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A MODEL FOR INDIVIDUAL DIFFERENCES IN MODES OF PROCESSING INFORMATION

by

Philip Maclean Clark

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy in the
University of Michigan
1963

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CHAPTER I

A MODEL FOR INDIVIDUAL DIFFERENCES IN MODES OF PROCESSING INFORMATION

The nature of human thought has long been a subject for intensive study. Research reports during the years since the advent of experimental psychology provide a colorful array of postulations, systems, and arguments bearing upon the nature of human thinking. Wundt in Germany and his disciple Titchener in America used introspective techniques to examine the elements which constitute thoughts and ideas. Dewey and James, with a functional orientation, viewed thinking as problem solving. The most popular points of view in recent years have been variations on Thorndike's associationism, with Guthrie, Hull, Spence, Skinner, and others advocating mechanistic S-R or S-O-R notions. Wertheimer, Kohler, and Koffka, on the other hand, posit the patterning of a stimulus array as the primary determinant of the response.

The great majority of this work has been aimed at arriving at generalizations concerning "how people think;" relatively little has been concerned with individual differences in modes of thinking. The latter is the concern of this investigation.

Background

Early Systematic Investigation: Factor Analysis: Much of the work that has been done in the area of individual variance in mental processing has been, naturally enough, closely allied with the growth of the mental testing movement. While it is true that many mental tests have been developed without reference to any underlying theory of the nature of mental processing, Spearman, Thorndike, and Thurstone, among others, using the technique of factor analysis, have developed theories of human thinking upon which tests have been based.

Differences in point of view among these theorists have been frequently considered. Spearman postulated a "g" factor (general ability) necessary for success on any mental task, and specific abilities, "s" factors, peculiar to the performance of each individual task. Thorndike took vigorous exception to Spearman's interpretation, suggesting that whatever generality could be demonstrated through test intercorrelation lay primarily in the similarity of the tasks performed rather than in the people who performed them. Thurstone, whose position is closer to Spearman's, places less emphasis on the generality of mental ability and more upon specific abilities.

All of these men recognized the existence of somewhat independent mental abilities. In 1938, Thurstone isolated

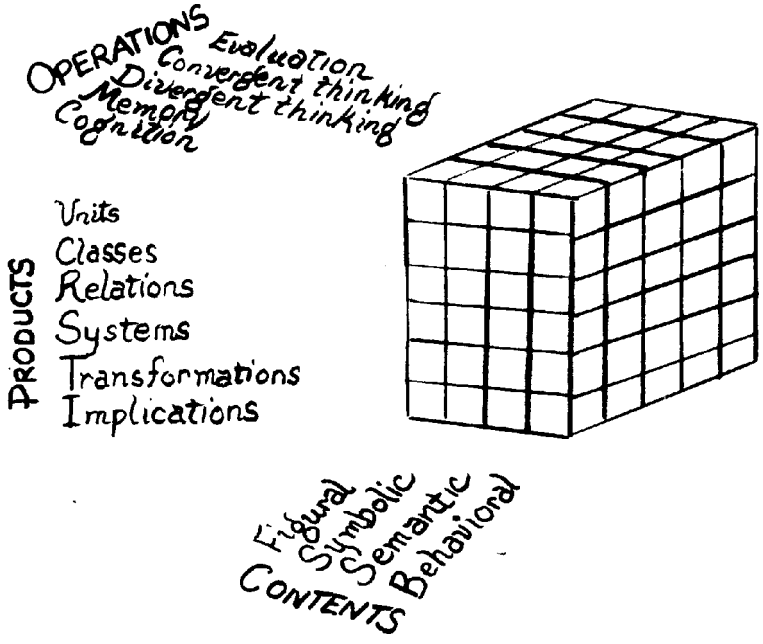
twelve such abilities through factor analysis. Three of these were unnamed; those identified were Spatial, Perceptual, Numerical, Verbal Relations, Memory, Words, Induction, Reasoning, and Deduction. Other investigators have isolated other mental factors (Guilford, Comrey, Green, and Christensen, 1950; Guilford, Green, and Christensen, 1951; Adkins and Lyerly, 1952; Rimoldi, 1948).

Critique of Early Factor Analytic Work: The discovery that the universe of abilities can be described in terms of a relatively few somewhat homogeneous "factors" was a brilliant first step in the history of attempts to understand the operations of the human intellect. The next step is that of determining the order among the factors.

Among the more important criticisms which can be leveled against the results of most or all factor analyses in the mental abilities realm is that the factors tend to lack logical parallelism or continuity. For example, consider Thurstone's named factors. They include Numerical and Memory. When Thurstone calls one factor Memory, what is it memory of? When one remembers numbers, is he exercising his memory or numerical ability or some combination of the two? If he is exercising a combination of the two, how can this be described? That is, while Numerical and Word ability may be parallel in one way, Inductive and Deductive ability are parallel in still another way. The

problem seems to arise from confounding the structural nature of the input (such factor designations as Numerical and Words), the structural nature of the output (such designations as Verbal Relations), and the functional nature of the operation of the organism upon the input to produce the output (such designations as Induction, Deduction, Reasoning, and Perception). The result is confusion and frustration when one attempts to work with the factors.

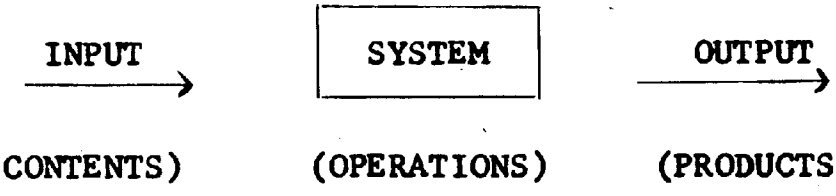
Formulation of Models: Guilford: Much of the theoretical concern in this area has pertained to the method of factor analysis itself rather than directly to the nature of human thinking. During the past decade, however, Guilford has evolved a model for the classification of mental processes with which he attempts to accommodate the wide variety of factors which have been isolated. His model takes the form of three orthogonal dimensions each representing an aspect of the phenomenon of thinking. He terms these dimensions "Operations," "Products," and "Contents" and suggests that any given phenomenon of thinking may be thought of in terms of these dimensions.



(Guilford, 1960, p. 4)

Guilford implies that this "Structure of Intellect" provides us with a more economical way of looking at the multiplicity of abilities which make up the intellect than has heretofore been available: "At first the number and variety of intellectual abilities seems overwhelming. This apparent complexity, however, is considerably mitigated by the principles of classification of the factors which simplify things for us a great deal" (Guilford, 1959a, p. 395). If one looks at Guilford's schema from the point of view of S-R learning theory, the "Contents" face is at least roughly equivalent to the stimulus, the "Products" face to the response, and the "Operations" face to the processes occurring within the "black box" or the functions performed by the

nervous system. If the model is viewed as a representation of man as an information processing system, the equivalences might be described as follows:



Critique of Guilford's Work: Guilford's model clarifies much of the confusion encountered in interpreting earlier factorial approaches to description of human thinking behavior, since it classifies the various factors so that they are roughly parallel on each face. The question posed earlier, for example, as to how the relationship between Numerical and Memory ability in a number-memory task can be described appears to be answered by this model. Memory is described as an "Operation" which may be performed on figural, symbolic (including numerical), semantic, or behavioral content. Likewise, the output might be in terms of units, or classes, or systems, and so on.

The organizational superiority of Guilford's model over earlier attempts at factorial descriptions of behavior is manifest. However, problems are encountered here too. The problems are, once again, problems of organization, but this time the organizational difficulty is found within each face

of the model and involves the concept of dimensionality. Though Guilford (1959a) speaks of the faces of his model as "dimensions," they really do not conform to the requirements for dimensionality. Dimensionality implies quantitative organization. For example, English and English define "dimension" as follows: "Any characteristic by which an object or event can be positioned in a quantitative series" (English and English, 1958, p. 153). The progression from figural through symbolic and semantic on the "Contents" face appears to satisfy the requirement in that it involves movement from molecularity to molarity. Three of the categories on the "Products" face - units, classes, and systems - involve a similar progression from singularity to multiplicity. (The other three factors positioned on this face of the Structure of Intellect - relations, transformations, and implications - suggest functions rather than structures; hence, their inclusion as "Products" might be questioned. A detailed consideration of this face, however, is outside the purview of this investigation). The organization of factors along the "Operations" face, however, does not satisfy the quantitative requirement for dimensionality.

The progression on this "Operations" face from cognition through memory, divergent thinking, and convergent thinking, to evaluation is clearly not a quantitative one but a roughly temporal one. Guilford's organization starts with the cognition

(or acquisition) phase, moves through memory to production (divergent and convergent thinking), and proceeds to an evaluation phase which is positioned at the end.

While the temporal bias is a reasonable one in terms of traditional thinking in psychology, it poses serious problems when applied as it is here. Let us consider once again, for example, the Guilford category called memory. A measure of the extent to which an individual can perform any function must be the result of testing. And, since testing samples former learning of some kind, it is not possible to test without reliance upon memory. Hence, memory enters into all the categories and, therefore, should not logically be positioned merely as one of them. Hebb has recognized this problem: "The conception of learning itself implies the conception of a short-term memory, at least; the two terms do not refer to different things, but to different aspects of the same phenomenon" (Hebb, 1958, p. 132). How do divergent and convergent thinking ability relate to each other, and don't both of them have something to do with cognition and evaluation? The interrelationships among the parts are real, but the parts are not organized in such a way as to point most meaningfully to their interrelationships. That is, the factors of Guilford's "Operations" face are not arranged quantitatively in keeping with the dimensionality requirement.

Guilford's classification technique goes a long way toward ordering the confusion represented by the earlier unorganized lists of abilities. But, as argued above, there are still organizational problems of real importance. Guilford, eminently aware of the results of mental ability factor analyses, many of which he has done himself, has organized his factors in a way which seems reasonable to him. If a significant quantitative dimension is to be substituted for Guilford's temporal ordering of factors on the "Operations" face of his model, it must be with reference to experimental evidence. The question then becomes: Where might one look for evidence germane to the establishment of such a quantitative dimension? The answer is that there is no one place to look, but many. Of relevance to the present problem are the psychology of thought, learning theory, theories of perception, personality theory, and neurophysiology, which will now be considered.

Relevant Findings

A strong clue to a quantitative "Operations" dimension based upon individual differences in modes of thinking is provided by a study done by Franks (1956). He reported a decided difference in conditionability between introverts and extraverts. Franks found that extraverted subjects do not condition as readily as introverted subjects when psychogalvanic response and eyeblink are used as conditioned responses.

Why should this be? On the face of it, this particular pairing of behaviors appears curious if not inexplicable. However, when we use the strategy of moving from the behavioral level to the physiological, we find ourselves in a position to account for this phenomenon as follows:

The neurohumors acetylcholine and cholinesterase have been well established as facilitator and inhibitor respectively of neural transmission at myoneural junctions and at some synapses in the nervous system (Tower, 1958). As one moves closer and closer to the higher centers, evidence for ACh and ChE as modulators becomes less convincing (Burgen and MacIntosh, 1955). However, there is no evidence to preclude the possibility of their operation at all synapses in the nervous system and Marrazzi (1953), for one, endorses this position. Smith and Carrigan (1959; Carrigan, 1961), following the logic that rapid circuit-breaking in the nervous system should co-vary with personality manifestations of high permeability or high susceptibility to environmental influence, have posited that introverted subjects should tend to be ACh dominant, i.e., to have high levels of ACh relative to ChE operating in synaptic transmission and/or at myoneural junctions. The correspondence is logically extended to a positive relationship between ChE dominance and extraversion.

To further elucidate this argument, we may refer to

Kaplan's recently devised model for arousal and perservation. Kaplan suggests:

> Any stimulus input impinging upon the units of an active trace may be blocked by that trace. Since a majority of the excitatory units of the active trace are likely to be either firing or refractory, and since the shell of inhibition limits firing in other excitatory units, the input pattern may be unable to establish a corresponding trace (Kaplan, 1962, p. 9).

He cites ACh and ChE as two of the likely modulators in his system. While he does not follow through with a detailed discussion of the precise effects of variations in balance of these two substances, one might readily infer that ACh dominance would give rise to traces which are less susceptible to the interference of further stimulation, while ChE dominance would give rise to traces which are more susceptible to the interference of subsequent stimuli and a resultant fractionation (loss of units from a network). The added fractionation should lead to more rapid "condensation" (Kaplan's term for "the development of a smaller, more efficient trace.") Kaplan states: "Since the homeostatic neural space requires new stimulation to maintain the activity level as traces condense, organisms seek novelty" (Kaplan, 1962, p. 18). We can reason from Kaplan's argument that the more rapid condensation which would logically o cur in the nervous system of the ChE dominant individual, because of enhanced fractionation, would lead to

a more pronounced seeking of novelty or a higher degree of curiosity in such a person.

Franks' finding relating conditionability to introversion, then, attains significance when we view it in terms of hypotheses from the personality and learning domains and relate it to physiological variables. If we take the next logical step, integrating the reported findings and speculations, we have a continuum characterized by high perseverative activity at the physiological level, high conditionability at the perceptual level, low curiosity at the conceptual level, and introversion at the personality level, on the one hand, and low perseverative activity, low conditionability, high curiosity, and extraversion on the other hand. This might be represented as follows:

Level	Dimension
Personality	Introversion $\longleftrightarrow$ Extraversion
Conceptual	Low Curiosity $\longleftrightarrow$ High Curiosity
Perceptual	High Conditionability $\longleftrightarrow$ Low Conditionability
Physiological	High Perseveration $\longleftrightarrow$ Low Perseveration

Theoretical Position

Using such a physiological model for individual difference in modes of processing information, one can build a dimension representative of the operations performed by the organism which is organized in a logical progression along a quantitative continuum. ACh dominance could be expected to be related

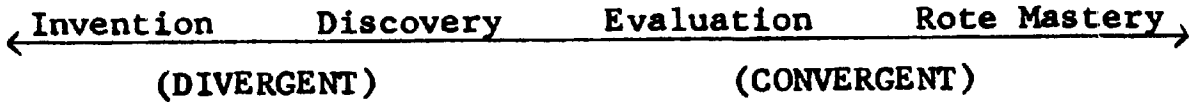
to highly perseverative thinking behavior and to relative indistractibility by random input: "Excessive ACh ought to be associated with prolonged fixation on a given stimulus, and hence with a considerable amount of reverberatory activity in the corresponding neural circuits; subsequent stimuli, presented while this activity is going on, would presumably not be attended to and, hence, would not be perceived" (Carrigan, 1961, p. 25). Hence, the ACh dominant individual would be most effective in mastering material by rote without having to relate it to a meaningful framework. This person's characteristic mode of responding would emphasize a high degree of stimulus support - simple perception of objects in the environment and the perseveration of the networks activated by these perceptions would be paramount. This mode would be effective for this individual since the networks representing the perceptions or pairings of perceptions would be relatively undisturbed by "subsequent stimuli" because of the "shell of inhibition" (Kaplan's term) resulting from the high degree of perseveration of the active trace. This ability might be called <u>rote mastery</u>.

The ChE dominant person, far less prone to long-term, single-network perseveration, should be able to move from point to point, from alternative to alternative, with relative facility. Experimental evidence relating ChE dominance

to such behavioral flexibility is provided by the research of Rosenzweig, Krech, and Bennett (1958). They found that rats which were relatively quick to abandon their original preferences and test other hypotheses in attempts to solve an insoluble maze problem tended to have substantially higher levels of ChE activity than did those which persisted in following their original hypotheses. Rosenzweig et. al. call these ChE dominant animals "adaptive" in view of their relatively high degree of behavioral variability or flexibility.

We might expect the ChE dominant individual to be more original in his thinking behavior than the ACh dominant one. Following Kaplan's model, he should exhibit more curiosity or a greater tendency to seek novelty. We might describe his dominant ability, frequently referred to in the literature as Perceptual Speed (Thurstone, 1944; Adkins and Lyerly, 1952; Guilford et. al., 1952), as invention. A person at a less extreme position on the invention end of the continuum might be expected to excel at seeing relationships, that is, tasks which have been classified as Speed and Strength of Closure (Thurstone, 1944). This ability might be termed discovery. Likewise, a less extreme position on the rote mastery side might be called evaluation, denoting an ability to compare various alternatives with established criteria of correctness.

The tasks a person at this position on the continuum would be expected to perform well, i.e., Designs and Gottschaldt Figures, load high on Thurstone's Flexibility of Closure factor (1944). Now we have a processing dimension which appears as follows:



When this dimension is compared with Guilford's "Operations" face, it will be noticed that the general modes of handling information are emphasized while the temporal distinctions which Guilford makes are eliminated. That is, Guilford's ordering suggests that cognition precedes memory, which in turn precedes the production categories of convergent and divergent thinking, and that evaluation must involve at least many of the operations which "precede" it along the face. The proposed dimension, since it emanates from a model which suggests the generality of mode or "style" of dealing with information within a given individual, eliminates distinctions having to do with time. The implication of the proposed dimension is that if an individual produces in an ACh dominant manner, he will also remember and "cognize" in an ACh dominant manner.[1]

The two hypothesized basic styles of processing information are called Divergent and Convergent after Guilford. These

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[1]This position is not unlike that expressed by Witkin, Dyk, Faterson, Goodenough, and Karp (1962).

have been subdivided, the Convergent categories being termed rote mastery and evaluation and the Divergent categories being termed invention and discovery.

CHAPTER II

METHOD

Three tests appropriate for measuring the extent of each of the processing modes were selected. These are:

Basic Style	Predicted Mode	Test	Guilford's Factor
Divergent	Invention	Coding Word Fluency Brick Uses	Divergent Thinking
	Discovery	Gestalt Completion Mutilated Words Remote Assoc. Test	Cognition Cognition
Convergent	Evaluation	Identical Forms Designs Concealed Figures	Evaluation Convergent Thinking
	Rote Mastery	Picture-Number Paired Associates Digit Span	Memory Memory

The tests were administered to 152 eighth grade students. It was predicted that factor analysis of the test results would yield four factors, two Convergent and two Divergent, and that these four factors would be related to each other in such a way as to confirm their suggested ordering. The factor analytic treatment appropriate for this task appeared to be one similar

to that used by Rimoldi (1951) in another study of mental factors - principal axes solution, oblique rotation, and second-order analysis.

Construction of the Test Battery

The primary criterion used in choosing the tests was that they be appropriate in terms of the theoretical model for measuring the extent of their respective modes. An effort was made to choose tests which might reasonably be termed perceptual. As may be noted, several of the tests do not meet this requirement. Indeed, the generalizability from one level of psychological enquiry to another implicit in the model makes the requirement unnecessary. Each of the four sets of tests contains at least one from Guilford's list of tests appropriate for measuring the abilities on his "Operations" face, and each of Guilford's factors contributes at least one test to the battery.

Coding (Wechsler, 1958) is a test adapted for group use from the Digit Symbol test in the Wechsler Intelligence Scale for Children. It requires the matching of symbols with their appropriate numbers in accordance with a number-symbol chart which may be referred to throughout the performance of the task. This test was chosen as a measure of the mode termed invention because it was felt that good performance on it would indicate a high level of perceptual speed necessary for

inventive behavior. On the neural transmission level, high ChE relative to ACh is postulated to lead to rapid circuit-breaking. On the behavioral level, this should lead to good performance on such a task as Coding which demands facile movement from one stimulus to another. L. H. O. Spearman (1960), in his analysis of data compiled by Smith and Carrigan (1959), found that Coding was the highest loading test on the factor he called Speed.

Word Fluency (Terman and Merrill, 1937) is the Word Naming test from Form L of the Stanford-Binet Intelligence Scale adapted for group use. Subjects are required simply to name as many words as they can in one minute. Word Fluency was chosen as a test of invention since it was thought that high scores would be obtained by people who are rapid circuit-breakers in terms of the model. That is, the production of a large number of words would require ability to move quickly from one idea or association to another. This test and the one following are probably more justifiably categorized as "conceptual" than as "perceptual." It is interesting to note that, while Guilford (1960) uses a category of tests which he calls Word Fluency as a measure of his Divergent Thinking factor, all four of his tests require that the words named contain a specified constant element, i.e., suffix, prefix, beginning letter. Terman (1916, p. 276) anticipated this type of variation

and objected to it on the basis that it would place an unreasonable emphasis on environment and formal instruction. A more pertinent objection in terms of the present model would be that those who score well on the task when an element is specified may do so because of perseveration within a series of neural networks immediately related to the one represented by the specified element rather than because of ability to break circuits rapidly. In any event, the concept of specification is, in some respects, antithetical to that of invention.

Brick Uses (Guilford, 1959) is a test developed by Guilford which, depending upon how it is scored, may be used as a test either of ideational fluency or semantic flexibility, both of which are sub-categories of his Divergent Thinking factor. Instructions are for subjects to name as many uses as possible for the common brick. The scoring method used here is the one recommended by Guilford for semantic flexibility: "Score is the number of times the class of use is changed" (Guilford, 1957). Since no list of classes of response is provided by Guilford in the literature, a classification system was worked out before this test was scored. An outline of the system used may be found in the Appendix. This task was chosen since it was felt that it would provide still another indication of circuit-breaking ability. The

scoring method used places emphasis not upon simple total of responses or even upon total number of classes named, but upon the number of times the subject shifts classes. This would serve to penalize the individual who perseverates within a given class (ACh dominance), and to reward the individual who has a high degree of response flexibility or facility for changing set (ChE dominance).

Gestalt Completion Test, Form 1950 A (Thurstone, 1944) is a paper and pencil form of the test used by Thurstone in his 1944 factorial study of perception which, in turn, is an adaptation of Street's (1931) original Gestalt Completion Test. It is composed of twenty-four mutilated pictures which the subject is required to identify. In Thurstone's 1944 study it was found that this test had its highest loading on the Perceptual Speed factor and its next highest loading on the Speed and Strength of Closure factor. Other studies have confirmed it as a test of speed of closure (Botzum, 1951; Pemberton, 1952). It was chosen for use in this study as a measure of discovery since it was thought that the ability to fill in the missing parts of the mutilated pictures would reflect the neural capability of moving from one portion of the stimulus figure to another rapidly enough for it to be seen and responded to as a whole rather than as separate segments. It should be noted that the discovery tasks involve

more stimulus support than do those for invention, but that they still stress speed of circuit-breaking or ChE dominance. Guilford (1960) recommends this as a test of Visual Cognition, which he subtitles Speed of Closure.

Mutilated Words, Form 1950 B (Thurstone, 1944) is a paper and pencil form of the test developed by Thurstone for use in his 1944 study of perception. In this and subsequent studies (Adkins and Lyerly, 1952; Pemberton, 1952) it has proved to be fairly highly correlated with the Gestalt Completion Test and seems to be measuring much the same ability, the chief difference in the two tests being that one is verbal while the other is figural in content. The rationale for its use is similar to that for the use of Gestalt Completion, and Guilford also pairs the two.

Remote Associates Test, Form 3, 1961 (Mednick, 1962) is an instrument developed by Mednick as a test of creativity in keeping with his associative hierarchy theory of the basis of the creative process. It is probably the least known test of those in the current battery. Each item involves the production of a single word which will serve to connect three given words. For example, if "railroad," "girl," and "class" are given, the appropriate response is "working." Mednick hypothesizes that the more potential responses an individual has for a given single stimulus, the better he will perform on

this test. It was chosen for the current battery on the basis that the facility for rapid scanning of possible responses for each item should both lead to good performance on the test and reflect the rapid circuit-breaking ability considered necessary for this task. This test is thought to be roughly analogous to the Gestalt Completion and Mutilated Words tests (given stimuli with necessity for closure from within). The Remote Associates Test is probably more properly classified as conceptual than as perceptual.

Identical Forms (Thurstone, 1938) is a test used by Thurstone in his 1938 factorial study of mental abilities. Each item involves matching a given stimulus figure with its exact duplicate which must be selected from among several similar but slightly different choices. Of the factor on which it loads highest, Thurstone says, "The perceptual function here seems to be a facility in perceiving detail that is embedded in irrelevant material" (Thurstone, 1938, p. 81). It was chosen as a measure of evaluation in the current study on the basis that good performance on it should depend upon perseveration of the trace or trace system activated by the stimulus item long enough and strongly enough for its analogue to be found among the similar choices. According to the model, this perseverative characteristic should be found in ACh dominant individuals. It should be noted that, while it was

either stated or implied in the directions of this and the other two tests chosen to measure this factor that the score would depend upon both speed and accuracy, the scoring formula actually used was number correct/number attempted, or a simple percentage score for all three tests. This was done in order to eliminate considerations of speed for this factor and thus increase the likelihood of accurate interpretation. Guilford recommends this test, scored in the usual way, as a measure of the figural identification "(traditionally known as 'perceptual speed')" (Guilford, 1960, p. 27) category of his Evaluation factor.

Designs (French, 1954) is a test developed by Thurstone and listed by French as a measure of Flexibility of Closure. Here the subject must select from among a long sequence of ambiguous figures the ones which contain exact duplicates of the given figure. Designs was chosen for use in the current battery not as a measure of flexibility of closure, but as a measure of evaluation. The rationale for its use here is that it seems to demand that the model figure be "held in mind" while exemplars of it are extracted from amidst a great deal of irrelevant material actually contrived to distract. It is slightly different from the Identical Forms task in that it requires that the model be held for a longer period of time, but it was expected that the two would load together.

Concealed Figures (French, 1954) is a paper and pencil adaptation by Thurstone of the Figures Test developed in the 1920's by the German psychologist Gottschaldt (1929). The subject is required in each item to select those from among several complex figures which contain a given relatively simple figure. Thurstone (1944) emphasizes the ability to "perceptually disregard" the irrelevant portions of the choice figures so as to reveal the stimulus figure as crucial to good performance on this test. Witkin's contention that the task requires that the subject "separate an item from the field in which it is incorporated" (Witkin, 1954, p. 83) places the emphasis more appropriately in terms of the rationale behind the selection of the test as a measure of evaluation in the current study. It was chosen as a measure of evaluation in this study on the basis that good performance requires the individual to hold the stimulus figure in a perseverative way while searching for forms which match it among an array of potentially distracting elements. That some individuals are decidedly deficient at this task is illustrated by Witkin's comment concerning one of his subjects:

> This occurred in a most dramatic way with the male S who received the poorest score of the entire group. In the first part of the test particularly, he found it so difficult to "retain" the simple figure that it had to be shown to him repeatedly; and as soon as it was removed and the complex figure presented,

> he "lost" it again. This occurred on trial after trial and so frustrated the S that he complained of the task as a hopeless one and repeatedly protested that he could not go on. The difficulty here did not seem to be one of memory, but rather a "blocking" of the simple figure by the conflicting complex pattern. In fact, the S himself successfully verbalized the nature of his difficulty several times. (Witkin, 1950, p. 12).

Guilford suggests this test as a measure of the figural redefinition category of his Convergent Thinking factor.

Picture Number (French, 1954) is an adaptation of a test developed by Anastasi and is listed by French as a measure of a factor which he calls Associative Memory. It involves the associating of numbers and pictures from memory. It was chosen for the current battery as a measure of rote mastery since it was felt that high scores would be obtained by individuals in whose nervous systems the associative traces would be expected to perseverate longest and most effectively (ACh dominant people). It should be noted that the tasks chosen as measures of this rote mastery factor all involve an extreme reliance on the immediate stimulus and a relative lack of reliance on the provision of information from within the organism. That is, a high level of stimulus support is the defining characteristic of these tasks. Also significant in the selection of these tests is that the connections required are essentially meaningless in comparison with those required for the other tests in the battery. There is no

particular logic, for example, to the connection of the number 30 with the picture of a spoon. Guilford specifies this test as a measure of rote memory.

Paired Associates (Carroll and Sapon, 1959) was developed by Carroll and Sapon as a measure of "the rote memory aspect of the learning of foreign languages" (Carroll and Sapon, 1959, p. 3). It comprises one section of the Modern Language Aptitude Test and requires the subject to associate pseudo-Kurdish words with their English equivalents from memory. This test was chosen for use in the present battery since it was felt that it placed minimum emphasis upon familiarity of association or compatibility between stimulus and response. That is, the relationship of "lah" and "wolf" is not one which would be logically expected by the English-speaking students who were to be the subjects. Hence, whatever association was made would be largely a "rote" one, and according to the model, would be easily accomplished and more readily held by ACh dominant people than by ChE dominant people.

Digit Span (Wechsler, 1958) is a paper and pencil adaptation for group use of a test of the same name found in the Wechsler Intelligence Scale for Children. Some form of it is also found in the original Binet Scale and all revisions of it. Here the subjects are required to report, in proper order, each one of a series of digits which the examiner has

read aloud. There are several items, each composed of a different digit series, and the length of the series increases with each item. Subjects must wait until an item has been read in full before starting to make their responses. The correlation of this test with measures of "general intelligence" is consistently low (Wechsler, 1958) and its relative uniqueness has been consistently high. It has been said to measure "ability to attend and concentrate" and "freedom from distraction." Terman points out that "digits have less meaning (fewer associations) than the words of a sentence"(Terman, 1916, p. 194). Notwithstanding the test's consistent uniqueness, it was chosen as a measure of rote mastery in the current investigation because it is felt that good performance on it should require relative freedom from distraction and reliance upon rote learning for retention, both of which should be characteristics of the ACh dominant individual. Guilford (1959) suggests this test as a measure of memory span.

Subjects

The subjects used in the study were a sample of eighth grade pupils of both sexes from the Jane Addams Junior High School in Royal Oak, Michigan, a middle-class suburb of a large industrial community. Since this school employs a form of ability grouping, the sample was not selected at random. Instead, the lowest and highest I.Q. groups were chosen along

with three average groups selected on the basis of ease of availability in terms of the school's schedule. The lowest reading level was represented by a grade-equivalent score of 4.7 as measured by the reading portion of the California Achievement Test (1957), and this was judged adequate for performance on the verbal sections of the battery.

In keeping with the school system's policy, a letter requesting parents' permission for students to participate in the project (see Appendix III) was sent out to the parents of students involved approximately three weeks prior to the date set for testing. A week before the tests were to be given, teachers were informed and they notified their pupils on the day before the actual testing. All but one of the expected subjects obtained parental permission to participate in the study, the one demurrer coming from a family already involved in extensive psychological testing and family therapy. If all the remaining expected subjects had been present, the total N would have been 159. Seven were absent from school on the day of testing making the number of subjects tested 152. Three subjects failed to follow directions and their papers were discarded. Total N was 149.

Administration of the Test Battery

The tests were administered in two sessions, one in the

morning and one in the afternoon. The morning group consisted of 84 of the subjects, and the afternoon group was composed of the remaining 68. This arrangement was necessitated both by school scheduling considerations and the size of the available testing room. The testing team consisted of the author and three assistants experienced in test administration. The entire test battery and its accompanying instruction booklet may be found in the Appendix.

CHAPTER III

RESULTS AND DISCUSSION

Procedure

The scores of 149 subjects on each of the twelve scales described in Chapter II were analyzed as follows:[2]

A. Test scores were intercorrelated.

B. The resulting correlation matrix was factored by the principal axes method.

C. The solution was rotated to an orthogonal structure.

D. The orthogonal structure solution was rotated to an oblique structure.

E. Oblique factors were intercorrelated.

F. The correlation matrix of oblique factors was, in turn, factored by the principal axes method to obtain a second order solution.

A. Intercorrelation: The twelve-variable intercorrelation matrix is reported in Table 1. With few exceptions, the

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[2]All computations, solutions, and rotations were performed by the I.B.M. 7090 Computer at the University of Michigan Computing Center. The writer wishes to thank Dr. R. C. F. Bartels for his kindness in permitting the use of the Computing Center without charge for this project.

highest correlation coefficients (.40 and above) appear near the main diagonal. Since the matrix is arranged so as to reflect the expected ordering (i.e., tests for invention, discovery, evaluation, and rote mastery, in that order), such high coefficients near the main diagonal coupled with diminishing coefficients as one moves away from the diagonal suggests an approximation to the prediction. This reasoning is not unlike that of Guttman (1954) in his discussion of an approach to ordering which he calls the "simplex."

Table 1

Twelve Variable Intercorrelation Matrix

	Test	1	2	3	4	5	6	7	8	9	10	11	12
1	Coding												
2	Wd Fl	.48											
3	Br Uses	.19	.40										
4	Gest Comp	.33	.33	.37									
5	Mut Wds	.28	.37	.11	.46								
6	RAT	.30	.32	.07	.25	.41							
7	Id Fms	.28	.15	.05	.11	.19	.34						
8	Designs	.21	.22	.04	.14	.29	.30	.29					
9	Conc Figs	.25	.22	.15	.31	.33	.45	.38	.52				
10	Pict-No	.41	.20	.03	.15	.28	.42	.24	.18	.28			
11	Pr Assoc	.29	.23	.13	.25	.29	.47	.23	.23	.41	.54		
12	Dig Sp	.17	.26	.08	.16	.25	.25	.22	.29	.35	.17	.16	

To make this argument more explicit, let us compare the mean correlation coefficient (using Fisher's z transformation) of the two diagonals nearest the main diagonal (those coefficients above the line in Table 1) with that of the nine coefficients in the lower left-hand corner of the matrix. By so doing we are comparing the predicted highest correlation coefficient with the predicted lowest ones. The mean correlation coefficient for the two diagonals is .33, while that for the lower left-hand corner is .21. This serves as a rough test of the adequacy of the hypothesis and suggests that it is reasonable to go on with further analytic procedures.

B. Factor Analysis: Principal Axes Method: The principal axes solution is reported in Table 2. Squared multiple correlations (s. m. c.'s) were entered in the leading diagonal according to the recommendation of Wrigley (1957), who points out that the s. m. c. represents the purest measure of the variance common to each given test and all other tests in the selection. The solution was programmed in such a way as to allow the extraction of all positive roots.

The same kind of analysis as that used in explicating Table 1 may be carried out with the unrotated principal axes solution in Table 2 which is, of course, a transformation of the matrix presented in Table 1. If we consider Factor I in Table 2 as the general ability factor, we can make a prediction about

Table 2

Principal Axes Solution

Test	Factor						
	I	II	III	IV	V	VI	h^2
Coding	.56	-.18	-.19	-.24	.04	-.08	.45
Wd Fl	.55	-.40	-.00	-.19	.05	.08	.51
Br Uses	.28	-.45	.06	.01	-.22	.03	.33
Gest Comp	.50	-.37	.06	.23	-.00	-.08	.45
Mut Wds	.58	-.11	.06	.19	.24	-.01	.45
RAT	.65	.18	-.08	.06	.06	.05	.47
Id Fms	.44	.21	.09	-.16	-.04	-.07	.28
Designs	.49	.22	.31	-.07	.01	-.00	.39
Conc Figs	.65	.22	.27	.07	-.14	-.02	.57
Pict-No	.54	.20	-.39	-.02	-.00	-.00	.48
Pr Assoc	.59	.17	-.27	.14	-.14	.04	.49
Dig Sp	.41	.06	.21	-.09	.06	.07	.23
Sums of Squares	3.39	.78	.51	.25	.16	.03	5.12

the ordering of the mean loadings of given subsets of these tests. That is, the order of the mean loadings (after appropriate z transformations) of the groups of three tests representing each hypothesized factor should be similar to that originally predicted. These values are as follows: invention, .47; discovery, .58; evaluation, .54; rote mastery, .51. These

figures suggest an order which is not identical with that predicted since Factor I, while extreme, is at the opposite end from that expected. While this result in part supports the model and is interesting in its own right, not all of the predictable variance is accounted for by this one factor (66 per cent) and, furthermore, another approach in terms of an oblique solution offers additional leverage for interpretation. However, before discussing the latter, let us consider the results of the orthogonal rotation.

C. Orthogonal Rotation: The principal axes solution was rotated orthogonally by means of Kaiser's (1956) Varimax method, and a three-factor result (see Table 3) satisfied the Wrigley-Kiel criterion of "3". Varimax was used in preference to other methods since it more nearly approximates simple structure. This offers the advantage of distributing the variance more evenly among the factors. The Wrigley-Kiel criterion of "3" specifies that each factor rotated must contain the highest loading for each of at least three of the variables. This criterion was chosen in keeping with the prediction that each factor would be defined by three of the tests. It should be noted that the three factors in Table 3 account for 91 percent of the common variance.

Table 3

Varimax Rotation of Principal Axes Solution

Wrigley-Kiel Criterion of 3

Test	Factor			
	I	II	III	h^2
Coding	-.42	.15	-.43	.38
Wd Fl	-.20	.17	-.63	.46
Br Uses	.02	.02	-.53	.28
Gest Comp	-.14	.19	-.58	.38
Mut Wds	-.26	.35	-.40	.35
RAT	-.49	.43	-.18	.46
Id Fms	-.25	.42	-.05	.25
Designs	-.12	.60	-.09	.38
Conc Figs	-.24	.68	-.17	.55
Pict-No	-.67	.17	-.08	.49
Pr Assoc	-.60	.26	-.14	.45
Dig Sp	-.10	.42	-.17	.20
Sums of Squares	1.50	1.67	1.48	4.65

D. Oblique Rotation: An oblique structure was found after 42 iterations of the three-factor orthogonal result using Carroll's (1957) Biquartimin method, which appears to combine the advantages of the Covarimin and Quartimin solutions, neither of which works well in practice (Harman, 1960, p. 324).

While the Biquartimin method represents only one of many solutions to the problem of the extent to which the axes should be allowed to rotate freely, its practicality dictated its use in this study. The oblique factor loadings are reported in Table 4. The improved approach to simple structure will be noted by comparing the number of low loadings in this rotation with those in Table 3. The factors in Table 4 are the ones we will be working with henceforth.

Table 4

Biquartimin Rotation of Three-Factor Orthogonal Structure

Primary Pattern

Test	Factor		
	I	II	III
Coding	.37	.04	.39
Wd Fl	.11	.08	.62
Br Uses	-.08	-.04	.55
Gest Comp	.05	.11	.57
Mut Wds	.16	.29	.35
RAT	.41	.37	.08
Id Fms	.17	.41	-.03
Designs	-.02	.62	-.00
Conc Figs	.09	.68	.06
Pict-No	.67	.06	.00
Pr Assoc	.57	.17	.06
Dig Sp	-.00	.42	.11

E. Correlations among Oblique Factors: The three-variable matrix representing the intercorrelations of these three oblique factors is reported in Table 5. To the extent that these intercorrelations have not been influenced by restrictions inherent in the Biquartimin method, they may be considered useful as descriptions of the relationships among the factors. To this extent, then, a second order analysis is a reasonable next step.

Table 5

Three-Variable Intercorrelation Matrix of Obliquely Rotated Factors

	I	II	III
Factor I			
Factor II	.39		
Factor III	.24	.30	

F. Second Order Analysis: Principal Axes Method: The correlation matrix of the three oblique factors was analyzed by the principal axes method to obtain a second order solution. As before, s. m. c.'s were entered in the main diagonal. The results of the second order analysis are reported in Table 6. This suggests that the relationships among first order factors in factor space are as follows: Factor II, Factor I, Factor III. Although the resulting order is based upon small differences in loadings, a cautious interpretation of the behavioral

significance of the factors and their suggested organization will be attempted in the following sections.

Table 6

Principal Axes Solution at Second Order Level

	I'
Factor I	.53
Factor II	.56
Factor III	.44

Results

The large number of zero and near zero loadings in Table 4 indicates an acceptable approach to simple structure. The factors will be presented in the following order: I, II, III.

Factor I: The highest loadings are:

Picture-Number Recall	.67*
Paired-Associates	.57*
Remote Associates Test	.41*
Coding	.37

*denotes highest loading for the test on any factor

Two of these tests, Picture-Number Recall and Paired Associates, load almost exlusively on this factor while the other two, Remote Associates Test and Coding, have roughly equivalent

loadings on other factors. No other test loads appreciably on Factor I.

Factor II: The highest loadings are:

Concealed Figures	.68*
Designs	.62*
Digit Span	.42*
Identical Forms	.41*
Remote Associates Test	.37

*denotes highest loading for the test on any factor.

The approach to simple structure is quite compelling for the four tests which load highest on this factor. The Remote Associates Test, on the other hand, loads almost as high on Factor I as it does on this factor.

Factor III: The highest loadings are:

Word Fluency	.62*
Gestalt Completion	.57*
Brick Uses	.55*
Coding	.39*
Mutilated Words	.35*

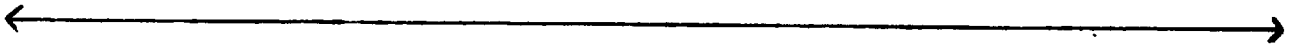
*denotes highest loading for the test on any factor.

The first three of these tests load on this factor practically exclusively. Only Coding and Mutilated Words are apparently complex enough to load on other factors as well.

Interpretation

Prediction: It was predicted that there would be two Divergent and two Convergent factors, and that they would be organized in a particular way. The composition and organization of these expected factors is outlined below:

Invention	Discovery	Evaluation	Rote Mastery
Coding	Gest Comp	Ident Fms	Pict-No
Word Fluency	Mut Words	Designs	Pr Assoc
Brick Uses	R.A.T.	Conc Figs	Digit Span



DIVERGENT CONVERGENT

The composition of the three factors which actually emerged will now be considered in the following order: II, III, I.

Composition of Factors: Factor II is defined primarily by four tests. Three of these, Identical Forms, Designs, and Concealed Figures were thought to identify an evaluation factor. Each requires the subject to match a stimulus figure with duplicates which are disguised in various ways among irrelevant distractors. Good performance on tasks such as these would presumably be facilitated by perseveration of a stimulus trace over a long enough time interval to allow the search and eventual matching to take place. That is, an individual's high

capacity for perseveration might account for his ability to hold the stimulus figure in the form of an "active trace" without stimulus support while he conducts his search for its analogue.

The resistance of this trace to the distractions in the field could be explained by the strength of the trace itself as suggested in Kaplan's "shell of inhibition" construct discussed earlier.

Digit Span's high loading is consistent with this view of the nature of the factor as stressing perseveration of the input pattern. The establishment of a chain of relatively independent active traces could well account for good performance of the Digit Span task. (Since the Remote Associates Test has high loadings on two factors, it will be considered later.)

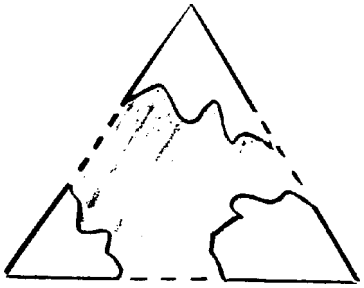
Factor III is defined by Word Fluency, Gestalt Completion, Brick Uses, Coding, and Mutilated Words. Two of these, Word Fluency and Brick Uses, appear to stress the ability to shift set rapidly. Subjects who score well on these tasks, unlike those who are expert at tests loading on Factor II, must <u>not</u> perseverate -- must <u>not</u> establish traces which are highly resistant to subsequent input. Gestalt Completion, the other test which loads exclusively on this factor, may also be viewed as requiring such a non-perseverative or set-breaking kind of

neural capability. If the input from each of the discrete portions of the mutilated figure perseverates in relative isolation from that of the other, the apprehension of the whole necessary for completing the figure will probably be less likely to occur. The same reasoning can be applied to Mutilated Words which also loads highest on this factor. (Coding has essentially equivalent loadings on this factor and Factor I and will be considered later.)

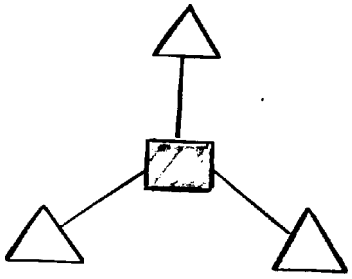
Factor I is defined by Picture-Number Recall, Paired Associates, the Remote Associates Test, and Coding. Two of these, Picture-Number and Paired Associates, are paired associate learning tasks. But how can the moderate to high loadings of the Remote Associates Test and Coding on this factor be accounted for?

The rationale for including the Remote Associates Test in the battery was that it should stress rapid circuit-breaking and, by analogy, should load with Gestalt Completion and Mutilated Words. The results indicate that it loads highest (.41) with two tests which define a factor which appears to represent the predicted rote mastery subdivision of the Convergent end of the continuum. This suggests that the task might contain an important "rote" or non-meaningful component. When the Remote Associates Test is compared with Gestalt Completion and Mutilated Words with this in mind, important

differences can be detected. When the missing parts are supplied in the Gestalt Completion and Mutilated Words tasks, a meaningful whole results. In the case of Remote Associates, on the other hand, the missing word is not one which partipates with the other three in constituting a whole, but one which is bonded singly with each of the other three. The difference might be described schematically as follows:



Gestalt and Mutilated Words case. Shaded area represents missing portion filled in.



Remote Associates case. Shaded area represents missing word.

Hence, the finding of the "correct" missing word in the Remote Associates situation appears to rely not so much upon the "closure" involved in the other two tasks as it does upon ability to remember a series of stereotyped phrases which happen to have a common element (the correct response). The end result in the Remote Associates case is still essentially meaningless as a whole even though its parts are now connected by a single link. This task may even be viewed as an elaboration on the paired-associate condition in that a potential

response must be paired with each of the three stimulus words after it has been generated.

Coding may also be viewed as a modified paired-associate learning condition in that the pairings of letter and symbol must either be mastered in advance or referred to throughout the performance of the task.

Factor I, then, is defined principally by the two paired-associate tasks, Picture-Number Recall and Paired Associates. The Remote Associates Test and Coding also load moderately to high on this factor. One thing which all have in common is that they all may be viewed as variations of paired associate learning tasks.

Ordering of Factors: The predicted ordering of factors is indicated on page 32. The one factor actually yielded by second order analysis (see Table 6) appears as follows:

III	I	II
Divergence	Pairing	Convergence
Word Fluency	Picture-Number	Concealed Figures
Gestalt Completion	Paired Associates	Designs
Brick Uses	Remote Assoc Test	Digit Span
Coding	Coding	Identical Forms
Mutilated Words		Remote Assoc Test



Factor II matches quite closely the predicted evaluation subdivision of the Convergent end of the postulated processing dimension. The variables loading on this factor strongly

suggest the dominance of perseverative as contrasted with non-perseverative neural capability. Factor III closely approximates a combination of the predicted invention and discovery subdivisions of the Divergent end of the continuum. No variable which was predicted to appear at the Convergent end of the continuum loads here, and the only one which was expected to load here and doesn't is Mednick's Remote Associates Test. The variables loading on this factor strongly suggest the dominance of non-perseverative as contrasted with perseverative neural capability.

These factors (II and III) are at opposite ends of the continuum. In the case of Factor II, this placement might be logically expected since it represents a combination of the two Divergent factors, discovery and invention. It was originally expected, however, that the factor defined by Picture-Number Recall and Paired Associates (Factor I) would be positioned further from the center of the final dimension than would that defined by Concealed Figures, Designs, and Identical Forms (Factor II). Instead, it is positioned in the middle. We must take a closer look at the tests loading on this factor in order to account for this apparent discrepancy.

It has already been suggested that all the tests loading on Factor I, the centrally-positioned factor, may be viewed as variations on the paired associate learning task. The reason

that Paired Associates, Picture-Number Recall, and Digit Span were originally chosen as measures for the most extreme Convergent factor was that they were thought to require mastery by rote rather than by relation to a meaningful framework. Such rote mastery, it was reasoned, should require an extreme in perseverative capability. The only one of the three which did, actually, load on what turned out to be the extreme Convergent factor was Digit Span, the one test of the three which could not be classified as a paired-associate learning task. The other tests which may be thought of as paired-associate tasks load moderately to high on the middle factor (Factor I). The question becomes: What is involved in good performance of these paired associate learning tasks? If it were pure perseveration as anticipated, this factor would not have positioned itself between the other two but would have appeared at the extreme beyond Factor II. Is it possible that a high score can be achieved in a circuit-breaking manner?

There are several studies in the literature to suggest that verbal units, at least, may be scaled along a dimension of meaningfulness or "association value" (See Underwood and Schultz, 1960). Most of this work has been done with nonsense syllables. It seems reasonable that if such nondescript verbal symbols as XZF and DPT can be scaled for meaningfulness, non-verbal symbols such as those appearing in Picture-Number Recall

and Coding ought similarly to be amenable to scaling. If it is true that the items comprising the associative tasks employed in the tests which loaded on Factor I are scalable in the manner suggested, the positioning of Factor I between the other two might be accounted for as follows: Parts of the items can be associated in a meaningful way as well as by rote. Apparently, that is, the associations involved in the tests used do not preclude meaningful association to the extent it was expected they would.

Some people, then, might score well on these tasks by associating the parts in the expected rote manner, while others would succeed by associating the pairs using already-established patterns. An example of the latter method of associating the pairs of Kurdish and English words on the Paired Associate test is provided by the following statement of one subject: "Some of them were easy. I knew 'hon' and 'cold' should go together; I just thought, 'Honey, I'm cold."

Discussion

This study was aimed at explicating the nature and organization of factors aligning themselves along a dimension similar to the "Operations" face of Guilford's Structure of Intellect model. The principal findings of the investigation are that, given the battery of tests that was used and the

sample of subjects tested, it is possible to isolate at least three processing factors; that two of these factors represent basic modes or "styles" of dealing with input at the perceptual and/or cognitive level; that the factors at the extremes of the dimension suggest a continuum of information processing modes running from high to low perseveration; that the factor in the middle of the continuum emerged because the tests which loaded on it allow success by both those who are predominantly perseverative in their processing behavior and those who are predominantly non-perseverative, each using his own style.

A notable departure from prediction was that the results did not sort out two degrees of each predicted style. On the Convergent side this might have been due to inappropriate test selection or, possibly, to a restricted "normal" population.[3] On the Divergent side a different explanation may be offered. When a Wrigley-Kiel criterion of "1" is used in the Varimax rotation of the principal axes solution, a five-factor result satisfies the criterion. Subsequent oblique rotation and second order analysis yield, in addition to a general Divergent factor similar to the one described here, two other divergent factors which approximate the predicted invention and discovery

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[3] For example, it might be predicted that compulsives and catatonic-like subjects will excel at tasks which are purely rote in nature, in accordance with evidence cited by Carrigan (1961).

facets of this end of the continuum (See Appendix V). This is another way of saying that if you "squeeze the data hard enough," something closer to prediction may result. It may even be that a selection of tests which did not include paired-associate tasks, or a selection of subjects which included highly abnormal individuals, could be made which would lead to a division of the Convergent end of the continuum in a way closer to prediction.

Though it is doubtful that Guilford would expect the techniques employed in this study to confirm his organization of factors on the "Operations" face, a consideration of this possibility is in order. The factor finally called Convergence in this study (Factor II) includes Digit Span, which Guilford suggests as a measure of Memory; Concealed Figures, one of Guilford's Convergent Thinking tasks; and Identical Forms, considered by Guilford a measure of Evaluation. The factor called Divergence in this study (Factor III) includes two of Guilford's Cognition tasks (Gestalt Completion and Muti-lated Words) and one of his Divergent Thinking tasks, Brick Uses. Picture-Number Recall, suggested by Guilford as a measure of Memory, loads on Factor I, the centrally located factor. Although some of the discrepancy may be the result of differences in scoring formulas, it is clear that the procedures employed here do not support Guilford's organization.

On the other hand, the present analysis of the various abilities subsumed under the "Operations" face of Guilford's Structure of Intellect is, at best, suggestive. The three methods of analysis, i.e., patterns of intercorrelations, the order revealed in the largest unrotated factor, and the results of the second order factor analysis, in part support the proposed model, but there are enough discrepancies and areas of doubt with respect to statistical significance to strongly recommend a refinement in the present model and the need for a better selection of tests to more adequately measure the various processing modes. The advantages of a more rigorous model, consonant with the suggested findings, over Guilford's would be that:

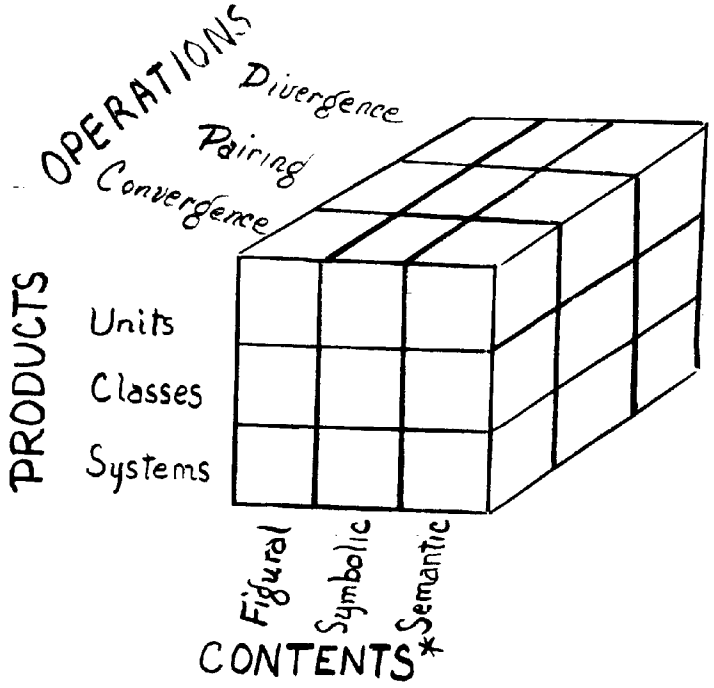
1. It would satisfy the requirements for dimensionality in that it described a progression from lesser to greater perseveration.

2. It would introduce into the Structure of Intellect provision for a more meaningful comparison of one individual with another with respect to modes of information processing.

3. While the derivation of the relationships among factors derived from theoretical speculation, their final ordering would be objective.

It has been suggested (p. 7) that the dimensionality of the "Products" face of Guilford's model may also be suspect. It might be possible to apply techniques similar to those used in this study to an analysis of this face as well. If, as expected, the three factors, Units, Classes, and Systems proved sufficient for

describing the "Products" face, the resulting model of intellect might appear as follows:



*Behavioral factor not included on Contents face because of lack of operational definition.

Implications

Two major implications, one theoretical and the other applicational, are suggested by the results of this investigation:

1. The results may give us some insight into some of the classical theoretical issues in the psychology of learning and thinking. For example, the question of whether human beings respond primarily to patterns as the Gestalt psychologists claim, or to discrete stimuli as the associationists argue becomes less urgent when we view thinking as it is viewed here.

Can we not simply say that both theoretical positions are correct? The question is not to be resolved by looking at the thinking processes of people in general, but by looking at the way separate individuals process information. The processing dimension resulting from this investigation strongly suggests that people vary as to basic mode of responding along a continuum which stretches from pattern discrimination at one extreme to emphasis on rote connection at the other. As Spence points out in a slightly different context, the averaging of individual data so often reported in the literature "often produces considerable distortion with the consequence that the group curve does not accurately reflect the individual curves" (1956, p. 60). A closer look at individual curves is in order.

2. An educational implication of the study is suggested by the often-heard plea of the educator that we "individualize instruction." Individualization of instruction is typically thought to begin and end with provision for differences in strength of intellect, most frequently interpreted through intelligence quotients. Occasionally, but all too seldom, some attention is paid to individual differences in mode of responding. Smith, Wood, Downer, and Raygor (1956),

for example, have studied the effects of various kinds of instruction in reading on different personality types at the college level. Thompson and Hunnicutt (1944) have demonstrated the differential effects of praise and reproof on introverts and extraverts in the elementary school. Fernald (1943), in a slightly different context, recommends input during remediation through as many sense modalities as possible on the basis that one individual may be a "visual" learner, while another is an "auditory" learner, and still another relies primarily on kinesthetic input for learning. More such attention to individual differences in responding is suggested by the present study.

Further Research

Results of factor analytic studies are frequently construed as guidelines for further investigation. Some of the more compelling possibilities for further research suggested by this study are as follows:

1. It should be possible to predict further behavioral variation between subjects performing well on Convergent tasks and those performing well on Divergent tasks. For example, subjects at the extremes

of the processing dimension should differ in rate of learning as a function of associative value of stimuli. If subjects at the extremes are required to learn a list of nonsense syllables of low associative value, it would be predicted that subjects at the Convergent end would score significantly higher than those at the Divergent end. Conversely, subjects at the Divergent end should be superior in rate of learning a list of high associative value.

2. If the differences in modes of processing information discussed in this paper have utility, it should be possible to design techniques which allow each individual to use his customary mode to the best advantage in the education setting. Experimental testing of various techniques aimed at achieving this end are in order. Medical students, for example, construct complex organizational schemes to facilitate memory for materials of low associative value. The utility of this strategy for "divergent" and "convergent" types could be tested experimentally.

3. Examination of the other two faces of Guilford's Structure of Intellect by methods similar to those employed here might be undertaken.

4. One of the central assumptions of this study has been that the differences in information processing investigated directly here should manifest themselves in predictable ways from level to level of psychological and physiological enquiry. Although evidence related to this point has been cited, the adequacy of the assumption has not been directly tested in this investigation. Further research of the type undertaken by Pemberton (1952), Franks (1956), and Witkin et. al. (1962), relating variables at different levels of behavioral enquiry might be fruitfully undertaken. This cross-disciplinary strategy or systems theoretical way of thinking has been spelled out at some length by Miller (1955).

64-6665
Philip Maclean Clark
University of Michigan

Please Note: Pages 57 through 91 not microfilmed at request of author. Material available for consultation at University of Michigan Library.

UNIVERSITY MICROFILMS, Inc.

APPENDIX II

DIRECTIONS FOR TEST BATTERY

"I am here to administer some tests to you. The results of these tests will be used for research purposes at the University of Michigan only, and will have nothing to do with your regular school activities. Many of the tasks will be different from the kinds of tests you are used to. Some, for example, will take only a minute or two to do. Each will require a different kind of performance on your part, so please pay close attention to directions. You will probably do quite well on some of the tasks and not so well on others, so do not be upset if you have trouble with some of the tests. Just do your best -- that is all that is expected.

"You will notice that there are several other people around the room who came with me today. They are here to help if you have any trouble following directions. Just raise your hand if at any time you need help. Address your questions to the assistants privately -- not to me.

"Notice that you have in front of you a booklet, a card, and a folder. Do not open the booklet until you are told to do so. All of these materials have numbers stamped on them. Find the number on your card. Write your name next to the number. (PAUSE) Now, find the number on the tab of your folder. Write your name next to this number. (PAUSE) Now,

notice the number on the upper right hand corner of the front of your test booklet. Write your name under this number. (PAUSE) This is the only time you will have to write your name on the test booklet. The assistants will now collect the cards." (PAUSE)

"Now, open the folder and place it near you on the table. (PAUSE) You will notice that the test booklet is put together like a pad of paper with the binding at the top. Carefully tear the front sheet of the booklet from the rest of the pad and place it frontside-down in the folder. As you work through the test booklet, each page will be placed front-side-down in the folder in the same way.

"Now, look at Page 2 of your test booklet. Do not bother to write your name on this sheet. Read the directions silently while I read them aloud. (READ DIRECTIONS FOR IDENTICAL FORMS)

"Ready, BEGIN."

*** Time: 2 Minutes ***

"STOP. Put your pencils down. Now, find Page 6 of your test booklet. Be sure that all pages up to Page 6 are placed frontside-down in your folder. (PAUSE) Now, read the directions silently while I read them aloud. (READ DIRECTIONS FOR STREET-GESTALT) Use more than one word for each if necessary. Don't worry about your spelling.

"Ready, BEGIN."

*** TIME: 3 Minutes ***

"STOP. Put your pencils down. Now, find Page 9 of your test booklet. Remember, all pages up to 9 ought to be front-side-down in your folder. (PAUSE) Now, find the divided boxes or squares at the top part of the page (Point out). Notice that each has a number on the upper part and a mark or symbol on the lower part. Each number has a different mark. (PAUSE)

"Now, find the section marked "SAMPLE" where the boxes have numbers, but the squares beneath have no symbols (Point out). I want you to put in each of these squares the symbol which should go there. In the first box there is a "2", so put in this mark ( )) right under it. (DEMONSTRATE ON BLACK-BOARD) In the next box is a "1", so you put in this mark (—). (DEMONSTRATE ON BLACKBOARD) Next is a "4", so put a (⊢) under it. (DEMONSTRATE ON BLACKBOARD) Now, you do it for the rest of the numbers in the "SAMPLE" blocks. Do not do any below the double line. (PAUSE)

"Now, find the word "START." When the signal is given, begin at that point and fill in as many squares as you can without skipping any. That is, do them in order. Keep working until I tell you to stop.

"Ready, BEGIN."

*** TIME: 2 Minutes ***

"STOP. Put your pencils down. Now, find Page 10 of your test booklet. Read the directions silently while I read them aloud. (READ DIRECTIONS FOR PICTURE-NUMBER)

"Ready, BEGIN."

*** TIME: 3 Minutes ***

"STOP. TEAR OFF PAGE 11 AND PLACE IT FRONTSIDE-DOWN IN YOUR FOLDER. CLOSE YOUR FOLDER. (Pause, 5-10 sec.) NOW, WHEN I GIVE THE SIGNAL, TURN THE PAGE AND WRITE IN THE APPROPRIATE NUMBER FOR EACH PICTURE.

"Ready, BEGIN."

*** TIME: 3 Minutes ***

"STOP. Put your pencils down. (PAUSE) Now, find page 13 of your test booklet. Read the directions silently while I read them aloud. (READ DIRECTIONS FOR CONCEALED FIGURES) There is one more example. Turn the page and find the first item, a circle with an upside-down "V" on top of it. This figure appears in the first choice to the right, so put a check mark under this choice. In the second choice the figure also appears even though there is a line through the upper part of it. Therefore, you should also place a check mark under this choice. A zero should be marked under the third choice since the figure doesn't appear there. The fourth choice has the figure in it, so place a check mark under it.

"All right, go ahead with the rest of the test."

*** TIME: 10 Minutes ***

"STOP. Put your pencils down." (VERY BRIEF BREAK IN WHICH STUDENTS STAND AND STRETCH)

*** TIME: 1 - 3 Minutes ***

"Now find Page 21 of your test booklet. All pages up to this point should be placed frontside-down in your folder. Read the directions silently while I read them aloud. (READ DIRECTIONS FOR MUTILATED WORDS) This test is 3 pages long. Do not stop until you have completed all three pages.

"Ready, BEGIN."

*** TIME: 4 Minutes ***

"STOP. Put your pencils down. Find Page 25 of your test booklet. Now I want to see how many different uses you can figure out for a common brick. For examples, in addition to its familiar use in the construction of buildings, a brick may be used as a paperweight. How many uses can you think of in addition to these two? Do not worry about your spelling. Please NUMBER your answers."

"Ready, BEGIN."

*** TIME: 5 Minutes ***

"STOP. Put your pencils down. Find Page 26 of your test booklet. I want to see how many different words you can name in one minute. Just any words will do, like "chair" or "happy." When I give the signal, you begin and write down as many words as you can think of as fast as you can. Don't worry

about your spelling. Don't bother to number your answers. Just write as many words as you can until I tell you to stop."

"Ready, BEGIN."

*** TIME: 1 Minute ***

"STOP. Put your pencils down. Find Page 27 of your test booklet. Now, I am going to say some sets of numbers. While I am saying each set of numbers, you hold your pencils in the air, like this. (DEMONSTRATE) When you are sure I have finished a set, write the numbers down in the order in which I have given them.

"Find Column I. Find the two spaces labeled "PRACTICE" at the top of Column I. Let's try two samples. All right, hold your pencils in the air.

1 - 2 (PAUSE)

"You should have written 1 - 2 (DEMONSTRATE) on the first line in the practice section of Column I.

"Hold your pencils in the air again.

5 - 3 - 7 (PAUSE)

"You should have written 5 - 3 - 7 (DEMONSTRATE) on the second line of the practice section of Column I.

"Remember, be sure I have finished with a set before you lower your pencil to start writing. Record your numbers in Column I.

"Pencils in the air!

3 - 8 - 6

"Pencils in the air!

3 - 4 - 1 - 7

"Pencils in the air!

8 - 4 - 2 - 3 - 9

"Pencils in the air!

3 - 8 - 9 - 1 - 7 - 4

"Pencils in the air!

5 - 1 - 7 - 4 - 2 - 3 - 8

"Pencils in the air!

1 - 6 - 4 - 5 - 9 - 7 - 6 - 3

"Pencils in the air!

5 - 3 - 8 - 7 - 1 - 2 - 4 - 6 - 9

"Now I am going to read some more sets of numbers. This time you will put them down in reverse order, like this. If I say "1 - 2", you put "2 - 1" on your paper. (DEMONSTRATE ON BLACKBOARD)

"Find Column II.[4] Find the two lines labeled "PRACTICE" at the top of Column II. Let's try two samples. Remember, you wait until you are sure I have finished with a set, then write the numbers in the opposite order from the way I have given them.

---

[4]"Digits-backward" section of this test not scored.

"Pencils in the air.

1 - 2 (PAUSE)

"You should have put "2 - 1" on the first line of the practice section in Column II, like this. (DEMONSTRATE ON BLACKBOARD)

"Pencils in the air.

4 - 3 - 8 (PAUSE)

"You should have put "8 - 3 - 4" on the second line of the practice section of Column II, like this. (DEMONSTRATE ON BLACKBOARD)

"Remember, be <u>sure</u> I have finished with a set before you lower your pencil to start writing.

"Pencils in the air!

2 - 5

"Pencils in the air!

5 - 7 - 4

"Pencils in the air!

7 - 2 - 9 - 6

"Pencils in the air!

4 - 1 - 3 - 5 - 7

"Pencils in the air!

1 - 6 - 5 - 2 - 9 - 8

"Pencils in the air!

8 - 5 - 9 - 2 - 3 - 4 - 2

"Pencils in the air!

6 - 9 - 1 - 6 - 3 - 2 - 5 - 8

"All right, put your pencils down. Turn to Page 28 of your test booklet. This page is labeled "Practice Exercise Sheet." Tear it out of your test booklet so you will be able to use it while you look at Page 29. Now, look at Page 29 and read the directions silently while I read them aloud. (READ DIRECTIONS FOR KURDISH-ENGLISH TASK)

"Go ahead, now, and start memorizing the vocabulary without writing. You will be tested on this later."

*** TIME: 2 Minutes ***

"Now, look at your Practice Exercise Sheet. Fill in the blanks with the English equivalents of the Kurdish words; continue memorizing as you go along. You may look at Page 29 if you can't remember some of the words; this practice is just to help you learn the vocabulary better."

*** TIME: 2 Minutes ***

"STOP. Put your pencils down. Now, read the instructions at the bottom of Page 29 silently while I read them aloud. Do not turn the page until you are told to do so. (READ DIRECTIONS ON BOTTOM OF PAGE 29)

"Now, place your Practice Exercise Sheet and Page 29 frontside-down in your folder. Close the folder. (PAUSE) Get ready to turn the page at the signal. You are not allowed

to look back either at the Practice Exercise Sheet or at Page 29 while you are doing the test. You will have 4 minutes to work.

"Ready, BEGIN."

*** TIME: 4 Minutes ***

"STOP. Put your pencils down. Turn to Page 31 of your test booklet. Read the directions silently while I read them aloud. (READ DIRECTIONS FOR DESIGNS)

"Ready, BEGIN."

*** TIME: 2 Minutes ***

"STOP. Put your pencils down.

(REST)

*** TIME: 5 Minutes ***

(Fill in information on sheet in front of you.)

(READ DIRECTIONS FOR RAT)

"Ready, BEGIN."

*** TIME: 30 Minutes ***

"STOP. Put your pencils down.

APPENDIX III

Order of Administration, Time Limits, Number of Items, & Scoring Formulas

Tests (in order of administration)	Time for Tests	Number of Items	Scoring Formula
Identical Forms	2 minutes	60	No. Correct/ No. Attempted
Gestalt Completion	3 minutes	24	No. Correct
Coding	2 minutes	93	No. Correct
Picture-Number	6 minutes	21	No. Correct
Concealed Figures	10 minutes	193	No. Correct/ No. Attempted
Mutilated Word	4 minutes	51	No. Correct
Brick Uses	5 minutes		No. of times class of use is changed
Word Fluency	1 minute		Total number of words
Digit Span		7	Length of last series correct before first miss
Paired Associates	8 minutes	24	No. Correct
Designs	2 minutes	300	No. Correct/ No. Attempted
Remote Associates Test	30 minutes	40	No. Correct

APPENDIX IV

LETTER REQUESTING PARENTAL CONSENT

(COPY)

JANE ADDAMS JUNIOR HIGH SCHOOL
Royal Oak, Michigan
March 11, 1963

Dear Parent or Guardian:

We have an opportunity to take part in some educational research which may help us know more about the learning characteristics of young people. One of the sources of information will be the results of some tests which will be administered by members of the doctoral program from the University of Michigan. These will be done during the regular school day and will be administered to the entire class in written form. They are, however, not a part of our regular testing program.

If you, as the parent or guardian of the bearer, do not wish to have this student take part in what we can say will be merely some challenging tests, please indicate that desire by filling out the bottom of this page and returning it to us. If it is all right that your student take part, do nothing except encourage him to do the best job he can. Thank you.

Sincerely,

G. Bruce Feighner
Principal

I would prefer that my son, daughter not take part in the testing situation as described in the above letter.

_____ Name of student

_____ Name of Parent or Guardian

APPENDIX V

TABLES RELATED TO FIVE-FACTOR SOLUTION

Table 7

Varimax Rotation of Principal Axes Solution
Wrigley-Kiel Criterion of 1

Test	Factor					
	I	II	III	IV	V	h^2
Coding	.08	-.44	-.34	.18	-.30	.44
Wd Fl	.17	-.42	-.14	.20	-.49	.50
Br Uses	.01	-.07	-.01	.04	-.57	.34
Gest Comp	.35	-.03	-.16	.14	-.52	.45
Mut Wds	.49	-.12	-.23	.28	-.24	.45
RAT	.24	-.12	-.48	.40	-.09	.46
Id Fms	-.01	-.14	-.23	.44	-.02	.27
Designs	.11	-.05	-.11	.60	-.05	.38
Conc Figs	.12	.08	-.29	.66	-.19	.56
Pict-No	.08	-.19	-.64	.16	-.01	.49
Pr Assoc	.10	.01	-.63	.24	-.15	.49
Dig Sp	.13	-.14	-.08	.42	-.10	.23
Sums of Squares	.51	.48	1.42	1.58	1.07	5.06

Table 8

Biquartimin Rotation of Five-Factor Orthogonal Structure

Primary Pattern

Test	Factor				
	I	II	III	IV	V
Coding	-.01	.35	.29	.08	.27
Wd Fl	.08	.33	.04	.12	.48
Br Uses	-.05	-.00	-.05	-.02	.60
Gest Comp	.29	-.06	.08	.04	.48
Mut Wds	.43	.05	.14	.20	.15
RAT	.15	.01	.42	.32	-.02
Id Fms	.09	.06	.15	.45	-.04
Designs	.02	-.03	-.02	.64	-.03
Conc Figs	.00	-.21	.16	.66	.09
Pict-No	.01	.09	.66	.04	-.07
Pr Assoc	.01	-.13	.63	.12	.06
Dig Sp	.06	.08	-.03	.43	.04

Table 9

Five Factors Derived From Table 8

Factor I:		Factor II:		Factor III:	
Mut Wd	.43*	Coding	.35*	Pict-No	.66*
Gest Comp	.29	Wd Fluency	.33	Pr Assoc	.63*
				RAT	.42
				Coding	.29

Factor IV:		Factor V:	
Conc Figs	.66*	Brick Uses	.60*
Designs	.64*	Wd Fl	.48*
Ident Fms	.45*	Gest Comp	.48*
Dig Sp	.43*	Coding	.27
RAT	.32		

*denotes highest loading for the test on any factor

Table 10

Five-Factor Principal Axes Solution at Second Order Level

	I'
Factor I	.41
Factor II	.31
Factor III	.58
Factor IV	.61
Factor V	.47

Factor II Factor I Factor V Factor III Factor IV



APPENDIX VI

RAW DATA

The following is the raw data collected in this study. Each row contains raw scores for one subject. Column numbers refer to tests as follows:

1. Coding
2. Word Fluency
3. Brick Uses
4. Gestalt Completion
5. Mutilated Words
6. Remote Associates Test
7. Identical Forms
8. Designs
9. Concealed Figures
10. Picture-Number Recall
11. Paired Associates
12. Digit Span

Scores recorded in columns 7, 8, and 9 are percentages and have all been reduced by one so that all scores could be expressed in two digits.

Subject	1	2	3	4	5	6	7	8	9	10	11	12
1	41	09	06	12	15	03	85	88	72	07	06	04
2	52	19	08	08	12	11	99	95	62	06	14	06
3	38	09	05	09	10	01	99	95	68	02	00	07
4	44	13	03	10	16	19	99	99	93	02	09	06
5	64	29	08	15	22	19	93	99	73	07	16	07
6	43	16	06	12	15	10	91	54	51	09	05	04
7	74	23	07	09	25	20	99	98	89	12	15	07
8	72	23	05	16	18	20	93	98	90	15	18	07
9	51	15	06	11	09	02	70	93	64	01	02	04
10	51	18	06	09	14	15	99	98	90	09	21	03
11	41	17	02	07	15	03	60	91	56	01	05	05
12	37	18	03	04	19	05	26	82	50	02	08	05
13	55	22	05	06	12	08	91	87	48	02	11	04
14	60	14	06	09	17	12	80	99	76	04	08	04
15	53	17	04	16	17	07	93	92	62	02	01	07
16	54	19	06	14	17	13	99	93	72	02	10	04
17	56	17	08	11	15	12	87	99	67	11	10	07
18	52	24	11	14	14	08	99	94	78	08	15	04
19	55	19	08	16	23	19	88	98	83	14	11	06
20	54	13	07	15	15	08	99	99	71	08	06	04
21	55	18	05	10	24	20	93	93	69	11	13	05
22	58	24	02	10	28	17	99	98	88	07	09	06
23	42	16	03	08	17	06	87	75	67	03	04	04

Subject	1	2	3	4	5	6	7	8	9	10	11	12
24	56	24	04	11	13	12	99	98	80	05	07	07
25	52	17	05	10	15	01	68	89	62	05	03	03
26	52	17	03	07	18	07	87	93	70	04	12	04
27	42	19	03	11	21	14	92	98	82	06	08	05
28	40	12	07	12	12	17	99	99	78	04	04	07
29	56	18	07	15	14	09	35	89	68	01	06	05
30	53	23	13	16	21	09	99	98	75	00	13	07
31	39	11	07	15	19	13	99	99	91	08	14	07
32	59	22	03	10	16	06	89	99	87	00	07	07
33	64	19	09	11	22	18	99	97	68	11	16	06
34	68	27	08	10	15	17	99	99	72	12	06	04
35	79	31	09	10	12	12	99	96	82	12	08	05
36	73	22	06	11	24	09	99	98	89	13	09	06
37	55	18	05	10	14	18	99	97	79	04	13	04
38	69	14	02	11	22	11	99	95	77	06	07	03
39	59	17	05	06	17	18	99	98	74	17	21	06
40	43	19	07	14	20	16	99	99	87	04	14	06
41	58	20	11	16	10	14	89	66	76	07	16	04
42	51	17	01	10	14	04	99	92	77	10	13	04
43	53	22	04	16	19	20	99	96	87	14	13	06
44	52	22	09	16	14	07	94	98	80	10	17	04
45	55	22	10	14	13	09	94	96	76	02	08	04
46	44	20	05	12	17	17	93	97	74	12	23	05
47	50	18	05	12	16	10	99	99	87	05	17	06
48	56	20	05	13	30	18	99	97	70	07	17	04
49	46	22	05	09	18	03	64	87	52	03	06	04
50	32	18	12	12	13	08	69	92	77	04	18	05
51	51	17	08	07	17	04	78	97	61	14	06	04
52	51	20	08	14	17	05	99	97	72	02	09	04
53	64	34	12	18	25	18	99	99	83	11	14	07
54	48	20	11	12	20	07	86	99	87	14	15	06
55	50	15	08	14	18	06	93	97	70	04	10	07
56	54	14	04	13	18	12	84	90	79	06	06	04
57	41	11	06	08	16	09	89	99	74	10	09	05
58	58	18	09	16	25	23	99	97	81	07	05	07
59	53	21	08	08	16	12	99	97	85	04	12	05
60	49	25	14	14	25	16	93	94	75	04	10	05
61	58	25	05	10	16	06	92	94	62	07	08	04
62	51	18	07	17	19	06	24	96	69	06	08	04
63	61	19	07	14	17	05	86	99	67	04	09	06
64	70	17	10	13	16	15	92	96	80	08	13	06
65	45	22	01	12	24	12	93	99	74	09	14	05
66	58	15	06	13	09	01	99	97	67	07	08	04
67	56	15	03	13	11	08	85	76	44	08	16	05
68	58	26	07	06	15	14	94	96	80	06	07	06

Subject	1	2	3	4	5	6	7	8	9	10	11	12
69	53	24	06	15	22	11	93	99	77	02	06	06
70	58	20	02	08	15	12	99	99	63	02	07	05
71	67	23	09	19	24	07	99	98	77	04	09	05
72	51	16	08	16	24	05	86	90	69	05	06	04
73	49	23	11	03	18	04	84	95	67	02	14	05
74	58	24	09	06	12	11	88	94	63	10	10	07
75	61	26	14	11	27	14	99	95	85	13	13	07
76	53	24	12	14	22	17	93	96	63	08	09	04
77	67	15	03	12	23	07	99	91	71	09	08	04
78	57	23	02	14	22	08	86	92	55	05	04	04
79	46	15	06	07	14	08	93	85	67	05	06	06
80	43	13	03	12	17	16	99	99	72	10	17	04
81	41	20	04	15	21	09	77	90	73	07	15	07
82	46	20	04	10	26	12	93	96	83	03	22	05
83	59	24	03	15	22	27	94	98	81	09	11	06
84	68	25	17	18	38	20	95	98	93	16	21	06
85	66	26	12	20	34	16	87	99	85	08	14	06
86	22	16	06	06	27	07	99	99	72	01	06	06
87	70	23	13	18	18	18	99	97	85	11	20	07
88	81	26	06	16	19	15	99	98	82	11	14	06
89	72	23	06	16	23	14	89	97	65	15	10	04
90	62	14	05	09	11	14	92	99	91	08	12	04
91	77	24	04	15	17	20	99	99	79	09	20	06
92	65	25	09	16	23	20	84	98	91	07	18	06
93	57	17	03	11	21	12	93	89	76	05	15	06
94	90	27	13	18	25	14	99	95	74	09	10	07
95	51	19	03	11	27	20	94	93	71	13	11	06
96	44	16	06	13	12	13	94	91	74	10	09	04
97	57	29	13	18	16	20	84	96	86	08	17	06
98	62	28	05	15	21	14	99	94	72	03	12	07
99	51	21	06	15	28	14	99	98	85	07	07	06
100	52	18	05	16	17	08	86	98	78	02	16	04
101	56	21	10	18	25	15	99	99	85	01	09	06
102	52	15	08	20	23	13	93	95	71	02	13	04
103	64	25	15	21	25	06	94	96	93	05	12	05
104	60	21	10	15	21	09	99	77	60	05	09	04
105	48	16	04	12	22	25	93	99	82	15	21	06
106	61	23	05	18	19	12	99	98	79	10	14	04
107	48	17	12	08	14	20	80	92	68	02	07	03
108	58	16	01	06	15	18	88	94	65	05	07	04
109	67	20	05	08	24	18	99	97	75	16	23	04
110	59	21	06	11	22	23	99	99	85	02	16	07
111	57	30	07	17	30	24	99	97	85	11	10	06
112	67	25	11	20	32	25	99	99	78	09	20	04
113	58	24	06	12	27	11	99	98	85	06	07	05
114	63	25	06	12	18	22	99	99	93	18	23	07
115	43	21	06	12	22	08	99	99	81	02	11	04

Subject	1	2	3	4	5	6	7	8	9	10	11	12
116	56	24	11	16	26	15	99	97	74	09	10	05
117	58	25	04	20	32	15	99	97	81	08	11	07
118	47	33	08	15	25	14	86	99	75	13	11	06
119	68	15	03	19	33	19	94	99	90	13	20	04
120	68	28	11	18	26	21	99	98	87	06	20	05
121	64	30	08	12	22	19	94	98	79	10	16	04
122	54	25	10	14	21	10	89	97	64	04	09	04
123	48	17	08	12	15	11	79	87	82	02	13	06
124	58	17	07	14	19	07	99	91	78	10	16	05
125	72	26	12	19	33	14	91	98	81	14	21	05
126	77	22	03	13	25	14	99	97	74	15	19	06
127	62	25	13	16	17	12	99	90	81	16	24	05
128	64	16	05	19	26	15	99	98	71	20	20	06
129	65	18	05	15	24	17	99	97	84	14	18	06
130	71	25	05	12	24	09	99	94	83	02	07	06
131	54	18	06	16	22	17	88	99	88	07	19	05
132	61	21	07	15	23	12	93	99	81	04	11	06
133	58	19	05	11	18	14	94	96	74	13	19	06
134	67	25	03	11	25	16	93	98	79	18	20	06
135	51	25	08	18	30	13	93	95	71	05	11	07
136	61	16	02	12	24	16	99	97	74	07	22	06
137	56	21	02	09	33	20	99	97	76	10	12	07
138	59	22	09	14	19	06	93	94	59	04	13	06
139	51	21	04	12	19	07	94	99	83	10	13	06
140	64	26	11	19	22	17	99	97	66	05	16	06
141	56	22	04	16	23	10	99	99	85	07	10	07
142	60	21	06	16	26	13	99	98	83	09	14	07
143	51	18	02	12	25	16	94	99	85	13	21	05
144	74	20	08	10	20	14	99	97	75	13	13	06
145	76	24	08	13	18	02	82	95	78	09	16	07
146	63	24	07	18	29	13	94	98	89	14	20	09
147	59	19	05	19	28	10	64	89	70	07	14	04
148	63	19	06	09	21	08	99	96	83	11	11	07
149	60	27	04	20	22	22	82	99	82	13	16	06

APPENDIX VII

CLASSES OF USE FOR BRICK USES TEST

Gross Buildings
Underfoot
Interior Decoration
Exterior Decoration
Weight
Prop
Marker
Support
Weapon
Writing Implement
Source of Gravel
Source of Pigment
Abrasive
Heat Saver

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