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ABSTRACT

The Goldstein-Scheerer Tests of Abstract and Concrete Thinking are reviewed. This evaluative summary supplements several reviews in the Mental Measurements Yearbook series. The Goldstein-Scheerer tests are used by clinicians and researchers to distinguish normal individuals (those able to engage in two qualitatively different levels of cognitive behavior--concrete and abstract) from abnormal individuals (organically impaired as well as psychiatric sub-groups, capable of concrete behavior only). The concrete and abstract attitudes are not acquired or learned but are capacity levels of the entire personality. The eight characteristics of the abstract attitude are listed, as well as descriptions of the five sub-tests making up the individual performance test battery: (1) Goldstein-Scheerer Cube Test; (2) Gelb-Goldstein Color Sorting Test; (3) Gelb-Goldstein-Weigl-Scheerer Object Sorting Test; (4) Weigl-Goldstein-Scheerer Color Form Sorting Test; and (5) Goldstein-Scheerer Stick Test. Intended practical applications, intended clientele, and the fact that the test manual includes no standard scoring system are briefly discussed. A number of validity studies, published from 1945 to the present, are reviewed. Cost of the test is also mentioned. (MAC)

The Goldstein-Scheerer Tests of Abstract and Concrete Thinking
Test Review

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July, 1987

INTRODUCTION

This paper is an extended review of the Goldstein-Scheerer Tests of Abstract and Concrete Thinking (The Psychological Corporation, 1945). Since the Goldstein-Scheerer tests currently are used by clinicians and researchers, this review should provide some insight into the empirical evidence bearing on the psychometric and statistical properties of the battery. As such, this evaluative summary supplements several reviews in the Mental Measurements Yearbook series.

I would like to thank Professor Robert L.Thorndike for providing guidance in searching out some of the older literature and for clarifying my thinking on the psychometric and statistical issues discussed here.

F. O'Brien

I. General Introduction

The present form of the Goldstein-Scheerer Tests of Abstract and Concrete Thinking (Psychological Corporation, 1945) evolved from the work of Gelb and Goldstein (1920) in the latter's experience with brain damaged patients during and after World War I. Gelb and Goldstein believed that one of the main effects of brain damage was a loss of the ability to think abstractly ("concreteness"). Their experience led them to hypothesize the existence of two qualitatively different levels of cognitive behavior--concrete and abstract. The normal individual is capable of engaging in both "attitudes", whereas the abnormal individual (organically impaired orginally, but later to include psychiatric sub-groups) is capable of concrete behavior only. The concrete and abstract attitudes are not acquired or learned behaviors, but are "capacity levels of the total personality" (Goldstein and Scheerer, 1941, p.1). The "abstract attitude" is defined in terms of eight characteristics:

1. "To detach our ego from the outerworld or from inner experiences."
2. "To assume a mental set."
3. "To account for acts to oneself: to verbalize the account."
4. "To shift reflectively from one aspect of a situation to another."
5. "To hold in mind simultaneously various aspects."
6. "To grasp the essential of a given whole: to break up a given whole into parts, to isolate and synthesize them."
7. "To abstract common properties reflectively: to form hierachic concepts "
8. "To plan ahead ideationally: to assume an attitude towards the 'mere possible' and to think or perform symbolically."

Theoretically, normal individuals possess each of these characteristics; operationally,

they exhibit the capacity to perform abstractly on each of the sub-tests of the Goldstein-Scheerer battery. Impaired individuals perform concretely on the sub-tests because of the inability to do 1 to 8 above.

II. Description of the Sub-Tests

The Goldstein-Scheerer Tests of Abstract and Concrete Thinking is an individual performance test battery consisting of five sub-tests which require the examinee to sort, classify or make designs with various objects, and for some of the sub-tests, to render a verbal justification for a given performative response. The five sub-tests and a task description of each are as follows:

a. Goldstein-Scheerer Cube Test. This sub-test basically is a modification of the Kohs Block Design Test. The modification consists of a standard set of aids given to subjects unable to complete an original design (e.g., copying from a life-size picture of the design, from a picture divided up into four squares representing each block, from a model of the design, etc.)

b. Gelb-Goldstein Color Sorting Test. The second sub-test in the battery consists of a large number of small woolen skeins of varying hue, brightness and saturation. The examinee is required to sort the skeins into groups according to hue and brightness. In the first part of the tasks, the subject picks a skein and sorts others that belong with the selected skein, and explains the basis of the sort in terms of color principles; in the second part, the subject must sort skeins that belong with an original skein selected by the examiner, and explain the basis of the completed sort.

c. Gelb-Goldstein-Weigl-Sheerer Object Sorting Test. This sub-test consists of over thirty everday objects. The subject is required to sort objects into conceptual groups (e.g., color, form, material, use, etc.) and explain the basis of the sort. As in the Color Sorting Test, the examinee initially selects an object of his choosing, sorts all objects which are believed to belong and renders an explanation for the basis of the sort.; secondly, the examinee is required to label the class of objects selected by the examiner.

d. Weigl-Goldstein-Scheerer Color Form Sorting Test. This fourth sub-test consists of four small plastic squares, four equilateral triangles and four circles, each figure within a geometrical group reproduced in one of four colors. The examinee is asked to sort all twelve figures into groups and explain the principle of the sort, and then to resort all the figures in a different way, and again, to explain the principle of the sort.

e. Goldstein-Scheerer Stick Test. The last sub-test in the battery consists of small plastic rectangular solids of several sizes which differ in length. The examinee is required to reproduce patterns with the sticks from pictures and from a memory of the pictorial designs presented one at a time.

No standard scoring system is suggested in the Goldstein-Scheerer manual (1941) for any of the five sub-tests. The examiner must decide whether the examinee exhibits the "concrete" or the "abstract" attitude on each sub-test derived from examples of kinds of responses that suggest an abstract or concrete attitude. The overall decision of assigning an individual's sub-test responses to the abstract or concrete category is likewise not explicitly stated in the manual. Owning to the original purpose and use of the instrument, the examiner is left to assess the patient's performance subjectively; the individual user of the test must rely on accumulated clinical experience for scoring individual response behavior. Zangwill, reviewing the test in the 3rd MMY (1949) made this point about the Goldstein-Scheerer battery by comparing it to the Rorschach:

> "It is essential in both cases to gain the necessary clinical experience in administering the tests before the results can be evaluated with any confidence."

In general, although a relatively standard method of administration is described in the manual, Goldstein and Scheerer do not present objective standardization data of any sort, nor are validity indices or reliability measures presented in the manual.

III. Intended Practical Applications

The authors intended the instrument to be used as a clinical adjunct in the diagnosis of brain damage. However, the instrument is used in the diagnosis and classification of the non-organically impaired such as schizophrenia.

IV. Intended Clientele

The test battery was intended originally for use with brain damaged adults, but the instrument has been used widely with other adult non-organically impaired individuals, There has been use made of some of the sub-tests for research purposes with children, but no evidence has been found indicating that the test has been used diagnostically with children.

V. Validity Studies

Introduction

Establishing the validity of the Goldstein-Scheerer battery is problematical for several reasons. The five sub-tests of the Goldstein-Scheerer battery represent a unique instrument in diagnostic psychological testing in providing no quantitative data in the manual on the subjects used, in providing no percentage of incorrect diagnoses, ignoring possible confounding variables such as age and IQ, and in assuming naively that the performance of normal individuals of average intelligence will be without error on the sub-tests. Although it is possible that the sub-tests do have high validity in the hands of a skilled clinician , it appears that the validity of the sub-tests is rather private to the individual user. Yates (1954) has said of the validity of the Goldstein-Scheerer battery:

> "The basic criticism to be made of these tests is not that they are invalid, but that there is no basis for a discussion of their validity" (p. 360)

The validity studies that have been conducted over the years on the Goldstein-Scheerer are difficult to subsume neatly; several reasons contribute to this. First, some investigators who have been dissatisfied with the lack of a standardized scoring system for any of the sub-tests and with the ambiguities present in the procedures for administering parts of the sub-tests, have modified both

administration and scoring procedures as well as supply local norms for certain sub-groups. Secondly, when validity studies of various kinds have been conducted, they have tended to be concerned with one, two or at most, three sub-tests of the original battery. And even in the endeaver to catalogue the validity of certain sub-tests, the results have been inconclusive and difficult to interpret.

Studies

Some investigaters have noted that the extensive definition given of the "abstract attitude" may be difficult to distinguish from measures of general intellectual functioning. Payne and Howlett (1960) assembled a large battery of tests in an attempt to discover what differences, if any, exist between normals and non-organically impaired individuals. They were specifically interested in the thought patterns of schizophrenics. Previous work had suggested that schizophrenics were abnormally "concrete" in thinking, whereas the present authors hypothesized that concreteness was primarily a function of "overinclusive thinking" (i.e., sorting which includes objects not belonging with the content of the concept, or a sorting whose concept is too inclusive in reference to the objects sorted). The battery of tests included measures of "psychoticism," "general intelligence," (Mill Hill Vocabulary Test, Nufferno Level Test, and the Arithmetic and Picture Completion sub-tests of the W-B Intelligence Scale), "psychomotor retardation," and "overinclusive thinking," and "concreteness" (five measures including the Object Sorting Test and the Color Form Sorting Test of the Goldstein-Scheerer battery). The tests were administered to 20 normals, 20 neurotics, 20 depressives and 20 schizophrenics who were matched for age, educational level, occupational status and pre-illness intellectual level (Mill Hill Vocabulary Test). Scoring procedures were developed for some of the sub-tests including the

Goldstein-Scheerer sub-tests. The scores for the entire group were combined (which is questionable because the sub-groups do not come from the same parent population since one-way ANOVA's showed unequal means to exist between the sub-groups on the majority of measures used which results in spuriously high correlations) and product-moment correlations were computed among all the measures. This intercorrelation matrix was factor analyzed using Thurstone's method for extracting centroid factors. See the attached copy of the three unrotated factor loadings and rotated factor loadings. The rotated factor loadings were obtained according to the criterion of maximum discrimintion between sub-groups in accordance with hypotheses of group differences that were of interest to the investigators. The loadings were computed in the following manner. Discriminant function weights were obtained for the three unrotated centroid factors on various sub-groups of interest (for example, between the depressive sub-group and the schizophrenic sub-group, etc.). Any such set of three weights were premultiplied into the three centroid factor loadings on a given variable to obtain a particular column of rotated factor loadings. The "O" factor ("overinclusiveness"), the "R" factor ("retardation") and the "G" factor ("general intelligence") are orthogonal factors. The "P" factor ("psychoticism") is an oblique factor (correlated with the "O" factor). It is notable that the two Goldstein-Scheerer measures of "concreteness" load equally as well on the "G" factor as the more conventional measures of intellectual level. The reversed loadings of the two Goldstein-Scheerer sub-tests reflect the way they were scored: a low score meant abstract, a high score meant concrete. These high loadings for the Goldstein-Scheerer sub-tests tend to indicate that those measures are just as good measures of intellectual level as more conventional measures of intellectual status. The small number of subjects used in this study in relation to the number of variables studied is noteworthy. It is usually

TABLE 1.103

Factor Saturations

Variables	Factor Unrotated Centroids I	II	III	Rotated Factors Factor 'O'	Factor 'P'	Factor 'R'	Factor 'G'
9. Mill Hill Vocabulary 'IQ'	−0 36	0 46	−0 31	−0 37	0 10	−0 04	−0 54
10. Brengelmann Picture Recognition Test	0 38	0 05	0 23	0 13	0 29	0·37	0 23
11 Object Classification Test No of 'A' Responses	−0 67	0 27	0 03	0 06	−0 25	−0 24	−0 68
12. Object Classification Test 'Non A' Responses	0 68	0 29	−0 27	−0 46	0 67	0 54	0 33
14. Object Classification Test Average Response Time	0 49	0 35	0 04	−0 16	0 59	0 57	0 12
15 Obj Class. Test: Average Time per 'A' Response	0 75	0 15	−0 15	−0 32	0 62	0 54	0 46
16 Luchins Test: No of Single Solutions after 'Set'	−0 22	0 13	−0 07	−0 07	−0 05	−0 08	−0 2-
18. Luchins Test: Difficult Solutions before 'Set'	0 22	0 04	0 39	0·31	0 18	0 32	0 19
19 Epstein Test: Total Time	0 58	0·38	0 10	−0 13	0 67	0 67	0 16
20. Epstein Test: Overinclusion Score	0·56	−0·42	−0·07	−0 03	0 07	0 06	0 70
2'. Epstein Test: Neologism score	0 61	−0 09	−0 32	−0·37	0 35	0 23	0·54
22. Goldstein Colour-Form 'Concreteness' rating	0 71	−0 03	−0 29	−0 38	0 46	0 35	0 57
23. Goldstein Object Sorting 'Concreteness' rating	0 68	−0 11	−0 07	−0 15	0 38	0 36	0 53
24. Goldstein Object Sorting 'Overinclusion' score	0 06	0 36	−0 44	−0 54	0 31	0 13	−0·10
25. Goldstein Object Sorting unusual sortings	0·10	0 20	−0 46	−0 51	0 22	0 04	−0 02
26. Waves Test: Average Amplitude	0 41	0 00	−0 12	−0 18	0 28	0·23	0 31
27. Waves Test: Average Wavelength	0·30	−0 07	−0·16	−0·18	0·15	0 10	0 28
28. Maximum Grip: Dynamometer	−0 13	0·34	0 09	−0 00	0 16	0 17	−0 33
29. Static Ataxia: No. of Reversals	0 25	0·14	−0 21	−0 28	0 27	0 18	0·11
30. Static Ataxia: Total Movement	0·29	0 04	−0 20	−0 25	0 23	0·15	0 21
31. Shaw Test: No. of 'A' Responses	−0 72	0 47	−0·19	−0 20	−0 14	−0 23	−0 83
32. Shaw Test: No. of 'B' Responses	−0 08	0 34	−0 40	−0·37	0 20	0 04	−0 25
33. Shaw Test: No. of 'C' Responses	0 48	0 06	−0 20	−0·29	0 37	0 29	0·33
34. Shaw Test: No. of 'D' Responses	0 52	−0 07	−0 42	−0 46	0·30	0 15	0 47
35. Shaw Test: Total Time	0·16	0 72	−0·17	−0·42	0 64	0 53	−0 35
37. Nufferno Level Test	−0 64	0 50	−0 09	−0 13	−0 06	−0 12	−0 90
38. Level Test Persistence Score	−0 13	0 76	0 18	−0 05	0 47	0 49	−0 62
39. Nufferno Speed Test A1 Unstressed	0 71	0 15	0 35	0 16	0 59	0 70	0·39
40. Nufferno Speed Test B1 Unstressed	0 48	0 30	0 38	0 18	0 54	0 65	0 12
41. Nufferno Speed Test A2 Stressed	0 68	0 18	0 33	0 13	0 59	0 68	0·35
42. Word Association Test. No. of Synonyms	−0 07	−0 22	0 11	0 18	−0 21	−0 16	0 09
43. Word Assoc Test: Repetition of Stimulus Word	0 53	0 16	0 00	−0 14	0 48	0 46	0 28
44. Word Assoc Test: Multiple Responses	0 16	−0 02	−0 36	−0 36	0 10	−0 03	0 17
45 Word Assoc. Test: Aside Remarks	0 06	0 13	−0 43	−0 45	0 14	−0 02	−0 00
46 Word Assoc Test: Repetition of Previous S or R	−0 08	0 23	−0 21	−0 26	0 12	0·03	−0 19
47 Babcock Motor Speed Tests	0 72	−0 06	0 11	−0 00	0 44	0 48	0 56
50. Babcock 'Substitution' Test	0 74	0 16	0 31	0 11	0 62	0 71	0 41
51. Time to Draw three squares	0 59	0 1-	−0 06	−0 22	0 54	0 50	0 31
52. Wechsler Arithmetic sub-test	−0 52	0 44	−0 31	−0 34	−0 02	−0 15	−0 65
53 Wechsler Picture Arrangement sub-test	−0 52	0 25	−0 05	−0 04	−0 17	−0 20	−0 55
54. Drawing Design Test Disproportionality	0 13	−0 48	−0 00	0 05	−0 27	−0 27	0 47
55. Drawing Design Test: Average Time	0 78	0 08	−0 00	−0 16	0 58	0·57	0 52
56. U S E S. Man and Finger Dexterity	−0 51	−0 01	−0 21	−0 10	−0 35	−0 42	−0·35
57 Proverbs Test 'Abstract' Score	−0 60	0 22	0 04	0 07	−0 24	−0·23	−0·59
58 Proverbs Test: Average No. of Words	0 35	0 44	−0 41	−0 58	0 56	0 38	0 00
59. Proverbs Test: Average Reaction Time	0·31	0 30	0 36	0·19	0 43	0 54	−0 01
60. Proverbs Test: Average Total Time	0 51	0 68	0 01	−0·30	0·86	0 80	−0 08
61. Pathway I: Time Required	0 56	0 12	0 22	0 07	0·46	0·52	0·31
62. Pathway I: Errors Made	0 27	0 03	0 12	0 06	0 20	0·24	0·17
63. Pathway II: Time Required	0 57	0 13	0 28	0·12	0·48	0·56	0 31
64 Pathway II: Errors Made	0·42	−0 07	−0 10	−0 14	0 23	0·20	0·37
65. Shaw Test: Average 'A − B' Response Time	0 80	0·15	−0 00	−0·19	0·65	0 63	0 49
66. Shaw Test: Total Number of Responses	−0 26	0·53	−0 51	−0 60	0·22	0·01	−0·50
68. Static Ataxia: Maximum Backwards Sway	0 19	0·07	−0·10	−0 15	0·18	0·14	0·10
% TOTAL VARIANCE	23.7	8.99	6.24				
% EXPLAINED VARIANCE	60.9	23.1	16.0				

recommended as a rule of thumb that there should be approximately ten times as many subjects as there are variables for a factor analytic study (Harman, 1967).

Boyd (1949) provided further evidence that intelligence may be an important factor in performance on some of the Goldstein-Scheerer sub-tests as well as an example that some the battery is not totatally resistant to quantification. Boyd devised a scoring system for the Cube Test by assigning scores for levels of performance and explanation (a step-wise scoring system corresponding to the "helps" for the original sub-test). When Boyd divided a group of 54 normal and female subjects into sub-groups according to levels of W-B Full Scale scores, he found that Cube Test scores varied as did IQ scores. He also computed upper/lower limits of Cube Test standard deviations in order to compare abnormals. When Boyd compared certain Cube Test scores of brain damaged and non-organically impaired subjects with the control group "norms" he found a slight trend of lower Cube Test scores for the deviant sub-groups as compared with the corresponding normal IQ groups, but the N's are too small to draw reliable statistical inferences.

McGaughran and Moran (1956) found variance in performance on the Object Sorting Test to be more closely associated with esti ated test intelligence and educational level than with psychiatric diagnosis. The authors tested two groups of individiuals, one group consisting of 37 male patients diagnosed as paranoid schizophrenics, the second group consisting of 40 male pateints in a VA hospital with non-psychiatric diagnoises; 37 of this latter group were matched with the 37 psychiatric patients for estimated test intelligence (vocabulary scores on the W-B), educational level and age. The Object Sorting Test was administered in accordance with the Rapaport (1945) modification. This modification for this sub-test has been widely adopted by investigators. The changes made by Rapaport involve using thirty three common objects that are very similar to the

Goldstein-Scheerer materials in which the examinee must sort the objects under two conditions or phases called the "active" and the "passive" (or compliant) phases, both of which closely correspond to the tasks described in the Goldstein-Scheerer and the Rapaport modification of the Object Sorting Test resides in the exteded sub-divisions that Rapaport has given to the levels of "abstract" and "concrete". The scoring system used by McGaughran and Moran in the present study is a slight modification of Rapaport's scoring system and was developed for the purpose of testing hypotheses which the Rapaport scoring system is not able to handle. Two methods of scoring sorting and verbalizations were employed in the present study: responses were first scored for "conceptual level" and then for "conceptual area". The Conceptual Area scoring method was deveoped by the authors for the purpose of testing hypotheses concerning the nature of schizophrenic thought patterns, which state that schizophrenics are not so much deficient in abstract ability as they are in social communication. The authors concluded that

> "The major differences between the schizophrenic subgroups based on intellegence and education is in the relative publicness-privateness of their conceptualization while the major differences between the nonpsychiatric subgroups is along the open-closed variable." (p.47)

The only discoverable evidence of the factorial composition of the Goldstein-Scheerer battery are two brief reports by Silverstein (1960) and Silverstein and Moran (1965) for the Object Sorting Test. Silverstein (1960) performed a cluster analysis on data reported by Rapaport et al. (1945). The data are apparently levels of performance on the Object Sorting Test as scored in accordance with Rapaport's scoring system. Thirteen variables from the sorting test were selected for analysis. The subjects consisted of "54 randomly selected members of the Kansas Highway Patrol." The score distributions, were dichotomized at the

median and intercorrelated using the phi/phimax index of association. The analysis employed was "McQuitty's elementary linkage analysis." Three clusters were obtained, two of which were identified as corresponding to the two major conceptual areas of the sorting test as described by Rapaport et al. (1945). One is called "active concept formation" and corresponds to the first part of the Goldstein-Scheerer sorting test in which the subject is required to select an object and sort all other objects that belong and give an explanation of the conceptual basis for the sort made. The second cluster was identified as corresponding to "passive concept formation," which corresponds essentially to the second part of the Goldstein-Scheerer procedure in which the subject must name the concept underlying the group of objects selected by the examiner. The third cluster obtained corresponds to an explanation of the concept underlying a grouping in terms of function or everyday usage (functional definitions can be scored in both the active and passive phases of the Rapaport scoring system). The term also corresponds to a concrete explanation in the Goldstein-Scheerer scoring system (1941).

The cluster analysis suggests to Silverstein that there is an abstract-concrete continuum present in verbal conceptual behavior with functional definitions representing an independent category, and not an abstract/concrete dichotomy. For this reason, Silverstein recommends changes in the scoring systems for measures of verbal comprehension, such as the Weschler Vocabulary sub-test, which call for active definitions of terms. Silverstein recommends giving less credit for a functional definition than for a concrete definition rather than the conventional procedure of giving credit in an abstract-functional-concrete order.

In another brief report Silverstein and Moran (1965) describe the results of a factor analysis performed to determine the relation between intelligence and performance on the Object Sorting Test. As in the 1960 cluster analysis reported

Silverstein, the Rapaport modification was used to score the main levels of performance on the sorting test. The data used were those reported by Rapaport for three groups: normals, neurotics and schizophrenics (sample sizes are not given). Thirteen measures from the sorting test along with the W-B Full Scale IQ's were selected for analysis. All of the score distributions were dichotomized, tetrachoric correlations were calculated and the resulting correlation matrices, one for each of the three groups, were factor analyzed using principal components followed by orthogonal rotation. The resulting factor solutions were not in complete agreement with one another, although they showed structural similarities. A single factor corresponding to active concept formation for the normal group split into two factors, which were interpreted as "Sorting" and "Verbalization" for the neurotic and schizophrenic groups, respectively. For all three groups there was a factor corresponding to passive concept formation, and for each group the IQ sub-tests loaded highest on this factor. Lastly, a doublet occured for functional definitions from the the two parts of the Object Sorting Test.

Silverstein draws three conclusions from the analyses. First, the results support Rapaport's distinction between active and passive concept formation which are involved in the two parts of the Object Sorting Test. This suggests that there is an abstract-concrete continuum in conceptual behavior. Secondly, the findings demonstrate that intelligence as measured by the W-B, at least, is more closely related to passive rather than active concept formation. Lastly, functional definitions do not lie on the abstract-concrete continuum but are an independent entity.

Although the Goldstein-Scheerer battery was developed principally for adults, some use has been made of some of the sub-tests in the study of conceptual development in children and adolescents. A brief summary of some of the main findings of some of the studies found in the literature will now be given.

One of the earliest studies in this area was the experiment performed by Reichard, Scheider and Rapaport (1944) in which 234 normal white children, ages 4 to 14, were tested with the Object Sorting Test and the Color Form Sorting Test. The scoring system for the Object Sorting Test used in the present study is the one that Rapaport et al. (1945) later came to adopt for that sub-test. The Color Form Sorting Test was scored in terms of the number of conceptual shifts exhibited by the children; i.e., the shift from a color sort to a form sort or vice versa. Using a chi-square test for within age group differences, it was found that at around 7 to 8 years of age, the ability to perform the two sorts became dominant on the Color Form Sorting Test. Moreover, throughout most of the age range tested, grouping in terms of form appears to be more probable than color grouping. The Object Sorting test results showed that, in the course of childhood and adolescence, the accuracy of active (sorting) concept formation develops earlier that the accuracy of definition in passive concept formation. The percentages of conceptual definition were higher in the active sorting phase than in the passive phase where the individual must explain the basis for an examiner made grouping, but no significance testing was reported.

Goldman and Levine (1963) in an excellent cross-sectional study found the same basic kind of concept formation changes to be a function of age. The investigators compared 8 groups of subjects (approximately 15 subjects per group) which represent the earliest school grades (K to grade 4), the middle school grades (6 and 9), college students and practicing scientists. Using their own elaborate scoring system for the Object Sorting Test, the authors found significant mean differences for almost every sub-group comparison made. The overall impression one gets from the study is analogous to the results reported by Reichard et al. (1944) concerning active and passive concept formation.

Heald and Marzolf (1953) employed the Stick Test and the Color Form Sorting

Test of the Goldstein-Scheerer battery with 138 r ɔrmal elementary school children ranging in age fiom 6 to 11 (n's range from 15 to 35 for the score distributions analyzed). The Stick Test was scored one point for each reproduction made from a picture or from memory of a picture. The Color Form Sorting Test was scored only for the percent of shifts at eac h age level. The Stick Test is apparently a very simple test even for children, as the range of percent correct for the age groups is from 90% for 6 years to 100% for the 11 years olds, the overall percent correct being 96%. No sex differences occured. The authors present findings on the Color Form Sorting Test which are quite diffenrent from those reported by Reichard et al. (1944). The present authors found that approximately 89% of the subjects in their experiment were able to sort the geometrical figures by both form and color, whereas only 56% of the subjects in the Reichard et al. study were able to sort both ways. Again, no sex differences were found on this task.

Although it would have been interesting to have seen results on the Object Sorting Test to be able to compare them with previous results, the authors seem to present fairly good evidence that elementary school children are capable of abstract behavior, at least as measured by the two sub-tests used in this study.

VI. Cost Effectiveness

Statistics on cost effectiveness come from the 6th MMY.

Total testing time: 30-60 minutes.

Complete set of testing materials: $64.00.

Individual sub-tests:

a) Cube Test: $5.75 per set of 2 design booklets and supplementary manual: $4.50 per set of Kohs' blocks: $3.50 per 50 copies of either seperate record booklet.
b) Color Sorting Test: $14.50 per set of wool skeins: $2.80 per 50 record booklets.

c) Object Sorting Test: $16.00 per set of objects: $4.20 per 50 record booklets: $1.00 per 50 supplementary sheets.
d) Color Form Sorting Test: $7.25 per set of blocks: $2.80 per 50 record booklets.
e) Stick Test: $4.25 per set of sticks and supplementary manual: $2.80 per 50 record booklets.

Manual: The 1941, 156 pp. monograph is $2.25 per copy.

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