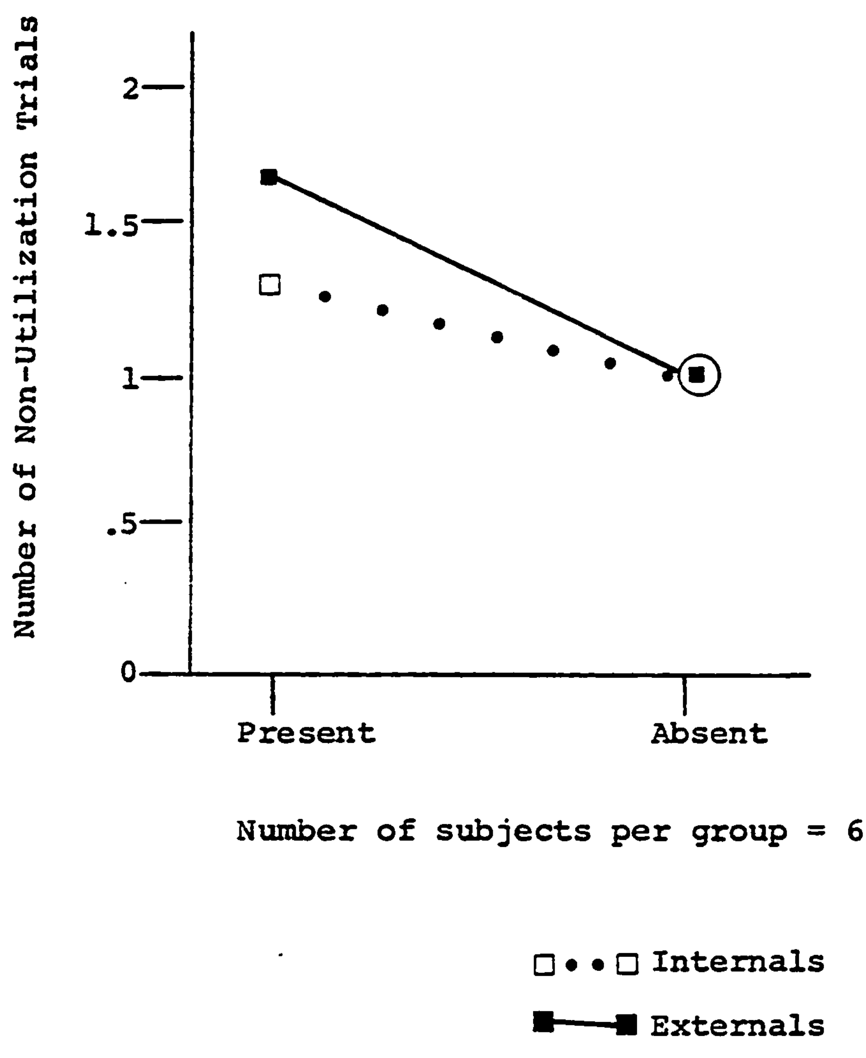
Number of Hypotheses Regarding Negative Instances, Trials 1-10, for Internals and Externals as A Function of Memory/Organization Support[a]



[a]See Table D for analysis of variance.

Figure 9

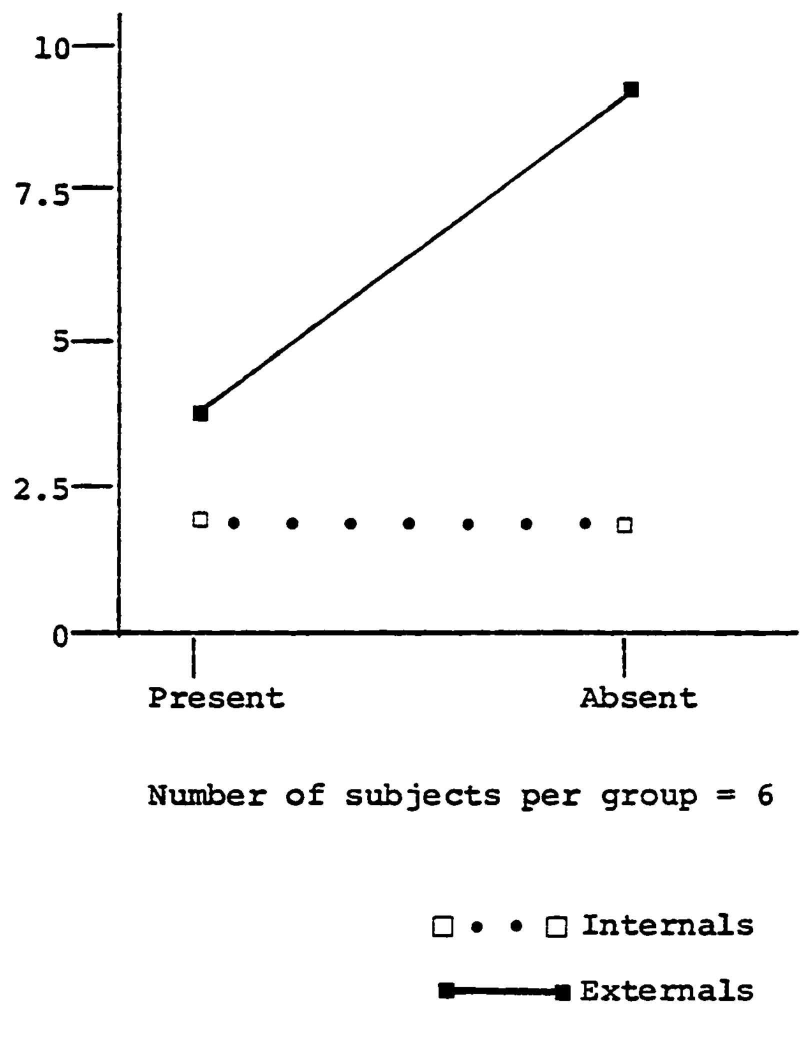
Number of Trials with Non-Utilization of Information For Internals and Externals as a Function Of Memory/Organization Support[a]



[a]See Table E for analysis of variance.

Figure 10

First Trial when Inference Regarding Negative Instance Was Made for Internals and Externals as a Function of Memory/Organization Support[a]



[a]See Table F for analysis of variance.

Table G

Performance of a Concept Attainment Task

As a Function of Model Sociality

Variables	Group	Inf. N=12	Social N=12	*t*
Number of Trials	Internals	16.33	13.66	1.66
	Externals	17.33	16.00	.23
	t	.17	1.85**	
Number of Inferences, Negative Instance Trials	Internals	3.17	3.67	.98
	Externals	3.00	4.83	3.58*
	t	.09	1.62	
Number of Hypotheses, Negative Instance Trials	Internals	2.33	2.83	.61
	Externals	3.67	3.83	.34
	t	1.82	1.66	
Number of Non-Utilizations	Internals	1.00	1.33	1.74**
	Externals	1.50	1.17	.81
	t	.56	.81	
First Negative Trial Inference	Internals	2.00	2.00	-0-
	Externals	8.83	5.67	1.84
	t	5.51*	3.03**	

* $p < .05$, 1-tailed

** $p < .05$, 2-tailed

Table H

Performance of a Concept Attainment Task as a Function of Memory/Organization Support

Variables	Group	Present N=12	Absent N=12	*t*
Number of Trials	Internals	14.33	15.66	.91[a]
	Externals	15.00	18.33	3.96*
	t	.75	6.33*	
Number of Inferences, Negative Instance Trials	Internals	2.83	3.83	1.75[a]
	Externals	3.33	4.17	.74
	t	.14	.28	
Number of Hypotheses Negative Instance Trials	Internals	2.67	2.50	.20[a]
	Externals	3.17	4.33	1.93
	t	.70	2.44*	
Number of Non-Utilizations	Internals	1.33	1.00	7.00[a]
	Externals	1.66	1.00	2.28*
	t	.97	0.00	
First Negative	Internals	2.00	2.00	0.00[a]
	Externals	3.67	9.17	4.43*
	t	2.17**	7.10*	

[a] not tested for significance

*$p < .05$, 1-tailed

**$p < .05$, 2-tailed

Figures 2, 4, 5, and 10 suggest the possible (although nonsignificant in the pilot study) existence of ordinal interactions as specified in the hypotheses. The possible disordinal interaction suggested in Figure 4, as a result of the increased performance of internals under the social model, contrary to the hypothesis, is probably explained by the smallness of the sample and the limited range of the measurement scale.

The direction of the scores for both internals and externals for non-utilization of information (Figures 4 and 9) are contrary to the hypotheses concerning model sociality and the provision of memory/organization support. It is likely that these reflect the small range of scores (1-4) for this measure, which appeared to result from the subjects' tendency (often mistaken) to record something, however helpful or not it might be, on each trial. This problem seriously limits the utility of this measure as an indicator of performance.

Despite the equivalence of the performance of internals and externals on four of the five dependent variables, there were significant differences in performance associated with the various treatment conditions. The performance of internals was unaffected by social modeling, as predicted, in all measures excepting non-utilization. The performance of externals increased, as expected, in the social model condition in terms of an increased number of inferences

($\underline{t}$(df 1,11)=3.58,p$<$.05), while all other differences failed to reach significance. Provision of memory/organization support was found to increase the performance of externals on three measures: trials to solution ($\underline{t}$(df 1,11)=3.96, p$<$.05), non-utilization ($\underline{t}$(df 1,11)=2.28, and mean trial of first inference based on negative instance information ($\underline{t}$(df 1,11)=4.43,p$<$.05).

Significant differences between internals and externals were obtained on at least one dependent variable for each specific prediction. The prediction that the performances of internals would exceed those of externals after receiving an informational model was confirmed in terms of a lower mean trial of first inference ($\underline{t}$(d,22)=5.5,p$<$.05), although results on the remaining measures were not found to be significant. The predicted equivalence of both groups following presentation of a social model was not supported in regard to the mean number of non-utilizations (t(1,22)= 1.85, $\underline{p}<$.025) and the mean trial of first inference (t(1,22)=3.03,$\underline{p}<$.025); significant differences were not found, however, on the three remaining variables.

Predictions that the performances of internals would exceed those of externals without the provision of memory/organization support was confirmed in terms of trials to solution ($\underline{t}$(1,22)=6.33,p$<$.05), mean trial of first inference ($\underline{t}$(1,22)=7.10,p$<$.05), and the mean number of hypotheses formulated ($\underline{t}$(1,22)=2.44,p$<$.05). The equivalence of internals' and externals' performance, given memory/organization support, was generally confirmed by the failure to locate significant differences between the two groups. The earlier inferences by internals ($\underline{f}(1,22)=2.17$, $p<.025$) contradicts this prediction.

Discussion

The pilot study revealed the need for further revision of the materials used to provide memory/organization support. On the basis of experience with the task and materials, the experimenter concluded that the use of complex paper and pencil materials placed excessive demands on the subjects' information processing and competed with the demands of the experimental task, increasing subjects' confusion (and anxiety) according to several subjects. The use of non-numerical instances would also seem desirable.

In spite of the small and heterogeneous sample used in this study, there were indications that trends may be evidenced in at least four of the dependent variables (trials to solution, number of inferences, number of hypotheses, and trial of first inference). As stated in the previous discussion of results, partial support was found for all of the specific comparisons, and for the major hypothesis concerning an interaction between locus of control and the provision of memory/organization support. Although the analyses of variance did not provide conclusive evidence of the hypothesized interactions, visual inspection of the graphed interactions in most cases supported the predictions concerning the direction in which differences would occur.

The results of this pilot study provide limited support for the assumption of an interaction between locus of control, model sociality, and the provision of memory/ organization support in a concept attainment task. This suggests that a more extensive investigation, using a larger sample from a homogeneous population and more powerful statistical techniques, is merited.

APPENDIX C

The Rotter Internal-External Control Scale

THE ROTTER INTERNAL-EXTERNAL CONTROL SCALE

This is a questionnaire to find out the way in which certain important events in our society affect different people. Each item consists of a pair of alternatives lettered a or b. Please select the one statement of each pair (and only one) which you more strongly believe to be the case as far as you are concerned. Be sure to select the one you actually believe to be more true rather than the one you think you should choose or the one you would like to be true. This is a measure of personal belief; obviously, there are no right or wrong answers.

Your answers to the items on this inventory are to be recorded on a separate answer sheet which is loosely attached to the questionnaire. REMOVE THIS ANSWER SHEET NOW. Print your name and any other information requested by the examiner on the answer sheet, then finish reading these directions. Do not proceed to the questionnaire until you are told to do so.

Please answer these items carefully but do not spend too much time on any one item. Be sure to find an answer for every choice. Find the number of the item on the answer sheet and circle the letter which most closely corresponds to the alternative you selected as most true.

In some instances you may discover that you believe both statements or neither one to be true. In such cases, be sure to select the one which you most strongly believe to be the case as far as you are concerned. Also try to respond to each item independently when making your choice; do not be influenced by your previous choices.

QUESTIONNAIRE

1. a. Children get into trouble because their parents punish them too much.
   b. The trouble with most children nowadays is that their parents are too easy with them.

2. a. Many of the unhappy things in people's lives are partly due to bad luck.
   b. People's misfortunes result from the mistakes they make.

3. a. One of the major reasons why we have wars is because people don't take enough interest in politics.
   b. There will always be wars, no matter how hard people try to prevent them.

4. a. In the long run people get the respect they deserve in this world.
   b. Unfortunately, an individual's worth often passes unrecognized no matter how hard he tries.

5. a. The idea that teachers are unfair to students is nonsense.
   b. Most students don't realize the extent to which their grades are influenced by accidental happenings.

6. a. Without the right breaks one cannot be an effective leader.
   b. Capable people who fail to become leaders have not taken advantage of their opportunities.

7. a. No matter how hard you try some people just don't like you.
   b. People who can't get others to like them don't understand how to get along with others.

8. a. Heredity plays the major role in determining one's personality.
   b. It is one's experiences in life which determine what they're like.

9. a. I have often found that what is going to happen will happen.
   b. Trusting to fate has never turned out as well for me as making a decision to take a definite course of action.

10. a. In the case of the well prepared student there is rarely if ever such a thing as an unfair test.
    b. Many times exam questions tend to be so unrelated to course work that studying is really useless.

11. a. Becoming a success is a matter of hard work, luck has little or nothing to do with it.
    b. Getting a good job depends mainly on being in the right place at the right time.

12. a. The average citizen can have an influence in government decisions.
    b. This world is run by the few people in power, and there is not much the little guy can do about it.

13. a. When I make plans, I am almost certain that I can make them work.
    b. It is not always wise to plan too far ahead because many things turn out to be a matter of good or bad fortune anyway.

14. a. There are certain people who are just no good.
    b. There is some good in everybody.

15. a. In my case getting what I want has little or nothing to do with luck.
    b. Many times we might just as well decide what to do by flipping a coin.

16. a. Who gets to be the boss often depends on who was lucky enough to be in the right place first.
    b. Getting people to do the right thing depends upon ability; luck has little to do with it.

17. a. As far as world affairs are concerned, most of us are the victims of forces we can neither understand nor control.
    b. By taking an active part in political and social affairs the people can control world events.

18. a. Most people don't realize the extent to which their lives are controlled by accidental happenings.
    b. There really is no such thing as "luck."

19. a. One should always be willing to admit mistakes.
    b. It is usually best to cover up one's mistakes.

20. a. It is hard to know whether or not a person really likes you.
    b. How many friends you have depends upon how nice a person you are.

21. a. In the long run the bad things that happen to us are balanced by the good ones.
    b. Most misfortunes are the result of lack of ability, ignorance, laziness, or all three.

22. a. With enough effort we can wipe out political corruption.
    b. It is difficult for people to have much control over the things politicians do in office.

23. a. Sometimes I can't understand how teachers arrive at the grades they give.
    b. There is a direct connection between how hard I study and the grades I get.

24. a. A good leader expects people to decide for themselves what they should do.
    b. A good leader makes it clear to everybody what their jobs are.

25. a. Many times I feel that I have little influence over the things that happen to me.
    b. It is impossible for me to believe that chance or luck plays an important role in my life.

26. a. People are lonely because they don't try to be friendly.
    b. There's not much use in trying too hard to please people, if they like you, they like you.

27. a. There is too much emphasis on athletics in high school.
    b. Team sports are an excellent way to build character.

28. a. What happens to me is my own doing.
    b. Sometimes I feel that I don't have enough control over the direction my life is taking.

29. a. Most of the time I can't understand why politicians behave the way they do.
    b. In the long run the people are responsible for bad government on a national as well as on a local level.

APPENDIX D

Instructional Materials and Equipment:

The Pilot Study

Instructional Materials and Equipment: The Pilot Study

Materials to be Used in the Informational Model Treatment

A two page typewritten paper will be provided to each subject in this condition. This paper is included in Appendix I.

Materials to be Used in the Social Model Treatment

A half inch black and white videotape recording, ten minutes in length, of a "live" model's performance of a concept attainment task will be viewed by the subjects receiving the social model condition (see Appendix J). Compatible monitor and playback equipment will be used.

Criteria for Instructional Materials to be Used

In order to provide two treatment conditions which are equated in all respects excepting that which is the treatment variable, namely the extent of social cueing in the model presentation, the following criteria were established for the written model and the videotaped model:

Equated: level of terminology used
information provided (content)
length of presentation (viewing time/average reading time)
amount of preprocessing of information; i.e., preorganization of material

Social Cueing (Present in Social Model, Absent in Informational Model):
emphasizes source of information is a "real"

person

encourages identification with model

implies social approval of effort/success at task

focuses on another person's thought processes and reactions as opposed to an abstract "ideal" process

The evaluation of these materials by judges is reported in the Pilot Study (see Appendix B).

The selection of a videotape format for presentation of the social model was selected on the basis of two considerations: convenience and the need to insure consistency in presentations across experimental occasions. It is noted, however, that the use of different formats (videotaped and written) might produce confounding effects making interpretation of results difficult. Any differential effects occurring as a result of the different formats could be attributed to such factors as learner preference for aural/visual mode, reading ability, different amounts of conceptual organization (preprocessing) in the presentations, or time spent interacting with materials. As the degree of preprocessing provided and time available have been equated by procedural manipulations, these factors are not of great concern. To the extent which one can assume that undergraduate university students can read at the relatively simple level of the materials provided, reading ability can be ruled out as an extraneous factor. Studies of locus of control in learning situations have not provided support for the notion of differential reading ability or intelligence. Although no studies have been reported which provide a test for a possible relationship between locus of control and preference for mode of presentation, locus of control theory does not suggest such a relationship. While experimental constraints requiring videotape presentation of the social model as well as the need to utilize an informational model low in social cueing necessitate the use of different formats in this study, there is no reascn to suspect effects other than those which are the focus of this study.

Materials to be Used in the Memory/Organization Support Condition

Subjects in both treatment conditions will utilize a specially designed notebook for receiving the presentation of task stimulus material and for recording their hypotheses and inferences. The spiral notebook, bound at the top, measures 1.1 cm x 1.4 cm. When opened it provides viewing of two pages simultaneously. On the top page is typed the cumulative list of instances for the appropriate trial, and on the bottom page is an easily removable scoring sheet (72 mm. x 72 mm.) for hypotheses and inferences and a 72 mm. x 32 mm. frame for the indication of guesses for the total concept. Each page contains the trial number.

A memory support board, constructed of heavy weight poster board, will be provided for subjects in the memory support condition. This board will measure 3 cm. x 3.75 cm. and will be scored into twenty sections, one for each trial. Each section will contain an adhesive dot to secure the scoring sheets removed from the notebook and placed on the board at the end of each trial.

APPENDIX E

Design Paradigm

Design Paradigm

	Blocks		Group	Schedule of Treatment	Experimental Events: Model Treatment	Experimental Events: Memory Support Treatment and C-A Post
L_1	B_1	R_2	E_{11}	R_2	X_1	$X_3 + M_1$
			E_{12}	R_2	X_1	$X_4 + M_2$
	B_2		E_{21}	R_2	X_2	$X_3 + M_3$
			E_{22}	R_2	X_2	$X_4 + M_4$

L_1 - Pretest administration, Rotter Internal-External Scale.

B_1 - Block 1, internals.

B_2 - Block 2, externals.

R_1 - Individual Ss are randomly assigned to treatment conditions.

R_2 - Ss are randomly scheduled to receive experimental occasions.

E_{11} - Ss receive experimental treatment in which an informational model is provided, and a concept attainment post-test without memory support.

E_{12} - Ss receive experimental treatment in which an informational model is provided, and a concept attainment post-test with memory support provided.

E_{21} - Ss receive experimental treatment in which a social model is provided, and a concept attainment post-test without memory support.

E_{22} - Ss receive experimental treatment in which a social model is provided, and a concept attainment post-test with memory support provided.

X_1 - Experimental treatment in which a written informational model is provided.

X_2 - Experimental treatment in which a videotaped social model is provided.

X_3 - Experimental treatment in which no memory support is provided.

X_4 - Experimental treatment in which memory support is provided.

M_1, M_2, M_3, M_4 - Administration of concept attainment task as a post-test.

APPENDIX F

Correct Hypotheses and Inferences for Each Stimulus Situation

Correct Hypotheses and Inferences for each Stimulus Situation

History	Positive Instance		Negative Instance	
	Changed Place	Unchanged Place	Changed Place	Unchanged Place
Place previously changed on (+) instance.	*	Hypothesis: P is probably not part of concept.	*	Hypothesis: P is probably not part of concept.
Place previously changed on (-) instance.	*	Hypothesis: P is probably part of concept.	*	Hypothesis: P is probably part of concept.
Place never previously changed.	Inference: P is not part of concept.	Hypothesis: P is probably part of concept.	Inference: P is part of concept.	Hypothesis: P is probably not part of concept.

*Indicates that this situation never occurs.

Note: Adapted from Wickelgren, W. A., & Cohen, D. H. Concept attainment and artificial language. *Psychological Reports*, 1962, *10*, 821. Copyright 1962 by Southern Universities Press. Reprinted by permission.

APPENDIX G

Schedule of Instances for Trials 1 to 10

Schedule of Instances for Trials 1 to 10

Trial	Instance	Example(+) Not Example(-)	Changed Place	Record	Optimal Inference (from Changed Places)	Hypotheses (Unchanged Places: Probabilistic Statements)
1	76838916	+	(focus)	x	-	-
2	76837916	-	P5	x	P5 is C	P1,2,3,4,6,7,8 are not C
3	26838916	+	P1	x	P1 is not C	P2,3,4,6,7,8 are C
4	74838916	-	P2	x	P2 is C	P3,4,6,7,8 are not C
5	76838926	+	P7	x	P7 is not C	P3,4,6,8 are C
6	73818916	-	P2, P4	-	ignore	P3,6,8 are not C
7	56838906	+	P1, P7	-	ignore	P3,6,8 are C
8	76828916	-	P4	x	P4 is C	P3,6,8 are not C
9	76038816	+	P3, P6	x	P3 & P6 not C	P8 are C
10	76838913	-	P8	x	P8 is C*	-

Concept is 6 in P2, 3 in P4, 8 in P5, 6 in P8.

Note: Adapted from Wickelgren, W. A., & Cohen, D. H. Concept attainment and artificial language. Psychological Reports, 1962, 10, 820. Copyright 1962 by Southern Universities Press. Reprinted by permission.

APPENDIX H

Instructions to Subjects:

The Pilot Study

Instructions to Subjects: The Pilot Study

1. Instructions spoken to subjects upon entering and being seated at a desk:

The purpose of this experiment is to examine the different ways in which people work a special kind of problem solving task called a concept attainment task. The first thing you will do is (read a paper/see a videotape) which will give you a general idea about how to go about solving the concept attainment task. You will be given more specific instructions just before you start the task. Before we go any further I'd like to remind you that I won't be able to give you any help or answer any questions during the experiment. Don't worry if everything isn't perfectly clear to you at first. The whole session should take about thirty minutes and I will be happy to answer any questions you have at the end of the session. Now please (read/watch) this and let me know when you are through, OK?

2. Instructions given after subject has completed the paper/videotape:

Now you are ready to begin the concept attainment task. Before you start I want to explain just how it works. The task is like the one you saw/read about, except it is more difficult. You will be shown a series of eight-digit numbers, like these, two at a time. The first one will always be an example of the concept marked with a plus sign. The second can either be another example, or not an example. If it is *not* an example, it will have a minus sign. The concept will be something like this:

the number 1 in place 1

the number 4 in place 3

the number 9 in place 8

So, any number which has a 1 in the first place, a 4 in the third place, and a 9 in the eighth place would be an example of this concept, regardless of what numbers were in the other places. To solve the task you must discover *how many* and *which places* are part of the concept, but you won't know in advance how many of these places are important.

When you open the booklet to the first page, at the top you will see the first examples and non-examples. Compare them carefully, and then complete the sheet on the bottom page. In the row marked MAYBE, write in your ideas as to what numbers in which places you suspect *might be* part of the concept. For example, if you think a 3 in the first place is *probably* part of the concept, your answer should look like this:

MAYBE:	3							
	1	2	3	4	5	6	7	8

In the row marked CERTAIN, write in the appropriate place the numbers which you are <u>sure</u> are part of the concept:

CERTAIN:	___	___	4	___	___	___	___	___
	1	2	3	4	5	6	7	8

When you think you have had enough information and have discovered the <u>entire</u> concept, write it in the space on the right side of the page and call for me to come and check it. If you have not guessed correctly, you will be asked to continue the task. Remember: LEAVE THIS SPACE BLANK if you don't think you know the correct answer yet.

<u>No Memory/Organization Support Subjects Only</u>

When you have completed the bottom half of the page, remove your answer sheet from its holder and place it in the box in front of you. AFTER YOU HAVE PLACED THE CARD IN THE BOX, turn to the next page and proceed as before until you have guessed the concept and called for me to check it. If you finish the booklet before guessing the concept, write your best guess on the last page and call me for additional instructions.

<u>Memory/Organization Support Subjects Only</u>

When you have completed the bottom half of the page, remove your answer sheet from its holder and place it face up over the square marked with the same number on the board on the table. You may use this any time you wish, as it will help you to keep track of your hunches. If you finish the booklet before guessing the concept, write your best guess on the last page and call me for additional instructions.

<u>All Subjects</u>

You may keep this card in front of you while you work to remind you of the five steps you must follow:

1. Open booklet to page 1 and compare the numbers.
2. Record your ideas on the bottom half of the page in the appropriate section.
3. Remove the answer sheet and place it
   No Support Subjects: in the box;
   Support Subjects: face up on the Memory Board.
4. Repeat these steps for the remaining pages or until you've discovered the concept. As soon as you think you have figured out the concept, write it in the TOTAL CONCEPT column and call the examiner.
5. If you've finished the booklet, write your best guess for the total concept on the last page and call the examiner.

APPENDIX I

Informational Model:

The Pilot Study

Informational Model: The Pilot Study

The act of categorizing or classifying objects or events is thought to be one of the most basic and important elements in human thought. Without this ability to group "things" that are alike together, one would not know how to respond to each new thing he encountered in the environment.

Consider the concept, or category, of cats. How would someone who had never heard of a cat learn what a cat is? What do all cats have in common? For example, four legs, whiskers, and a tail. But given this definition, how could one tell a cat from a dog? It too has four legs, whiskers, and a tail. To do this one must not only know what all cats have in common, but also how they differ from other four-legged animals with whiskers and tails; e.g., a cat meows.

To summarize, the basic act of learning a concept involves asking two types of questions:

> If we use the symbols A and B to stand for two members of a class (e.g., cats), how are they alike . . . . what properties do they share?
>
> Then, how are A and B different from C (things which aren't cats)?

One interesting finding in several studies of concept learning is that many people compare examples of the concept to discover their common properties, but fail to pay much attention to the ways in which an example differs from a non-example. This happens even though it is throwing away half of the information available.

Consider the following example: The task is <u>to identify what properties determine the concept</u>, that is, what do the examples have in common which distinguishes them from the non-examples?

If the word

PORE is an <u>example</u> of the concept;

PARE is <u>not an example</u> of the concept;

SORE is an <u>example</u> of the concept;

PART is <u>not an example</u> of the concept.

Is the word MOLE an example of the concept?

CLUE: The concept is defined by the <u>joint</u> presence of two properties . . . a certain letter in a certain place in the word.

YES, the word MOLE is an example of the concept. The concept is words that end with the letter "E" and have the second letter "O."

Here is the way that comparing examples and non-examples can be used to arrive at the correct definition of the concept:

Word	Example(+) Not Example(-)	Decide
PORE	(+)	
PARE	(-)	Since it's the only one that differs, the second letter must be part of the concept, and it must be "O" since that's what it is in the example.
SORE	(+)	Since one example starts with an S and one starts with a P, the first letter can't be important to the concept.
PART	(-)	Since the last letter is different from both of the examples (PORE and SORE), it must be part of the concept. So, the concept is "words with the second letter "O" and the fourth letter "E". So MOLE must be an example of the concept.

When doing a concept learning task, it is important to remember to use <u>all</u> the information . . . from examples and non-examples alike.

APPENDIX J

Videotape Script for the Social

Model: The Pilot Study

Videotape Script for the Social Model: The Pilot Study

Title: Concepts

Audio Portion	Video Portion
(Experimenter): Christa, I'd like to start by thanking you for agreeing to make this videotape about concept formation. As I explained before, what we're going to do is have you work a very simple concept attainment task after I've reviewed a few basic ideas about concepts.	Experimenter and Subject
Before we start, I'd like to point out a couple of things about concepts. First, forming a concept involves classifying things into categories based on what they have in common. For example, how would you teach a child who had never seen a	Experimenter
cat what cats were? You'd probably start by describing the common characteristics or properties of cats . . . . they are four-legged animals with whiskers and a tail. But then he sees a dog and says "cat." The second thing you have to do in learning any concept is to figure out how cats are different from other four-legged animals.	Experimenter and Subject
Let me summarize . . . to learn a concept you have to ask two kinds of questions: First, if you let A and B stand for examples of a concept, or members of a class--for example cats, in what ways are they alike, what properties do they share? But the second question is just as important . . . in what ways are A and B different from C, that is, things	Experimenter
that aren't cats? People usually pay close attention to how two examples are alike, but they often ignore the ways in which examples differ from non-examples . . . . even when it means they're throwing away half the information they need.	Experimenter
Now, Christa, I'm going to give you a simple task. Your job is to identify the properties which determine the concept; that is, what do the examples have in common which distinguishes them from the non-examples?	Experimenter and Subject

Audio Portion	Video Portion
On these cards and on the board are five words . . . . two that are examples of the concept (they're the ones marked with the plus signs) and two which are not examples, the ones with the minus signs. The last word, MOLE, you have to decide whether or not is an example of the concept. I'll give you a clue: the concept is determined by the *joint* presence	List of Words PORE (+) PARE (-) SORE (+) PART (-) MOLE ?
of two properties . . . certain letters in certain places in the word. Let me remind you to pay close attention to the non-examples as well as the examples.	Experimenter and Subject
Why don't you think out loud while you're working so that we can follow your reasoning?	Subject
(Subject): Well, let's see . . . . PORE is an example but PARE isn't. Since the only difference between them is the second letter that must be important. OK . . . so the second letter has to be part of the concept and it has to be an	List of Words
"O" since that's what it is in the example, so part of the concept must be words that have the second letter "O".	Subject
The third word is SORE and it's an example. What does that tell me . . . well, it could mean that the "O", "R", and "E" are important. But it can't be the first letter. Hmmmmh . . .	List of Words
so far I know it has an "O" for the second letter and the first letter can't matter. Now PORT is *not* an example . . . . this is harder.	Subject
Let's see, how is it *not* like PORE and SORE? The first and *last* letters are different, and I already know that the first letter isn't part of the concept so it must be the last letter	List of Words
it should be "E". OK, what is the concept . . . . it has to be a word that has an "O" for the second letter and ends in "E", so MOLE must be an example. OK, I'll say yes. How did I do?	Subject

Audio Portion	Video Portion
(Experimenter): Very well! MOLE is an example of the concept and I think you seemed to be using information from the non-examples just as well as you were using the examples.	Experimenter
Christa, thanks again for helping make the videotape for this project.	Experimenter and Subject

APPENDIX K

Apparatus

APPARATUS

Instructional materials and apparatus used in this study include a brief paper (informational model), a videotape (social model), and a microcomputer system for presentation of the experimental task. Materials and equipment are described as follows:

Informational Model: a seven-page typewritten paper describing an efficient cognitive strategy for concept attainment and providing instructions for solving the experimental task. This paper is included as Appendix L.

Social Model: a 3/4-inch black and white videotape recording (cassette), twelve minutes in length, of the experimenter's instructions and a "live" model's performance of the experimental task. A J.V.C. 5000 playback unit with a Sony KU 1210 receiver housed in a carrell was used for viewing of the videotape. (See Appendix M for videotape script.)

In order to provide models varying only in the extent of social cueing involved in the model presentation, the materials used in the information and social models were equated in regard to the level of terminology used, informational content, length of presentation (average reading time/viewing time), and amount of preprocessing, i.e., preorganization, of the information presented.

An Apple II microcomputer was used to administer the experimental task to subjects. The Apple II is a self-contained computer utilizing a microprocessor unit (large scale integration circuit). Special features included: a video display including text and color graphics, 32 bytes of memory (2 RAM), keyboard, audiocassette for storage of program and data, and a rotary hand control with pushbutton for selection of alternatives. A 19-inch Sony KU 1920 receiver was utilized for presentation of the visual displays (see Figure 11). A Centronics 779 Printer was used to provide hard copy data on the subjects' performance.

The software utilized in this experiment consisted of a program (see Appendix N) which utilized a game-like format with presentation of stimulus items, two rows of eight colored dots, in the upper center of the screen. After presenting the stimulus items, which are designated as either examples or non-examples of the concept, the computer instructs the subject, using text on the lower display screen, to "Guess, or Press P" (P for pass), as shown in Figure 12. Pressing P is recorded as a non-utilization of information and advances the subject to the next trial. To guess, the subject rotates the knob on the rotary hand control until the dot hypothesized as a criterial or non-criterial attribute begins to flash off and on. The button on the control knob is depressed to record the selection and to advance to the next question.

The computer then asks, "Is it Part of the Rule? Y or N." After the subject has depressed the Y or N key on the keyboard, "Are You Sure? Y or N" appears as the text. A response of Y indicates an inference (certainty) while N indicates an hypothesis or provisional statement. The query, "Are You Ready To Guess The (Total) Rule? Y or N" then appears. If the subject's response is N, the program proceeds to a new trial; if Y, the subject enters selections with the hand control. If the guess is incorrect, a new trial automatically appears. Twenty trials are provided to the subject. Following the correct entry, the subject is rewarded with a visual display reading "YOU GOT IT!!!!!!!!!!!!!" and a message from the examiner thanking the subject for participating.

Subjects in the memory support condition received a cumulative graphic display of their previous hypotheses and inferences concurrently with the stimulus items (see Figure 13). This record of earlier responses was organized in two sections titled "Sure" and "Not Sure." Included in each section were two rows of dots. The top row provided a visual standard and was identical to the top row of the stimulus item, which remained unchanged throughout the twenty trials. The bottom row of dots in the memory support section was presented in Trial 1 as eight white dots. As the subject selected a dot as a criterial attribute, the corresponding white dot automatically changed to the color selected. Selection of non-criterial attributes resulted in the elimination of that dot from the display. These changes occur in the section reflecting either the hypothetical or inferential nature of the subject's decision.

The computer provided a visual display, in alphanumeric format, of the subject's responses at the end of each task (see Figure 14). This summary of responses, which was stored on audiocassette for later print-out, included, on a trial by trial basis: trial number, stimulus items by hypotheses and inferences for each trial indicating whether they were selected as criterial or non-criterial attributes, and correct and incorrect guesses of the rule.

Figure 11

Microcomputer Unit and Video Receiver

Utilized in Experimental Task

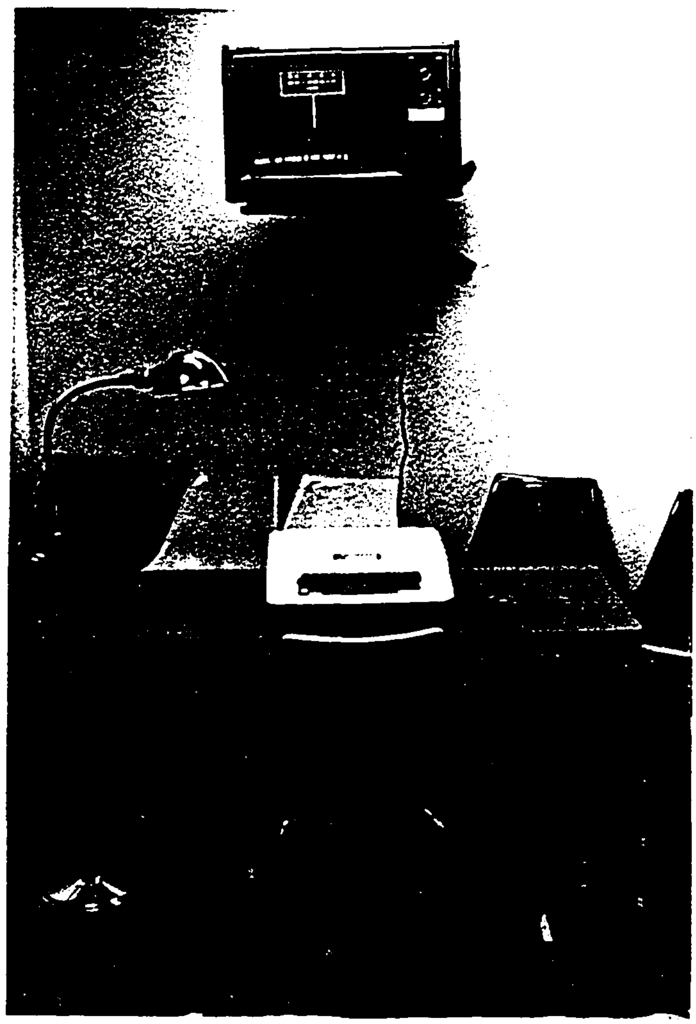


Figure 12

Visual Display of Initial Stimulus Items:

No Memory Support Condition

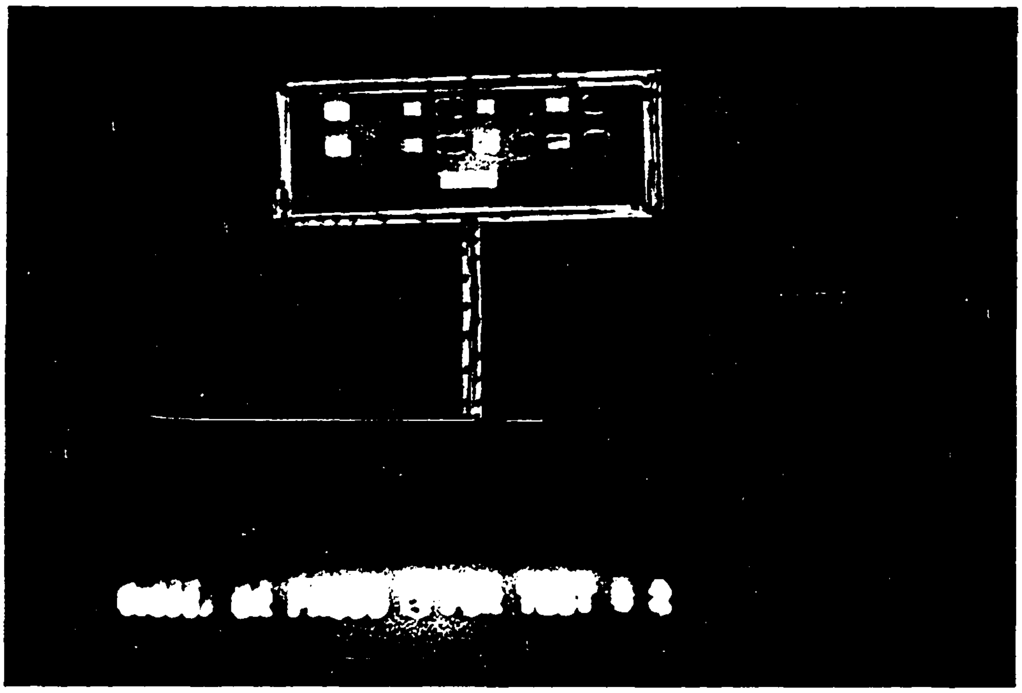


Figure 13

Visual Display: Memory Support Condition

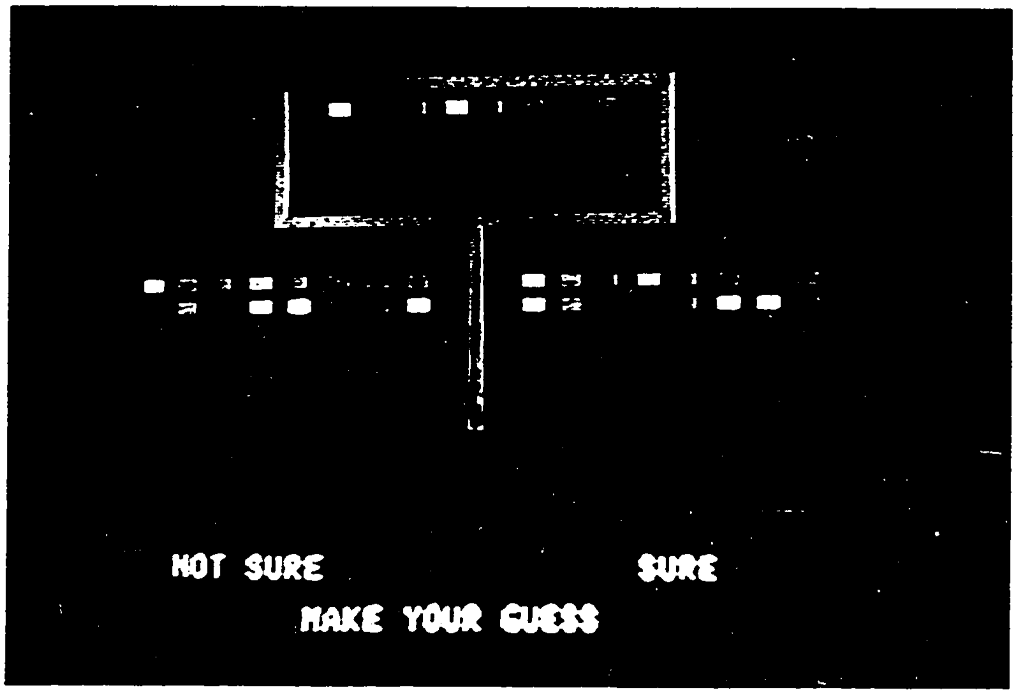
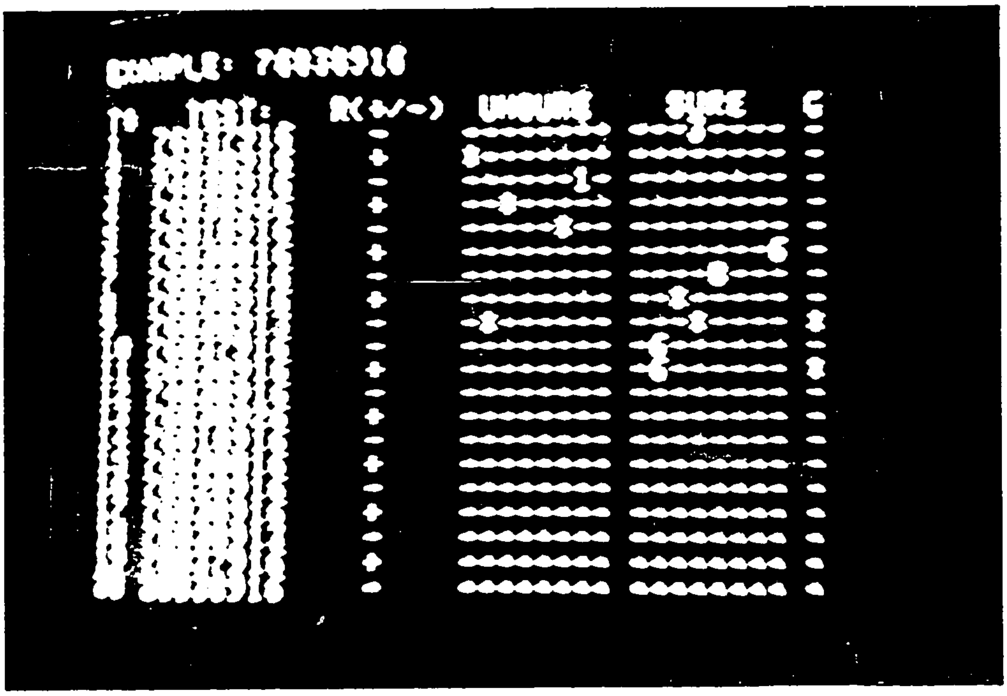


Figure 14

Alphanumeric Display of Subject's Data



APPENDIX L

Informational Model

INSTRUCTIONS FOR PLAYING THE FAX GAME

The act of categorizing or classifying objects or events is one of the most important aspects of human thought. A concept refers to a category or class of things which are alike in some important ways.

An object cannot be a member of the category unless it shares with other members of that category some important properties--it is these shared properties which define the category. For example, the category "lemon" might be defined by the following properties which all lemons have; i.e., those properties which anything must have to be considered a lemon. These properties, taken as a group, can be called the concept rule. For the concept of "lemon" the rule might be: anything which is a small yellow fruit, which is sour and has a wrinkled peel.

The game you are going to play in a few minutes requires the use of a process called concept attainment. In a concept attainment game the task is to figure out the rule (i.e., the required properties) by looking at various objects which either are or are not members of a class. To do this, one has to ask certain questions:

If two objects are both members of that class (e.g., lemons)--what properties do they share?

How does a member of a class (e.g., a lemon) differ from an object that is not a member (e.g., a lime)?

E.g., a lemon is yellow, a lime is green, so part of the rule must be "yellow"!

One interesting finding in several studies of concept learning is that many people compare examples of the concept to discover their shared properties, but fail to pay much attention to the ways in which a member of the class differs from nonmembers. This happens even though it amounts to throwing away half of the information available.

The game you are about to play is called the FAX game. Please read these instructions and examples carefully so you understand the process. You don't need to memorize the instructions.

THE FAX GAME

1. FAX is played on a small computer--it looks just like a typewriter hooked up to a television screen.
2. This game involves an imaginary class of objects, called FAX. A FAX is a row of colored dots which has certain colors in certain places in the row. The object of this game is to discover, in as few trials as possible, the rule that determines whether or not a row of dots is a FAX or a non-FAX. For example, the rule *might* be:

   To be a FAX, the row's first dot must be red, its third dot blue, and its fourth dot green.

   Any row not having *all* of these colors in the proper places would be a non-FAX.

3. The player will get 20 chances to figure out the rule; i.e., there are 20 rounds in this game, and at the end of each round he/she has a chance to guess the rule. Here is what happens in each round:

   Two rows of colored dots will appear on the TV screen, accompanied by either a plus (+) or minus (-) sign. A new set of dots will appear for each new round of the game. Actually, only the bottom row of dots will change each round, and the top row stays exactly the same. This way the player only has to remember the important places and not the colors while working. Remember that the sign (+ or -) refers to whether or not the bottom row is a FAX, because the top row is always a FAX.

A		B	
○ ○ ○ ○	Fax	○ ○ ○ ○	Fax
○ ○ ○ ○	Fax	○ ○ ○ ○	Non-Fax
+		-	

   In example A, both rows are FAX (i.e., they follow the rule) so the sign is (+). In B, the bottom row does not follow the rule (i.e., does not have all the properties of a FAX) so the sign is (-).

4. The player's first job is to compare the two rows of dots to decide if they tell which places are (or cannot be) part of the rule. That is, to select a place which is or is not an important property of FAX.

5. At the bottom of the TV screen are the instructions: "Guess, or Press P." If the player is not ready to enter a guess, the "P" key on the typewriter (P is for PASS) should be pressed and a new round will start.

If, after seeing the two rows of dots, the player thinks a certain dot is part of the rule (or cannot be part of the rule); e.g., that the second dot must be yellow--the player is ready to guess. To make a guess, simply turn the knob on the hand control and it will make a dot start flashing off and on. Turn the knob until the dot you want to select is flashing. Then press the button on the hand control. Hold the button down for a few seconds to register your guess with the computer.

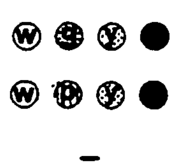
When the guess has been entered, these words will appear on the screen: "IS IT PART OF THE RULE? Y OR N." If the dot you selected <u>is</u> part of the rule (i.e., a property all FAXs must have), then press Y (Yes) on the typewriter. If the dot <u>cannot</u> be part of the rule, press N (NO).

Then the following question will appear on the screen: "ARE YOU SURE? Y OR N." If you are certain that your answers were correct, then press Y. If you think they were but aren't sure, press N.

The next question which will appear on the screen is: "ARE YOU READY TO GUESS THE RULE? Y OR N." If not, press N. When the player knows the whole rule, Y is pressed and the hand control is used as before to register each of the dots that are part of the total rule. This is done by locating the first dot that is part of the rule by turning the knob on the hand control until it begins to flash and then pressing the button, then locating the second dot that is part of the rule and pressing, and so on until all the dots that are part of the rule have been registered. If the player has guessed correctly, the game will end. If not, another round will automatically come on the screen.

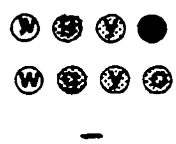
6. If you have not guessed the concept by the last round (number 20), try to guess the rule at that time.
7. Please call the examiner when you have finished, or if you have any problems with the machine.

Here is an example of how four rounds of the game might go, and the reasoning involved:

SCREEN	DECIDE	RESPONSE
	Since it's the only one that differs, the second dot must be part of the rule, and it must be green since that's what it is in the FAX.	
GUESS OR PRESS P		Turn knob to flash second dot, press button.

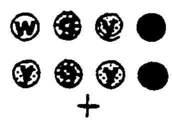
IS IT PART OF RULE? Y OR N		Press Y
ARE YOU SURE? Y OR N	I'm pretty sure.	Press N
ARE YOU READY TO GUESS THE RULE? Y OR N		Press N

- -



	Since the only difference between the FAX and the non-FAX is the last dot, part of the rule is a black dot in the last place.	
GUESS OR PRESS P		Turn knob to flash fourth dot, press button.
IS IT PART OF RULE? Y OR N		Press Y
ARE YOU SURE?		Press Y
ARE YOU READY TO GUESS THE RULE?		Press N

- -



Since one FAX starts with white and one with yellow, the first dot can't be part of the rule.

GUESS OR PRESS P

Turn knob to flash first dot, press button.

IS IT PART OF THE RULE?

Press N

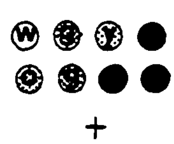
ARE YOU SURE?

Press Y

ARE YOU READY TO GUESS THE RULE?

Press N

- -



Since the first dot is not part of the rule, it can be disregarded. Both rows are FAX, so the third place can't be part of the rule or it would have to be the same in both rows.

GUESS OR PRESS P

Turn knob to flash third dot, press button

IS IT PART OF THE RULE?

Press N

ARE YOU SURE?

Press Y

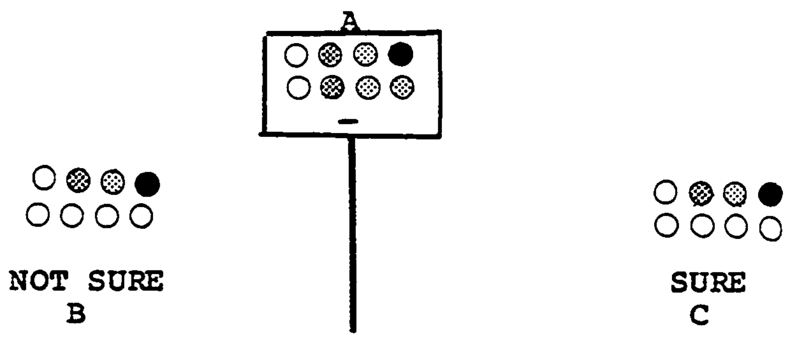
ARE YOU READY TO GUESS THE RULE?

Since the first and third dots aren't part of the rule, the rule must be the second dot is green and the fourth dot is black as in the example.

Press Y. Turn knob to flash second dot, press button. Turn knob to flash fourth dot, press button.

Memory Support Subjects Only

To help players remember their previous guesses (what they thought important on earlier rounds), a record of these guesses appears on the screen like this:

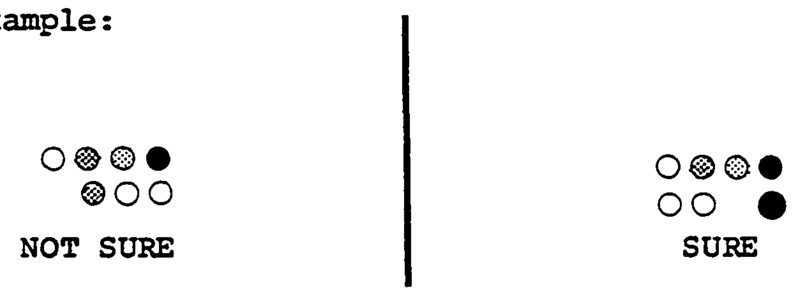


The information in A is the two rows of dots discussed earlier which are compared to help select important places. The top row of dots in both B and C are identical to the top row in A; that is, they are FAX and they never change to different colors. The bottom row of dots in B and C start out white. If the player selects a dot and presses Y to indicate that it is part of the rule, the same dot will change from white to the color selected. If N (not part of the rule) is pressed, the dot will disappear from the screen.

If Yes was pressed for "Are you sure?" this change will happen on the right side of the screen (labeled SURE).

By looking at B and C on the screen, the player can see a summary of his/her reasoning.

For example:



This tells the player that he/she is sure the fourth dot is black and the third dot is not part of the rule, and that he/she thinks that the second dot may be green and the first dot may not be part of the rule.

APPENDIX M

Videotape Script Used in Social Model

Videotape Script Used In The Social Model

Title: Concepts

Audio Portion	Video Portion
(Experimenter): Christa, I'd like to start by thanking you for agreeing to make this videotape about concept formation. As I explained before, what we're going to do is have you work a very simple concept attainment task after I've reviewed a few basic ideas about concepts.	Experimenter and Subject
(Subject): Fine.	
The act of categorizing or classifying objects or events is one of the most important aspects of human thought. A concept refers to a category or class of things which are alike in some important ways.	Experimenter
For example, the category "lemon" might be defined by the following properties which all lemons have; i.e., those properties which anything must have to be considered a lemon. These properties can be called the concept <u>rule</u>. For the concept of "lemon" the <u>rule</u> might be: anything which is a <u>small</u> <u>yellow</u> <u>fruit</u>, which is <u>sour</u> and <u>has a</u> <u>wrinkled</u> <u>peel</u>.	
The game you are going to play in a few minutes requires the use of a process called concept attainment. In a concept attainment game, your job is to figure out the rule (i.e., the required properties) by looking at various objects which either <u>are</u> or <u>are</u> <u>not</u> members of a class. <u>To do this, you</u> must	Experimenter and Subject
ask certain questions:	Experimenter
If two objects are <u>both</u> members of that class (e.g., <u>lemons</u>)--what properties do they share?	

> How does a member of a class (e.g., a lemon) differ from an object that is not a member (e.g., a lime)?
>
> You might decide that since a lemon is yellow and a lime is green, part of the rule must be "yellow"!

One interesting finding in several studies of concept learning is that many people compare examples of the concept to discover their shared properties, but don't pay much attention to the ways in which a member of the class differs from nonmembers. This happens even though it amounts to throwing away half of the information available.

Now, the game you are about to play is called the *FAX* game. It's set up like a video-game and played with this little computer. You don't need to memorize the instructions because they will be on the screen in front of you.	Experimenter and Subject
This game involves an imaginary class of objects, called FAX. A FAX is a row of colored dots which has certain colors in certain places in the row. The object of this game is for you to discover, in as few trials as possible, the *rule* that determines whether or not a row of dots is a FAX or a non-FAX. For example, the rule *might* be:	Experimenter

> To be a FAX, the row's first dot must be red, its third dot blue, and its fourth dot green.

Any row not having *all* of these colors in the proper places would be a non-FAX.

There are 20 rounds to this game, so you will get 20 chances to figure out the rule; and at the end of each round, you have a chance to guess the rule. Here is what happens in each round:	Experimenter and Subject

Two rows of colored dots like this will appear on the TV screen, accompanied by either a plus (+) or minus (-) sign. A new set of dots will appear for each new round of the game. Actually, only the bottom row of dots will change each round, and the top row stays exactly the same. This way the player only has to remember the important places and not the colors while working. Remember that the sign (+ or -) refers to whether or not the bottom row is a FAX, because the top row is always a FAX.

○ ○ ○ ○ Fax

○ ○ ○ ○ Fax

+

In this example, both rows are FAX (they follow the rule) so the sign is (+). Now, in this example, the bottom row does not follow the rule because it does not have all the properties of a FAX, so the sign is (-).

○ ○ ○ ○ Fax

○ ○ ○ ● Non-Fax

—

Your first job is to compare the two rows of dots on the screen to decide if they tell which places must be or cannot be part of the rule.

Experimenter and Subject

At the bottom of the TV screen are the instructions: "Guess, or Press P." If you don't want to make a guess, press the "P" key on the typewriter (P is for PASS) and a new round will start.

Guess, or Press P

If, after seeing the two rows of dots, you think a certain dot is part of the rule (or cannot be part of the rule); e.g., that the second dot must be yel-low--you are ready to guess. To make a guess, you simply turn the knob on the hand control and it will make a dot start flashing off and on. Turn the knob until the dot you want to select is flashing. Then press this button on the hand control.

Experimenter

When your guess has been entered, these words will appear on the screen: If the dot you selected is part of the rule (i.e., a property all FAXs must have), then press Y (YES) on the type-writer. If the dot cannot be part of the rule, press N (NO).

Is it part of the rule? Y or N

Now see what happens! It asks: "ARE YOU SURE? If you are certain that your answers were correct, then press Y. If you think they were but aren't sure, press N.

Are you sure?
Y or N

The next question which will appear on the screen is: "ARE YOU READY TO GUESS THE RULE?"

Are you ready to guess the rule?
Y or N

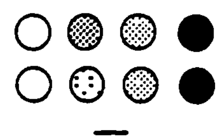
When you think you know the <u>whole</u> rule, use the hand control <u>just like</u> before to enter each of the dots that are part of the rule, one at a time.

Experimenter and Subject

Now, Christa, if you don't mind, I'd like for you to try it. Please think out loud for us while you work.

(Subject): OK.

(Subject): Let me see . . . since it's the only one that differs, the second dot would have to be part of the rule, and I think it must be green since that's what it is in the FAX. What do I do now to enter my guess?



(Experimenter): You turn the knob till the second dot flashes, then press this button.

Guess or Press P

(Subject): Like this? OK

Is it part of the rule? I said yes, so now I press Y.

Is it part of the rule? Y or N?

(Experimenter): Good.

Experimenter and Subject

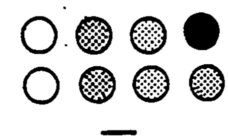
(Subject): I'm pretty sure, so I press Y.

Heaven's no. I'm not ready to guess yet. So, N.

Are you ready to guess the rule?
Y or N?

(Experimenter): So now you've got a second round on the screen. What do these tell you?

Experimenter and Subject



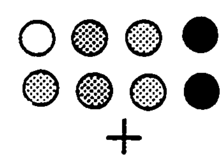
(Subject): Well, since the only difference between the FAX and the non-FAX is the last dot, I'd have to say that part of the rule is that there has to be a black dot in the last place.

Guess or Press P

So, I'll turn the knob to the fourth dot and press the button. Yes, it must be part of the rule. Yes, I'm sure, but No, I'm not ready to guess the rule yet.

Experimenter and Subject

OK . . . round three. Well, this is different since I have two rows which are both FAX. The first dot can't be part of the rule or they both couldn't be FAX, since one is white and one is yellow. So . . . No . . . Yes . . . No, and No, I'm not ready to guess.

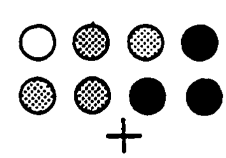


Guess or Press P

(Experimenter): All right, Christa, I think this is the last round.

Experimenter and Subject

(Subject): Well, I've already decided that the first dot cannot be part of the rule, so I can disregard it. Both rows of dots are FAX, so the third place can't be part of the rule or it would have to be the same in both rows. So, the third place is not part of the rule.



Guess or Press P

So, I press N for not part of the rule. And Y because I <u>am</u> sure.

Is it part of the rule? Y or N

I think that I'm ready to guess. Let me try the second dot and the fourth dot. Since the first and third dots are not part of the rule, the rule has to be the second dot is green and the fourth dot is black.

Subject

(Experimenter): OK. Then turn the knob and press the button for each one that you think is part of the rule.

Experimenter and Subject

(Experimenter): Well, you were absolutely right, and in the minimum number of trials. Christa, let me thank you again for helping to make this videotape.

(Subject): I enjoyed it!

APPENDIX N

Program Documentation

The Experimental Task: Computer Program in Integer Basic

```
    List
 0 A=0:LM=2048:HM=32767: DIM R(8),T(8),S(170),NS(170),G(20)
 1 DIM R$(20),C(4),Z(20)
 2 REM  ******************
 3 REM  *
 4 REM  *  PROGRAMMED BY *
 5 REM  *  SHAWN MIKITEN *
 6 REM  *       OF       *
 7 REM  *  COMPU*SCIENCE *
 8 REM  * SAN ANTONIO,TEX*
 9 REM  *      5/79      *
10 REM  *                *
11 REM  ******************
18 CALL -936: GOTO 50
20 K= PEEK (-16384): IF K>127 THEN RETURN : GOTO 20
21 PRINT "INSERT DATA TAPE AND PRESS PLAY/RECORD": INPUT "AND
   HIT RETURN", B$:CM= PEEK (204) + PEEK (205)*256
22 A=CM-LM: POKE 60,4: POKE 61,8: POKE 62,5: POKE 63,8: CALL -
   307
23 POKE 60,LM MOD 256: POKE 61,LM/256: POKE 62,CM MOD 256:
   POKE 63,CM/256: CALL -307
24 PRINT "DATA TABLE SAVED": RETURN
25 PRINT "INSERT DATA TAPE AND REWIND.": PRINT "PRESS PLAY";:
   INPUT "THEN HIT RETURN",B$
26 POKE 60,4: POKE 61,8: POKE 62,5: POKE 63,8: CALL -259
27 IF A>0 THEN 29:P=LM+A: IF P>HM THEN 29:CM=P: POKE 60,LM
   MOD 256: POKE 61,LM/256: POKE 62,CM MOD 256: POKE 63,CM/256:
   CALL -259
28 PRINT "DATA READ IN": RETURN
29 PRINT "*** TOO MUCH DATA BASE***": RETURN
50 POKE -16368,0: FOR I=1 TO 170:S(I)=-1:NS(I)=-1: NEXT I:
   FOR I=1 TO 20:G(I)=0: NEXT I
51 FOR I=1 TO 20:Z(I)=0: NEXT I
52 CALL -936: PRINT "DO YOU WISH TO INPUT DATA FROM TAPE?"
53 X= PEEK (-16384): IF X>127 THEN 54: GOTO 53
54 POKE -16368,0: IF X=217 THEN GOSUB 25
55 IF X=217 THEN 810
56 POKE -16368,0: CALL -936: PRINT "WHICH OPTION A,B OR C?"
57 X= PEEK (-16384): IF X>127 THEN 58: GOTO 57
58 IF X=193 THEN FLAG =0
59 IF X=194 THEN FLAG =1
60 IF X=195 THEN 999
69 C(1)=4
70 C(2)=8
80 C(3)=10
90 C(4)=16
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```
100 R(1)=7
101 R(2)=6
102 R(3)=8
103 R(4)=3
104 R(5)=8
105 R(6)=9
106 R(7)=1
107 R(8)=6
180 R$="-+-+-+-+--+-+-+-+-+-"
190 GOTO 290
200 T(5)=7: RETURN
201 T(1)=2: RETURN
202 T(2)=4: RETURN
203 T(7)=2: RETURN
204 T(4)=1: RETURN
205 T(6)=12: RETURN
206 T(4)=2: RETURN
207 T(3)=12: RETURN
208 T(8)=3: RETURN
290 GR : IF FLAG=1 THEN 300
291 CALL -936: POKE 34,21: TAB 5: PRINT "NOT SURE"
300 FOR I=2 TO 16 STEP 2: COLOR=R(I/2): PLOT I+10,3
301 IF FLAG=1 THEN 304
302 PLOT I,17
303 PLOT I+20,17
304 NEXT I
320 COLOR =2
330 VLIN 1,12 AT 9: VLIN 1,12 AT 29: HLIN 10,28 AT 1: HLIN
    10,28 AT 12: VLIN 13,29 AT 19
331 IF FLAG=1 THEN 340: COLOR=15
332 FOR I=2 TO 16 STEP 2: PLOT I,19: PLOT I+20,19: NEXT I
340 S1=0
350 M=1
360 S=0
370 L=12
380 FOR I=1 TO 8:T(I)=R(I): NEXT I
390 FOR J=1 TO 8
400 COLOR=R(J): PLOT L,3
410 GOSUB 200+S
420 COLOR=T(J): PLOT L,6
430 L=L+2
440 NEXT J
450 J=1
460 POKE -16368,0
469 COLOR=0: FOR I=18 TO 20: VLIN 8,10 AT I: NEXT I
470 IF R$(S1+1,S1+1)="+" THEN 476
471 COLOR=12: HLIN 18,20 AT 9: GOTO 480
476 COLOR=12: HLIN 18,20 AT 9: VLIN 8,10 AT 19
480 CALL -936: VTAB 23: PRINT "GUESS, OR PRESS";
481 POKE 50,63: PRINT "P";: POKE 50,255: PRINT " FOR TEST # ";
    S1+2
490 X= PDL (0)/16+2
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```
500 X1=X/2-1
510 X=X/2:X=X*2
520 COLOR=0: PLOT X+10,3
530 FOR D=1 TO 100: NEXT D
540 COLOR=R(J+X1): PLOT X+10,3
550 FOR D=1 TO 100: NEXT D
560 IF PEEK (-16384)=208 THEN 710
570 IF PEEK (-16387)>127 THEN 575: GOTO 490
575 IF F1=1 THEN 670
576 POKE -16368,0: CALL -936: VTAB 24: TAB 5: PRINT "IS IT
    PART OF THE RULE?";: POKE 50,63: PRINT "Y OR N": POKE
    50,255
577 GOSUB 20: POKE -16368,0: IF K=217 THEN 580
578 Z(S1)=1
580 POKE -16368,0: CALL -936: VTAB 24: TAB 7: PRINT "ARE YOU
    SURE?  PRESS Y OR N"
590 GOSUB 20: POKE -16368,0
610 IF K=217 THEN 630
620 NS(M+X1)=R(J+X1): IF FLAG=1 THEN 640
621 IF Z(S1)=1 THEN COLOR=0
623 PLOT X,19
624 GOTO 640
630 S(M+X1)=R(J+X1): IF FLAG=1 THEN 640
631 IF Z(S1)=1 THEN COLOR=0
633 PLOT X+20,19
640 CALL -936: VTAB 23: TAB 6: POKE 50,63: INPUT "ARE YOU
    READY TO GUESS THE RULE?": POKE 50,255
641 TAB 12: PRINT "(PRESS Y OR N)": GOSUB 20
650 POKE -16368,0: IF K=206 THEN 710: COLOR=0: HLIN 12,26
    AT 6: G(S1+1)=1: FOR I=18 TO 20: VLIN 8,10 AT I: NEXT I
660 F1=1:F2=1:F3=0: CALL -936: VTAB 24: TAB 12: PRINT "MAKE
    YOUR GUESS": GOTO 490
670 CALL -936:F2=F2+1
680 FOR I=1 TO 4: IF C(I)=X THEN F3=F3+1: NEXT I
690 IF F2>4 THEN F1=0: IF F3=4 THEN 800: IF F1=0 THEN 370
700 FOR I=1 TO 500: NEXT I: GOTO 490
710 S=S+1:S1=S1+1:L1=L1+2: COLOR=0: HLIN 12,26 AT 6:M=M+8
720 IF S>8 THEN 360
730 IF S1=20 THEN 790
740 GOTO 370
790 CALL -936: VTAB 23: TAB 10: PRINT "END OF TEST": GOTO 810
800 TEXT : CALL -936:VTAB 12: TAB 10: PRINT "YOU GOT IT!!!!!!"
810 POKE -16368,0: FOR I=1 TO 1000: NEXT I
811 CALL -936: VTAB 11: TAB 4: PRINT "THANK YOU FOR YOUR HELP":
    VTAB 14: TAB 4: PRINT "PLEASE LET ME KNOW THAT": VTAB 16:
    TAB 4: PRINT "YOU'VE FINISHED."
812 VTAB 20: TAB 15: PRINT "SHARON TURNBULL"
813 X= PEEK (-16384): IF X>127 THEN 819: GOTO 813
819 POKE -16368,0: TEXT : CALL -936: VTAB 1: INPUT "PRESS
    RETURN TO RECORD DATA", A$
820 CALL -936: VTAB 1: PRINT "EXAMPLE:";: FOR I=1 TO 8:
    PRINT R(I);: NEXT I:  PRINT
```

```
830 PRINT : PRINT "T#  TEST:  R(+/-) UNSURE   SURE  G"
840 S=0:S1=1:M=1
841 REM
850 FOR I=1 TO 8:T(I)=R(I): NEXT I
860 GOSUB 200+S: PRINT S1;: TAB 4: FOR J=1 TO 8
861 W=T(J): IF W=12 THEN W=0
862 PRINT W;: NEXT J: PRINT "    "; R$(S1,S1);"    ";
863 S=S+1: IF S>8 THEN S=0: FOR I=0 TO 7: IF NS(M+I)=-1
    THEN 872
864 IF Z(S1-1)=1 THEN 873
871 PRINT NS(M+I);: GOTO 874
872 PRINT "-";: GOTO 874
873 PRINT "*";
874 NEXT I
875 PRINT " ";: FOR I=0 TO 7: IF S(M+I)=-1 THEN 879
876 IF Z(S1-1)=1 THEN 878
877 PRINT S(M+I);: GOTO 880
878 PRINT "*";: GOTO 880
879 PRINT "-";
880 NEXT I
900 PRINT " ";: IF G(S1)=1 THEN PRINT "*": IF G(S1)=0 THEN
    PRINT "-"
901 S1=S1+1: IF S1>20 THEN 930:M=M+8: GOTO 841
902 END
910 IF PEEK (-16384)>127 THEN 910: GOTO 910
920 POKE -16368,0
930 K= PEEK (-16384): IF K>127 THEN 931: GOTO 930
931 REM
932 GOTO 940
940 PRINT "DO YOU WISH TO SAVE DATA ONTO TAPE?": POKE -16368,0
941 X= PEEK (-16384): IF X>127 THEN 942: GOTO 941
942 POKE -16368,0: IF X=217 THEN GOSUB 21
943 POKE -16368,0: GOTO 50
999 DIM A$(30)
1000 CALL -936: VTAB 2: TAB 7: PRINT "A B C D E F G H I J
     K L M"
1010 VTAB 4: TAB 8: PRINT "N O P Q R S T U V W X Y Z"
1011 A$="ABCDEFGHIJKLM"
1020 VTAB 20: TAB 12: PRINT "GUESS OR PRESS";: POKE 50,63:
     PRINT "P": POKE 50,255
1030 X= PDL (0)/20+1
1040 X1=X*2+5
1050 POKE 50,63: VTAB 2: TAB X1: PRINT A$(X,X): POKE 50,255
1051 FOR T=1 TO 100: NEXT T
1053 VTAB 2: TAB X1: PRINT A$(X,X)
1054 FOR T=1 TO 100: NEXT T
1060 IF PEEK (-16287)>127 THEN 1080
1075 GOTO 1030
1080 VTAB 20: TAB 8: POKE 50,63: PRINT "IS IT PART OF THE
     RULE? Y OR N": POKE 50,255
1081 POKE -16368,0
```

```
1090 X= PEEK (-16384): IF X>127 THEN 1091: GOTO 1090
1091 VTAB 20: PRINT "
1100 VTAB 20: TAB 12: PRINT "ARE YOU SURE? Y OR N"
1110 POKE -16368,0
1120 X= PEEK (-16384): IF X>127 THEN 1130: GOTO 1120
1130 VTAB 20: TAB 1: PRINT "ARE YOU READY TO GUESS THE RULE?";:
     POKE 50,63: PRINT "Y OR N": POKE 50,255
1140 POKE -16368,0
1150 X= PEEK (-16384): IF X>127 THEN 1160: GOTO 1150
1160 GOTO 56
```

APPENDIX O

Results of Multivariate Analysis of Variance

Table I

F Values Derived from Wilk's Criterion

Source	F	df	p
Locus of Control	3.42	5,36	.02
Social Cueing	0.73	5,36	.61
Memory Support	1.02	5,36	.42
Locus of Control x Social Cueing	2.47	5,36	.0507
Locus of Control x Memory Support	1.16	5,36	.35
Social Cueing x Memory Support	0.89	5,36	.50
Locus of Control x Social Cueing x Memory Support	1.45	5,36	.23

APPENDIX P

Results of Univariate Factorial Analyses of Variance

Table J

Analysis of Variance of the Effects of Locus of Control, Social Cueing, and Memory Support on Trials to Solution

Source	*df*	*MS*	*F*
Locus of Control (IE)	1	4.69	.25
Social Cueing (SC)	1	0.02	.01
Memory Support (MS)	1	6.02	.32
IE x SC	1	157.69	8.48**
IE x MS	1	0.52	.03
SC x MS	1	1.02	.05
IE x SC x MS	1	50.20	2.69
Within	40	18.60	

**$p < .01$

Table L

Analysis of Variance of the Effects of Locus of Control, Social Cueing, and Memory Support on Number of Hypotheses

Source	*df*	*MS*	*F*
Locus of Control (IE)	1	22.69	10.75**
Social Cueing (SC)	1	0.19	0.09
Memory Support (MS)	1	0.52	.25
IE x SC	1	6.02	2.85
IE x MS	1	2.52	1.19
SC x MS	1	4.69	2.22
IE x SC x MS	1	9.19	4.35*
Within	40	2.11	

*$p < .05$
**$p < .01$

Table K

Analysis of Variance of the Effects of Locus of Control, Social Cueing, and Memory Support on Number of Inferences

Source	*df*	*MS*	*F*
Locus of Control (IE)	1	11.02	4.61*
Social Cueing (SC)	1	.02	0.01
Memory Support (MS)	1	3.52	1.47
IE x SC	1	2.52	1.05
IE x MS	1	1.69	0.71
SC x MS	1	2.52	1.06
IE x SC x MS	1	7.52	3.15
Within	40	2.39	

*$p < .05$

Table M

Analysis of Variance of the Effects of Locus of Control, Social Cueing, and Memory Support on Number of Non-Utilization Trials

Source	*df*	*MS*	*F*
Locus of Control (IE)	1	3.52	1.95
Social Cueing (SC)	1	2.59	2.59
Memory Support (MS)	1	0.52	2.88
IE x SC	1	0.19	0.10
IE x MS	1	3.52	1.95
SC x MS	1	1.02	0.56
IE x SC x MS	1	7.52	4.16*
Within	40	1.81	

*$p < .05$

Table N

Analysis of Variance of the Effects of Locus of Control, Social Cueing, and Memory Support on First Trial When Inference Was Made

Source	df	MS	F
Locus of Control (IE)	1	17.50	3.27
Social Cueing (SC)	1	0.52	0.10
Memory Support (MS)	1	1.69	0.31
IE x SC	1	9.1875	1.71
IE x MS	1	0.02	0.00
SC x MS	1	0.52	.10
IE x SC x MS	1	0.52	.10
Within	40	5.36	

APPENDIX Q

Results of *a posteriori* Comparisons

Among Cell Means

Table O

Comparisons of the Performance of Internal and External Groups Receiving the Social Model

Variable	df	SS_c	MS	F
Trials to Solution	1,40	107.84	18.60	5.60*
Number of Inferences	1,40	12.04	2.39	5.04
Number of Hypotheses	1,40	35.95	2.11	12.30**
First Trial Inference	1,40	19.77	5.31	3.73
Non-Utilizations	1,40	2.64	1.81	1.46

*$p < .025$
**$p < .01$

Table P

Comparisons of the Performance of Internal and External Groups Receiving the Informational Model

Variable	df	SS_c	MS_w	F
Trials to Solution	1,40	54.73	18.60	2.89
Number of Inferences	1,40	1.49	2.39	0.62
Number of Hypotheses	1,40	2.64	2.11	1.25
First Trial Inference	1,40	0.67	5.31	0.13
Non-Utilizations	1,40	1.03	1.81	0.57

Table Q

Comparisons of the Performance of Internal and External Groups Receiving No Memory Support

Variable	df	SSc	MSe	F
Trials to Solution	1,40	4.162	18.60	0.22
Number of Inferences	1,40	3.09	2.39	0.74
Number of Hypotheses	1,40	2.01	2.11	0.95
First Trial Inference	1,40	0.59	5.31	0.11
Non-Utilizations	1,40	0.00	1.81	0.00

Table R

Comparisons of the Performance of Internal and External Groups Receiving Memory Support

Variable	df	SSc	MSw	F
Trials to Solution	1,40	1.03	18.60	.055
Number of Inferences	1,40	10.64	2.39	4.45
Number of Hypotheses	1,40	20.10	2.11	9.52**
First Trial Inference	1,40	8.10	5.31	1.53
Non-Utilizations	1,40	6.94	1.81	3.836

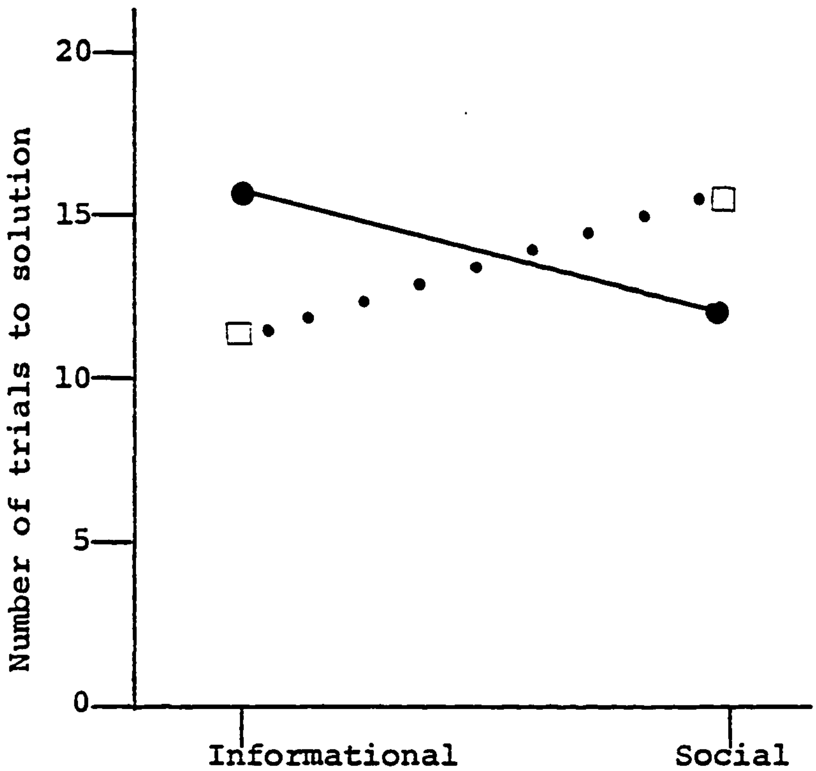
**$p < .01$

APPENDIX R

Graphic Representation of Cell Means

Figure 15

Number of Trials to Solution for Internals and Externals as a Function Of Social Cueing[a]



Number of subjects per group = 12

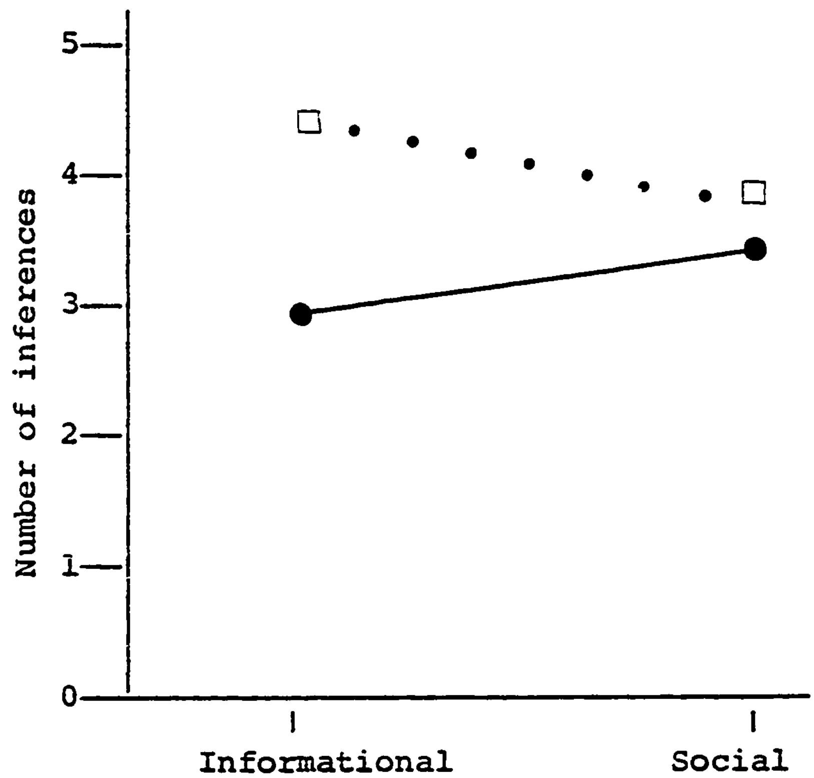
□ Internals

● Externals

[a]See Table J for analysis of variance.

Figure 16

Number of Inferences Regarding Negative Instances, Trials 1-10, for Internals and Externals as A Function of Social Cueing[a]



Number of subjects per group = 12

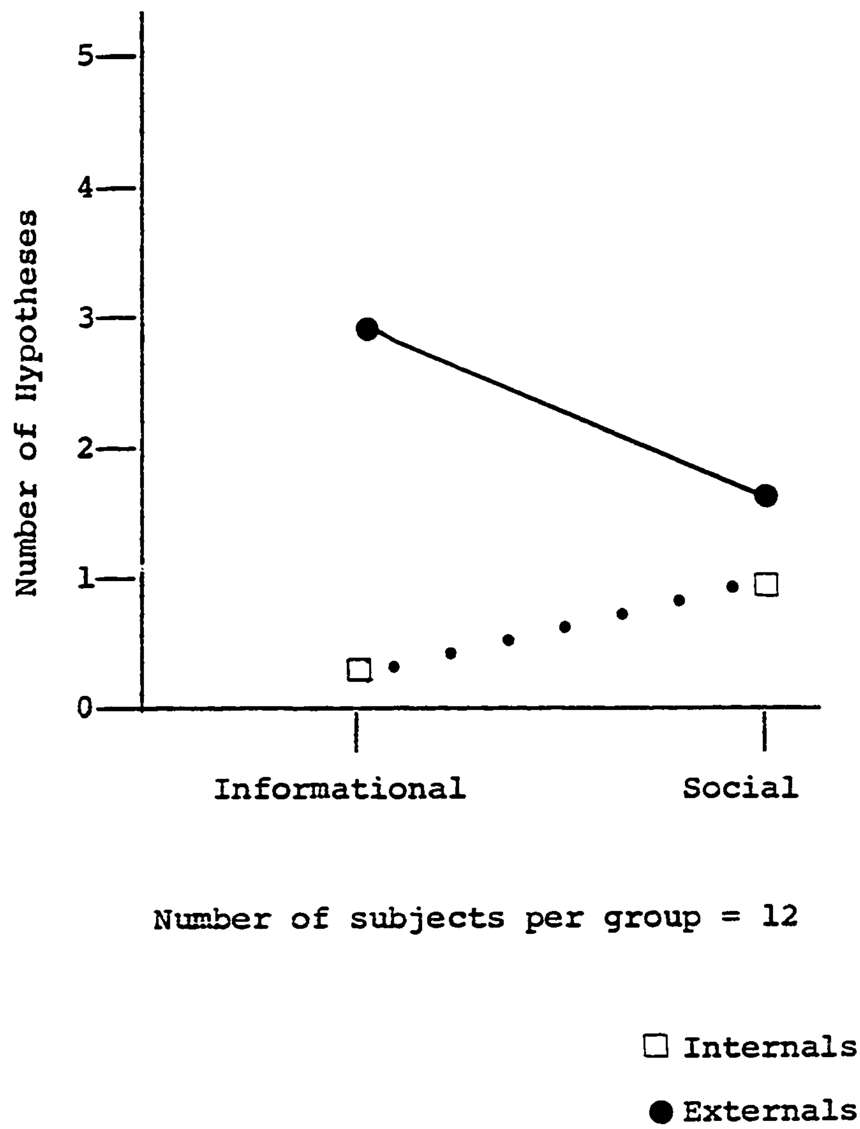
□ Internals

● Externals

[a]See Table K for analysis of variance.

Figure 17

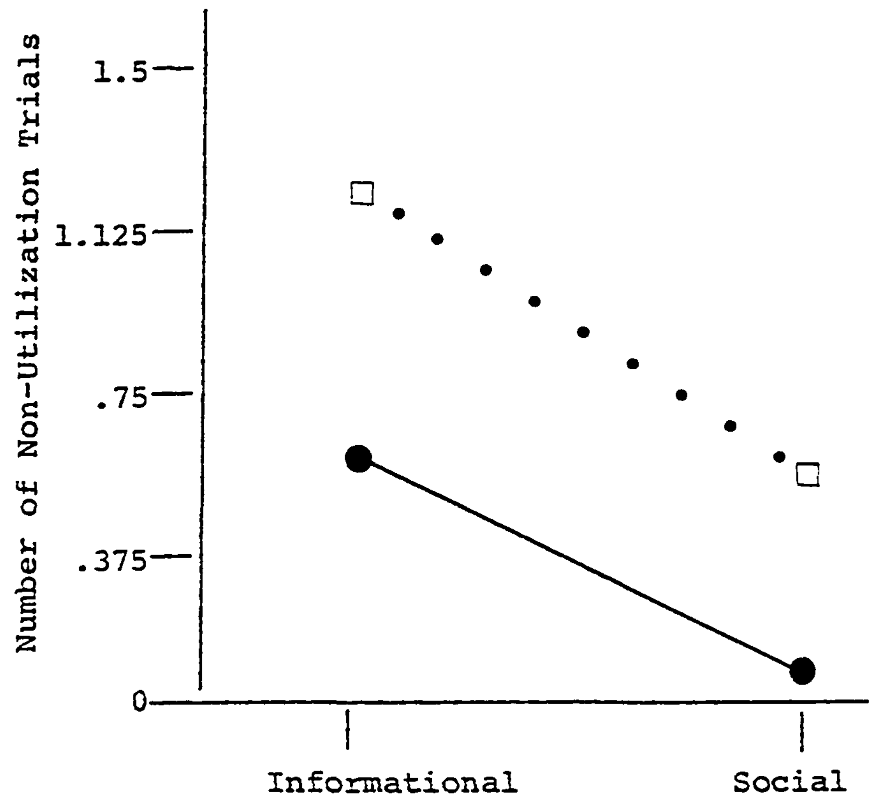
Number of Hypotheses Regarding Negative Instances, Trials 1-10, for Internals and Externals as A Function of Social Cueing[a]



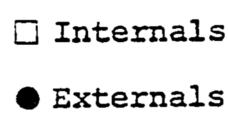
[a]See Table L for analysis of variance

Figure 18

Number of Trials with Non-Utilization of Information for Internals and Externals as a Function Of Social Cueing[a]



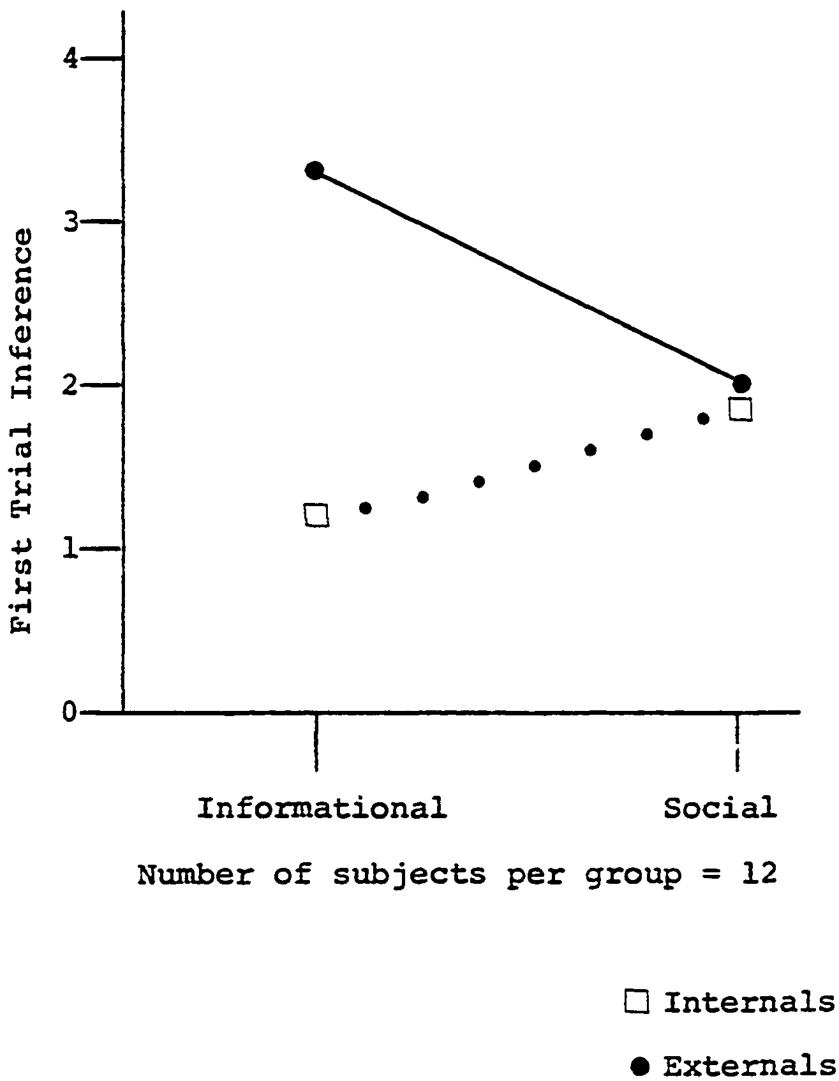
Number of subjects per group = 12



[a]See Table M for analysis of variance

Figure 19

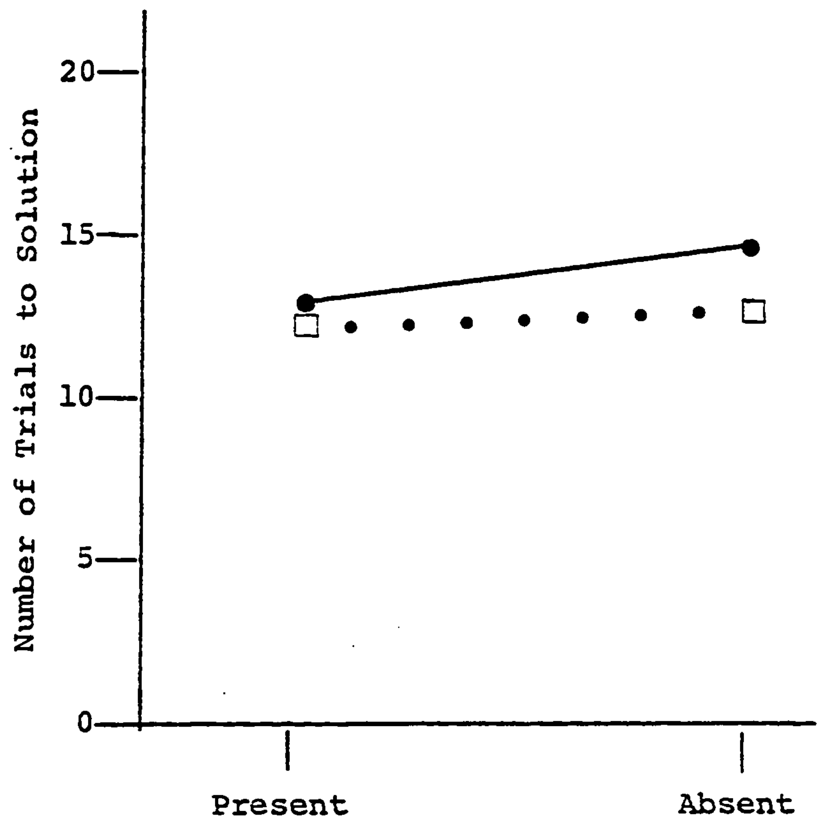
First Trial When Inference Regarding Negative Instance Was Made for Internals and Externals as a Function Of Social Cueing[a]



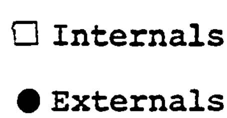
[a]See Table N for analysis of variance.

Figure 20

Number of Trials to Solution for Internals And Externals as a Function of Memory Support[a]



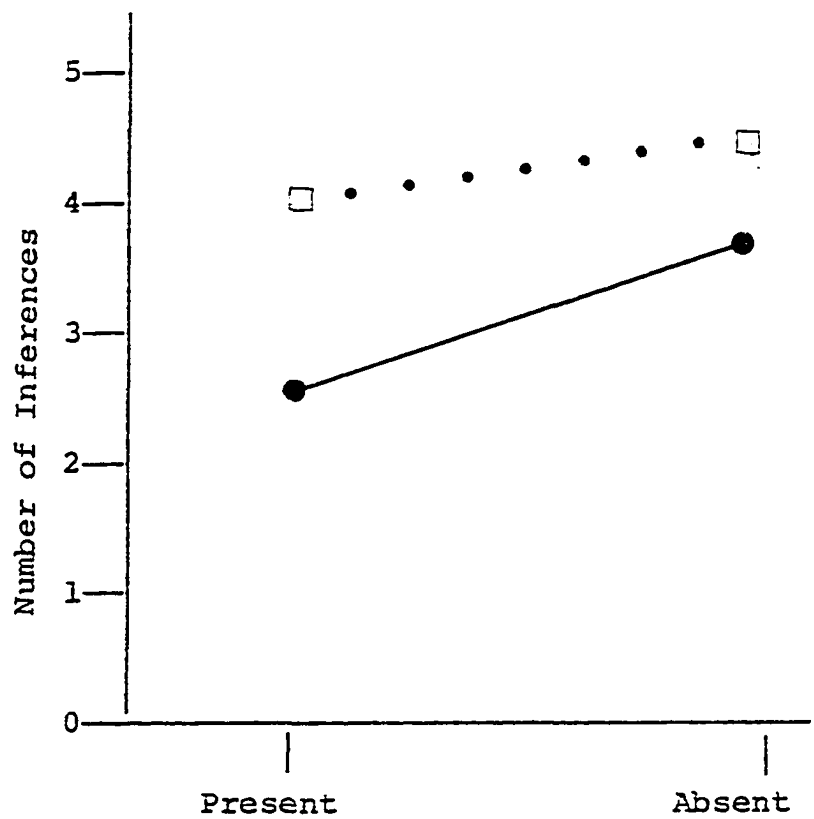
Number of subjects per group = 12



[a]See Table J for analysis of variance

Figure 21

Number of Inferences Regarding Negative Instances, Trials 1-10, for Internals and Externals as A Function of Memory Support[a]



Number of subjects per group = 12

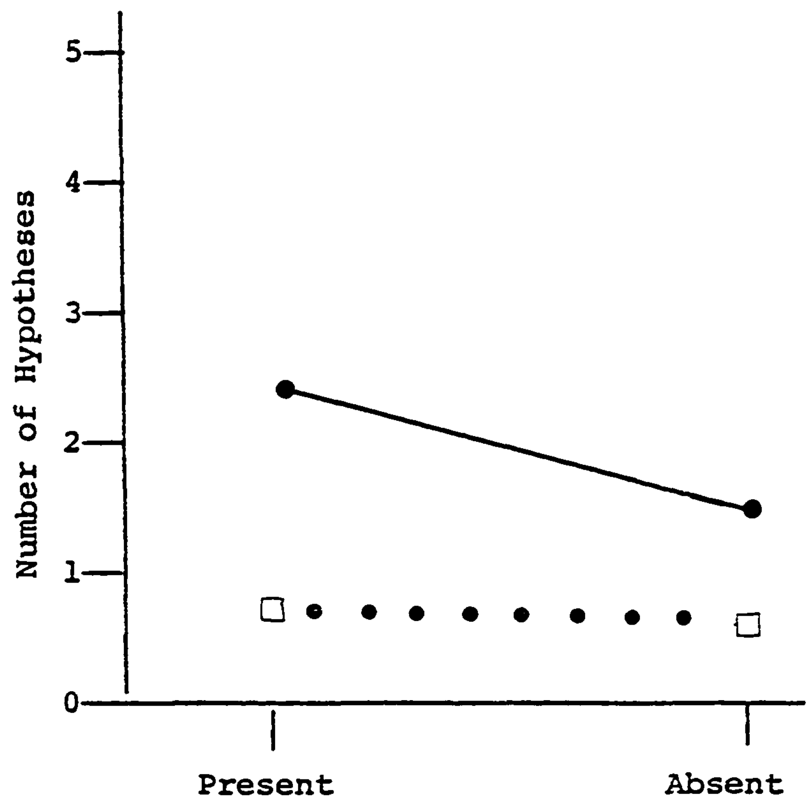
□ Internals

● Externals

[a]See Table K for analysis of variance

Figure 22

Number of Hypotheses Regarding Negative Instances, Trials 1-10, for Internals and Externals as A Function of Memory Support[a]



Number of subjects per group = 12

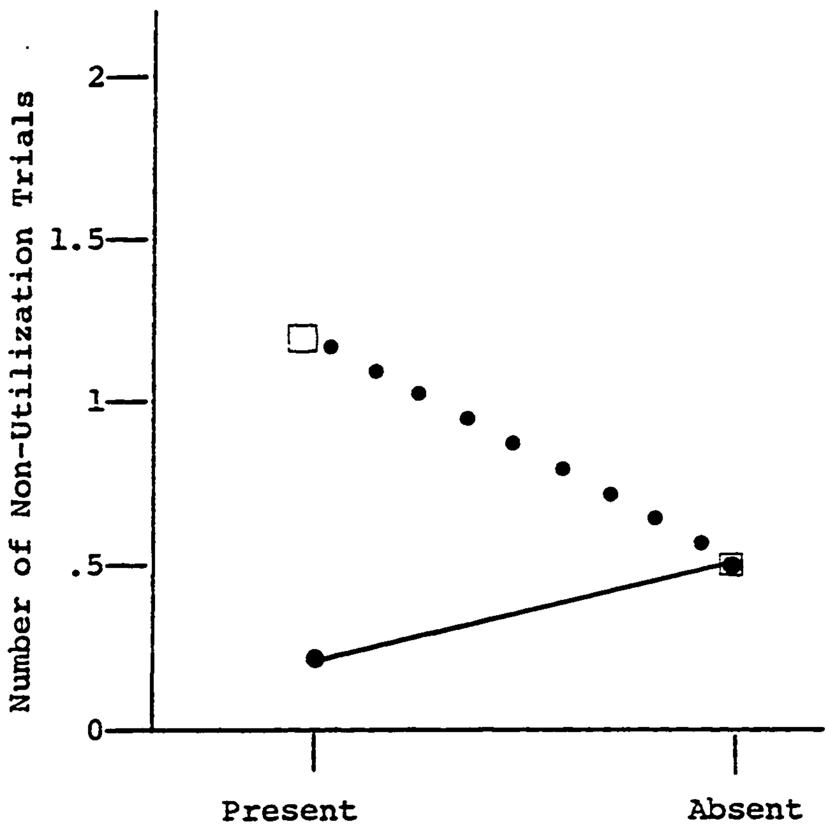
☐ Internals

● Externals

[a]See Table L for analysis of variance.

Figure 23

Number of Trials With Non-Utilization of Information For Internals and Externals as a Function Of Memory Support[a]



Number of subjects per group = 12

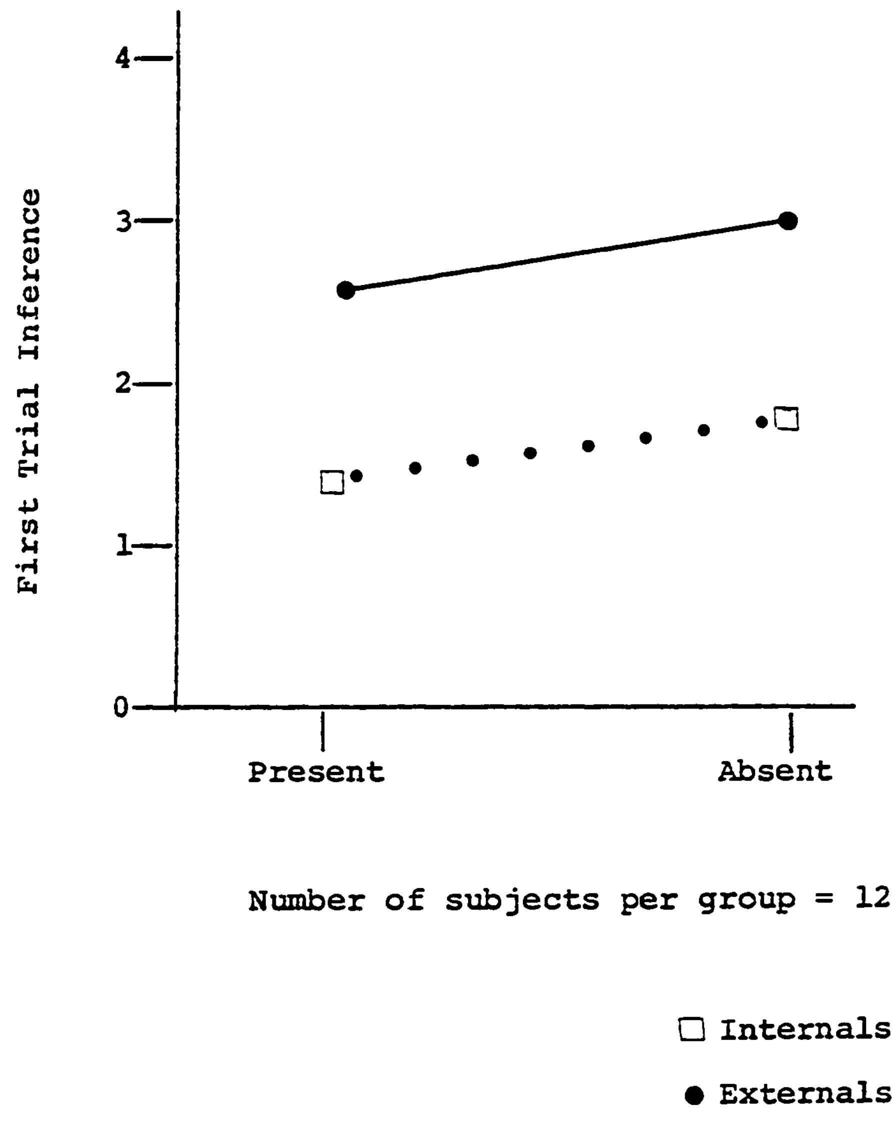
□ Internals

● Externals

[a]See Table M for analysis of variance

Figure 24

First Trial When Inference Regarding Negative Instance Was Made for Internals and Externals as a Function Of Memory Support[a]



[a]See Table N for analysis of variance

Figure 25

Number of Trials to Solution for Internals and Externals as a Function of Social Cueing

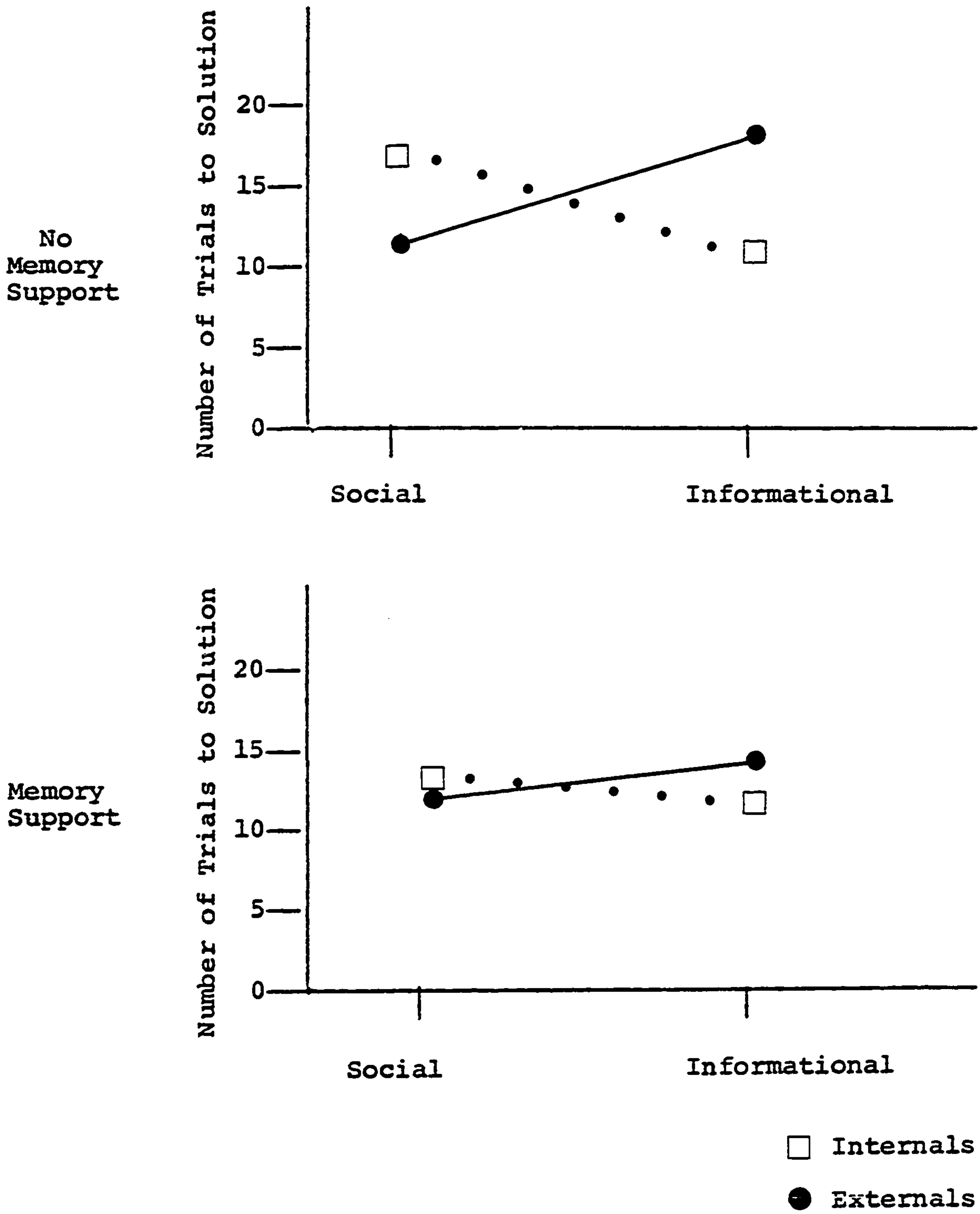


Figure 26

Number of Inferences Regarding Negative Instances,

Trials 1-10, for Internals and Externals as a

Function of Social Cueing

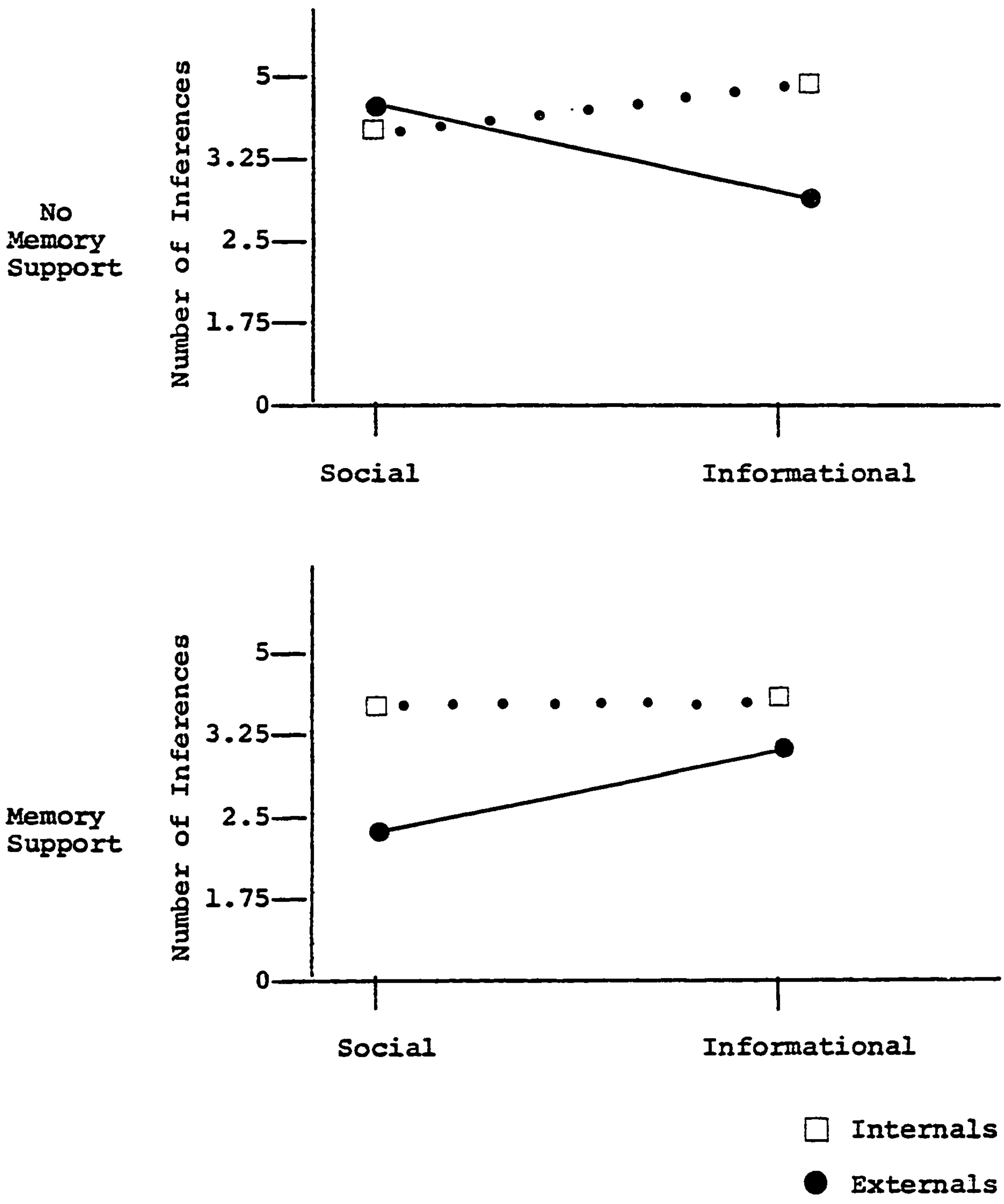


Figure 27

Number of Hypotheses Regarding Negative Instances, Trials 1-10, for Internals and Externals as a Function of Social Cueing

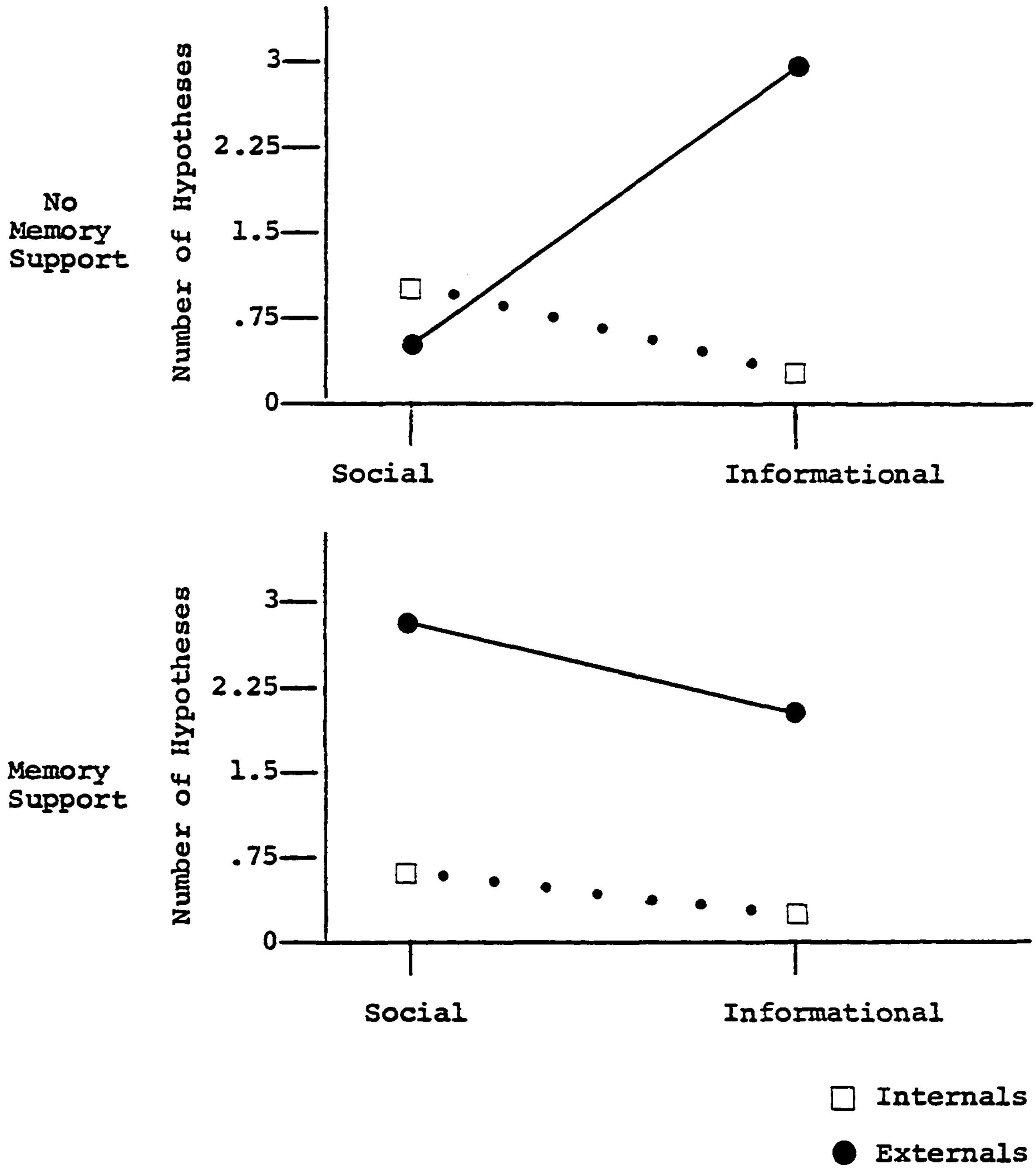


Figure 28

Number of Trials with Non-Utilization of Information For Internals and Externals as a Function of Social Cueing

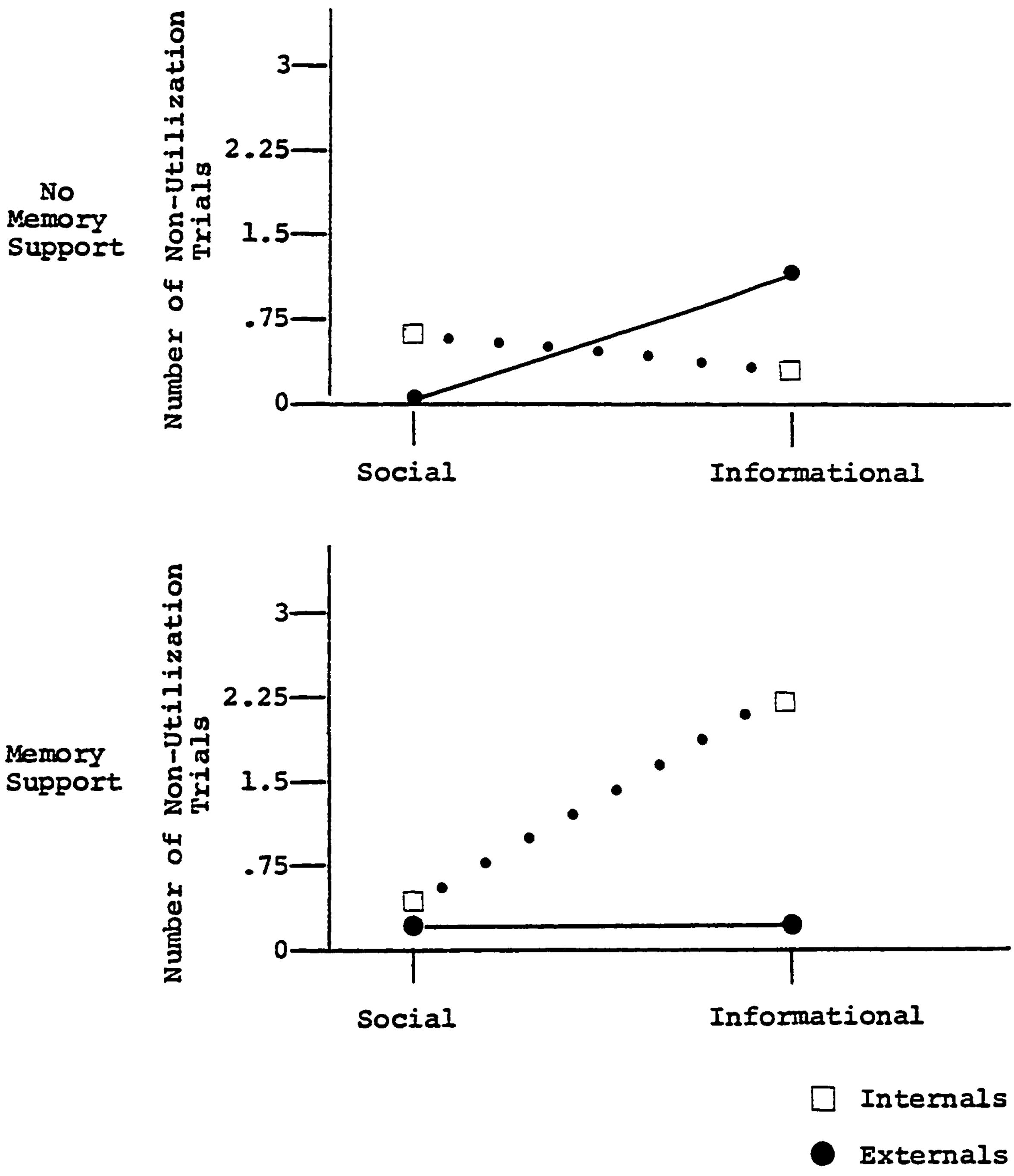
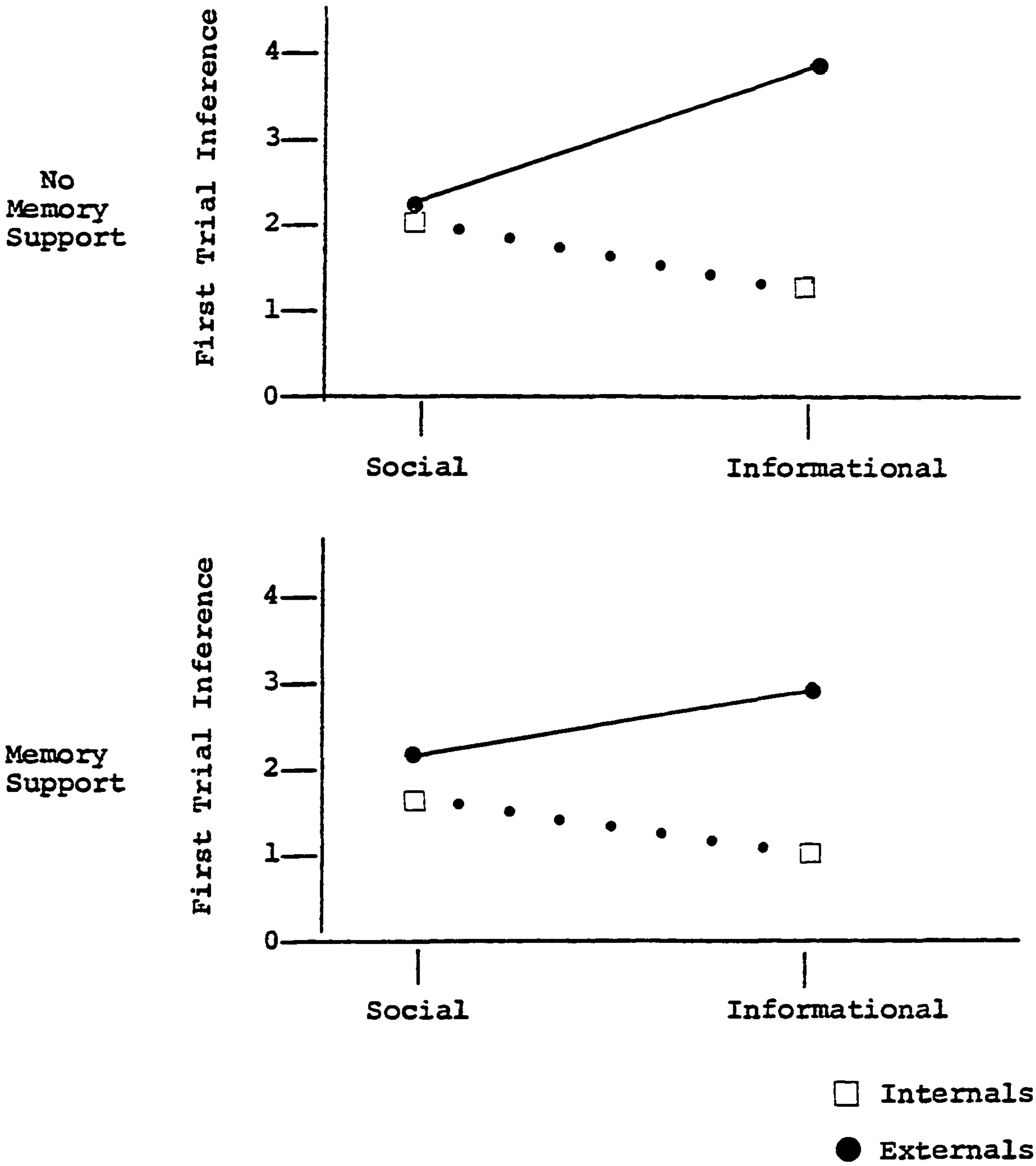


Figure 29

First Trial When Inference Regarding Negative Instance Was Made for Internals and Externals as a Function for Social Cueing



APPENDIX S

Raw Scores

Raw Scores, by Subject, on the Rotter Internal-External Control Scale and the Five Dependent Variables

Subject #	Comparison Group	I-E Scale 1st	I-E Scale 2nd	Variables* A	B	C	D	E
1	E1	5	5	5	5	0	1	0
2	E6	10	9	20	1	5	8	0
3	E4	1	1	10	5	0	1	0
4	E6	17	17	10	4	1	2	0
5	E5	11	11	20	5	5	1	5
6	E8	14	13	15	3	2	4	1
7	E7	12	12	9	5	0	1	0
8	E3	4	4	20	5	0	1	1
9	E4	7	6	16	2	2	3	1
10	E2	6	6	12	5	0	1	2
11	E7	17	17	13	5	0	1	0
12	E3	5	6	20	4	1	1	2
13	E7	15	15	10	5	0	1	0
14	E5	13	12	11	0	4	3	1
15	E1	3	3	15	4	1	3	1
16	E6	16	16	11	5	0	1	0
17	E3	4	4	20	2	3	7	0

*A = number of trials to solution
B = number of inferences regarding negative instances, trials 1-10
C = number of hypotheses regarding negative instances, trials 1-10
D = first trial when inference regarding negative instance was made
E = number of trials with non-utilization of information

18	E8	16	15	17	4	1	1	0
19	E4	1	1	20	5	0	1	0
20	E5	8	8	20	2	3	5	0
21	E5	9	9	13	0	5	11	0
22	E4	6	6	11	4	1	3	0
23	E5	9	9	18	5	0	1	0
24	E5	9	8	20	5	0	1	0
25	E8	10	9	11	0	5	2	0
26	E8	10	10	11	0	5	2	0
27	E2	6	6	9	5	0	1	0
28	E6	8	8	11	3	2	2	0
29	E7	9	9	9	5	0	1	0
30	E2	5	6	16	2	1	1	2
31	E1	2	2	9	5	0	1	0
32	E2	2	2	9	5	0	1	1
33	E3	3	2	20	2	3	1	0
34	E7	12	11	20	2	3	6	0
35	E8	12	12	12	3	2	1	0
36	E4	8	7	14	3	1	1	1
37	E8	11	11	9	4	1	3	0
38	E4	3	3	11	5	0	1	0
39	E1	3	3	12	5	0	1	1
40	E1	7	7	9	5	0	1	0
41	E6	14	13	20	2	3	1	1
42	E2	3	3	20	3	1	1	8

43	E1	5	5	13	4	1	1	0
44	E6	17	17	14	4	1	3	0
45	E2	3	3	8	5	0	1	0
46	E3	7	7	9	5	0	1	0
47	E3	5	5	9	5	0	1	1
48	E7	11	12	9	5	0	0	0

E1 = Internals, Informational Model, No Memory Support

E2 = Internals, Informational Model, Memory Support

E3 = Internals, Social Model, No Memory Support

E4 = Internals, Social Model, Memory Support

E5 = Externals, Informational Model, No Memory Support

E6 = Externals, Informational Model, Memory Support

E7 = Externals, Social Model, No Memory Support

E8 = Externals, Social Model, Memory Support