THE RELATIONSHIP BETWEEN PSYCHOLOGICAL DIFFERENTIATION AND QUESTIONING BEHAVIOUR IN STUDENT-TEACHERS

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CURRICULUM STUDIORUM

Winifred C. Ejeckam was born December 8, 1947, in Ogbunike, Anambra State, Nigeria. She received the Bachelor of Science in Education/Geography from the University of Nigeria, Nsukka, Anambra State, in 1974. The title of her thesis was Relationship Between Pupils' Attitude to Their School and Their Performance in School.

ABSTRACT OF

The Relationship Between Psychological Differentiation and Questioning Behaviour in Student-Teachers

The question examined in this study was whether a student-teacher's level of psychological differentiation is related to the type of questions (higher or lower order) he tends to ask. It was hypothesized that relatively field-independent student-teachers ask a greater proportion of higher-order questions than relatively field-dependent student-teachers.

The sample comprised seventy-nine volunteer student-teachers who were enrolled in the English elementary school section of the Bachelor of Education programme in the Faculty of Education, University of Ottawa.

Extent of psychological differentiation was measured by Thurstone's Closure Flexibility Test (CFT), while questioning behaviour was measured by the proportion of higher-order questions the subjects set on a passage provided by the researcher.

Subjects whose scores on CFT fell into the top and bottom thirds were designated field-independent and field-dependent, respectively.

The questions set by these extreme groups were categorized into the six levels of Bloom's taxonomy by five

trained judges who worked independently. A question was regarded as a higher-order question if three or more of the judges classified it into the Application, Analysis, Synthesis and/or Evaluation levels.

The Fisher Exact Test, for differences between proportions, was used to analyse the data.

The research hypothesis that field-independent student-teachers set a greater proportion of higher-order questions than the field-dependent ones was supported.

The study thus indicates that, for elementary school teacher-trainees, level of psychological differentiation is related to questioning behaviour. This result, when taken together with the finding from other research that teachers in elementary schools tend to be predominantly field-dependent, offers a possible explanation for the preponderance of the use of lower-order questions in the schools, especially at the elementary level.

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INTRODUCTION

That one's degree of psychological differentiation is related to one's broad perceptual and intellectual functioning has been variously demonstrated.

The theory of psychological differentiation can be traced back to Witkin's work on individual differences in perception. The extent of psychological differentiation has come to be quantitatively ascertained by a battery of perceptual tests. The underlying concept in all the tests is the ability to deal with a part of a whole separately from the whole and this has been described as 'analytic ability'. This ability has been shown to be normally distributed, with people at the extreme ends being referred to as field-dependent and field-independent, respectively.

Ability to structure a situation which is not organized, and the ability for independent assessment of a situation are some of the characteristics which are associated with field-independence.

These analytical, structural and evaluative abilities are some of the mental processes which Bloom et al. identified from a number of educational objectives and test items which they collected from schools.

One of the aims of education is to produce people who can think critically. Researches indicate that one of the ways to educate for critical thinking is by using higher-order

questioning techniques. That means that the teacher must demonstrate expertise in effective questioning techniques that will stimulate thought, critical analysis, originality and evaluative ability in the students. The cognitive characteristics of field-dependence and field-independence suggest a tendency of field-independent persons to ask more such higher-order questions than their field-dependent counterparts.

The purpose of this research was therefore to investigate the relationship between extent of psychological differentiation and tendency to ask questions at higher cognitive levels.

The research report comprises three chapters. The first chapter contains the theoretical rationale, a review of previous studies in the area, and the research hypothesis. The experimental design is presented in the second chapter. This includes a description of the sample, a description and justification of the psychometric instruments and techniques used, data collection and the planned statistical analysis. The results are presented and discussed in chapter three. This is followed by a summary of the research and conclusions.

CHAPTER I

REVIEW OF THE LITERATURE

The study is designed to examine the relationship between psychological differentiation as hypothesized by Witkin and questioning behaviour as judged by Bloom's taxonomy of educational objectives in the cognitive domain.

Researchers have linked the field-dependence - field-independence dimension to a wide range of psychological functioning such as perceptual and intellectual functioning. This chapter thus presents a theoretical rationale for expecting a relationship between questioning behaviour and psychological differentiation. The first section deals with perceptual functioning. The nature of the psychological differentiation construct is outlined in the second section. This leads to cognitive style, which is discussed in the third section. The fourth section contains a summary of some criticisms on the theory of psychological differentiation. The fifth section is a discussion of Bloom's taxonomy of educational objectives in the cognitive domain. Finally, a justification for relating Bloom's taxonomy and Witkin's construct is made in section six. This is followed by a summary and the statement of the problem and the research hypothesis in section seven.

1. Perceptual Functioning and Field Dependence

Witkin's earlier studies[1,2,3,4] in "Space Orientation" established that people vary in the ways they orient themselves in space, that is, in the manner of perceptions. These studies indicated that there exist varying degrees of dependence upon the visual field and of ability to use bodily cues to overcome the influence of the prevailing field. This, Witkin holds, is an evidence of the presence of personal factors[5] and techniques for coping with problems. He rejects the view that what is perceived is determined by the nature of the outer world as

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1 S.E. Asch and H.A. Witkin, "Studies in Space Orientation: I. Perception of the Upright with Displaced Visual Fields", in Journal of Experimental Psychology, Vol. 38, No. 3, 1948, p. 324 - 337.

2 S.E. Asch and H.A. Witkin, "Studies in Space Orientation II. Perception of the Upright with Displaced Visual Fields and with Body Tilted", in Journal of Experimental Psychology, Vol. 38, No. 4, 1948, p. 455 - 477.

3 H.A. Witkin and S.E. Asch, "Studies in Space Orientation III. Perception of the Upright in the Absence of a Visual Field", in Journal of Experimental Psychology, Vol. 38, No. 5, 1948, p. 603 - 614.

4 H.A. Witkin and S.E. Asch, "Studies in Space Orientation IV. Further Experiments in Perception of the Upright with Displaced Fields", in Journal of Experimental Psychology, Vol. 38, No. 5, 1948, p. 762 - 783.

5 Personal Factors - motivational, emotional, and cognitive characteristics.

Gottschaldt[6] postulates or by the nature of the stimuli which bring about the perception. He also rejects the contention that what is perceived is determined by the perceiver's past experiences with the stimulus.

To measure this degree of dependence on the field and self-consistency in manner of establishing the upright, it was necessary to observe the subjects in different situations which require orientation towards the upright. To investigate self-consistency in perception generally, the subjects needed to be observed in situations involving perceptual processes other than orientation. This led to the development and validation of a battery of tests of space orientation and other perceptual processes.

The tests include the Rod-and-Frame Test (RFT)[7] and the Tilting-Room-Tilting-Chair Test (TRTC)[8] for measuring space orientation, and the Embedded Figures Test (EFT)[9] for measuring other perceptual processes.

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6 L. Gottschaldt, Uber den Einfluss der Erfahrung auf die Wahrnehmung von Figuren, 1: Uber den Einfluss gehaufter Einpragung von Figuren auf ihre Sichtbarkeit in umfassenden Konfigurationen, in Psychol. Forsch., Vol. 8, p. 261 - 317, cited by H.A. Witkin et al., in Personality Through Perception, New York, Harper, 1954, p. 1.

7 H.A. Witkin, R.B. Dyk, H.F. Faterson, D.R. Goodenough, and S.A. Karp, Psychological Differentiation, New York, Wiley, 1962, p. 36 - 37.

8 Ibid., p. 37 - 39.

9 Ibid., p. 39 - 40.

The RFT evaluates the individual's perception of the position, in relation to the upright, of an item within a limited visual field. The subject is placed in a completely darkened room facing a movable luminous frame pivoted at the centre. The frame surrounds a luminous rod pivoted at the same point as the frame, but which can move independently of the frame. With the frame tilted either to the right or to the left, the subject is required to move the rod to a position which he perceives as upright. The standard administration of the test comprises three series of eight trials each. In one set the subject is tested while sitting erect while the frame is tilted. In another set of trials, the subject is tilted to the same side as the frame and in the last set, the subject and the frame are tilted to opposite sides.

If the subject brings the rod to a position which is upright or close to it, he is said to have resisted the field. If he aligns the rod with the frame he is said to be dependent on the field. Those subjects who perceive the rod independently of the surrounding field (frame) are said to be field-independent while those whose alignment of the rod with the upright is dependent or influenced by the frame are said to be field-dependent.

The TRTC is used to evaluate the subject's perception of the position of his body and of the whole surrounding field in relation to the upright.

To evaluate the subject's perception of the position of his body in relation to the upright, he is seated in a tilted room and required to bring himself to a position he perceives as upright. If he brings his body to an upright position or very close to it, he is also said to have resisted the influence of the field (tilted room) by using his body sensations as a reference. The above test now forms a sub-test of the TRTC and is known as the Body-Adjustment Test (BAT).

In order to determine how the subject perceives the position of the whole surrounding field, the room in which he is seated is tilted and he is again required to bring it to an upright position. This he does by directing the experimenter on which way to turn the room until he is satisfied that it is upright. If he succeeds in getting the room upright or near upright, he is said to have made use of his body sensations. This subtest has come to be known as Room-Adjustment Test (RAT).

If the subject can establish the upright position of his body or the room regardless of the initial amount of tilt, he is said to be field independent. If the subject fails in this task he is said to be field dependent.

The Embedded-Figures Test is another test of perceptual functioning. It is a paper-and-pencil test which requires the subject to find or disembed a familiar simple figure within a

larger and more complex figure. It is a test based on Gottschaldt's figures. The EFT was developed to determine whether a given degree of ability to deal with an item independently of its surroundings (as indicated by results from the RFT and TRTC) is a pervasive characteristic of a person's perception. The test consists of twenty-four items. For each item, the subject is first shown a picture of the complex figure in which a simple figure is embedded. Then he is shown a copy of the simple figure he is to identify or disembed. The simple figure is taken away and the complex figure re-presented. The two figures are never presented together. The subject's score is the mean amount of time taken to find a simple figure in a complex one. The EFT thus operates on the same principle as RFT and TRTC. This is because each of them requires the subject to be able to separate an item or part from a field or a whole. Therefore, successful performance of the tasks implies an application of an analytical approach which characterizes the field-independent. Poor performance in the tests indicates a more global approach which characterizes the field-dependent.

The significant correlations which exist between scores for the EFT and the orientation tests indicate that the person who finds it difficult to get the rod upright when the frame is tilted in the RFT and who aligns his body to the axis of the tilted room (in TRTC) also finds it difficult to locate a simple figure in a complex one (in EFT). They

therefore suggest an individual's consistency in manner of perception. Furthermore, these relationships between space-orientation tests and tests of other perceptual functioning (EFT) led to the conclusion that the kind of perception shown by an individual represents a deep-rooted feature of his psychological make-up.

The RFT, TRTC, EFT and others have come to be accepted as tests of the field-dependence - field-independence dimension.

2. The Nature of Psychological Differentiation

Witkin and his colleagues[9a] observed that a pattern was emerging from the results of their earlier studies. The pattern was the tendency for young children to perceive in a more field dependent manner and to progressively become more field independent. The pattern also showed a tendency for a child's mode of perception to remain relatively consistent and stable relative to those of his age group at any given time.

These observations made Witkin realize that the perceptual functioning in human beings undergoes a developmental process which is related to maturational development. Considering general developmental characteristics, a child is undifferentiated in many areas of human functioning, but as he grows older he starts to discriminate between things. Witkin, Dyk and others noticed that at any given age level,

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9a H.A. Witkin, et al., Op. cit., 1962, p. 7 - 8.

the characteristics of field dependence are generally more reminiscent of the less differentiated functioning of childhood, while those of field independence are more related to a more differentiated perceptual functioning of adulthood.[9b] They therefore postulated that modes of perception lie on a continuum with the relatively undifferentiated at one extreme and the relatively more differentiated at the other.

It was at this point in Witkin's studies that he realised that the patterns which emerged from his studies could be looked at in terms of differentiation and that the characteristics of perceptual functioning he and his colleagues found are reflections of extent of psychological differentiation in individuals.[9c] This reasoning therefore formed the groundwork for the formulation of the psychological differentiation hypothesis.

This concept of differentiation originated from Werner's[10] orthogenic differentiation. Werner maintains that differentiation is important in the development of biological forms. He stated that:

9b Ibid., p. 8.

9c Ibid., p. 8.

10 H. Werner, Comparative Psychology of Mental Development (Rev. ed.), Follet, Chicago, 1948, xii - 564 p.

> The development of biological forms is expressed in an increasing differentiation of parts and an increasing subordination or hierarchization. Such a process of hierarchization means for any organic structure the organization of the different parts for a closed totality, an ordering and grouping of parts in terms of the whole organism.[11]

Witkin, Dyk and others[12] agree with Werner that the degree of differentiation is an important characteristic of any system, not only biological, as was Werner's concern, but also psychological and social.

Differentiation subsumes or implies complexity of a system's structure. The development towards greater differentiation will then involve, according to Witkin,

> ... progress from an initial relatively unstructured state, which has a limited segregation from the environment, to a more structured state, which has relatively definite boundaries, and which is capable of greater specificity of function.[12a]

For Witkin and his colleagues, a less differentiated state is said to be homogeneous in structure and function while a more differentiated state is relatively heterogeneous. They emphasize that differences in the manifestations of psychological functioning are not indications of kind of differentiation, but rather the extent of differentiation.

In relation to the individual's psychological system then, Witkin and his associates hold that specialization

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11 Ibid., p. 41.

12 H.A. Witkin, et al., Op. cit., 1962, p. 9.

12a Ibid., p. 22.

implies "the degree of separation of psychological areas"[13] or behaviours like feeling as distinct from perceiving. Specialization also implies the level of specificity of functions within given psychological areas. This is illustrated by the fact that specific reactions are elicited by specific stimuli in a more differentiated state as opposed to diffuse reactions given to various stimuli in a less differentiated system.

Greater differentiation is further distinguished from less differentiation by its clear and distinct separation of what is identified as belonging to the self and what is identified as external to the self.[14] According to Witkin et al. this separation helps to make the functioning of the system less dependent on external factors or field. Thus the relatively differentiated person tends to be field independent in his perceptual performance and would have little difficulty in overcoming the influence of the surrounding field in the RFT, TRTC and the EFT. On the other hand, a less differentiated person would be expected to be more dependent on or more influenced by the distracting and surrounding field in his performance in the tests of perceptual functioning. This greater reliance on external nurturance and support for

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13 H.A. Witkin et al., Op. cit., 1962, p. 10.

14 Ibid., p. 10.

maintenance typical of the relatively undifferentiated state,[15] has been borne out by empirical research.

In retrospect, the psychological differentiation hypothesis emerged from the observations of past studies that there is a progression from an initial relatively unstructured state with limited sense of separate identity to a more structured state with a greater segregation of self. This is summed up in the following excerpt from Witkin's writings:

> ... experience of the body-field matrix is early essentially global, and during development becomes progressively more articulated so that body, self, and objects in general are experienced as segregated. Segregation, or analysis, and with it structuring of experience ... are manifestations of developed psychological differentiation.[16]

These manifestations of lesser or greater developed psychological differentiation have been observed in other psychological areas such as pure intellectual functioning and personality characteristics. This has led to the wider concept of cognitive style to include both perceptual and intellectual functioning and the associated personality characteristics.

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15 H.A. Witkin et al., Op. cit., 1962, p. 10.

16 Ibid., p. 14.

3. Cognitive Style

Evidence accumulated by many researchers indicates that the mode or style which Witkin, Dyk and others identified in perceptual functioning appears in problem-solving behaviour and in thinking as well. Witkin noticed that the individual who, in perception, cannot keep an item separate from the surrounding field is also likely to have difficulty with the kind of problem that requires taking some critical element out of the context in which it is presented. Such a person also finds it difficult to restructure the problem material so that the element is now used in a different way.[17] This means that a field-dependent person who exhibits a global approach in perceptual tasks and perceptual functioning is likely to find it difficult to solve intellectual problems which require analytical and re-organizational abilities.

The above observation led Witkin and his colleagues to the conclusion that each individual has a characteristic mode of functioning in both perceptual and intellectual activities which he exhibits in a highly consistent and

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17 H.A. Witkin, "The Role of Cognitive Style in Academic Performance and in Teacher-Student Relations", Research Bulletin, Educational Testing Service, Princeton, 1973, p. 6.

pervasive way.[18] This mode they called "cognitive style"; 'cognitive' because it encompasses perceptual and intellectual activities and 'style' because it is one's characteristic approach to a wide range of situations.[19]

Witkin and many other investigators have identified a variety of cognitive styles,[20] but this paper will be dealing with only one such style viz. field-dependent - field-independent cognitive style.

The cognitive characteristics involved in relatively field-dependent or field-independent cognitive style have been shown to influence students' performance in different school subjects, choice of subjects and vocational preferences. They are also related to performance in the sub-tests in standard intelligence tests. The subject-matter areas and vocations which call for analytical skills are favoured by field-independent students while the field-dependent students try to avoid them and vice versa. Examples of such subject areas which require analytical skills are the sciences, mathematics, engineering, technical and mechanical activities.

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18 H.A. Witkin, Op. cit., 1973, p. 2.

19 Ibid., p. 7.

20 Ibid., p. 12 - 13.

This is supported by studies conducted by Chung[21] and Clar.[22] In addition, Galvin's study on "Psychological Differentiation and Achievement in Mathematics" showed that students who exhibited a field-independent cognitive style were found to score significantly higher on tests of mathematical achievement than field-dependent students.[23]

Witkin et al.[24] found a high and significant correlation between performance in three sub-tests of the WISC and performance in tests of perceptual functioning. This lends support to the hypothesis that the cognitive characteristics in field dependence/field independence are related to intellectual functioning.

Cognitive style has been found to be related to students' preference of learning methods and teachers' methods of teaching. Relatively field-dependent teachers have been found to prefer a discussion or discovery method of teaching,

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21 W.S. Chung, Relationships among Measures of Cognitive Style, Vocational Preferences, and Vocational Identification, Doctoral Dissertation, George Peabody College for Teachers, 1966.

22 P.N. Clar, The Relationship of Psychological Differentiation to Client Behaviour in Vocational Choice Counselling, Doctoral Dissertation, University of Michigan, 1971, cited by H.A. Witkin, Op. cit., 1973, p. 17.

23 G.F. Galvin, Psychological Differentiation and Achievement in Mathematics, unpublished master of arts thesis, University of Ottawa, 1974, p. 51.

24 H.A. Witkin et al., Op. cit., 1962, p. 67 - 71.

rather than a lecturing method which is preferred by relatively field-independent teachers.[25,26] On the other hand, students who are field independent find it equally easy to learn through the expository and discovery methods while the field-dependent students find it more difficult to learn difficult and unfamiliar tasks through the expository method. Thus the field-dependent students learn an unfamiliar task more easily through the discovery and simulation-game methods. This preference may be explained by the fact that the discovery and simulation methods enhance learning by intensifying and personalizing both the "concreteness of experience and the actual operations of abstracting and generalizing from empirical data".[27] These observations are supported by the findings from studies conducted by Grieve

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25 J-J. Wu, Cognitive Style and Task Performance - A Study of Student Teachers, Doctoral Dissertation, University of Minnesota, 1967, Ann Arbor, Michigan, University of Michigan Microfilms, 1968, No. 68-7408, 186 p.

26 F.W. Ohnmacht, Relationships Among Field Independence, Dogmatism, Teacher Characteristics and Teaching Behaviour of Preservice Teachers, Paper presented at the Meeting of the American Educational Research Association, 1967, cited by H.A. Witkin, Op. cit., 1973, p. 27.

27 D.P. Ausubel, The Psychology of Meaningful Verbal Learning, Grune and Stratten, New York, 1963, quoted by T.D. Grieve and J.K. Davis, "The Relationship of Cognitive Style and Method of Instruction to Performance in 9th Grade Geography", in Journal of Educational Research, Vol. 65, 1971, p. 140.

and Davis[28] and DeNike[29].

Thus far, the discussion has been centred on how cognitive style influences both perceptual and intellectual functioning. There is evidence to show that this style extends into other psychological domains, beyond cognition. In fact, the word style, as used by Witkin, subsumes personal as well as cognitive characteristics.[30]

It is observed that the field-dependent person, who is strongly influenced by the immediately surrounding framework in his perception of an item within it, is similarly influenced by social contexts. He will, in social situations, likely use the prevailing social frame of reference to define his attitudes, his beliefs, his feelings, and his self-view. These relationships are documented by Witkin, Dyk and others,[31] Konstadt and Forman,[32] Linton and Graham[33] and many others.

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28 T.D. Grieve and J.K. Davis, Ibid., p. 137 - 141.

29 L. DeNike, "An Exploratory Study of Cognitive Style as a Predictor of Learning from Simulation Games", Educational Resources Information Center, Vol. 10, No. 6, June 1975, p. 98.

30 H.A. Witkin, Op. cit., 1973, p. 9.

31 H.A. Witkin, et al., Op. cit., 1962, p. 140.

32 N. Konstadt and E. Forman, "Field Dependence and External Directedness", Journal of Personality and Social Psychology, Vol. 1, 1965, p. 490 - 493.

33 H. Linton and F. Graham, "Personality Correlates of Persuability", in I. Janis, et al., Personality and Persuability, New Haven, Yale University Press, 1959, p. 69 - 101.

It is found that because the field dependent persons use external sources of information for self-definition[34] they are selectively attentive to the human content of the environment. Therefore, they prefer activities that involve interpersonal relationships. This explains their preference for such vocations as teaching, such subjects as the social sciences and humanities and teaching methods such as the discovery and simulation-game methods. This attention to people and reliance on external social standards make field-dependent subjects show a significantly stronger tendency than field-independent subjects to adapt their performance on a cognitive task to a modelling demonstration.[35]

Many studies which have investigated this cognitive style variable indicate sex differences in field dependence. The studies show a tendency for males to be generally more field independent than females. These differences are more apparent after the age of seventeen. In fact, according to Witkin and his colleagues, "although females tend to be more field dependent than males at all ages it is only at the adult level this difference is large and manifest under almost all test conditions".[36]

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34 H.A. Witkin, Op. cit., 1973, 58 p.

35 H.A. Witkin, Op. cit., 1973, p. 9.

36 H.A. Witkin, H.B. Lewis, M. Hertzman, K. Machover, P.B. Meissner, S. Wapner, Personality Through Perception, New York, Harper, 1954, p. 171.

It is therefore not surprising to find that more females than males major in those subject-areas and choose such vocations as education and social science that favour field-dependent persons. It is important to note, though, that it has not been shown that there exists any significant sex difference in the performance and choice of subjects among the field-independent persons or among field-dependent persons. This is attested to by Galvin's[37] study. He found that there was no significant interaction between sex and psychological differentiation factors.

In this section, the analytical and global approaches which characterize field-independent and field-dependent perception, respectively, were shown to be present also in intellectual functioning. This led to the adoption of the wider concept of cognitive style to encompass this characteristic mode prevalent in perceptual and intellectual functioning. Cognitive style was also shown to be related not merely to perception and intellectual tasks but also to other psychological areas such as personality factors and sex differences.

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37 G. Galvin, Op. cit., p. 50.

4. Criticism of Witkin's Psychological Differentiation Hypothesis

The psychological differentiation hypothesis has not gone uncriticised. In this section, some of the criticisms are reviewed.

Some authors such as Wallach[38] think that the psychological significance of cognitive style has been exaggerated. Others[39] criticize Witkin and his colleagues for mistaking field articulation for field independence. Such writers as Dubois and Cohen,[40] Zigler,[41] Watchel,[42] Spotts and Mackler[43]

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38 Wallach, cited by P.E. Vernon, in "The Distinctiveness of Field Independence", Journal of Personality, Vol. 40, 1972, p. 366 - 391.

39 R.W. Gardner, et al., "Personality Organization in Cognitive Controls and Intellectual Abilities", Psychological Issues, Vol. 2, No. 4, monograph 8, 1960, p. 1 - 148.

40 T.E. Dubois and Cohen, "Relationship between Measures of Psychological Differentiation and Intellectual Ability", Perceptual and Motor Skills, Vol. 31, No. 1, 1970, p. 411 - 416.

41 E. Zigler, "A Measure in Search of a Theory?", Contemporary Psychology, Vol. 8, No. 4, 1963, p. 133 - 135.

42 P.H. Watchel, "Field Dependence and Psychological Differentiation Re-examination", in Perceptual and Motor Skills, Vol. 35, No. 1, 1972, p. 179 - 189.

43 J. Spotts and S. Mackler, "Relationship of Field-Dependent and Field-Independent Cognitive Styles to Creative Test Performance", in Perceptual and Motor Skills, Vol. 24, 1967, p. 239 - 268.

criticize Witkin for not controlling the intelligence factor in his experiments on field dependence. They even contend that field independence is only a factor of intelligence and not distinct from it.

These criticisms have been replied to by Witkin and his colleagues and by other writers such as Vernon.[44] Vernon agrees with the critics that field dependence is related to intelligence, but he maintains that the relationship does not mean that the field-dependence concept should be discarded. He says:

> There is no reason why psychologists should not use a construct which overlaps with other constructs provided that it constitutes a measurable, fruitful hypothesis.[45]

Witkin and his associates[46] replied to the criticisms by saying that field independence is related to intelligence to the extent that the tests for the two variables are loaded on the same analytical factor. They illustrated this by correlating scores on the three sub-tests of WISC which were loaded on the analytical factor with scores on tests of field independence. This gave a significant correlation of 0.66. On the other hand, Witkin and his colleagues found a

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[44] P.E. Vernon, "The Distinctiveness of Field Indepencence", Journal of Personality, Vol. 40, 1972, p. 366 - 391.

[45] Ibid., p. 366.

[46] H.A. Witkin, et al., Op. cit., 1962, p. 80.

non-significant correlation of 0.26 between scores of field independence and scores on the sub-tests of WISC which are not loaded on the analytical factor.

These results show that the field-independent persons are not necessarily more intelligent than the field-dependent persons as the criticisms imply. The person who is field independent may score highly on Object Assembly, Picture Completion and Block Design sub-tests of WISC while he scores a very low mark on the Vocabulary, Comprehension and Information sub-tests. The converse could also be true for the field-dependent person.

Despite the criticisms, the field-dependent - field-independent cognitive style has continued to be recognized as a distinct variable which permeates different areas of psychological functioning. One's position on the field-dependence - field-independence continuum has also continued to be used as an indication of extent of psychological differentiation.

The extent of psychological differentiation has been shown to relate to many cognitive behaviours and functioning, examples of which are the cognitive (mental) processes and levels involved in questioning. In the next section therefore, a discussion of these mental processes, as categorized by Bloom, will be presented.

5. Bloom's Classification of Educational Objectives and Test Items

In this section the rationale and guiding principles for the development and the structure of the taxonomy of educational objectives (cognitive domain) are discussed.

Though Bloom *et al.*'s work is labelled "Classification of Educational Objectives", it must be noted that the work is really a classification of both educational objectives and test questions used in assessing the attainment of the objectives.

The major purpose in developing this taxonomy of educational objectives was to facilitate communication among examiners. The need arose from an observation that there was a lack of common frame of reference and terminology for describing and referring to the human behavioural characteristics and outcomes which examiners in education attempt to evaluate. It was felt that a theoretical framework was needed to provide a convenient system of describing and ordering test items, examination techniques, and evaluation instruments. The framework would also clarify and tighten the terminology of educational objectives and would provide a classification scheme that would make comparison of educational programmes possible. A group of college examiners[47] set out to

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[47] Members of the American Psychological Association in 1948.

construct what is today known as the Taxonomy of Educational Objectives. Two volumes, on Cognitive Domain and Affective Domain, respectively, have already been published.

The Cognitive Domain with which this paper is concerned, treats those objectives which deal with the recall or recognition of knowledge and the development of intellectual abilities and skills. According to Bloom, Hastings and Madaus[48]

> The Cognitive Domain classifies objectives which involve intellectual tasks. For some of these objectives the student has to do little more than remember; for others he must determine the essential problem and then re-order given material or combine it with ideas, methods, or procedures previously learnt.[49]

In the process of ordering objectives and test items, Bloom et al. realised that objectives and test items differed in complexity. As a result they adopted the principle of complexity as the major ordering basis for the objectives in the cognitive domain. On the basis of the principle of complexity, behavioural aspects of educational objectives were placed within a hierarchical framework. In the framework, each category is assumed to include behaviour more complex,

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48 B.S. Bloom, J.T. Hastings, G.F. Madaus, Handbook on Formative and Summative Evaluation of Student Learning, McGraw-Hill Book Company, Toronto, 1971, v - 923 p.

49 B.S. Bloom, et al., Op. cit., 1971, p. 39.

abstract, or internalized than the previous category. Thus the categories are arranged along a continuum from simple to complex.[50]

These levels or categories in the hierarchy relate to or reflect the difficulty and complexity levels of the learning process. So an objective or test item classified in the lower level is presumably easier and probably quicker to attain and answer, respectively, than a more complex objective or item on a higher level of the hierarchy.

The taxonomy contains six major classes or levels in the hierarchy. These are: 1. Knowledge; 2. Comprehension; 3. Application; 4. Analysis; 5. Synthesis; 6. Evaluation.

As has been mentioned, the objectives in one class make use of and are built on the behaviours found in the preceding classes in the list. A brief definition and summary of each class will help to bring out the hierarchical nature of the taxonomy.

Knowledge involves the recall of specifics and universals, the recall of methods and processes, or the recall of a pattern, structure, or setting.[51] The knowledge objectives and test items emphasize and involve, respectively, the

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50 Ibid., p. 39.

51 B.S. Bloom, et al., Taxonomy of Educational Objectives - The Classification of Educational Goals, Hand Book I: Cognitive Domain, David McKay Co. Inc., New York, 1956, p. 201.

psychological processes of remembering.

Comprehension represents the lowest level of understanding. It refers to a type of understanding or apprehension such that the individual knows what is being communicated and can make use of the material or idea being communicated without necessarily relating it to other material or seeing its fullest implications.[52]

The Application level entails the use of abstractions in particular and concrete situations. An example is the application or use of a theory, principles or general ideas to solve a practical problem.

Analysis involves the breakdown of a communication into its constituent elements or parts such that the relative hierarchy of ideas is made clear and/or the relations between the ideas expressed are made explicit. Such analyses are intended to clarify the communication, to indicate how the communication is organized, and the way in which it manages to convey its effects, as well as its basis and arrangement.[53]

The process involved in Synthesis is putting together of elements and parts so as to form a whole.[54] This involves the process of working with pieces, parts, elements, etc.,

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52 Ibid., p. 204.

53 B.S. Bloom, et al., Op. cit., 1956, p. 205.

54 Ibid., p. 206.

and arranging, combining and structuring them in such a way as to constitute a pattern or structure not clearly there before. In short, it entails imposing a structure or organization where it does not exist.

Finally, Evaluation involves making judgements about the value of material and methods for given purposes. It involves quantitative and qualitative judgements about the extent to which materials and methods satisfy criteria. It entails use of a standard of appraisal. The criteria may be those determined by the student or those given to him.[55]

The above summary serves to portray the idea of hierarchy and the principle of complexity. A question classified under Synthesis, for example, requires the person responding to it to have acquired some basic knowledge about the topic involved. It requires him to be able to understand, interpret and even apply the knowledge in other situations. In addition, the question requires the person to be able to analyse the data into their component parts, see how the different sections are related and finally to be able to put the relevant bits of his knowledge together in order to produce an adequate response. Thus the response to such a question is built out of the processes in all the preceding levels.

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55 B.S. Bloom, et al., Op. cit., p. 207.

Bloom et al. have sometimes found it convenient to group the six categories into only two major types. One represents the simple behaviour of remembering and recalling knowledge which they call the "Knowledge level". The other level involves the more complex behaviours of abilities and skills. This second group has been labelled "Intellectual Abilities and Skills".[56] In solving problems requiring intellectual abilities, the student is expected to organize or reorganize a problem, to recognize what material is appropriate, to remember such material, and to make use of it in the problem situation.

Bloom, like the authors of other taxonomies or classifications of objectives and questions, has not specified at which of the levels of his classification questions are to be regarded as low order or higher order. As a result many researchers[57,58] in the area of questioning have variously defined 'lower order' and 'higher order' questions to suit their purposes. Others[59] have mainly talked

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56 Ibid., p. 38.

57 J-J. Wu, Op. cit., 186 p.

58 P. Babin, Adaptations of Modelling Procedures and Their Effect on the Development of Higher-Order Questioning Behaviour in an Elementary Teacher-Education Program, unpublished doctoral dissertation, University of Ottawa, 1971.

59 B. Olmo, "Questioning: Heart of Social Studies", Social Education, Vol. 33, No. 8, December 1969, p. 949 - 952, 989.

about achieving a wider spread of questions across all the levels without grouping them into higher or lower levels.

In this paper the Knowledge and Comprehension levels are designated the lower levels, while Application, Analysis, Synthesis and Evaluation are designated higher levels. This grouping is in harmony with Crump's[60] four-level "Categories of Questioning" which are: 1. Reproduction, 2. Translation, 3. Reflection, and 4. Valuation. She calls questions in the first two levels "Convergent questions", these are characterised by having either one right answer as in reproduction level or only few acceptable answers as in translation. The 'convergent questions' involve such mental processes as are involved in Bloom's Knowledge and Comprehension levels. The processes include recognition, recall, citation, quotation, recounting, naming, defining (in reproduction) and translating, interpreting, illustrating, rephrasing, summarizing and explaining in one's own words (as in translation). It must be noted that Crump uses 'translation' in a wider sense than Bloom. Her 'translation' encompasses Bloom's "Comprehension".

Crump calls questions in her last two levels - Reflection and Valuation - "divergent questions". Reflection questions are characterised by having many possible correct

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60 C. Crump, "Teachers, Questions and Cognition", Educational Leadership, Vol. 27, No. 7, April 1970, p. 657 - 660.

answers and by being more open-ended. Valuation questions, on their part, do not have correct answers, but rather are characterised by controversy and open-endedness.

Reflection encompasses Bloom's Analysis and Application levels, while Valuation is equivalent to Bloom's Evaluation and Synthesis levels. Crump designates the convergent and divergent questions as belonging to the lower and higher cognitive levels, respectively.

The rationale for designating Knowledge and Comprehension as the lower level is that, as Bloom et al. said, "comprehension is not made synonymous with complete understanding or even with the fullest grasp of a message".[61] They have also stated that comprehension represents "an understanding of the literal message contained in a communication".[62] Nevertheless, to reach such an understanding one may need to change the communication in one's mind or overtly to some parallel form more meaningful to one. Comprehension may also involve simple extension beyond what is given in the communication, as a demonstration that the communication is understood.

The Translation sub-level of Comprehension entails changing a communication into another form, language or terms.

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61 B.S. Bloom, et al., Op. cit., 1956, p. 89.

62 Ibid., p. 89.

It quite often involves one-to-one rendering from one form to another. It does not involve the mental processes which characterize the higher levels.

The second sub-category of Comprehension is Interpretation. This involves "dealing with a communication as a configuration of ideas whose comprehension may require a reordering of the ideas into a new configuration in the mind of the individual".[63] This sub-category involves considering the relative importance of the ideas, their interrelationships and their relevance to generalizations which are implied or described in the communication. The generalizations, inferences and summarizations one makes from a communication give a clear indication of whether the communication was well interpreted or misinterpreted.

Interpretation sometimes appears to spread into the higher levels, for example, Analysis. It is, however, very different from Analysis in that the latter emphasizes the form, organization, the effectiveness, and the logic of the communication, whereas interpretation is not concerned with any of these but rather with the ability to make out the meaning of the communication irrespective of the logic or organization. Likewise, Interpretation is distinguished from Application in that the latter is more concerned with the

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63 Ibid., p. 90.

meanings a communication has for other generalizations and situations, or vice versa. Interpretation also differs from Evaluation in that it does not involve making value judgments based on some stated criteria.

Finally, extrapolation involves the making of estimates, or predictions based on an understanding of the trends, tendencies, or conditions described in the communication. The emphasis here is on understanding the trends, etc., which are described in the communication. An understanding of these may permit making inferences with respect to implications, consequences, corollaries and effects which are in accordance with the conditions described in the communication. It differs from Application in that it does not involve the use of abstractions or generalizations from other experiences or situations but, rather, the thinking is based on what is given in the communication.

In general, then, a problem in the Comprehension category requires the student "to know an abstraction well enough that he can correctly demonstrate its use when specifically asked to do so".[64] On the other hand, at the application level, given a problem new to the student, he will be able to select and apply the appropriate abstraction without having to be prompted as to which abstraction is correct

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64 B.S. Bloom, et al., Op. cit., p. 120.

and without having to be shown how to use it in the new situation. The Application level, therefore, requires the student to be able to restructure an initially unfamiliar problem into a familiar context by using familiar elements, and consequently to be able to select the appropriate abstraction for its solution.

On the basis of the foregoing characteristics of the Comprehension level, it is grouped, for the purposes of this study, together with "Knowledge" into the lower level. In addition, there is no reason to expect any differences at the Comprehension level between field-independent and field-dependent persons. This is because operations at this level merely depend on the understanding of the given communication. Above this level, however, the individual differences in the ability to select and apply, analyse, synthesize and evaluate become very important.

Thus, for the purposes of this study, the Application, Analysis, Synthesis and Evaluation levels of Bloom's taxonomy will be designated as higher level, the Knowledge and Comprehension levels being called lower level.

Bloom's taxonomy has been criticized by Ormell.[65] Despite Ormell's description of the taxonomy as an

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65 C.P. Ormell, "Bloom's Taxonomy and the Objectives of Education", Educational Research, Vol. 17, No. 1, Nov. 1974, p. 3 - 18.

inadequate and blunt instrument for some subject-matter areas like mathematics, Sanders finds the taxonomy an "ingenious plan for classifying educational objectives".[66] Sanders used the taxonomy as a basis for his taxonomy of questions.

In his taxonomy of questions, Sanders implies, like Gall,[67] that an external stimulus such as professional training is the thing needed to make teachers use higher order questions. That only a few teachers ask higher order questions despite increased number of trained teachers and improved quality of training suggests that teachers' questioning behaviour is not necessarily a function of professional training. It is not unlikely that this questioning behaviour of teachers is related to their extent of psychological differentiation.

In summary, the taxonomy of educational objectives was constructed to meet the demand for a logical framework which would bring communicability among college examiners. The basis of the classification was the principle of complexity which led to the development of a hierarchy consisting of six major classes. The mental processes required at each level

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66 N.M. Sanders, Op. cit., p. 2.

67 M. Gall, "The Use of Questions in Teaching", Review of Educational Research, Vol. 40, No. 5, Dec. 1970, p. 716 - 717.

or class are related to the mental processes in the learning process and so the categories could be reduced to only two on the basis of the degree of complexity of the mental processes involved. Hence we have Knowledge category and Intellectual Abilities and Skills category, by Bloom et al., and, for the purpose of this study, lower level (Knowledge and Comprehension) and higher level (above Comprehension). Despite some criticisms, the taxonomy has remained a useful tool for classifying objectives and questions, and has provided a common frame of reference for examiners.

The relationship between Bloom's taxonomy, teachers' questioning behaviour and psychological differentiation of the teachers is explored in the following section.

6. Relationship between Field-Dependence-Independence and Questioning Behaviour

In this section, the points of intersection between Witkin's psychological differentiation construct and Bloom's taxonomy of educational objectives and test items are discussed. This leads to the statement of the problem and the hypothesis.

Underlying the connection between field-dependence - field-independence and teacher questioning behaviour is the degree to which a given questioning-behaviour pattern as determined by Bloom's taxonomy calls for the particular cognitive skills involved in a more global or analytical style.

The cognitive skills which distinguish a more field-independent approach in intellectual and perceptual functioning are:

1. the ability to analyse an experience or problem (i.e. seeing parts of a field as discrete from the background).
2. the ability to structure an experience or problem (i.e. being able to impose organization upon a field that lacks it).[68]

One can at once see where these characteristics fit into Bloom's taxonomy. In Bloom's taxonomy, analysis implies the ability to break down a communication into its constituent elements or parts such that the relative hierarchy of the ideas expressed are made explicit. The field-independent person, who applies the analytical approach, is able to break up a problem into parts and to pick out the relevant information without being trapped by the surrounding irrelevant portions. He is able to go even beyond analysis to synthesize or put together elements and parts so as to form a whole. This entails being able to impose structure or organization on a feature that lacks it.

On the other hand, the field-dependent person, who conforms passively to the influences of an embedding field

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68 H.A. Witkin et al., Op. cit., 1962, p. 27.

(i.e. applying a global approach), is not able to analyse or synthesize a given body of knowledge in order to discern which material is appropriate for the solution of a new and unfamiliar problem. Such a person will more readily recall the given material in the form it was received than use it for other purposes.

The characteristics of field independence, more than those of field dependence, are also more compatible with the mental processes involved in Application and Evaluation.

Application goes a step beyond Comprehension. It involves the application or use of the appropriate abstraction, in a new situation, without an external aid or prompting as to which abstraction to use and how to use it. In other words, application demands an independent use, in a new situation, of knowledge, skill or abstraction, already acquired.

Because of the tendency for the field-dependent person to depend on outside sources for self-definition, he may not be able, by himself, to see relationships between a new problem and the abstraction - theory, principle, or idea etc., - which he has already learned.

The processes that have been discussed are required in all problem-solving situations. The levels employed in each case are determined partly by the nature of the problem and partly by the cognitive style of the person solving the

problem. One such problem is the construction of test questions by teachers.

The field-dependent teacher tends to be engaged by the total or general meaning and by isolated facts. He will be less likely to analyse the material and to see the inter-relationships of the different parts, than the field-independent teacher. Therefore, the field-dependent teacher will more probably ask questions related to the knowledge and the comprehension of the subject matter and ask only a few, if any, questions above these two levels.

The tendency to depend on external sources or values for self-definition will, in addition, make the field-dependent teacher more inclined to accept the material as it is presented without asking for alternative lines of reasoning to the ones in the text. He will also tend to accept a conclusion made in the text rather than arrive at one independently. He will not find it easy to see uses of a theory, or of principles, other than those presented in the text. Such a person is unlikely to ask questions that require the application of the material he has taught.

The ability and tendency of the field-independent teacher to look for relationships between parts of a whole or between situations will cause him to create situations, in the form of questions, which demand his students to demonstrate not only the ability to remember and understand the

learned material, but the ability to apply the material in new, but related, situations.

At this point it is pertinent to ask what a 'question' is and what questioning behaviour implies. Many authors have taken the word 'question' for granted without trying to explain what activities they imply by it.

One of the early attempts to define the word 'question' was made by Cohen[69] who contended that a question was a logical entity and that questions were variables, values of which are answers. Fahey[70] defined a question as "... verbal expression of a problematic situation existing in the mind of the questioner". He explained that 'problematic' in this context was to be interpreted broadly enough to include realization of lack of specific information, awareness of gaps in relationships, or a consciousness of a conflict between present and past experiences. This explanation implied that the purpose of the question would be the finding of a means of supplying the lacked information, closing the gap, or resolving the conflict. The definition appears to be referring to higher order questions only, because a low order

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69 F.S. Cohen, "What is a Question?", in Monist, Vol. 39, 1929, p. 353 – 354.

70 C.L. Fahey, "The Questioning Activity of Children", The Journal of Genetic Psychology, Vol. 60, Second Half, June 1942, p. 339.

question which requires mere recall of some specific facts already learnt does not cause any conflict, neither does it create any gaps in relationship between past and present experience.

It takes an analytical mind to create a situation in which there is a realization of lack of specific information, a situation which presents gaps in relationships and which causes conflict in present and past experience. It is an analytical mind that can create such a situation in which the respondent is expected to find, from his repertoire, the right techniques and relevant materials required to close the gap and resolve the conflict. It is therefore expected that the field-independent person with his analytical approach will be more able and more likely than the field-dependent to construct questions corresponding to the higher levels of Bloom's taxonomy, which have the previously mentioned characteristics of a "problematic situation". The field-dependent person cannot impose structure on a nonspecific stimulus[71], as illustrated by Witkin's experiment on recognition-efficiency test. It would therefore not be natural for the field-dependent person to create such situations which require structuring or reorganization in relation to test items.

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71 H.A. Witkin, Op. cit., 1962, p. 93 - 95.

7. Summary and Hypothesis

In this chapter, sections of the psychological differentiation hypothesis relevant to the present study were discussed. The field-dependent and field-independent approaches, which were first observed in perceptual functioning, were shown to be present in intellectual behaviour too. This lead to the development of the concept of cognitive style.

Bloom's taxonomy was discussed in regard to its underlying principles and structure.

Finally, the relationships among field-dependent - field-independent cognitive style, Bloom's taxonomy, and questioning behaviour were discussed.

The purpose of this study, therefore, is to test the hypothesis that field-independent student-teachers ask a greater proportion of questions in the higher level of Bloom's taxonomy, as defined earlier in this paper, than field dependent student-teachers.

CHAPTER II

EXPERIMENTAL DESIGN

This chapter is concerned with the method by which the hypothesis of this study is investigated. The chapter is divided into six sections. In the first section is presented a description of the subjects. This is followed by a description of the psychometric instruments. The procedure for the training of the judges who classified the questions into the six levels of Bloom's taxonomy and the method of establishing the inter-judge rating reliability are presented in section 3.

The procedure for data collection is described in the fourth section. After a description of the scoring of the tests, the planned statistical analysis of the data is presented in the final section.

1. The Subjects

The sample in this study comprised seventy-nine student-teachers, pursuing a B.Ed. degree programme in the English Elementary Section of the Faculty of Education, University of Ottawa. Fifty-nine of the seventy-nine subjects were females while twenty were males. The mean age of the subjects was 24.56 years. The hypothetical population to which the findings may be generalized is that of student-

teachers in the B.Ed. elementary school programme at the University of Ottawa.

Both the male and female student-teachers who volunteered to take part in the study were used as research subjects, no control being set on the sex factor. This was because even though there is ample evidence to show that males tend to be more field-independent than females, no significant interaction effect on the dependent variable has yet been found between sex and psychological differentiation in either the field-independent group or the field-dependent group. Galvin[1], for example, tested the difference between the mean mathematics scores of the field-independent female and male students and also the mean mathematics scores of the field-dependent male and female students and found no significant difference in their performance.

2. The Psychometric Instruments

Scores were obtained for each subject on psychological differentiation and questioning behaviour.

Degree of psychological differentiation was measured by Thurstone's Concealed Figures (Closure Flexibility) Test, quite often referred to as the Concealed Figures Test (CFT).

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1 G.F. Galvin, Psychological Differentiation and Achievement in Mathematics, Unpublished Master of Arts thesis, University of Ottawa, 1974, p. 51.

This is a pencil-and-paper test which can be administered individually or in groups. Like Witkin's Embedded Figures Test, the CFT was developed from Gottschaldt's Figures Test. The CFT consists of forty-nine items. Each item is made up of one simple figure and four complex figures.

The subject is required to locate the simple figure in each of the complex figures, if it is there. He is to indicate by a check, (✓), those complex figures that embed the simple one, and by a zero those that do not. The subjects' score is the difference of the number of incorrect responses and the number of correct responses. Taking the difference is a method of correcting for guessing. The standardized testing time for the test is ten minutes.

The original form of CFT has a split-half reliability coefficient of 0.78[2] as reported in the test manual. The present form of the test is reported by Pemberton[3] to possess a corrected split-half reliability of 0.94 as given by Spearman-Brown prophecy formula. More recent investigators have also found equally high reliability coefficients for

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2 L.L. Thurstone and T.E. Jeffrey, Closure Flexibility (Concealed figures) - Test Administration Manual, Industrial Relations Centre, University of Chicago, 1965, 1 - 18 p.

3 C.L. Pemberton, A Study of the Speed and Flexibility of Closure Factors, Unpublished Ph.D. dissertation, Department of Psychology, University of Chicago, 1951, cited by L.L. Thurstone and T.E. Jeffrey, Ibid., p. 8.

the CFT. In recent studies, Bowles[4] and Galvin[5] reported KR-21 reliability coefficients of 0.93 and 0.91 respectively.

The CFT has variously been shown to be loaded on the same factor as the EFT. Witkin et al. accept it as an adequate measure of field dependence. This view is evidenced in the following exerpt:

> Taken together, these studies provide impressive support for the view that flexibility of closure, spatial decontexualization, and field dependence may be different names for the same dimension. In view of this evidence we may appropriately consider results obtained with tests loaded on the flexibility-of-closure and spatial-decontextualization factors as bearing upon the field-dependence dimension.[6]

Phillips et al.[7] and Goodman[8] reported correlations of 0.77 ($P<.01$) and 0.69($p<.01$) respectively, between EFT

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4 A. Bowles, Extent of Psychological Differentiation as Related to Achievement in Science and Attitude in Science, Unpublished Master's thesis, University of Ottawa, Ottawa, 1973, p. 38.

5 G.F. Galvin, Op. cit., p. 46.

6 H.A. Witkin, et al., Psychological Differentiation, New York, Wiley, 1962, p. 52.

7 L. Phillips, et al., The Application of Development Theory to Problems of Social Adaptation, in Progress Report No. 2 to USPHS. Worcester State Hospital, Massachussetts, 1957, cited by H.A. Witkin, et al., Op. cit., 1962, p. 49.

8 B. Goodman, Field Dependence and the Closure Factors, Unpublished study, cited by H.A. Witkin et al., Op. cit., 1962, p. 49.

and Thurstone-Gottschaldt scores. Many other researchers such as Bowles[9] and Galvin[10] have used the CFT in their studies and all these lend support to the construct validity of the test.

A copy of the CFT is presented in Appendix 1.

The measures of the dependent variable of the study, questioning behavior,, are based on questions set by the subjects on a given passage provided by the researcher. In Chapter I, Bloom's taxonomy was divided into two broad categories: higher level and lower level. Questioning behaviour is measured by the proportion of questions set at the higher level of the taxonomy. Such questions will be referred to as "higher-order questions".

The passage provided by the researcher was an essay on "Danish Agriculture and Industry". A copy of the passage is presented in Appendix 3. A number of passages were tried out to ascertain whether or not anything inherent in any of them would influence the subjects' questioning behaviour. Eventually, the passage used in this study was chosen as appropriate.

The questions set on the passage by the subjects were categorized by five judges. The training of these

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9 A. Bowles, Op. cit., IV - 71 p.

10 G. Galvin, Op. cit., IV - 88 p.

judges and the method by which the reliability of their categorization was estimated are discussed next.

3. Training of the Judges and the Establishment of their Inter-Rater Reliability

Five judges were selected from the 1976-77 graduate students in the Faculty of Education, University of Ottawa. They were all highly familiar with Bloom's taxonomy. Nevertheless, the five judges were given copies of the Raters' Manual, presented in Appendix 4, which is a summary of Bloom's taxonomy. The judges and the researcher together made a brief oral review of the classifications. The judges were then requested to read and study the manual carefully and to write down any doubts, questions or comments relating to the manual. This was to enable modifications to be made before the judges could use the manual for classifying questions.

The five judges and the researcher met collectively in three training sessions. The essence of the sessions was to ensure an adequate understanding of the categories and the classification process; and also to help resolve any doubts, and review or modify the manual if need be.

In each training session the judges were given a copy of Directions to Raters, presented in Appendix 5, and a rating sheet, presented in Appendix 6. They were also given a passage and a set of ten questions based on the passage.

The judges independently read the passage and classified all the questions into the six categories of Bloom's taxonomy. After the classification, there followed a discussion on the classifications each judge had made. An attempt was made to justify the choice or rejection of each category as the appropriate category for a given question. Questions were raised and agreements were reached.

At the end of each training session the amount of agreement between the judges (inter-judge reliability coefficient) was calculated, using the one-way analysis of variance technique for repeated measures.

The analysis of variance (ANOVA) table and the reliability estimate for each training session are shown in Table I.

The inter-judge reliability coefficient, as indicated in Table I, was found to be 0.76 for the first orientation session, 0.91 for the second and 0.92 for the third. These figures show a steady increase in the amount of agreement among the judges' classifications. It was felt that an inter-judge reliability coefficient as high as 0.92 justified the acceptance of the judges' classification as reliable.

Table I

Analysis of Variance for Repeated Measures and Reliability Coefficients of Ratings on Three Training Sessions Undergone by Five Judges

Source	ndf	SS	MS	Reliability Coefficient (r)*
SESSION I				
Among Questions	9	5.92	0.66	
Within Questions				
T (Among Judges)	4	1.12	0.28	0.76
TQ (Residual)	36	5.28	0.15	
MS Within Questions			0.16	
SESSION II				
Among Questions	9	8.9	0.99	
Within Questions				
T	4	0.2	0.05	0.91
TQ	36	3.4	0.09	
MS Within Questions			0.09	
SESSION III				
Among Questions	9	8.8	0.98	
Within Questions				
T	4	0.2	0.05	0.92
TQ	36	3.0	0.003	
MS Within Questions			0.08	

*$r = 1 - \frac{MS_W}{MS_A}$

4. The Procedure for Data Collection

The data was collected in two sections. The CFT was administered first.

The passage on "Danish Agriculture and Industry", contained in Appendix 3, was given to the subjects after they had completed the CFT. The subjects were required, as indicated on the instruction page, to read the passage and write ten questions that could be used to test students' learning from the passage. They were to assume 1) that a lesson had been taught on the topic of the passage to a grade eight class; 2) that the content of the passage comprised all that was said in that class; 3) that the pupils had no prior knowledge of the content. This exercise was not timed. Subjects completed the assignment at their own rates, and each was allowed to leave when he had written and submitted his questions.

The subjects wrote the questions under the researcher's invigilation in order to avoid any consultations or discussions between subjects on the type of questions to write.

5. Scoring

The scoring key provided in the CFT manual, and presented in Appendix 2, was used for marking the CFT. In accordance with the authors' instructions, a subject's score was given by the difference of the number of correct responses

on the CFT and the number of incorrect responses.

The degree of psychological differentiation is a variable which is normally distributed and therefore lies on a continuum from field dependence at one end to field independence at the other. As a result, neither Witkin nor any of the researchers working in this area has attempted to say what score, on tests of field independence, should be regarded as indicating field independence or field dependence. Thus, people are often regarded as relatively more field-independent or field-dependent than other members of the group to which they belong.

It has therefore been the practice for workers in this field to use the bottom and top thirds (or any other arbitrary proportions) as field-dependent and field-independent subjects, respectively. The middle third is regarded as containing people who are mid-way on the psychological differentiation continuum, in whom neither the characteristics of field dependence nor those of field independence predominate. Thus the middle group, whose scores were not used, acted as a buffer zone between the extreme groups. The top third and the bottom third, each comprising twenty-seven subjects, were designated field-independent and field-dependent respectively.

The scripts containing the questions written by the field-dependent and field-independent subjects, on the given

passage, were thoroughly mixed up and assigned code numbers in order to hide the identity of their authors. The scripts were then given to the five trained judges.

These judges, who worked independently, classified the questions into the six categories of Bloom's taxonomy. All the questions were rated by all the judges.

Any questions classified by at least three out of the five trained judges into either the Application, Analysis, Synthesis and/or Evaluation level were designated higher order questions. This cut-off line was used, instead of Knowledge/above-Knowledge division made by Bloom et al.[11], because the comprehension level does not involve such mental processes as would discriminate efficiently between field-dependent and field-independent subjects.

Because of the nature of Bloom's taxonomy it was decided to regard any question as higher order if three or more of the judges classified it into the higher levels. Bloom and his colleagues acknowledge that "a difficulty in classification results from the fact that the more complex behaviours include the simpler behaviours".[12] To by-pass

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11 B.S. Bloom, et al., Taxonomy of Educational Objectives - The Classification of Educational Goals, Hand Book I: Cognitive Domain, David McKay Co. Inc., New York, 1956, p. 28.

12 Ibid., p. 16.

this difficulty, they advise that a particular behaviour be placed in the most complex class which is appropriate and relevant. Nevertheless, they admit that "comprehensiveness, of course, is never finally determined".[13] Thus, in view of the fact that the judges classified the questions into six categories and not into just two categories, of higher and lower levels, it was felt that if three or more judges classified a given question into the higher levels, that question could be safely regarded as a higher order question.

In Appendix 7 are presented the scores obtained by the subjects on psychological differentiation and questioning behaviour.

The planned statistical design to be used for the analysis of the data is discussed in the following section.

6. Planned Statistical Design

In order to test the research hypothesis in the null form, it was planned to use normal approximation of the Fisher Exact Test.[14] The independent variable was the degree of psychological differentiation while the dependent variable was the proportion of higher order questions.

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13 B.S. Bloom, et al., Ibid., p. 21.

14 V. Keith and M. Cooper, Non-Parametric Design and Analysis, University of Ottawa Press, Ottawa, 1974, p. 146 - 150.

The level of significance was set at 0.05.

In the next chapter, the actual analysis of the data, the results and a discussion of the findings are presented.

CHAPTER III

PRESENTATION AND DISCUSSION OF RESULTS

In this chapter, the research hypothesis is presented first. It is followed by the results of the statistical analysis, the discussion of the results and suggestions for further research.

1. Hypothesis

The purpose of this study, as indicated in Chapter I, was to determine if student-teachers' questioning behaviour is related to their degree of psychological differentiation. The hypothesis which emerged from this projected relationship was:

> Field-independent student-teachers ask a greater proportion of higher-order questions than the field-dependent student-teachers.

The results of the analysis of the data are presented in the next section.

2. Results of Statistical Analysis

The literature[1,2,3] on questioning behaviour has suggested that a frequency distribution on this variable with higher-order questions as the criterion measure will be highly skewed. This skewness is a result of the tendency for teachers to set mostly lower order questions.

Corey[4], for example, found that 71% of the questions asked by teachers in a one-week period in a laboratory high school were classified by three judges as factual questions. To check this assumption, the frequency polygon shown in Figure 1 was constructed. The polygon shows that twenty-four of the fifty-two subjects (i.e. 46.15%) wrote only lower-order questions, fourteen (26.92%) wrote only one higher-order question each; eight (15.38%) wrote two higher-order questions each, two (3.8%) wrote three higher-order questions each, etc. Thus, the polygon shows that there is indeed a strong positive skewness in the distribution.

---

1 S.M. Corey, "The Teachers Out-Talk the Pupils", The School Review, 1940, Vol. 48, p. 745 - 752.

2 B.S. Bloom, et al., Taxonomy of Educational Objectives - The Classification of Educational Goals, Handbook I: Cognitive Domain, McKay Co. Inc., New York, 1956, p. 30 and 34.

3 C. Crump, "Teachers, Questions and Cognition", Educational Leadership, Vol. 27, No. 7, April 1970, p. 657 - 660.

4 S.M. Corey, Op. cit., p. 745 - 752.

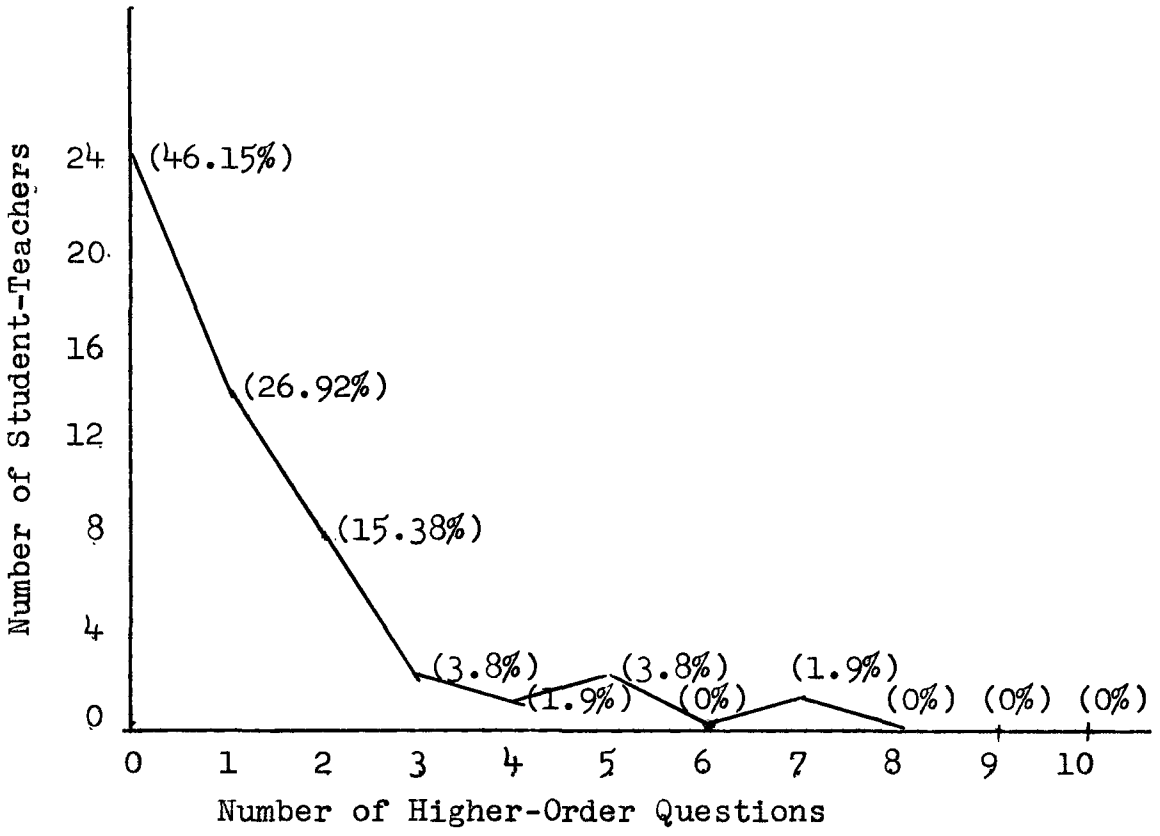

Figure 1. Frequency Polygon Showing the Distribution of Higher-Order Questions for all the Subjects.

In general, 89.02% of all the questions written by the subjects were lower-order types and only 10.98% were higher-order questions.

Because it is believed that field-independent student-teachers tend to set a greater number of higher-order questions, it is expected that there will be a difference between the variances in the distributions of scores on questioning behaviour of the field-dependent and field-independent subjects.

The frequency polygon in Figure 2 bears out this expectation about difference in variance of the scores on questioning behaviour of the field-dependent and those of the field-independent subjects. The number of higher-order questions set by field-dependent subjects range from zero to three out of ten. On the other hand, the number of higher-order questions from the field-independent subjects range from zero to seven out of ten. Thus, the criterion measure for the field-independent subjects shows a wider dispersion than for the field-dependent subjects.

Because of the extreme skewness and heterogeneity of variance (which was also confirmed by the Levene test for homogeneity of variance, using the proportion of higher-order questions set as the dependent measure for each subject; $F=4.58$; $ndf=1,52$; $P<0.05$), it was decided that a parametric test was inappropriate. A non-parametric test, the

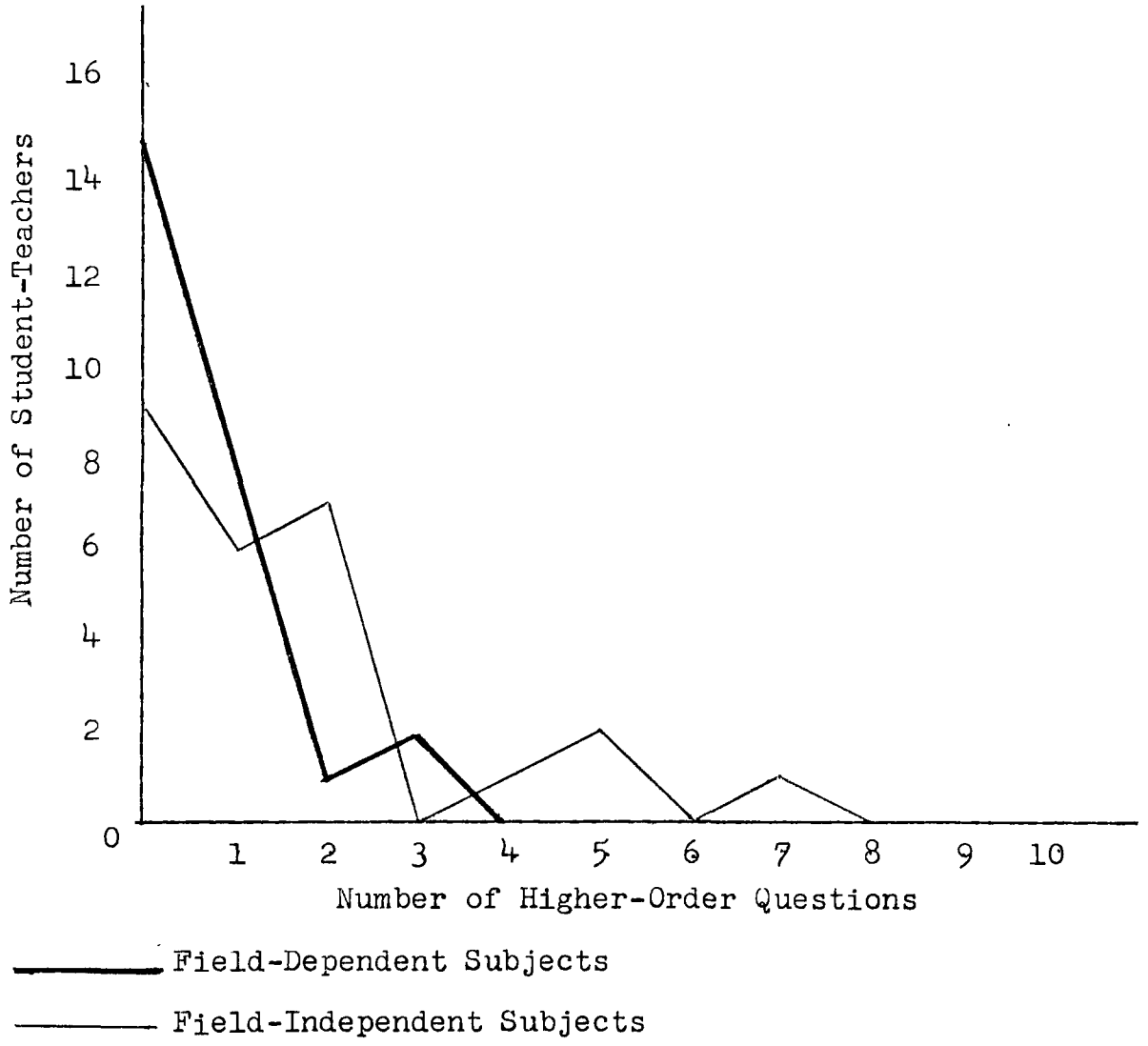

Figure 2. Separate Frequency Polygons of the Distributions of Higher-Order Questions for Field-Dependent and Field-Independent Subjects.

Fisher Exact Test[5], was therefore used to examine the research hypothesis that the proportion of higher-order questions set by field-independent subjects is greater than that set by field-dependent subjects.

After two subjects who wrote only five and seven questions, respectively, had been eliminated, the questions were classified into the cells of a 2x2 contingency table for the Fisher Exact Test. This table is presented below as Table II.

Table II

Numbers of Higher-Order and Lower-Order Questions Set by the Field-Independent and Field-Dependent Samples Respectively

		Sample		
		Field-Independent	Field-Dependent	Total
Type of Question	Higher Order	41	16	57
	Lower Order	219	243	462
	Total	260	259	519

5 V. Keith and M. Cooper, Non-Parametric Design and Analysis, University of Ottawa Press, Ottawa, 1974, p. 146 - 150.

The value of Z obtained by use of the normal approximation of the Fisher Exact Test was 3.50. This value is significant at 0.05 level, the critical value for a two-tailed test being 1.96. The null hypothesis was thus rejected. Since the proportion of higher-order questions set by the field-independent sample was greater than that set by the field-dependent sample, the research hypothesis was supported.

3. Discussion of Results

The hypothesis investigated in this study was derived from Witkin's Theory of psychological differentiation and Bloom's taxonomy of educational objectives. The theory of psychological differentiation and the related literature led to the hypothesis that student-teachers who apply a field-independent approach to both intellectual and perceptual activities set a greater proportion of higher-order questions than their counterparts who apply the field-dependent approach.

The results of the statistical analysis, using Fisher Exact Test, support the hypothesis and therefore provide justification for the extension of the theory of psychological differentiation to questioning behaviour.

Research[6] has indicated that elementary school teaching particularly attracts relatively field-dependent persons. The evidence provided by the results of this study, in turn, indicates that field-dependent elementary school teacher-trainees ask a greater proportion of low order questions than the field-independent ones. These findings, taken together, help to explain the preponderance of low order questions in teacher-made tests, especially at the elementary school level, a problem which has been of great concern to educationists and yet has evaded any solution.

Many educationists, for example, Gall,[7] hold that one of the ways to develop intellectual skills and critical thinking in students is by using higher-order questioning techniques. Many have variously tried to induce this higher-order questioning behaviour in teachers and/or student-teachers.

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6 H.A. Witkin, et al., "Field-Dependent and Field-Independent Cognitive Styles and Their Educational Implications", Research Bulletin, 75-24, Princeton, New Jersey, Educational Testing Service, 1975, p. 64 and 67.

7 M. Gall, "The Use of Questions in Teaching", Review of Educational Research, Vol. 40, No. 5, Dec. 1970, p. 712.

Examples of such attempts are those made by Crump[8] and Borg et al.[9] Crump succeeded, through her procedure, in reducing the proportion of lower-order questions from 89.1%, in the pre-instruction period, to 73.4% in the post-instruction period. She admitted that "the convergent-type questions [reproduction and translation] continued to dominate but to a lesser degree in the post instruction period".[10]

With the indication of the present study that questioning behaviour is related to cognitive style, which is a function of psychological differentiation, the success or failure of such attempts like Crump's to change questioning behaviour, will depend, to a large extent, on how amenable to change cognitive style is. In any case the above-mentioned attempts were not made to change cognitive style, but they were rather made to change the questioning behaviour.

This discussion suggests a number of problems, presented in the next section, which need to be investigated further.

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8 C. Crump, "Teachers, Questions and Cognition", Educational Leadership, Vol. 27, No. 7, April 1970, p. 657 - 660.

9 W.R. Borg, M.L. Kelly, P. Langer and M. Gall, The Minicourse: A Microteaching Approach to Teacher Education, Beverly Hills, Calif., Macmillan Educational Service, 1970, p. 128 - 138.

10 C. Crump, Op. cit., p. 659.

4. Suggestions for Further Research

The researchers considered in the preceding section, who have tried to improve teachers' and/or student-teachers' questioning behaviour, did not investigate the success of the attempts on different personality types such as field-dependent and field-independent subjects. Considering the field-dependent persons' susceptibility to dominant organization, salient cues and suggestion, it is probable that the modelling method of training for higher-order questioning behaviour is more effective with that group of people. On the other hand the usual analytical methods may be more effective with the field-independent subjects.

The results of the present study indicate that psychological differentiation (cognitive style) is related to the type of questions student-teachers set. Since different strategies for improving questioning behaviour do not and cannot change the cognitive style or the extent of psychological differentiation, it is suggested that research be carried out to investigate, on a longitudinal study basis, the permanency of the experimentally-induced or achieved higher-order questioning behaviour for the field-dependent subjects.

In conclusion, the results of the investigation show that the questioning behaviour of student-teachers is related to their degree of psychological differentiation.

This finding, however, is obtained from subjects belonging to a fairly limited population. It is therefore suggested that other workers replicate this study with student-teachers selected from different universities located in different parts of the province or country.

In this chapter was presented the result of the statistical analysis, the discussion of the results and suggestions for further research. This is followed in the next section by a summary and conclusions.

SUMMARY AND CONCLUSIONS

Witkin's theory of psychological differentiation postulates that people have a characteristic and pervasive mode of approach to both perceptual and intellectual activities. Ample research evidence has supported this hypothesis.

The term 'differentiation' refers to the formal, as opposed to material properties or content characteristics. Because of its dynamic nature, differentiation is related more to processes than to achievement. These formal and dynamic characteristics of psychological differentiation make it possible to link psychological differentiation with the cognitive processes which Bloom et al. identified and arranged in a hierarchy. The purpose of this study was therefore to explore this as yet unestablished link between degree of psychological differentiation and questioning behaviour. It was hypothesized that field-independent student-teachers set a greater proportion of higher-order questions than the field-dependent subjects.

Seventy-nine student-teachers with an average age of 24.56 years served as volunteer subjects for the study.

The degree of their psychological differentiation was measured by Thurstone's Concealed Figures Test.

Based on the CFT scores, the extreme groups, comprising twenty-seven subjects in each, were designated

field-dependent and field-independent subjects, respectively.

Questioning behaviour was measured by the proportion of higher-order questions which the subjects wrote on a passage provided by the researcher.

The questions written by these extreme groups were given to five trained judges to categorize into the six levels of Bloom's taxonomy.

Any question which three or more of the judges classified into the Application, Analysis, Synthesis and/or Evaluation categories, was designated a higher-order question.

The results of a Fisher Exact Test showed a significant difference between the proportions of higher-order questions set by the field-independent and field-dependent subjects.

It was, therefore, concluded that field-independent elementary school teacher-trainees tend to ask a greater proportion of higher-order questions than do the field-dependent ones. Thus the findings of this study indicate that there is a relationship between questioning behaviour and extent of psychological differentiation.

BIBLIOGRAPHY

Bloom, B.S., (ed.), Taxonomy of Educational Objectives: The Classification of Educational Goals, Handbook I, Cognitive Domain, New York, David McKay Co., 1956, 207 p.

The book is the result of the earliest attempt to develop a taxonomy for educational objectives and test items. The work was undertaken to facilitate communication among examiners and with their colleagues about educational objectives and test items. The behavioural aspects (mental processes) of educational objectives were identified and arranged in a hierarchy in which each level builds on and includes the preceding behaviours. The underlying principle in the taxonomy is that of increasing complexity.

Crump, C., "Teachers, Questions, and Cognition", Educational Leadership, Vol. 27, No. 7, April 1970, p. 657 - 660.

The article brings out the existing state of affairs in the area of teachers' questioning behaviour. The article is one of many evidences which show that teachers' questions are predominantly lower-order in nature, despite special training to the contrary. It was recommended that teachers be acquainted with a means of classifying questions and also with other strategies for improving teachers questioning behaviour such as video tapes, microteaching, etc.

Dubois, T.E. and W. Cohen, "Relationship between Measures of Psychological Differentiation and Intellectual Ability", Perceptual and Motor Skills, Vol. 30, No. 2, Oct. 1970, p. 411 - 416.

The authors question the adequacy of Witkin's notion that significant relationships between measures of field-independence and intelligence can be explained on the basis of a common requirement for overcoming embedded contexts.

Gall, M.D., "The Use of Questions in Teaching", Review of Educational Research, Vol. 40, No. 5, Dec. 1970, p. 707-- 721.

The author critically reviews the existing classification systems or taxonomies for questions; bringing out their strengths and weaknesses. The article confirms Crump's observation that emphasis had hitherto been laid on lower-order questions and similarly, stresses the need for improvement in teachers' questioning behaviour.

Witkin, H.A., "The Role of Cognitive Style in Academic Performance and in Teacher-Student Relations", Research Bulletin, 73-11, Educational Testing Service, Princeton, 1973, 58 p.

Witkin relates the findings from various researches on and the characteristics of the field-independent-dependent cognitive style to a wide range of educational activities and interrelationships.

--------, C. Moore, D. Goodenough and P. Cox, "Field-Dependent and Field-Independent Styles and Their Educational Implications", Research Bulletin, 75-24, Princeton, Educational Testing Service, 1975, 115 p.

Witkin summarizes the findings from researches on field-dependent and field-independent cognitive style and draws out their educational implications.

--------, H.B. Lewis, M. Hertzman, K. Machover, P.B. Meissner and S. Wapner, Personality Through Perception, New York, Harper, 1954, vii - 571 p.

The book provides a systematic and experimental evidence that motivational factors are important in perception and therefore that perception is directly connected with a wide range of an individual's psychological functioning.

--------, R.B. Dyk, H.F. Faterson, D.R. Goodenough and S.A. Karp, Psychological Differentiation, New York, Wiley, 1962, v - 418 p.

This book maintains the theme of psychological individuality which runs through the 1954 text. But in addition, the present text deals with problems of cognition in a developmental context. It also presents formally the theory of psychological differentiation which forms a link between cognitive and personality aspects of development.

Zigler, E., "A Measure in Search of a Theory?", Contemporary Psychology, Vol. 8, No. 4, 1963, p. 133 - 135.

In this review of Witkin's book - Psychological Differentiation (1962) - the author questions both the validity and reliability of the instruments, the findings and the conclusions of Witkin's work.

APPENDIX 1

CLOSURE FLEXIBILITY (Concealed Figures) TEST (Form 'A')

Directions and the Test

CLOSURE FLEXIBILITY

(Concealed Figures)

(Form A)

Please fill in:

Name _____

Age _____ Sex _____ Date _____

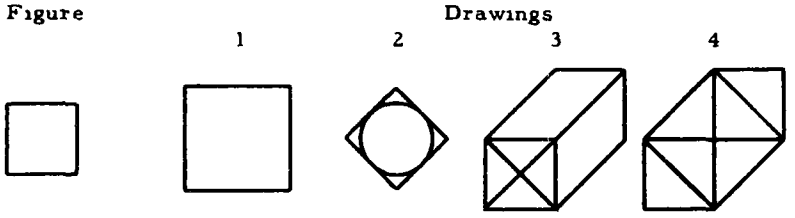
Occupation _____

_____

Developed by: L.L. Thurstone, Ph.D. and T.E. Jeffrey, Ph.D. - The Psychometric Laboratory - The University of North Carolina

Directions:

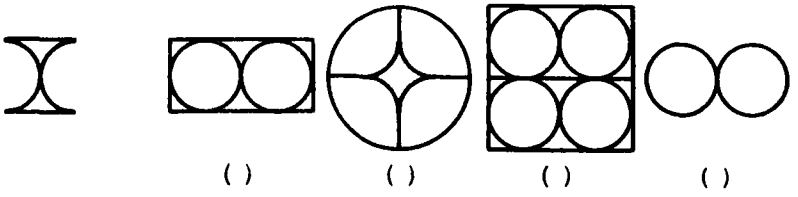
The row of designs below is a sample item of this test. The parts have been labeled to make description easier. These labels do not appear in the test items. The left hand design in each row is the figure. You are to decide whether or not the figure is concealed in each of the four drawings to the right. Put a check mark (✓) in the parentheses under a drawing, if it contains the figure. Put a zero (0) in the parentheses under a drawing, if it does not contain the figure. Look at the row of designs below.



In the row above a zero (0) has been written in the parentheses under drawing 1 The first drawing is a square but it is larger than the figure A zero (0) has been written under drawing 2. Although the second drawing contains a square of exactly the same size as the figure, it has been turned. Check marks (✓) have been written under the third and fourth drawings since they each contain a square of exactly the same size as the figure and have not been turned. It does not matter that the figure contained in drawings three and four is on a different level from the figure at the left.

Sample:

Here is another example for practice. Try it.

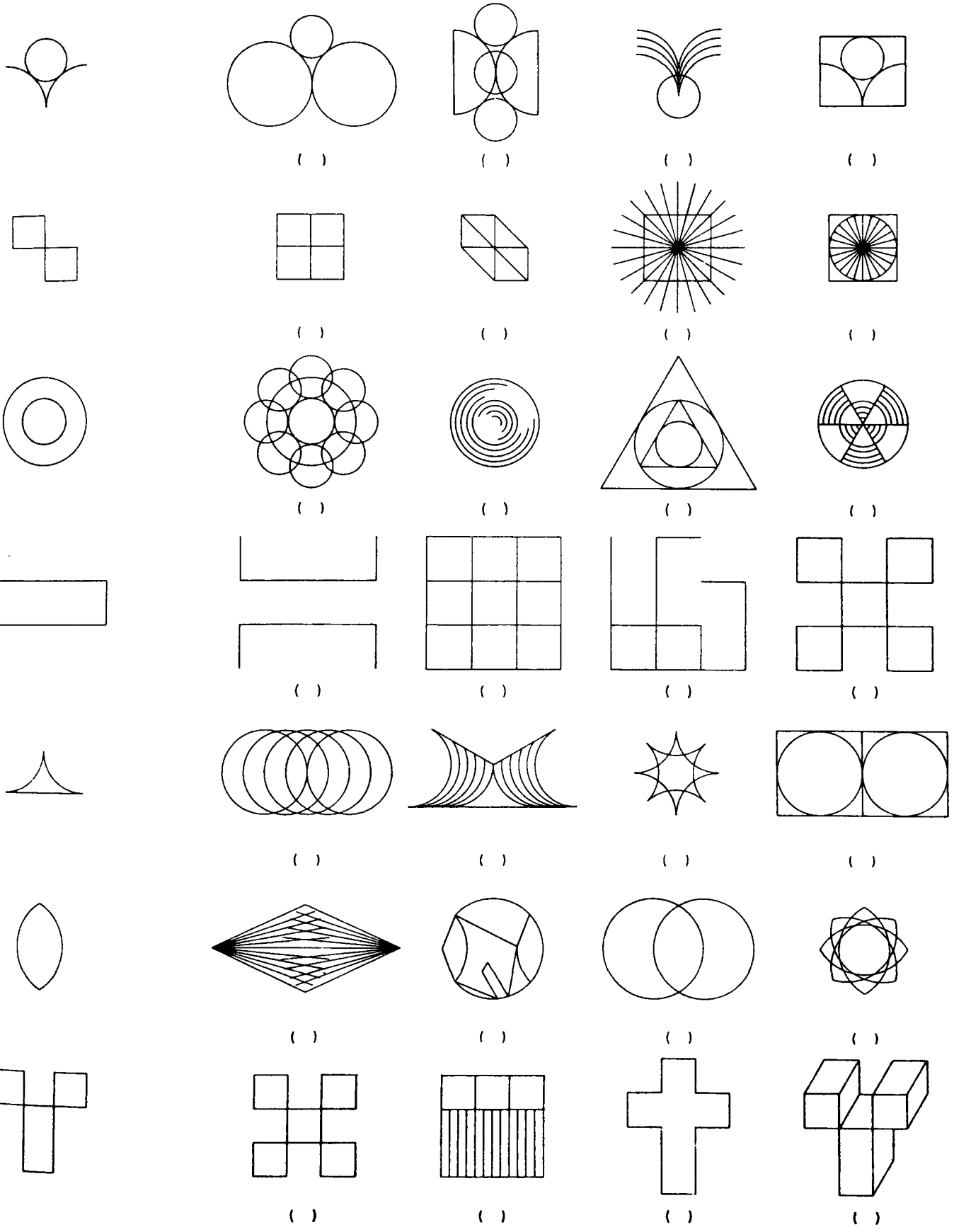


You should have placed check marks (✓) in the parentheses under the first and third drawings and zeros (0) in the parentheses under the second and fourth drawings.

WHEN YOU GET THE SIGNAL TO BEGIN, turn the page and mark more problems of the same kind Work as fast and as accurately as you can, but do not guess. Wrong answers will count against you You are not expected to finish in the time allowed You will have exactly ten minutes to do as much as you can.

TMNF-119
8-3-5000

Published by Industrial Relations Center The University of Chicago
1225 East 60th Street Chicago, Illinois 60637



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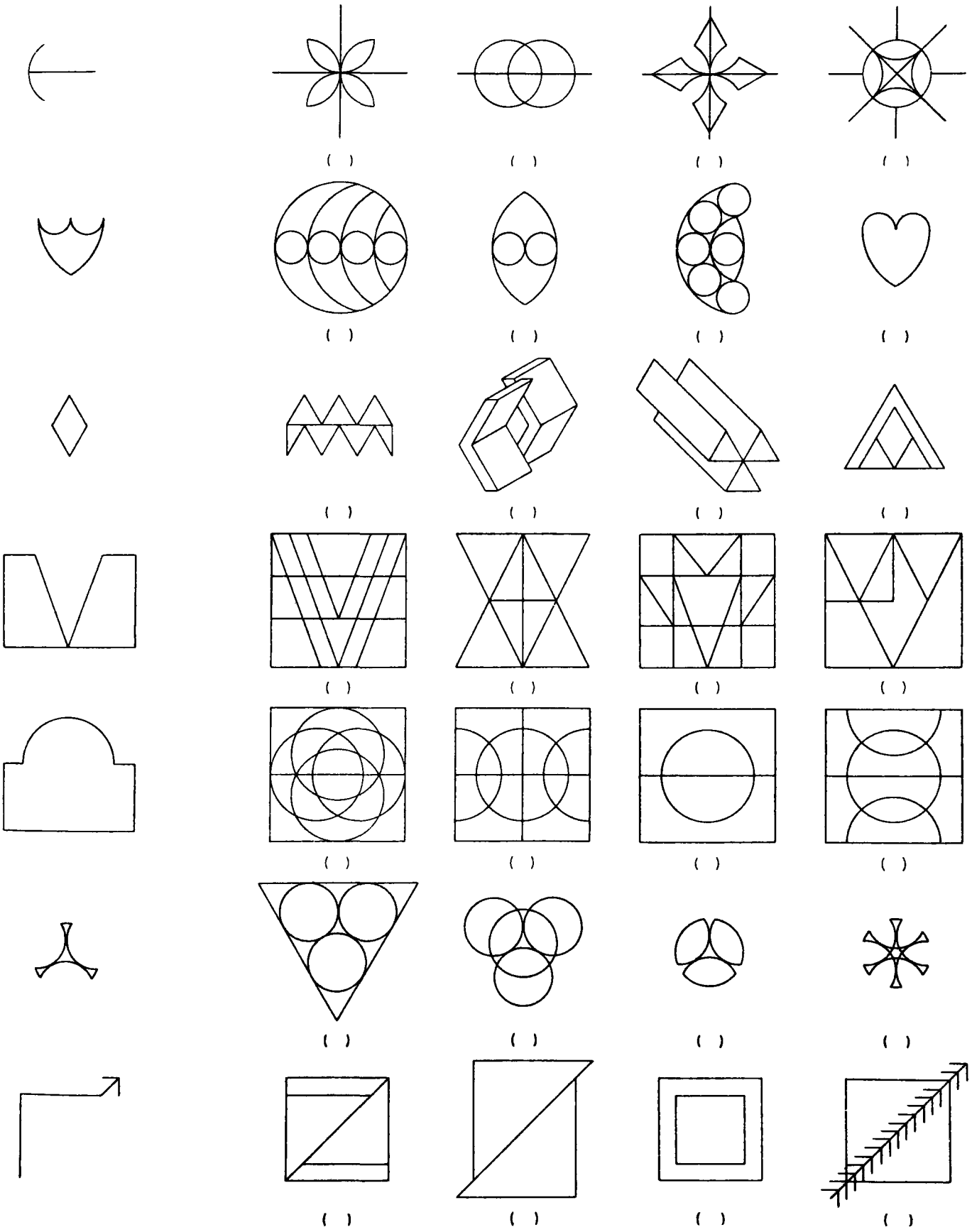

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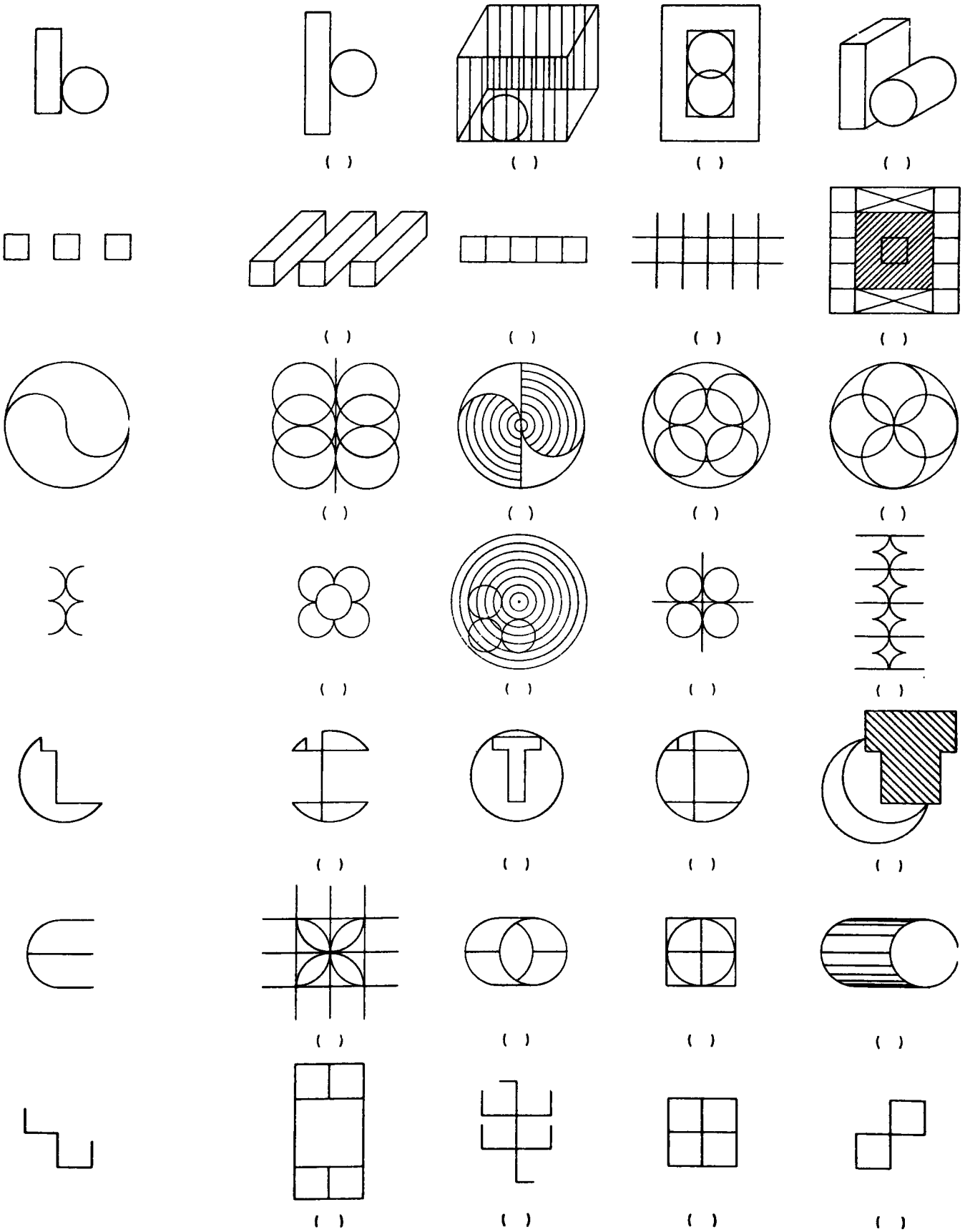

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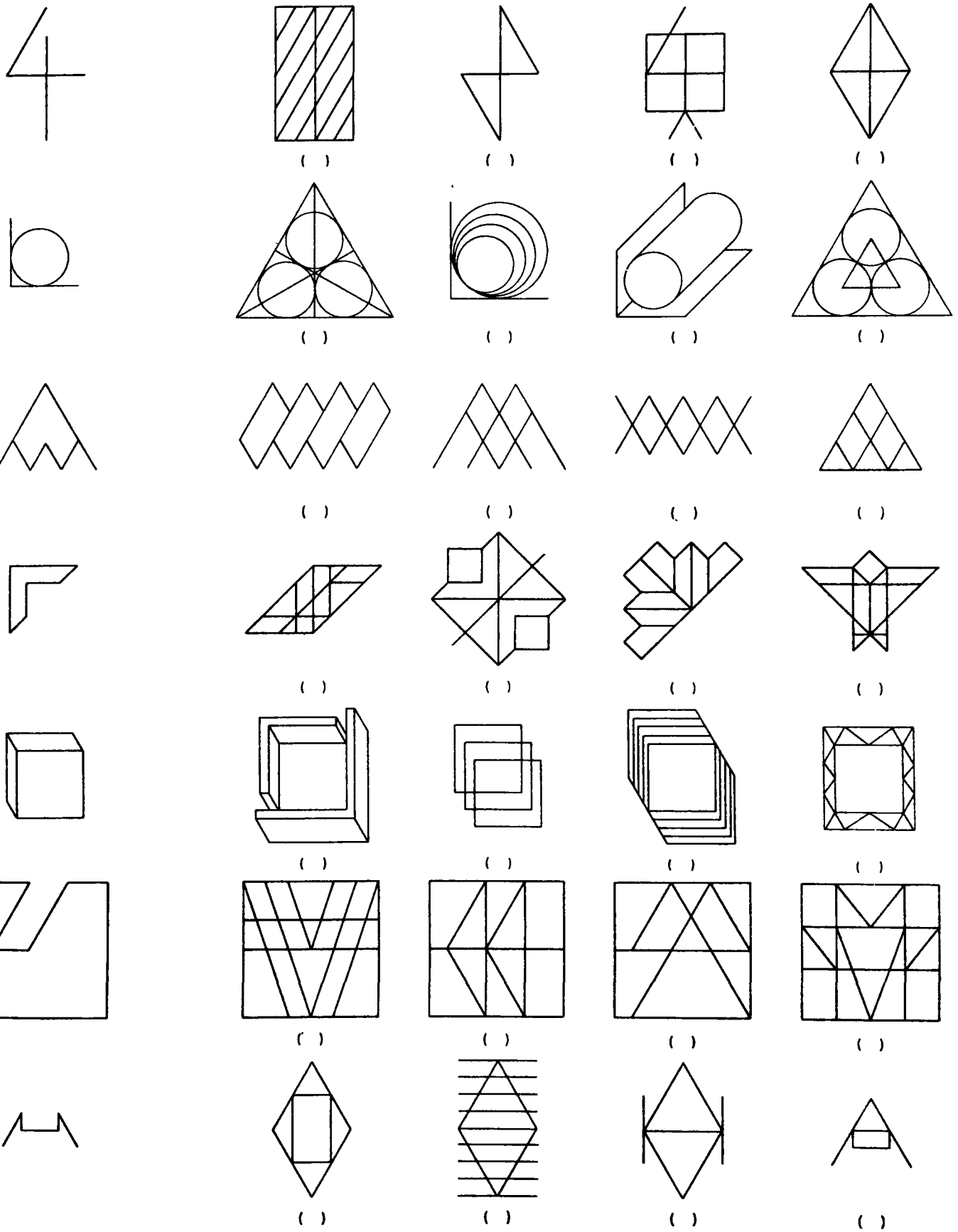

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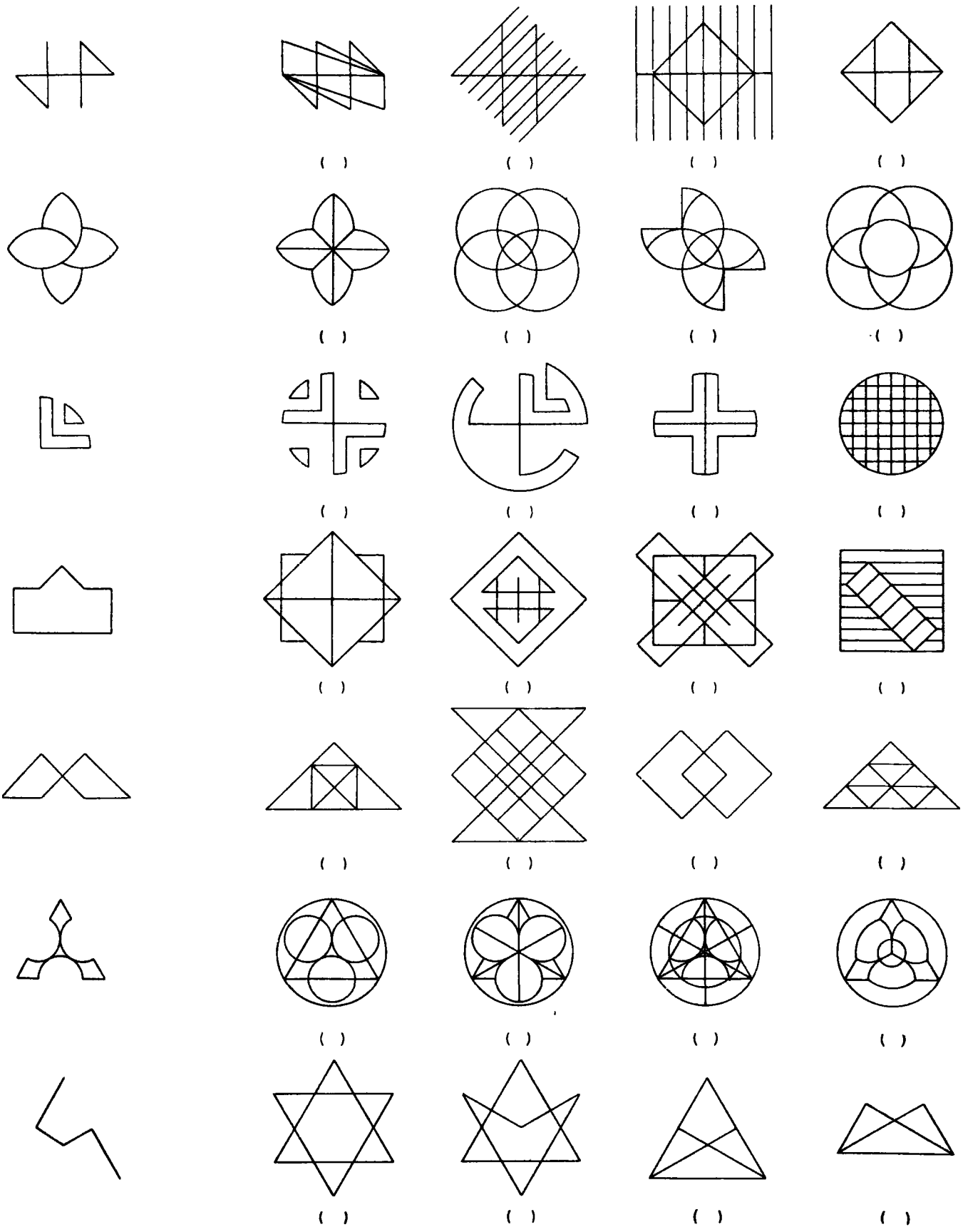

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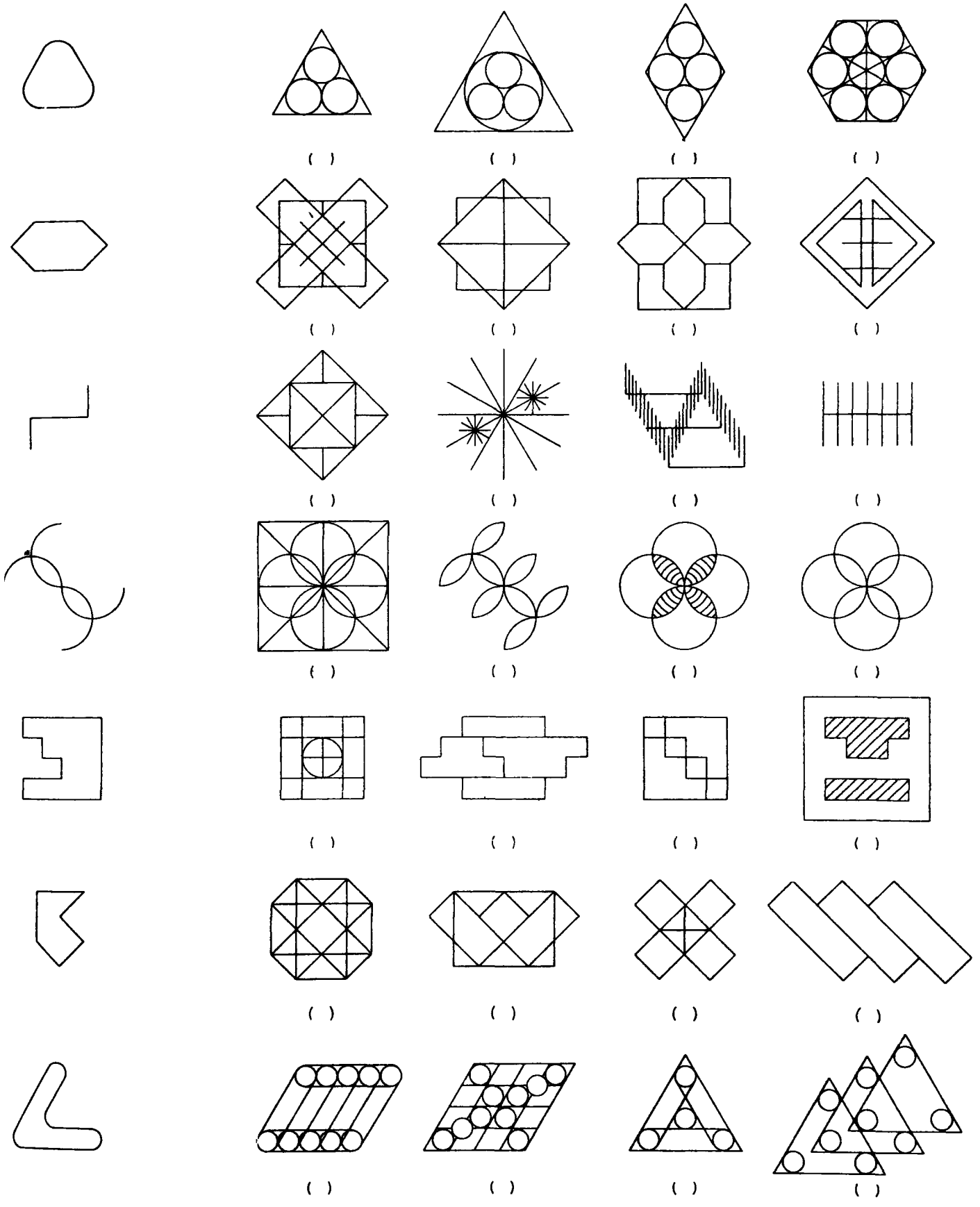

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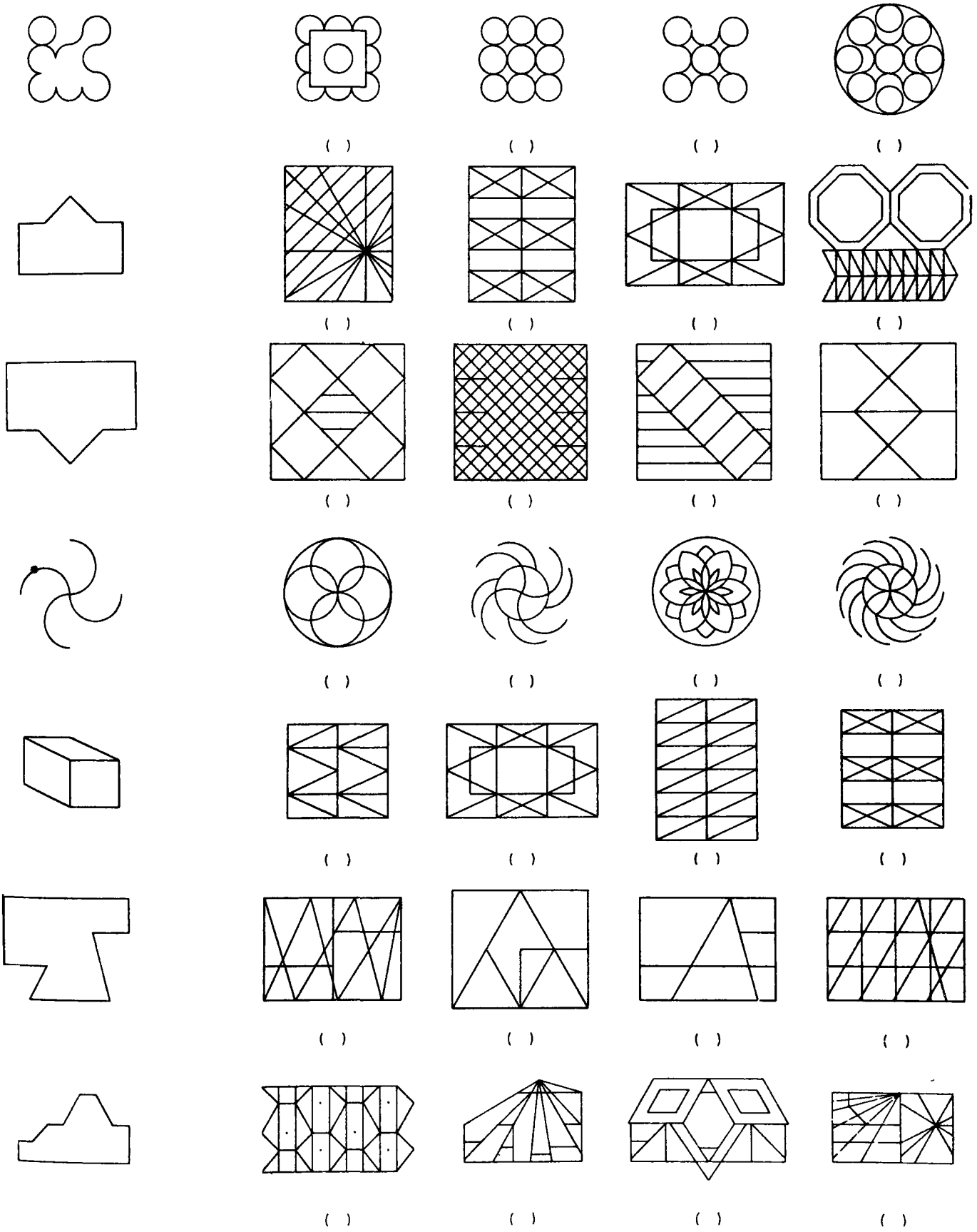


STOP HERE -- WAIT FOR FURTHER INSTRUCTIONS.

APPENDIX 2

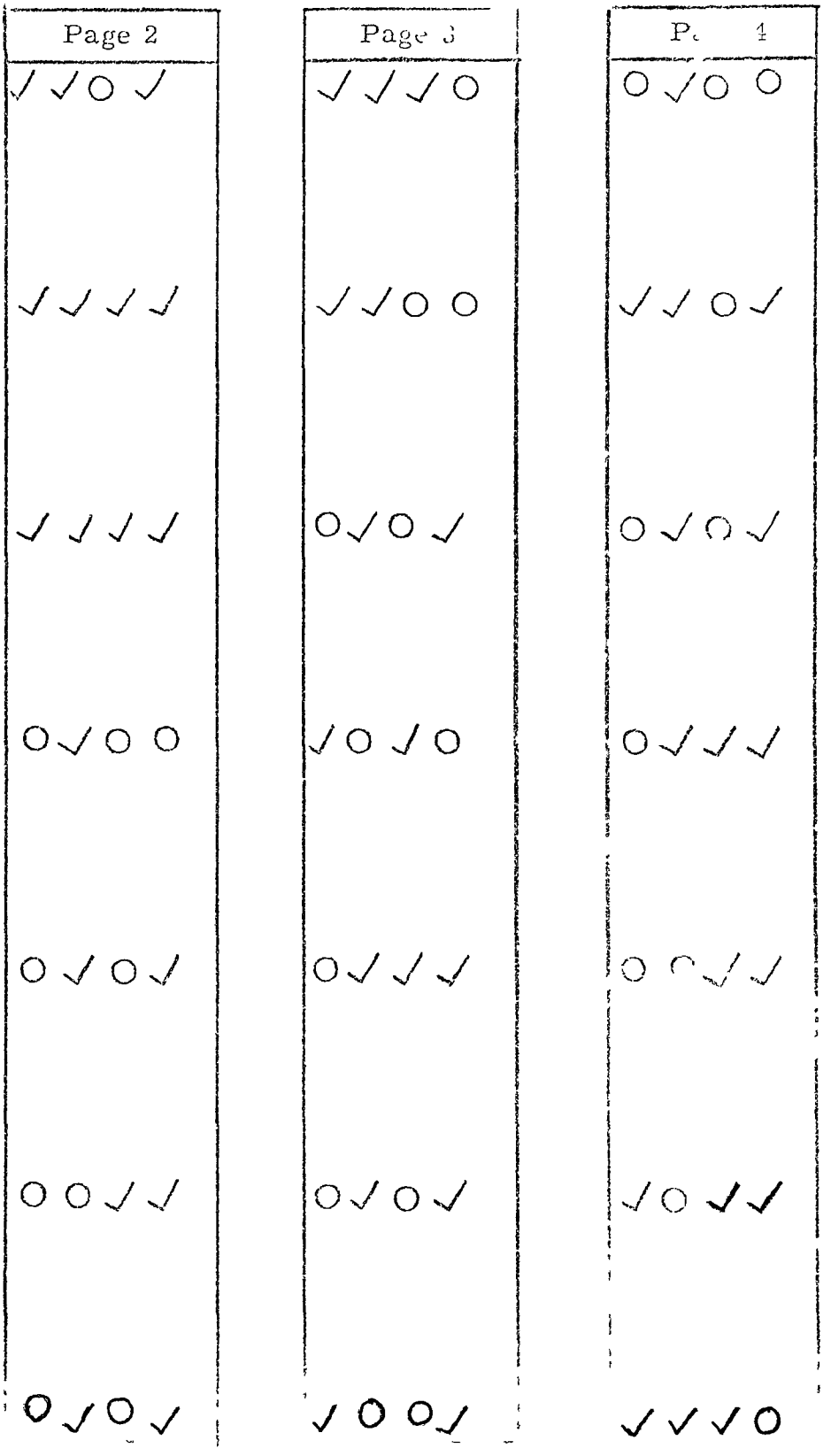
SCORING KEY FOR THE CLOSURE FLEXIBILITY TEST (Form 'A')

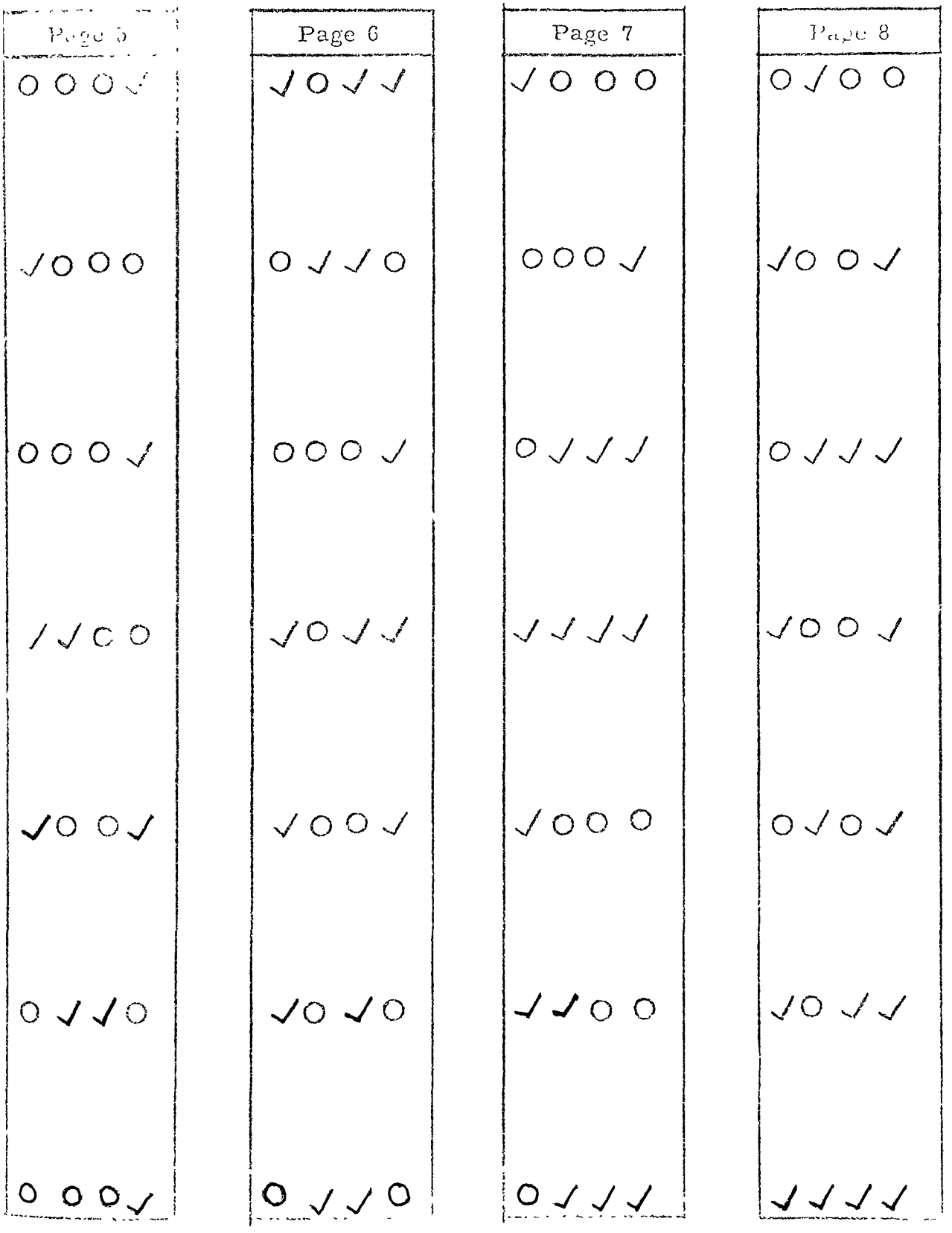
CLOSURE FLEXIBILITY
(Concealed Figures)
(TMNF 119)

Raw Score: Number right minus the number wrong (R - W).

(Do not include in the scoring procedure those items which have not been answered.)

See Manual (TMNF 319-R3) for Normalized Standard Score equivalents and Percentile equivalents of Raw Scores.




Page 5
Page 6
Page 7
Page 8

APPENDIX 3

INSTRUCTIONS AND THE PASSAGE FOR THE WRITTEN ASSIGNMENT

NAME: _____

SEX: _____

AGE: _____

GROUP/ TEAM _____

PRESENT QUALIFICATION (Underline the appropriate one):

(i) Bachelor's degree _____

(ii) Higher degree(s) (specify) _____

MAJOR SUBJECT AREA(S) IN YOUR PREVIOUS DEGREE(S):

example: history, psychology, etc. _____

INSTRUCTIONS

Carefully read the passage below.

ASSUMPTIONS

1. Assume that a lesson has been taught, on the topic of the passage, to a grade eight class.

2. Assume that the material in the passage comprises all that was said during the lesson.

3. Assume that the pupils have no prior knowledge of the content.

ASSIGNMENT

Write ten questions you could use to test the pupils' learning from the passage. Write such questions that can be objectively scored and/or require not more than two-sentence answers.

Please return the passage with your questions.

Denmark is one of the Scandinavian countries (the others are Norway and Sweden). It is a small country made up of Jutland and a group of islands, the larger ones being Sjaelland, Fyn, Lolland, Bornholm and Langeland.

Denmark was affected by the glacier during the ice age. The western portions of Jutland were covered by sterile out-wash sands from the ice-sheet. On the other hand, the eastern parts of Jutland and the rest of the country were covered by deep loamy soils rich in lime (this came from rolling, moranic deposits of the last glaciation). The lime comes from the chalk beds which underlie much of the country.

The country is generally low, with no part rising higher than 200 metres.

The climate is mild and moist and the country has a short growing season.

There are two main vegetation regions: the western part of Jutland which is covered by extensive, open scruslands , and the rest of the country which is covered by heavy forests of beech and oak. Much of the forest of the east has been cleared over the years while much of the west of Jutland has been planted with conifers.

The main type of agriculture used to be mixed farming, by means of which the Danish peasant produced as great a variety of crops and livestock products as he could to ensure self-sufficiency. This meant the cultivation of wheat and rye for bread grains, oats and hay for livestock, and barley for making beer. But things have changed.

Today when one thinks of Danish agriculture one usually thinks of Danish bacon, Danish butter, and Danish eggs. Denmark has specialized in dairy farming. Though her soil is excellent for growing wheat, and Denmark leads the world in the yield per hectare, she could not hope to export sufficient wheat to enable her to buy all the things she needs. Denmark also realised that the prairies of North America and the Steppes of the Ukraine could produce grain more cheaply than the Danish farmers could market it themselves. She could not face the competition; thus she turned to dairy farming.

The Danes have so developed dairy farming that it has become a highly specialized industry. The main products are butter, bacon, cheese, eggs and meat.

In Denmark, cows are not allowed to roam at will, but are tied to stakes and compelled to eat the grass within the circle of their rope before they are moved on to the next stake. Of course this means extra trouble for the farmer, but the Danes maintain that this is a better method.

Despite the commitment to dairy farming, Denmark has only a few fields of permanent grass. In fact 85 per cent of the cultivated land in Denmark is ploughed. She grows special grasses as part of the system of rotation of crops which are either eaten by the cows as described above or made into hay for winter use. A large proportion of the land is devoted to the production of root crops and cereals for animal food.

Danish farms are small in size. A tiny farm of two hectares may be divided into seven or eight strips, each growing a different crop. The Danish farmer practices a seven - or eight - year rotation system. Some of the rotation crops are rye, barley, mangolds, clover, wheat, oats, peas, beans, and potatoes. About half of the farms are less than sixteen hectares, and one-fifth of them are less than three hectares , and only a few exceed sixty hectares. As even a small holding of two hectares is made to keep a family in comfort, the land has to be very carefully cultivated so as to make it produce as much as possible. When, as in Denmark, a great deal of labour is expended on small plots of ground in order to make them yield the maximum produce, the cultivation is said to be intensive.

On large farms, milking is done by machines. The cows are milked three times a day. Individual farmers do not have churns or cream separators, for the Danish farmer's wife does not make her own butter. Instead, trucks collect the milk from all the farms in a given district, and take it to a central creamery or butter factory. Here the cream is taken out to be made into butter, and the farmer receives back his skimmed milk to feed his calves and pigs.

Most of the creameries are run by the farmers themselves on co-operative lines. Co-operative movement is, indeed, a great feature of Danish life. In addition to the socities which run the creameries there are societies for collecting and marketing eggs, for curing bacon, and for buying seeds, fertilizers, and other things the farmers require.

Helping to effect this radical economic and social transformation have been the so-called "peoples' high schools", which gave instruction in scientific farming practices and management. These schools are run for adults. Attendance at them is quite voluntary, but every year several thousand young men and women attend the courses, which last for four or five months.

Not only have the changes of the last century given Danish agriculture a new orientation, but, in a sense, they have also given the country a new geographic orientation. To expedite its export trade with Britain - a principal buyer of Danish food stuffs - Denmark built a new seaport on the west coast of Jutland. The name of the port is Esberg. It is now the fourth largest city and also the leading fishing port in Denmark.

Denmark does not have many minerals. She has no coal, oil or hydro-electric potential. But the little mineral that she has, has given rise to several specialized industries. The chalk and clay deposits that occur in close proximity in the north eastern areas of Jutland have encouraged the development of many large cement plants in the Aalborg region. The Danes manufacture and export heavy machinery for cement industries. They also "export" their engineering skills for building dams, bridges and highways.

There are Kaolin deposits in the crystalline rocks of Northern Bornholm. This is used in making porcelain.

The industries that have developed within Denmark are totally dependent on imported energy. Most of the industries are sited in the port cities. Food processing, textiles, and other light consumer industries predominate; but metal working, engineering, and shipbuilding are also found in some of the larger cities.

Copenhagen is the nation's capital. It is the largest and the most important city. It has a strategic location on the water route between the North and the Baltic Seas.

Adapted from:

Vincent H. Malmstrom, Geography of Europe: A Regional Analysis, Foundations of World Regional Geography Service, Englewood Cliffs, Prentice-Hall, Inc., 1971, p. 135 - 138.

and

Thomas Pickles, Europe, London, Dent, 1948, p. 48 - 51.

APPENDIX 4

RATER'S MANUAL

(Based on Bloom's Taxonomy)

RATER'S MANUAL

BASED ON BLOOM'S *TAXONOMY OF EDUCATIONAL OBJECTIVES - COGNITIVE DOMAIN*

DEFINITION OF EACH CATEGORY; KEY CONCEPTS

AND RELATED EXAMPLES

Category	*Definition and Operations Performed*	*Key Concepts*	*Examples*
Knowledge 1 K	Recall of or recognition of information. If the student remembers the information presented to him he will know it applies to the question. It involves (a) recall of specifics (b) recall of universals or generalizations (c) recall of methods and processes (d) recall of pattern, structure or setting	Knowledge memory description remembering recall recognition acquisition repitition definitions listing naming recounting citing quoting	Who is the prime minister of Canada? Define 'OSMOSIS'. List the names of the hospitals in Ottawa. When was the first Sputnik launched in the U.S.S.R.?

Category	*Definition and Operations Performed*	*Key Concepts*	*Examples*
Comprehension 2 C	Understanding what is being communicated in a way to be able to use the material or idea being communicated without necessarily relating it to other materials or seeing its fullest implications. It involves a) a) translation: putting a communication into another language, into other terms, or into another form of communication, e.g. from verbal to graphical, pictorial, etc. and vice versa. It involves changing the communication in hissmind or his overt responses to some parallel from more meaningful to him. b) Interpretation: explaining or summarizing the communication. It may involve re-ordering and rearrangment of ideas into a new configuration in the mind of the individual. c) Extrapolation: The extension of trends or tendencies beyond the given data to determine implications, consequences, corrolaries, effects, etc. which are in accordance with the conditions described in the original communication.	translate paraphrase predict interpolate estimate differentiate interpret explain summarize	What, in you own words, does "socialism" mean? What does the cartoon illustrate? Paraphrase Milton's poe on 'Lycidas'. From the graph provided is it true or false to say that more money was spent on Education in 1940 than in 1920?

Category	*Definition and Operations Performed*	*Key Concepts*	*Examples*
Application 3 P	Independent application/use of the appropriate abstraction to a new situation, without having to be prompted as to which abstraction is correct or without having to be shown how to use it in that situation. The abstractions include: - technical principles - ideas - theories	apply select and use identify and use transferring generalizing	Can you think of another reason why people in tropics wear white? The temperature at the top of a mountain, 1500m high, is 20° C. what is the sea level temperature at the foot of the mountain? Explain the fact that Canadians use wood instead of cement to make the walls of thei houses.

Category	*Definition and Operations Performed*	*Key Concepts*	*Examples*
Analysis 4 A	The breakdown of the material into its consistent parts and detectionoof the relationships of the parts and of the way they are organized. Entails the solution of a problem in the light of conscious knowledge of the parts and processes of reasoning. An analysis question must be preceeded by instruction in the form of reasoning required by the question. The student distinguishes, classifies, and relates the assumptions, hypothesis, evidence; conclusions and structure of a statement of a question with an awareness of the thought process he is using. One applies a set of one or more criteria to a group of examples in order to callsify some or all into one or more categories. Cue word is 'Why'.	detecting classifying distinguishing discriminating categorizing deduction contrasting induction formal reasoning logic inferring	Why does British Columbia have warmer winters than the Atlantic provinces? What are the underlying assumptions in this passage? What is the mood of the poet in this poem? Distinguish between facts and opinions in the passage.

Category	*Definition and Operations Performed*	*Key Concepts*	*Examples*
Synthesis 5 S	The putting together of elements and parts so as to form a whole. This involves the processes of working with pieces, parts, elements, etc., and arranging and combining them in such a way as to constitute a pattern or structure not clearly there before. - Engaging in imaginative, creative, and original thinking. Diverse solutions (divergent thinking) are elicited. Students are allowed great freedom in seeking solutions. Questions at this level have many possible approaches and solutions. But the solution requires a new and unique product, plan, proposal, or communication. Instruction for questions at this level are not very specific. Synthesis differs from application in that application entails a horizontal transfer and it starts with a given set of materials or elements which constitute the whole in itself. On the other hand, synthesis entails drawing from many sources and putting these together to form an integrated whole not-there before.	producing originating modifying documenting proposing planning specifying formulating creating divergence productive thinking imaginative novelty	Write as many possible uses of a coat hanger as you can think of. You have been asked by the government to suggest ways of solving the problem of unemployment Write your suggestions which you believe are the answer to unemployment. Can you tell the class, in detail, what you would do if you won one million dollars today. Give the pros and cons of mechanized agriculture.

Category	*Definition and Operations Performed*	*Key Concepts*	*Examples*
eEvaluation 6 E	Making of judgments about the value, for some purpose, of ideas, works, solutions, methods, materials, etc. It involves using criteria or standards for appraising the extent to which particulars are accurate, effective, economical, or satisfying. The judgments may be qualitative or quantitative. The criteria may be either those determined by the student or those which are given to him.	judgment appraisal evaluation selection validation	Which political system is best for Canada and why? Are wars necessary? Why? Would you favour strict laws requiring all farmers to practice soil conservation? Give reasons for your answer. Education and health whic in your opinion, should getta greater share of the government budget? Justify your answer.

APPENDIX 5

DIRECTIONS TO RATERS

1. Complete the rating sheet as follows:

   (a) Write your name against "Rater's Name".

   (b) Write the student-teacher's code numbers in the column provided.

2. Each transcript contains the questions written by each student-teacher which he/she could use to test the pupils' learning from a lesson on the topic of the attached passage.

3. Assume, as the subjects did, that the passage comprises all that was said in that lesson.

4. Assume, also, that the pupils had no prior knowledge of the material.

5. Examine each question written by each student-teacher and decide which of Bloom's categories it belongs to. The categories are shown below:

1. Knowledge (K)	4. Analysis (A)
2. Comprehension (C)	5. Synthesis (S)
3. Application (P)	6. Evaluation (E)

   The categories are designated by letters as indicated above. 'P', for example, stands for the Application level.

6. For each question, enter the letter representing the category under the number of the question on the rating sheet and in the same row as the student-teacher's code-number. If Question 8, for example, is classified as being at the "analysis" level, enter "A" in column 8 in that student-teacher's row.

7. One question may not be placed in two categories at the same time; choose only one. If you feel strongly that a question belongs to two levels, put it in the higher of the two levels.

8. Concentrate on what the student-teacher actually wrote in each question and not on what you think he "really meant".

9. Leave the columns to the right-hand side of the double line blank.

APPENDIX 6

RATING SHEET

RATING SHEET: BLOOM'S CLASSIFICATION

RATER'S NAME: ____________________________________

STUDENT-TEACHERS'					QUESTIONS						LOWER	HIGHER	PROPORTION
CODE NOS.	1	2	3	4	5	6	7	8	9	10	ORDER	ORDER	OF H. ORDER

APPENDIX 7

SUBJECTS' SEX, SCORES ON CFT AND NUMBERS OF HIGHER- AND LOWER-ORDER QUESTIONS

FIELD-INDEPENDENT SUBJECTS

Sex	Age	CFT	Questioning Behaviour		Proportion of Higher-Order
			Lower-Order	Higher-Order	
F		142	8	2	0.2
F	21	136	10	0	0.0
M	25	132	8	2	0.2
F	28	126	10	0	0.0
F	22	124	10	0	0.0
F	22	124	8	2	0.2
M	25	123	10	0	0.0
M		116	5	5	0.5
F		115	9	1	0.1
F	41	115	5	5	0.5
M	26	114	9	1	0.1
F	24	110	3	7	0.7
F	21	110	9	1	0.1
F	22	108	8	2	0.2
F	23	107	10	0	0.0
F	25	107	6	4	0.4
F	22	104	10	0	0.0
*M	24	100			
F	21	100	8	2	0.2
F	21	99	8	2	0.2
F	30	98	10	0	0.0
M	21	98	9	1	0.1
M	28	98	9	1	0.1
F	30	98	8	2	0.2
F	24	96	10	0	0.0
M	23	95	9	1	0.1
F	23	93	10	0	0.0

*Eliminated for writing only five questions

APPENDIX 7

MIDDLE GROUP BETWEEN ON THE FIELD-DEPENDENT - INDEPENDENT CONTINUUM

Sex	Age	CFT
F	23	92
F	25	91
F	25	89
F	20	88
F	22	88
F	23	88
M	28	87
F	24	86
F	28	86
F		85
F	22	84
F	24	84
F	25	83
F	22	82
F	20	82
F		81
F	22	78
F	23	78
F	24	78
F	26	77
F	27	76
F	22	76
F	22	76
M	24	75
F	24	72

FIELD-DEPENDENT SUBJECTS

Sex	Age	CFT	Questioning Behaviour		Proportion of Higher-Order
			Lower-Order	Higher-Order	
M		72	10	0	0.0
F	28	72	9	1	0.1
F	29	70	10	0	0.0
M	20	70	10	0	0.0
M	27	69	10	0	0.0
M	25	68	9	1	0.1
M	22	67	9	1	0.1
M	23	65	7	3	0.3
M	29	65	9	1	0.1
F	23	64	9	0	0.0
F	22	64	8	2	0.2
M	38	64	7	3	0.3
F	25	62	10	0	0.0
F	22	62	10	0	0.0
F	23	58	10	0	0.0
F	24	57	10	0	0.0
F	25	56	9	1	0.1
F	23	55	10	0	0.0
F	24	54	9	1	0.1
F	23	48	9	1	0.1
F	25	48	10	0	0.0
M	27	48	9	1	0.1
M	24	47	10	0	0.0
F	22	34	10	0	0.0
*F	25	33			
F	23	32	10	0	0.0
F		30	10	0	0.0

*Eliminated for writing only seven questions