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**An Empirical Comparison of the Techniques
For the Differentiation of Handedness**

by

Margaret R. Procyk

**A Thesis Submitted to the Faculty of the Graduate School of
Loyola University in Partial Fulfillment of
the Requirements for the Degree of
Master of Arts**

June

1966

Vita

Margaret Rose Procyk was born in Chicago, Illinois, on January 19, 1943.

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An Empirical Comparison of the Techniques
For the Differentiation of Handedness

Margaret R. Procyk

Loyola University, Chicago

Introduction. Handedness has been defined as the consistent use of one side in performing complex and highly differentiated tasks(Wills, 1960). Expressions of hand preferences are both multiply and complexly determined (Hildreth, 1950; Palmer, 1964; Provins, 1956) and measured. For example, Palmer(1963) has stated that hand lateralization represents a gradual process of motoric differentiation which is under the control of the ego. The experimental research involving handedness is replete with various techniques or systems of classification from simple right-left discriminations to quantified indices.

The degrees to which handedness can be differentiated has potential theoretical and practical significance, particularly in automatization and perceptual-motor research (Crovitiz and Zener, 1962; Fleishman, 1953; Palmer, 1964). Fleishman has emphasized its relationship to the organization of response as well as in the development of a class of skills dependent on the varying degrees of performance preference. This statement was meant to emphasize the

involvement of handedness in the whole hierarchy of organizations and integrations used in any task. It also points to one of the many 'U', organism or subject, variables experimentalists are becoming more and more concerned about.

The use of such techniques is also pertinent to the field of personality and clinical research. Palmer(1963) extends his concept of lateralization as an index of motor maturity. And as he points out, if such an index reflects developmental differentiation, then it should also be related to other general aspects of psychological development.

A priori considerations and observations have suggested that the left-handed individual is handicaped in a right-handed society(Wittenborn, 1946). In fact, a rather unique collection of research as well as superstitions make up the literature on man's handedness. More recent surveys support a greater incidence of left-handedness among certain pathological groups(Hildreth, 1950; Palmer, 1963). Such references are made in relation to speech disorders(Blau, 1946; Bolin, 1953; Brain, 1945; Bryngelson, 1940; Bryngelson and Clark, 1933; Bryngelson and Rutherford, 1937; Chrysanthis, 1947; Daniels, 1940; Hildreth, 1950; Pickford, 1949) and reading disabilities(Dearborn, 1931; Harris, 1957; Hildreth, 1940). It is interesting to note that in the earlier studies, organic involvement was minimized and a more causal

relationship was suggested between handedness and communication difficulties. Mental defectives as a group supposedly include more left-handed individuals(Dart, 1938; Fitt and O'Hallaran, 1934; Gordon, 1920; Mintz, 1947; Murphy, 1962). In terms of personality disorders, there are reportedly: more left-handed children with character disorders(de Ataide, 1951; Friedman, 1931); neurotics(Blau, 1946; Estabrooks and Huntington, 1929; Quinan, 1922); and psychopaths(Fitt and O'Hallaran, 1934; Schacter, 1955). Left-handed individuals tend to be more introversive(Dayhaw, 1953; Downey, 1926; Estabrooks and Huntington, 1929) and exhibit more compensatory behavior in relation to the Adlerian concept of inferiority(Deutsch and Kadis, 1947; Negener, 1954; Plottke, 1948). This material indicates what is available in the literature. The author considers the implications and relationships presented as debatable and pending further investigation.

Palmer has theorized that the problem is not essentially one of right or left handedness but of strength of laterality of function. Laterality is interpreted in terms of more ego strength, canalized expression, and less maladjustment or awkwardness. In this case, the left-handed may be less highly lateralized because of cultural and mechanical demands, and therefore experience more difficulty in

adjustment to the environment. It would seem that the ambidexterous person would have an even more difficult problem. It seems doubtful that an individual would master equally efficient and skilled performance of the same task with either hand.

In addition to the controversial nature of the theoretical implications of handedness, there is the question of assessment methods for research. The superficial acceptance of certain statistical data without an examination of research techniques has led to the acceptance of many of the relationships mentioned earlier (Twitmeyer and Nathanson, 1933). Before any replication or investigative studies can be done or the present literature evaluated and compared, the methodology for determining handedness should be considered.

Purpose. It is the purpose of this study to begin an evaluation of measurement techniques. Such a study is lacking in the literature. The first step would be an empirical comparison of different technique results.

Related Literature

From an operational point of view, Benton, Meyers, and Polder(1962) have pointed out that the concept of handedness has become rather complex. Handedness may mean a verbal report, either a typological classification according to simple statements, "I am right handed.",(Benton et al., 1962; Briggs, 1960; Gordon, 1924) or a more detailed questionnaire of preference in specific activities(Crovitz and Zener, 1962; Bingley, 1958; Downey, 1927; Hull, 1936; Humphrey, 1951; Smith, 1945; Twitmeyer and Nathanson, 1933; Wittenborn, 1946). For example, the Twitmeyer and Nathanson lateral dominance questionnaire contains 88 statements including: "Is your 'MINOR HAND' clumsy and awkward for most operations?"(p. 147); "If you wear a wristwatch on which arm is it worn?"; "Do you know if as a young child you sucked your thumb? If you did was it..."(p. 145); and some questions on daily tasks, "In which hand do you hold the comb when combing your hair?" (p. 144).

Observed hand preferences in activities are assumed to provide more functional definitions of handedness. The tasks may be actually performed(Davison, 1948; Durost, 1934; Johnson and Duke, 1937; Smith, 1945) or pantomimed(Harris, 1947; Johnson and Duke, 1940).

The relative dexterity with which skilled acts are

performed has also been considered (Benton et al., 1962; Clark, 1957; Merrell, 1957), but has not been systematically investigated. Simon (1964) has demonstrated that such measures as a steadiness test are insensitive measures of handedness.

Experimenters have used regular batteries like the Harris Tests of Lateral Dominance (1958) or other various combinations of report (Falek, 1959; Hecaen and deAjuaguerra, 1964). Such an approach attempts to compensate for the unequal values of obtainable information. These differences are attributed to the heterogeneity of the intraindividual variations among subjects, particularly the left-handed (Downey, 1933; Humphrey, 1957; Simon, 1964).

The Harris Tests in particular, claim to be sensitive to "directional confusion" (p. 3). This also appears to be the only series which discusses reliability and validity. The reliability study used a contingency table for simultaneous writing, handwriting, and tapping with a pencil; the contingency coefficients were respectively, .83, .76, and .75. It would seem that these results are of dubious value since the college students used as subjects would use the same writing hand for such similar tasks. And, since Harris is primarily concerned with identifying poor readers at the elementary school level, his subject choice seems

inappropriate. Harris also reports face validity which is of little value to the experimentalist. The critical support of his tests in terms of "other measures" is asserted but this "available" evidence is not cited in the manual (p. 20). Harris himself reports that some of the tests in his series are "probably neither better nor worse than other tests of a similar nature"(p. 20). However, Harris also reports that his tests for hand dominance have been able to clearly distinguish clinical cases of reading disability from unselected school children. This is interesting in view of the fact that neither eye or other laterality measures were successful. Other cross validation and content studies seem in order before such tests as handwriting can be accepted as indicators of dyslexia. Since there is a marked change in both handedness and reading disability with increasing age, the handedness ratings becoming less "mixed", one might investigate the developmental aspects of this relationship.

The lateralization systems generally distinguish among: those who consistently use the right hand; those who usually prefer the right hand but occasionally or originally used the left; and those who consistently used the left hand; and, those who usually preferred the left, but used the right hand(Downey, 1924; Rife, 1922; Wittenborn, 1946). Quantified

indices have been used for more differentiating study by Smith(1945), Zangwill(1960), and Crovitz and Zener(1962).

The Smith study used a test of sidedness to compare pre-operative patients(commisural systems of the cortex) and normal college students. The patients were also tested post-operatively for additional comparison. Criticisms of the experimental design would first include the use of a performance test only for the patients and a questionnaire form for the relatively younger students. The index obtained was taken to represent the percentage of right or left sidedness from ambilaterality. The data indicated that in either right- or left-sided individuals, the percentage of laterality is in general higher for activities involving the use of the hands. Smith's concept of difference from ambilaterality or specialization is similar to the formulations of Palmer, mentioned earlier.

Crovitz and Zener's questionnaire was used in screening 1569 students. The distributions of right and left handedness from their point system are sharply negatively skewed, and more extreme for women. A comparison was also made of the students' point scores and self reports of handedness. The results supported the need for a more discriminating scale of handedness. For this study, the item selection used by Crovitz and Zener was considered typical and was used in a

modified form. The items were rearranged to facilitate scoring and the "X" category meaning "I don't know" was eliminated. Items answered "X" on the original form were prorated by the experimenters according to the trend of the items. However, since the Ss in this study also performed the tasks and exhibited some irregular behavior patterns, the "X" category was not considered feasible.

Hypothesis. Using the same items and three different administration techniques, there will be no significant performance differences. The results would be expected to be highly related among the three measures. Additionally, the relationship between self classification and scaled classification will be investigated.

Each S was tested individually in the same 6'x6' soundproof booth with the same equipment.

Condition A. The S completed the questionnaire in the test booth following E's statement to read and complete the form. The following printed instructions preceded the items.

"Answer the following questions carefully. Imagine yourself performing the activity described before answering each question. Answer by drawing a circle around the appropriate set of letters appearing to the left of each question."

Condition B. The S performed each task on the 14 item questionnaire. For example, the S was asked to write his name or to throw a ball to the E. The materials needed for each item, e.g. a ball, were placed in the center of the table directly in front of the S. The E recorded all performances and spontaneous verbalizations such as "I really can use either." These verbalizations were scored accordingly.

Condition C. Each S was asked to pantomime the 14 tasks. For example, the E asked, "Show me how you would brush your teeth." The E recorded all preferences as well as the spontaneous qualifications made by the S.

The results of these three preference records were scored using a modified scale system developed by Crovitz and Zener. The following weights were given.

ITEMS: 1 - 9	Ra=1; Rm=2; E=3; Lm=4; La=5
10 -14	Ra=5; Rm=4; E=3; Lm=2; La=1

The range of the scaled scores is from 14 to 70.

A completely right handed person would score 14; an ambidextererous person would have a score of 42; and the completely left handed person would score 70.

Results

The results of the self classification statement for the initial population of 332 Ss is presented in Table 1.

Table 2 presents categorical data on the experimental subjects for comparison. A three by three contingency table was used to describe the degree of association or correlation between self classification and classification by Conditions A, B, and C. In this case, $C=.29$. Following McNemar's(1962) suggestion to avoid the unwieldy sampling error formula for C, the value of X^2 was also used to test the significance of the relationship, $X^2= 16.2(p<.01)$.

Table 1.

SELF-CLASSIFICATION OF HANDEDNESS BY INTRODUCTORY
PSYCHOLOGY STUDENTS (N=332)

	<u>Right</u>	<u>Left</u>	<u>Ambidexterous</u>
Males	211	24	17
Females	72	6	2

Table 2.

EXPERIMENTAL SUBJECTS CLASSIFICATION OF HANDEDNESS
BY SELF STATEMENT AND BY CONDITIONS A, B, C (N=60)

	<u>Self</u>	<u>A</u>	<u>B</u>	<u>C</u>
Right	45	51	51	51
Left	10	9	9	9
Ambidexterous	5	0	0	0

Figure 1 graphically presents the results for Conditions A, B, and C using the weighted scores in a frequency distribution. Each frequency polygon is markedly positively skewed.

The means and standard deviations for the scaled scores for the three conditions are presented in Table 3.

The relationships among the scaled scores for all the conditions are included in Table 4. In each instance, the degree of relationship or correlation is significant beyond the .01 level.

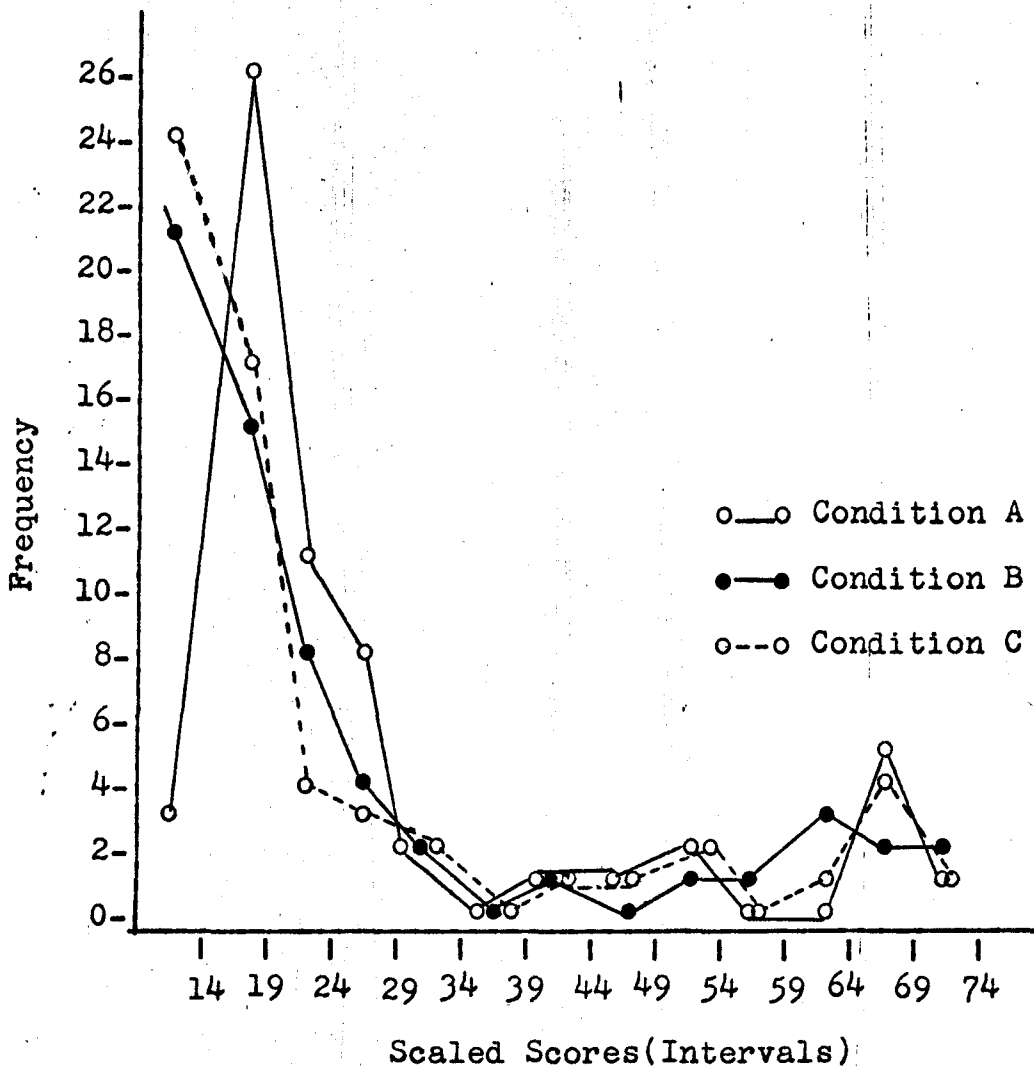


Fig. 1. Frequency polygons for scaled scores of handedness for Conditions A, B, C (N=60).

Table 3.

MEANS AND STANDARD DEVIATIONS OF PERFORMANCE
IN CONDITIONS A, B, C (N=60)

	<u>Mean</u>	<u>Standard Deviation</u>
Condition A	26.48	15.93
Condition B	25.12	17.06
Condition C	24.18	16.69

Table 4.

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS FOR
THE RELATIONSHIPS AMONG CONDITIONS A, B, C (N=60)

<u>Conditions</u>	<u>r Coefficient</u>
A and B	.97
A and C	.98
B and C	.98

Discussion

The hypothesis that there would be no significant difference among the three administration techniques was accepted in view of the results. The high correlation values indicated that while using the same items, the major techniques produced like results. It would seem more to the advantage of the experimenter to use the questionnaire method as a more easily administrable form and as one suitable for group usage.

The comparisons of self and Conditions A, B, and C classifications led to some interesting observations. Six of the subjects who misclassified themselves on the self statement were right handed according to Conditions A, B, and C. This is the opposite of what might be expected in terms of Palmer's discussion of the left handed seeming to be less specialized and his expectation that the right handed are so to an extreme. As was assumed in the Introduction, no individual was considered to be ambidexterous in terms of his performance on A, B, and C. It also seems that most of the subjects' perception of their handedness was based on the question, "Which hand do you write with?" For example, the Ss who had misclassified themselves on the self statement in relation to A, B, and C identified themselves as left handed on the self statement and on the first item

of A, B, and C, the writing hand. It might be plausible then to suggest that in certain studies the determination of handedness might be limited to the question of which hand one writes with.

However, a point scale still seems invaluable for use in perception, motor, and other studies and more amenable to statistical manipulation. An examination of the Ss' scores which varied considerably from the mean might be carried out in relation to other variables, for example, co-ordination, social awkwardness, and the adjustment measures suggested by Palmer.

The next step in empirical investigation seems to be the determination of items, the length and detail of such a test. In view of Fleishman's indication of the involvement of handedness in any specific integrated task, a special index for each experimental situation might be required. This, however, seems infeasible and a rather formidable task.

Also to be considered is the use of a five-point scale. In addition to the scaling problem, both the clinician and the experimentalist might also be interested in studying the person who describes himself in terms of extremes, e.g., one who always uses the right hand. In this study, persons with scale scores of 14 and 70 might be compared in terms of other variables.

Summary

Sixty male, general psychology student volunteers were compared in terms of their self classification of handedness and classification according to three experimental conditions. Each of the conditions used the same 14 item task form and differed in methods of obtaining hand preference information. The methods were a questionnaire form, actual performance, and pantomime. The results were scored according to a five-point scale for each item. Each S was tested individually; the same equipment was used for all Ss. The results indicated that there was no significant difference among the administration techniques. The degree of relationship or correlation among the three techniques was significant beyond the .01 level. The questionnaire was considered to be the most practical form of administration. Suggestions for further research included determination of specific items, type of scale or scoring index, and a comparison of related variables.

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Appendix A

Ra = right hand always
Rm = right hand most of
the time
E = both hands equally often

La = left hand always
Lm = left hand most of
the time

- (1) Ra Rm E Lm La : is used to write with
- (2) Ra Rm E Lm La : to throw a ball
- (3) Ra Rm E Lm La : is used to draw with
- (4) Ra Rm E Lm La : to hold scissors when cutting
- (5) Ra Rm E Lm La : to hold knife when cutting food
- (6) Ra Rm E Lm La : to hold toothbrush when
brushing teeth
- (7) Ra Rm E Lm La : holds tennis racket when playing
- (8) Ra Rm E Lm La : to hold pitcher when pouring
out of it
- (9) Ra Rm E Lm La : to hold drinking glass when
drinking
- (10) Ra Rm E Lm La : to hold nail when hammering
- (11) Ra Rm E Lm La : to hold bottle when removing
top
- (12) Ra Rm E Lm La : to hold potato when peeling
- (13) Ra Rm E Lm La : to hold needle when threading
- (14) Ra Rm E Lm La : to hold dish when wiping

APPROVAL SHEET

The thesis submitted by Margaret R. Procyk has been read and approved by three members of the Department of Psychology.

The final copies have been examined by the director of the thesis and the signature which appears below verifies the fact that any necessary changes have been incorporated, and that the thesis is now given final approval with reference to content, form, and mechanical accuracy.

The thesis is therefore accepted in partial fulfillment of the requirements for the Degree of Master of Arts.

May 31, 1966
Date

Ronald E Walker
Signature of Adviser