One of the criteria of every psychological theory has been the degree to which it was successful in leading its concepts derived from behavior back to behavior sequences predictable from the theory. A criticism often leveled at the cognitive approach is that its intervening variables are so vague and beyond precise measurement that the only kind of explanation they are capable of is of the post hoc variety. In the present study an attempt is made to delineate some of the dimensions of cognition, measure them, and relate the resulting scores to behavior in a problem solving situation.

The cognitive approach in psychology stresses the organization of selected stimuli and postulates a representational model of this organized and energized configuration as a determinant of responses. The intervening variable of this model has been called "the life space," "the phenomenological field," "the cognitive field," or "the cognitive map" of the individual. Common to all these conceptions is the assumption that a full description of the person's life space allows the nonparticipating observer to understand and predict subsequent behavior.

This has been done in a great number of studies, each of which has inferred some substructure of the cognitive field as an explanatory concept, or inferred a principle about the process of interrelationships between substructures. As examples one might cite Tolman's (1948) rat experiments relating maze behavior to "signgestalten" (stimulus configurations as meaningful parts of the cognitive map), Krechevsky's (1932) experiments with rats inferring "hypotheses," as substructures (reorganization of stimulus representations), and several of the attitude studies in which attitudes were defined as organized substructures of the cognitive field.

We propose to examine the cognitive representation processes by which outer stimulation and inner selective and energizing forces are combined, with the aim of defining its properties and finding
correlates in relevant behavior. As Tolman has shown, the processes of conceptualization can be thought of as a series of constantly changing cognitive maps. Using Tolman's concept we can compare and contrast different kinds of maps on a number of systematic dimensions as follows.

The first such dimension is accuracy of representation. Cognitive maps may vary from very distorted images of the objective conditions, such as are found in psychotics or under conditions of externalization and cognitive defense, to highly accurate representations of the environment. A second characteristic is complexity or inclusiveness. Attitude studies have revealed that people differ in the degree to which they resolve the social and political scene into its components. Bieri and Blacker (1956) have already set up a complexity dimension in the perception process and Barron (1953) proposes complexity-simplicity as a personality dimension.

Since the cognitive map is defined as an organized representation of both inner and outer stimulating conditions, we have here decided to differentiate between a dimension of outer complexity referring to the degree of inclusion of so-called outer events (events "outside the skin") and a dimension of inner complexity referring to the degree of inclusion of inner events, such as the energizing or "motivating" conditions and other so-called functional factors. This latter dimension has been mentioned by Henry and Neugarten, in an unpublished report, as "affective complexity."

A fourth characteristic of cognitive maps is here defined as degree of organization. This dimension refers to the degree of integration of subparts of the over-all cognitive field and reflects the extent to which different parts can be combined or integrated with each other if a new situation demands transposition or higher order structuring of subparts for adequate representation. In psychology this dimension has sometimes been studied in the negative under such headings as rigidity or dogmatism.

In summary, the following dimensions are proposed because they seem useful in the description of the properties of cognitive maps:

1. **Representativeness**, defined as degree of approximation of perceptual structures to distal stimulus variables.

2. **Range of Outer Complexities**, defined as the degree of inclusion of details and relationships found in the stimulus field.
3 *Range of Inner Complexities*, defined as the degree of inclusion of details and relationships in the motivational, emotional and stored-past-experience areas

4 *Organization*, defined as the degree of integration of subparts of the cognitive field into wholes or into higher order patterns

Even though these four properties are described as separate dimensions, no statements about either their independence or the nature of their interrelationships are assumed, nor deemed necessary here.

It is further proposed that individuals differ consistently from each other in the extent to which their cognitive processes are typically representative or distorted, include outer and inner complexities or exclude them, and are organized or compartmented. Along with the work of Klein (1954) on styles of perceiving and of Rokeach (1956) on styles of thought, these dimensions are here seen as styles of cognitive representation or as enduring capacities which should reveal an individual's characteristic approach to the environment and should in turn be open to the influence of various developmental and environmental factors.

Representativeness as a property of the cognitive map then becomes *Representational Capacity* as a process variable. Perhaps this is already familiar in another context as the ego's function of reality testing as described in the writings of some psychoanalysts.

Range of outer complexities becomes *Capacity to Include Outer Complexities*. Range for inner complexities becomes *Capacity to Include Inner Complexities*. Organization becomes *Organizational Capacity*. These would operate in such a way that a person low in organizational capacity would possess representational models of a low order of organization, a person high in representational capacity would have cognitive maps highly reflective of his environment, etc.

A first attempt to test this model and its relevance to behavior has been made in the present study by finding a more or less direct measure for each capacity and relating this to some relevant behavior in a task which allowed breakdown of approach into a number of measures.

The Rorschach test was chosen as a source of measures of the cognitive variables, because cognitive representations were assumed to be more "visible" in reactions to highly unstructured stimulus materials and because some indices of Rorschach performance had
already been standardized. The assumption here was that the perception and organization of inkblots is an illustration of the kind of cognitive maps a person typically forms. The following quantifiable measures of the Rorschach test were used to represent each of the four dimensions of cognitive functioning. Some of these are so-called traditional Rorschach measures of personality, but are adopted here with somewhat changed rationale.

1. **Representational Capacity** was measured by rating form level of Rorschach responses in line with the test assumption that the E's identification of S's concept in the blot outlines is indicative of good contact with reality on the principle of consensual validation. The Kloper-Richardson rating system, which assigns different numerical values to responses according to judged similarity to blot outlines, was used. The S's total score became the average of his form-level ratings.

2. **Human movement responses** require perhaps the greatest internal effort since movement is not in the strictest sense an attribute of the blot. According to test rationale such responses are also a sign of breakthrough of the inner life of feeling into the cognitive area. They were hence used as a measure of the capacity to include inner complexities. According to the Rorschach assumptions about indications of breakthrough or exclusion of so-called inner life, each human response was assigned a numerical value of 1.0. If the response occurred among the first half of the responses to a card, 0.5 was added. If the perceived movement was vigorous rather than subdued or almost static, another 0.5 added. If the movement was seen as expressed by real people rather than imaginary people like ghosts or by animals, a further 0.5 was added, and 0.25 was added if the response did not occur in so-called popular concepts. The total score for each S was the sum of all these divided by the total number of test responses.

3. **Capacity to include outer complexities** was measured by the use of color in S's responses, because awareness of color in concept formation includes a stimulus component in addition to outline, and because Rorschach's assumptions label the color-oriented person as "extra-tensive," paying more attention to outside stimulation. A value of 1.0 was assigned any color response, and 1.0 was added if the color response was adequately integrated with the formal outlines of the blot to warrant the traditional FC score. The total score was the sum of all color ratings divided by the number of total responses on the color cards.

4. **Capacity for organization** was measured by taking into account the degree of organization of features of the inkblots into inclusive responses as reflected in the traditional W score. Beck's 'Z' score was used to measure the percentage and the amount of responses when two or more portions of a figure were seen in relation to one another.

In order to find a task that would allow a measurement of behavior representing the operation of the four dimensions, it was necessary to focus on behavior that did not depend on S's verbalizations as on the Rorschach test. In addition, it had to be simple...
Cognitive field dimensions

and concrete enough to warrant specific hypotheses about how one might expect the four capacities to affect it.

Sackett (1934) and Scott (1936) had asked their subjects either to draw maps of or to visualize verbally a learned path through either a T-type finger maze or a circuitous stylus maze and found great individual differences in the reproducibility of the learned path as well as individual differences in the type of imagery used to describe the paths. Sartain (1940) tried to find out if learning a maze is related to clearness and accuracy of perception of the path and utilized a Carr stylus maze in which the T-shaped stylus, moving in inverted T-shaped grooves, struck hidden nails pushed up from underneath in the blind alleys. This removed the need for the traditional blindfolds in human maze experiments. He used a circuitous maze pattern which had been shown to elicit the visual learning method. In a questionnaire about the choice points, administered after every third trial, he found great individual differences, even after successful learning had taken place. These experiments suggested individual differences in the ability to translate cognitive maps into appropriate behavior and suggested an approach to the problem at hand.

A modification of the Carr stylus maze was used with the addition of the procedure of Mann and Jewell (1941) who asked their Ss to draw a map of the maze on a paper facsimile after every third trial. They were interested in the effect of learning on so-called figurational aspects and found among other things great individual differences in the maps, which were used as indicators of the aspects. They noted that the correct map patterns became larger and fewer in number during the course of learning. The Ss in this experiment were required to reproduce their estimation of the path on a two-dimensional representation of the maze after every third trial (Figure 1). Such maps could be scored for number of correct responses, for their effect on the decrease of errors on the maze, for the percentage of correct moves out of the total drawn, and finally for correct patterns. The latter, a feature used in Mann and Jewell's experiment, was defined as any sequence of three or more moves in correct order regardless of absolutely correct position on the map. This yielded two additional measures: average size of correct pattern and number of larger, uninterrupted patterns drawn.
The presentation of specific hypotheses relating Rorschach responses to maze behavior will be delayed until after the experimental procedures and the measures of behavior have been enumerated.
METHOD

Tests and apparatus

The Rorschach has already been mentioned. The verbal scale of the Wechsler-Bellevue intelligence test was also administered to gain a rough measure of intelligence. Since this factor might enter into the determination of individual differences in cognitive processes, it was important to assess its effect, if any, on the various measures involved in the study.

The maze, a black box 9 by 14½ inches, consisted on the surface of 13 rows and nine columns of one-inch squares of black bakelite with grooves between them that widened at the base to allow a T-shaped stylus to travel freely within them. Invisible pins stopped the stylus in blind alleys and recorded the errors electrically. This procedure obviated any need for a blindfold and made for less artificiality.

The maze path finally selected was a circuitous pattern. According to Scott (1936) a circuitous pattern tends to elicit a maximum amount of visualization and can be assumed to activate fully the cognitive processes. Another consideration that went into the choice of pattern was the time taken to learn it. The adopted pattern (see Figure 1) was difficult enough so that six Ss failed to learn the criterion within an hour. On the other hand, nine Ss learned it so fast, that they took less than 15 trials, thus yielding only four maps. The average learning time was approximately one hour.

Procedure

The 49 Ss were drawn from two summer session classes in introductory psychology. In order to control motivation and interest as other possible variables in the cognitive approach, special attempts were made to arouse interest and to maintain rapport, feedback results, and explanations. In the first of two experimental hourly sessions, the Rorschach and the vocabulary scale of the Wechsler-Bellevue were administered.

In the second session the S was seated before the maze while the E read out standard instructions on how to find the correct path. The S was shown the stylus, how to use it, and where the entrance was, and was informed how he could tell an error and that he should return to the last correct position in case of a blind. The criterion of three errorless runs was explained and any questions were answered. Since retracing the correct path was also defined as an error, the S was informed of this whenever he did so. During the trials the Ss were given frequent reassurance or praise, especially if they became exasperated at their errors or their lack of progress. Each S was informed routinely of his progress in rather general terms. After every three trials the maze was covered up. He was then handed a map sheet (see Figure 1) and a red pencil and told “Now draw on here as much of the maze path as you think you know.”

Treatment of the data

On the Rorschach, in addition to the four scores mentioned above, the following scores were computed:

1. The conventional extroversion/introversion ratio was computed (sum of all human movement responses divided by the sum of responses using color as a determinant).
2. Degree of “rigid intellectual control” (percentage of form, shading, and achromatic color responses).
Attention to large details (percentage of so-called D responses)

Measures involving the maze and the maps were as follows

1. Errors were recorded for each trial on the maze
2. Each map was scored for total number of moves drawn. A move was defined by a red pencil line along one side of the many squares of the map sheet.
3. Each map was scored for total number of correct moves drawn
4. In addition, each map was analyzed for correct patterns. A correct pattern was defined as three or more correct moves in succession, regardless of position, as long as the pattern was in the general area in which it was supposed to occur. The number of times a pattern of three or more correct moves occurred was counted for each map.
5. By adding all the moves of all the correct patterns on a map, an additional measure of the total number of correct moves (by patterns) was available.
6. A percentage score of correct pattern moves in proportion to total number of moves drawn was worked out for each map.
7. The average size of correct patterns per map was obtained by dividing the total number of correct pattern moves by the number of patterns counted for the map.

It was found that the only way in which maps drawn by different Ss could be compared meaningfully was by establishing a point in the maze learning that would be psychologically equivalent for all Ss. Such a point could be found by comparing maps that preceded or followed a trial on which a certain defined number of errors had occurred. This procedure equalized conceptual performance at identical stages in the learning process of each S, and in this way his individual learning speed did not enter into the map measures, as would have been the case had we compared the first, or the fifth map drawn by every S. For the same reason only one map, rather than the average of all the maps preceding the equivalent point in the learning process, was used in comparing individuals on map measures. By inspection it was found that when the maze performance had improved beyond 17 errors, all Ss had drawn at least one map (i.e., had been through at least four trials on the maze). Therefore this point was chosen for conceptual measures in the beginning stages of the learning process. Similarly, the maps were again measured and compared at the point that preceded the trial in which the S had for the first time reached two or fewer errors. This yielded measures for the end stages of the learning process.

All the above seven measures were worked out for the map preceding the trial with 16 errors or less. For the second map, at the end of the learning process, some measures had to be omitted because they yielded too little variability to be meaningful, such as total number of moves drawn. However, an additional measure was introduced at this point.

8. Each S received a tally if his map contained large correct patterns over 20 moves.
9. A measure was obtained of the efficacy of maps in the learning process. It consisted of the difference between the average decrease in errors between trials that immediately preceded and immediately followed a map and the average decrease in errors from trial to trial. If this difference was positive, the implication was that the drawing of a map had helped to reduce errors.
Cognitive field dimensions

beyond the reduction that would have occurred between trials where no map had intervened. This score was obtained for both the learning preceding the 16-error stage and the learning intervening between the 16-error and the 2-error stage.

10. The learning speed was computed for each individual in terms of the number of trials needed to reach a stage of two errors or less. It was not possible to obtain for all Ss the number of trials to reach the criterion of no errors, since a few individuals did not reach this in the time allotted for the experiment.

For computational purposes the chi-square model was used, because in this exploratory study only gross measures seemed appropriate. Correlational analysis was ruled out because Rorschach variables do not form normal distributions. For this reason chi-square has also been recommended for use on Rorschach variables by Cronbach (1949). The sample was roughly divided in two or sometimes three groups depending on the refinements possible on all measurements and compared with other measures by chi-square analysis. The null hypothesis was assumed in each case and rejected when the significance level reached .03 or below, because the number of cross-comparisons made over and above the ones suggested by the specific research hypotheses seemed to require more stringent level of significance.

The sample was too small to allow examination of net relationships among the variables, that is, the relationship between variables \( x \) and \( y \) at a fixed level of some third variable \( z \). Thus only gross relationships are here attempted to test the assumed connection between the two sets of measures as a first exploratory step in testing the model of cognitive processes proposed here.

**RESULTS**

*Relationships between Cognitive Variables as Measured on the Rorschach*

While no assumptions about independence or orthogonality of the four cognitive process variables were made, or were necessarily tenable in view of the integrative nature of cognition as an adaptive process, their interrelationship was tested here with chi-square analysis. Only the relationship between representational capacity and organization capacity as measured here was significant (\( P < .001 \)). Whether or not the four dimensions of cognition are indeed independent so that one can isolate the separate effects of each on behavior, cannot be properly assessed until different and new ways of measuring them can be found. The degree of measured independence is also a function, of course, of the range and variability of the scores in the particular sample employed.

*The Effect of Intelligence*

All map and Rorschach scores were compared with a prorated verbal IQ score derived from the performance on the Wechsler-
Bellevue vocabulary test. This IQ score took the age of the S into consideration. No relationship was found with any of the variables. This was expected here, since a task was chosen which would not reflect the difference in ability along the intelligence dimension. This allows for the interpretation of behavior on the maps in terms of the cognitive model proposed here without referring to the effect of intelligence. However, differences in intelligence are undoubtedly reflected in other measures of cognitive processes, especially those requiring more complex problem-solving behavior than is possible on a maze. The restricted intellectual range of the present sample is also an important consideration.

Relationships between Cognitive Variables and Maze Performance in the 16-Error, or Initial, Stage of Learning

Three hypotheses regarding specific relationships between some of the cognitive variables in the two tasks may now be proposed:

1. Representational capacity as measured by form level on the Rorschach is expected to affect the accuracy of maps drawn and is hence reflected by number of correct moves drawn.

2. Capacity to include outer complexities as measured by attention to color on the inkblots is expected to be revealed by inclusion of the complexities of the maze path in the maps, and would be evident in more complex patterns of correct moves drawn on the maps.

3. Organizational capacity as measured by whole responses on the Rorschach is expected to show up in attempts to organize the maze path into larger wholes, which would reveal itself in the quicker emergence of larger and more integrated patterns of correct moves drawn.

The findings with regard to these are now presented. In view of the tentativeness of the proposed model of cognitive processes, a number of other measures of some Rorschach and maze performance variables were related to each other on a more hit or miss fashion and results are reported subsequently.

As we can see from Table 1, Representational Capacity is not related to any map measure at the initial stage of learning though the relationship is in the expected direction with number of correct moves. Either it does not deserve the status of a separate variable as discussed here, or it was poorly measured. A third possibility is that it did not vary sufficiently in the sample and that a more hetero-
TABLE 1

RELATIONSHIP BETWEEN THE FOUR COGNITIVE DIMENSIONS AND MAP MEASURES AT THE 16-ERROR STAGE

<table>
<thead>
<tr>
<th>MAP MEASURES</th>
<th>COGNITIVE VARIABLES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Representational capacity</td>
</tr>
<tr>
<td></td>
<td>Chi-Square*</td>
</tr>
<tr>
<td>Total Number of Moves</td>
<td>3.47</td>
</tr>
<tr>
<td>Drawn</td>
<td></td>
</tr>
<tr>
<td>Total Number of Correct</td>
<td>&lt;2.71</td>
</tr>
<tr>
<td>Moves</td>
<td></td>
</tr>
<tr>
<td>Total Number of Correct</td>
<td>&lt;2.71</td>
</tr>
<tr>
<td>Pattern Moves</td>
<td></td>
</tr>
<tr>
<td>Percentage of Correct Pattern</td>
<td>&lt;2.71</td>
</tr>
<tr>
<td>Moves</td>
<td></td>
</tr>
<tr>
<td>Average Size of Correct</td>
<td>&lt;2.71</td>
</tr>
<tr>
<td>Pattern</td>
<td></td>
</tr>
<tr>
<td>Utilization of Maps for</td>
<td>&lt;2.71</td>
</tr>
<tr>
<td>Learning</td>
<td></td>
</tr>
</tbody>
</table>

* Based on one degree of freedom
b Based on two degrees of freedom

geneous sample—perhaps one including some psychotics—would produce a more significant relationship. The first of the three research hypotheses, linking this variable with accuracy of maps drawn, was hence not verified at this stage of the learning process.

2 A significant association was found between capacity to include outer complexities and average size of map patterns. Good form–color integrations were thus associated with larger correct map patterns. The ability to be attuned to more complex features of the Rorschach enables a person to conceptualize by combining the subparts of a problem into a complex whole. This occurs at a stage where no clear conceptualization of the continuity of the path is as yet possible. However, the complexity-attuned person can structure subparts into more complex units—i.e., into patterns that are relatively larger—by including a greater number of the correct moves. This finding supports the second research hypothesis which predicted an effect of this capacity on complexity of patterns of moves on the map.
3 Significance is reached when the Rorschach score for organizational capacity is compared with the total of correct pattern moves. The occurrence of many well integrated Rorschach concepts was thus found to be associated with a high number of correctly conceptualized moves on the map. The organizational capacity exhibited on the Rorschach emerges on the maze as an ability to organize conceptually more of the maze path into a larger unit. This finding is partially a substantiation of the third research hypothesis which predicted that greater organizational capacity would result in larger, more integrated patterns of the maze emerging on the map.

4 While no hypothesis was formulated with regard to capacity to include inner complexities, it was significantly related to percentage of correct pattern moves, so that a high degree of human movement responses on the Rorschach was associated with a high percentage of correct pattern moves in relation to moves drawn. A high score means that most of the moves drawn were arranged into correct patterns. Another way of putting this is that very little motion was wasted by Ss with a capacity to include inner complexities, so that they operated with a greater degree of "cognitive efficiency." Thus one might say that the capacity to be attuned to inner complexities operated to facilitate the accuracy of cognitive representation. One is tempted here to equate this capacity with conscious control of the well-functioning ego. According to some clinical writers, this state of affairs is accompanied by a relative absence of repression resulting in a relative lack of anxiety, which clears the decks for more efficient problem-solving behavior.

5 Two near-significant trends were observed involving the number of moves drawn as related to both representational capacity and organizational capacity. Since Ss who drew few moves at the beginning quite often drew maps with well below the number of actual moves in the correct pattern, drawing a map with many moves regardless of its correctness may reflect the confidence derived from previous successes in accurate object appraisal and organizational ability which were here related in their respective Rorschach measures. No other near-significant trends beyond a significance level of 10 were observed in the analysis of the measures reported here.
Relationships between Cognitive Variables and Maze Performance at the Two-error or Terminal Stage of Learning

When the relationships between these variables are examined at the terminal phase of the learning process, it is found that all the previous evidence of association has disappeared. (Total number of moves was omitted here because of lack of variability at this stage, and one variable was added—a tally for presence of large correct patterns of 20 moves or more.) Nor do any new ones appear. In fact, when we compare the distribution of scores in the fourfold or sixfold distribution tables for map measures at the 16-error with those of the 2-error stages, we find a consistent, though not statistically significant, reversal. Correlations between the map measures for the two stages turn out to be low and nonsignificant.

A clue for this curious lack of relationship—and near reversal with distributions of Rorschach measures—at the final phase is supplied by pairing two other, traditional Rorschach scores with measures of the final maps. Three other scores were computed as described above and were tried out without any specific hypotheses as to their effect on conceptualization. None of them yielded a significant relationship at the 16-error stage. However, as is apparent from Table 2, it was noticed that the percentage of so-called formal responses, or the measure of rigid intellectual control, is significantly associated with several measures of map-drawing and learning at the 2-error stage. The measure itself is scored by counting all Rorschach responses that do not involve any movement—whether animal, human, or inanimate forces—or chromatic color, and dividing this sum by total number of responses. It was here significantly related in the negative direction to our inner-complexity score of human movements (chi-square significant at the 0.009 level) but not to the outer complexity or color integration score.

In Table 2 we see that a high average of correct patterns on the almost-terminal map, a high percentage of correct pattern moves, the presence of a few large correct patterns over 20 moves, and a high speed of learning are all associated with a high percentage of so-called formal responses, and hence with relative neglect of both movement and color as response determinants. What this means is that the lack of attention to either inner or outer complexities favors an efficient completion and better-than-average conceptual organiza-
### Table 2

**Relationship between Percentage of Formal Responses, Percentage of Detail Responses on the Rorschach, and Map Measures at the 2-error Stage**

<table>
<thead>
<tr>
<th>Map Measures</th>
<th>Rorschach Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percentage of formal responses</td>
</tr>
<tr>
<td></td>
<td>Chi-square</td>
</tr>
<tr>
<td>Total Number of Correct Pattern Moves</td>
<td>&lt;2 71</td>
</tr>
<tr>
<td>Percent of Correct Pattern Moves</td>
<td>12 30</td>
</tr>
<tr>
<td>Average Size of Correct Pattern</td>
<td>8 85</td>
</tr>
<tr>
<td>Presence of Large Correct Patterns (&gt;20)</td>
<td>5 97</td>
</tr>
<tr>
<td>Utilization of Maps for Learning</td>
<td>&lt;2 71</td>
</tr>
<tr>
<td>Speed of Learning</td>
<td>7 57</td>
</tr>
</tbody>
</table>

These new relationships did not hold in the beginning map, in fact, were again slightly reversed. In order to find where in the learning process this change and reversal might have occurred, map measures were computed for a midpoint at which at the most ten errors were still made on the maze. Again the original relationships between Rorschach dimensions and map measures did not hold, so that only at the beginning of learning was the hypothesized connection between conceptual process dimensions and map variables demonstrated. An explanation for the change in relationships as a function of stage of learning is offered below.
Discussion

An a priori model of cognitive processes has been described having implications for relationships between performance on widely divergent tasks. One set of such relationships was examined in the present study. The model postulated four kinds of cognitive capacity, four characteristic approaches to the world of stimuli and the world of feelings. After initially estimating individual differences in three of these capacities from Rorschach responses, these differences were related to aspects of effective performance during the early stages of a problem solving task. This might be considered a first step, then, in the validation of the model. It is the task of subsequent research to investigate these capacities or cognitive dimensions in other situations.

Representational capacity, as measured by form level on the Rorschach, did not show the predicted relationship with number of correct moves drawn. This failure may reflect choice of the wrong performance measure in the maze problem. The range of scores on this measure was very restricted. Perhaps the task itself is not ideally suited to bring out differences in representational capacity. More complex situations involving social issues and events might be more revealing in this regard.

Interpretation of both positive and negative results is complicated by the relationships among the Rorschach measures and also among the various measures of task performance on the maze. Further studies using larger numbers of Ss would provide an opportunity for isolating independent relationships, thus facilitating interpretation. Perhaps the four dimensions herein proposed can be reduced to fewer factors as implied by the observed relationship between two of the four measures used here, and also suggested theoretically by Rokeach (1956).

One of the most interesting and unexpected results was the disappearance of initially observed relationships between Rorschach measures and map-maze variables toward the middle and end of the learning process. Instead we find relationships between learning or conceptualization and the Rorschach variables of form percentage and attention to detail. This change in the relationship between Rorschach and task performance variables over time strongly suggests that different capacities are involved in degree of initial success and of ultimate mastery. A plausible interpretation involves
certain inferences about the motivational accompaniments of orientation to complexity. In the early stages of problem solution, those Ss high in complexity orientation are more capable of conceptualizing the maze and make more rapid headway. As the trials progress, however, the monotony of the task may become more and more apparent to them and their performance may stabilize at some point as a function of loss of interest and withdrawal of involvement. The Ss who perform more effectively during the later stages, however, are those commonly described as "emotionally constricted"—as indicated by their high $F\%$ and attention to detail. It seems reasonable to assume that their involvement in progress toward task solution would be relatively persistent and that they would therefore end up doing better than the Ss who are more responsive to interfering stimuli both from without (color) and from within (movement).

This line of thought suggests a self-regulatory mechanism whereby energy is directed to the most complex integration and adaptation tasks an organism is capable of, provided this energy is readily available (i.e., not tied up elsewhere).

In conjunction with the speculations of General Systems Theory and the personality theories which describe personality development in terms of hierarchically more complex stages of integration, we propose the present model of the cognitive map as a means by which the individual organizes and utilizes the energy available for problem solving, i.e., for forming hypotheses about problems and for adaptation in general. In the sense that cognitive maps have the properties of accuracy, complexity, and organization they are devices for using available energy for the most efficient transformation of informational input into response output. This idea is supported by the prediction arising from results in this study that the complexity-oriented person does relatively poorly on a tedious task because he mobilizes his energy only for complexity-challenging problems. A further study using both challenging and nonchallenging problems would be necessary to prove this point.

The finding regarding the increase of so-called learning and conceptualization abilities in simplicity-oriented Ss also has an implication for contemporary learning theory. Since most learning experiments use outcome or learning as the criterion in order to study the process of acquisition of learning, such procedure may
often introduce a source of error, as our experiment shows. People who learn quickly may differ from one another and may learn in different ways or with the aid of different internal processes, so that their learning may not be due to a similar underlying process of connecting stimuli. To attribute this individual difference simply to motivation would not constitute an adequate explanation, because such motivation may be different at various stages of the learning process according to the analysis proposed above.

The wider implication here is that learning may be more complex than mere connecting of stimulus, response, and drive variables. Perhaps a complex interaction effect may actually be at work to the extent that cognitive processes determine how a person consistently approaches a situation and also the secondary (or motivational) effects which influence the subsequent approach.

Our model seems to allow for the kind of feedback mechanism suggested here for many kinds of learning situations. This feedback is operating in the sense that continued availability of energy (or motivation) is dependent on the cognitive approach, which in turn determines how a problem is evaluated by the perceiver at various stages of problem solution. To speak of human learning in terms of stable increments of strength in the connection between stimulus and response may thus be quite misleading.

**Summary**

A model specifying four properties of a cognitive map was proposed and, assuming individual differences in the manifestation of these properties, they were reformulated as capacities or consistent approaches to the environment. The degree to which an individual possesses a capacity was expected to influence his behavior in a problem-solving situation. The four capacities were representational capacity (accuracy), capacity to include outer complexities, capacity to include inner complexities, and organizational capacity. These were measured separately on the Rorschach test. The problem-solving situation chosen was a complicated stylus maze (with hidden blinds) in which the S learned the circuitous path, drawing a map of his conception of the path after every third trial.

Of three predictions between measures of the capacities on the Rorschach and measures available for the map and maze behavior, two were confirmed on 49 undergraduate Ss in the initial stages of
the learning process (a) the capacity to include outer complexities was related to awareness of complexities of the maze paths as shown by drawing more complex patterns of correct moves on the map, and (b) organizational capacity was related to attempts to organize the maze path into larger wholes as shown by the emergence of larger, more integrated patterns of correct moves on the map.

In the initial stage there was also a significant relation between the Rorschach measure for capacity to include inner complexities and percentage of correct moves by patterns to total moves drawn on the map. This finding gave rise to a speculation about greater cognitive efficiency. Relationships between any of the map and maze measures and a short measure of verbal intelligence were not evident.

None of these relationships held toward the middle or the end of the hour-long learning process. Here Rorschach measures of rigidity and orientation to detail were related to faster learning speed and better conceptualization of the path on the maps drawn. An explanation was advanced that the noncomplexity and nonorganization oriented person emerges as winner by default of those who are no longer challenged by a tedious and repetitious task.

A feedback mechanism in learning that can be explained by the present model was discussed, and considered as an implied criticism of connectionist learning theory.

REFERENCES

BAKER, F Complexity-simplicity as a personality dimension J abnorm soc Psychol, 1953, 48, 163-172
BIERI, J, & BLACKER, E The generality of cognitive complexity in the perception of people and inblots J abnorm soc Psychol, 1956, 53, 112-117
CRONBACH, L J Statistical methods applied to Rorschach scores A review Psychol Bull, 1949, 46, 393-429
KRECHEVSKY, I 'Hypotheses' in rats Psychol Rev, 1932, 6, 516-532
MANN, C W, & JEWELL, W O Configurational aspects of human learning on the electrical maze Amer J Psychol, 1941, 54, 536-545
ROEKAEC, M On the unity of thought and belief J Pers, 1956, 25, 224-250
SACKETT, R S The influence of symbolic rehearsal upon the retention of a maze habit J gen Psychol, 1934, 18, 376-398
SARTAIN, A Q The conception of the true path and efficiency in maze learning J expir Psychol, 1940, 28, 74-93
SCOTT, T C Imagery—to what extent is it a function of the maze pattern? J genet Psychol, 1936, 48, 271-278
TOLMAN, E C Cognitive maps in rats and men Psychol Rev, 1948, 55, 189-208

Manuscript received July 28, 1958
This document is a scanned copy of a printed document. No warranty is given about the accuracy of the copy. Users should refer to the original published version of the material.