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Jason W. Lohman

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Southern Illinois University at Carbondale

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# Factors Influencing Handwriting Legibility

Handwriting is one of the most important means of communication used by humans even with modern society's dependency on computers, faxes, and telephones to communicate. Although each of these advances has made communicating more universal, the ability to write legibly is still a skill needed by all members of society. Because of the importance of being able to communicate ideas in legible handwriting, researchers have studied various factors of handwriting and designed instruments to measure legibility. One factor which has been given considerable attention in handwriting studies is the differences between the handwriting of left-handed and right-handed students. Still, researchers have often failed to focus on the possible explanations for the stereotype that the handwriting of left-handed individuals is less legible than that of right-handed individuals. This experiment is designed to not only question this stereotype, but also to discover various factors which may influence legibility.

An important factor in any study which discusses differences between left-handed and right-handed subjects is a measure of the operational definition of a subject's degree of handedness. Most studies on the handwriting of left-handed and right-handed subjects use a listing of activities in which the subject indicates which hand they primarily use for a given activity. The items included on each list vary, and researchers argue over which items should be included. Longoni and De Gennaro (1992) used performance tests of elementary school children to determine if various items should be included on future handedness inventories. The following items were found to have very high correlations with subjects "preferred hand": erasing, writing,

mixing, and combing. Other items (drinking, and dealing cards) did not seem to differentiate left-handed and right-handed individuals from one another. Another group of items, which included cutting and throwing, seemed to correlate well for self-acclaimed preferred right-handed individuals, but not left-handed individuals. At first, Longoni and De Gennaro suggest that possibly only the first group should be included in most item lists. However, after reflection, they note that including even the low differentiating items would be useful when trying to assess mixed handedness. Coren (1992) discussed various means of assessing handedness, and came to the conclusion that the important items to include in a questionnaire are those items that participants will indicate correctly which hand they actually use for a given activity. In other words, if Coren says he typically swats a fly with his left hand, and you observed him over a given period of time, he would typically swat a fly with his left hand. The researcher agrees with Coren's logic and has chosen a paraphrased version of the items that Coren recommends (1992, p.37).

Also, hand posture of both left-handed and right-handed individuals needs to be assessed to see if this is a contributing factor to the legibility of their handwriting. When Peters & McGrory (1987) studied the differences between legibility (described as "sentence quality" and ranked on a five point scale) between inverted and noninverted left-handed and right-handed subjects, results were not significant in terms of differences between writers of different postures, and "there was no overall significant difference in the quality of writing between left- and right-handed writers (Peters & McGrory, 1987, p. 24). The present study will try to duplicate the findings of Peters & McGrory to see if hand posture is a contributing factor to

legibility.

Sometimes the means of measuring hand-posture can skew the resulting percentages of inverted versus noninverted subjects in a population. According to Levy (1984), the percentage of subjects using a particular hand-posture is directly related to the means of assessment. In other words, when subject rate themselves a smaller percentage of writers will rate themselves as using a "hooked position" than if observers had rated the same subjects. When pictorial examples are the basis for either subject or observer ratings, the differences between the percentages can be explained in one of two ways according to Levy. Either, subjects are "biased to attend to dimensions in drawings" that teachers do not pay attention to (i.e., wrist angle, pen angle), or subjects are biased against seeing themselves as writing in an inverted position because of society's negative reaction to this choice (1984, p.113). To correct for this difference between observer and subject ratings, Levy suggests giving subjects a brief questionnaire including questions about the paper angle (i.e, "the paper is straight up and down."), direction of tip of pen, pen position in relation to written line, and a general hand-posture question (1984, p. 119). Using Levy's questionnaire, it was found that subjects ranked themselves accurately on paper angle and pen position in relation to the written line (in comparison to observer ratings). This supports the use of these questions in further research, but in the end is not sufficient enough to warrant the elimination of other methods. The present study does not use Levy's questionnaire because the researcher did not feel that it had been adequately tested in multiple studies.

Once subjects degree of handedness and hand-posture have been assessed,

some means of obtaining a sample of subject's handwriting must be selected. When evaluating subjects handwriting it is important that all of the individual items which might be included in data analysis are available in the participants' writing samples. Peeples (1989) has offered a two paragraph sample which includes all the letters of the alphabet and the digits 0 - 9. This sample is short practical means of getting a complete sample of subjects' handwriting.

Once a sample of handwriting is generated, the researcher must assess legibility using some form of objective and/or subjective ratings. Graham (1986) studied factors contributing to variability in handwriting. Graham noted several problems with current methods of handwriting analysis including, the fact that "'readability' . . . is not totally dependent upon the relative formation of individual letter forms" and is partially based on subjective assessment (Graham, 1986, p. 64). Graham also suggested that multiple samples (taken on separate days) should be used in handwriting analysis because the legibility of a person's handwriting may vary from one day to the next. Further, Graham noted that when a given measure is based on a "copying task" or a "creative writing assignment" differences in the quality of writing may result. Still another variable influencing the legibility score a given subject receives is based on examiner characteristics. An examiner may consciously or unconsciously react to "different elements (e.g., letter formation, slant, letter size) when evaluating various specimens" (Graham, 1986, p.65). Other examiner-related factors include "personal familiarity" with the experimental hypotheses and examiner fatigue. Graham included The Handwriting Scale of the Test of Written Language (TOWL) in this study, and indicated that along with other measures of "readability"

this scale fails to "include samples of the least and best possible handwriting and [does] not provide separate scales for various groups of writers" (1986, p. 68). Further, it is recommended that this scale only be used "for general estimates of handwriting competence" (Graham, 1986, p. 68). Graham also suggests ways of limiting the variability between various legibility ratings. Among these are extensive training of raters, elimination of "identifying factors" of samples, "averaging the scores from several independent testing sessions," having at least two raters rate each sample independently, and having raters refrain from rating while fatigued (Graham, 1969, p. 69). Efforts were made in the present study to eliminate identifying factors on each writing sample, make multiple ratings by two raters independently, and monitor fatigue of raters.

As noted above, the Handwriting Scale of the TOWL (Hammill & Larsen, 1983) can be used for "general estimates of handwriting competence" (Graham, 1986, p. 68), and the current study uses it to make a partial assessment of participants' legibility. This scale includes five cursive samples of handwriting which range from illegible to very clear handwriting. The samples themselves are ranked 1, 3, 5, 7, and 9 respectively with higher rankings indicating increased legibility. In addition, the ratings 0, 2, 4, 6, 8, and 10 are indicated between the samples to designate rankings for samples which fall between the five examples. For this scale, a ranking of 5 is not considered average; the average ranking is determined by the characteristics of the given sample, and normative tables for various age groups are included in the manual. The TOWL also provides additional suggestions for "Informal assessment of written language" including the mechanical component which

is based on penmanship (Hammill & Larsen, 1983). Within this is a list of common letter malformations, and suggestions on ways to analyze specific characteristics of writing such as spacing, slant, line quality, and size of letters. Interestingly, when Hammill and Larsen redesigned the Test of Written Language - Two in 1988, they eliminated the Handwriting Scale. They decided that because this scale failed to correlate well with the other scales within the TOWL and did not correlate well other external measures of writing, that it was not appropriate to included it in TOWL-2. However, they did recognize that penmanship was still important, but no longer in terms of their testing instrument.

The Handwriting Scale from the TOWL was used by Graham, Boyer-shick and Tippets (1989) "to measure the general legibility of learning disabled students' writing" (p. 166). Graham et al. also ranked each sample on "six handwriting elements including letter formation, slant, size, spacing, alignment, and neatness" (1989, p. 166). In their study, it was discovered that best predictors of a subject's TOWL Handwriting rank were letter formation, neatness, and spacing (accounting for 44.35%, 29.87, and 25.79% of the variance in TOWL scores, respectively). The measures of slant, size, and alignment were not found to be significant predictors of the TOWL Handwriting ranks of subjects.

Beyond the research questions about the legibility of left-handed writers there lies an argument that society must make an effort to improve the handwriting instruction of left-handed students. Several researchers and teachers have suggested that society stop stereotyping left-handed handwriting as sloppy and focus on teaching left-handed students how to write more legibly. Teachers can not assume that

teaching left-handers using the same methods used for right-handers will be sufficient. Like students with other individual characteristics, left-handed writers need trained a specific way. Among the suggestions given to improve the legibility of left-handers' writing are the following: group lefties together while giving them instruction on handwriting (Harrison, 1981; Plattor & McQueen, 1986), have a left-handed model with good penmanship teach them (Harrison, 1981; Plattor & McQueen, 1986; Salend, 1984), suggest that they slant their papers to the right (Burns 55, Harrison, 1981; Plattor & McQueen, 1986; Salend, 1984; Wasylyk, 1989), suggest holding pens and pencils approximately one and a half inches from the tip (Burns 55, Harrison, 1981; Peisekovicius, 1989; Plattor & McQueen, 1986; Salend, 1984; Wasylyk, 1989), provide a sample of a model cursive alphabet written by a lefty (Burns, Harrison, 1981;, Plattor & McQueen, 1986), and seat left-handed students at desks with an arm rest on the left-side (Peisekovicius, 1989; Plattor & McQueen, 1986). Also, it is suggested that left-handed writers be encouraged to write on the chalkboard to help them become accustomed to "writing below the bottom line of the writing space rather than above it as in the hooked position" (Plattor & McQueen, 1986, p.12). Salend (1984) suggests that placing masking tape on the child desk to indicate the lower edge of paper would angle the paper to the right. Putting tape on the child's pencil will help encourage the child to hold the pencil at the tape location. For most students, the tape can be removed after only a few days because children no longer need the tape to indicate where place their paper or hold their pens. A final suggestion for teachers is to talk with other teachers about their experiences and work together on improving handwriting instruction in your school (Plattor & McQueen, 1986).

The present study focuses on the factors which influence the legibility of both left-handed and right-handed individuals. A handedness inventory of the items suggested by Coren (1992) was used to assess degree of handedness. The first experimental hypothesis was that as the degree of handedness increases or decreases to a level in which participants use one hand for all activities, the subjects' handwriting will be rated more legible. A second hypothesis is that left-handed writers as a group will not have significantly less legible handwriting than right-handers. The operational definition of legibility for this study is split into two categories. The first of these categories is observer rating, and this rating is composed of the average between the four TOWL Handwriting Scale scores and the number of types of letter formation errors included in the sample. The second, subject rating, is composed of the average of four of the original five self-report responses of teachers complaining of illegible handwriting. Pictorial models of three pen and paper positions for each hand-preference based partially on models suggested by Levy (1984) assessed hand posture. It is hypothesized that there will be no significant difference between the legibility ratings of participants who select the "inverted posture" versus the other two posture choices. In addition, the questionnaire asks participants to what degree their models assisted them in learning how to write (i.e., suggested paper/pen position, etc.) A fourth hypothesis is that there will be a significant increase in the legibility of participants who had the highest level of assistance and support (i.e., left-handed desks and scissors were available to them in school). A forced switch question is included to see if those individuals who were forced to switch the hand they write with, write less legibly.

## Method

### Participants

Undergraduate students attending a midwestern university were solicited to participate in this study. More specifically, all of the participants were enrolled in courses in psychology or sociology. In addition, because the experimental hypotheses concerned primarily left-handed writers, an effort was made to increase the subject pool of left-handed writers by restricting five of the 13 experimental sessions to left-handed writers. Unfortunately, the experiment took place near the end of a semester and participants often ignored these restrictions in lieu of much needed extra points. Still, these efforts were able to increase the percentage of valid responses from left-handed writers to 21.74% (30 participants) as compared to approximately 10% in the general population. It should be noted that only those students enrolled in psychology courses received course credit for their participation, and more than 95% of the total number of research participants were enrolled in an introductory psychology course.

Overall, a total of 232 participants were involved in this experiment. However, 94 of the participants were eliminated from the subject pool for the following reasons: 31 for claiming to have more than five parents, 25 for failure to follow directions (i.e., choosing more than one model as a primary model, answering questions they were instructed to omit, etc.), 22 for failure to complete demographic information, nine because they were much older than the general participant population, six due to dishonesty (i.e., claiming to be ambidextrous but marking all right responses to the hand preference items in questionnaire), and one in view of his response that he was not able to remember his experiences in preschool through junior

high. The remaining 138 participants consisted of 66 males and 72 females. Although various races, economic backgrounds, and ages were represented in the sample; the average participant was a 21 year old caucasian from a middle class economic background.

Materials

The materials used in this experiment include the following: a cover letter/informed consent form, writing sample sheet, lined notebook paper, "Questionnaire #1," verbal script, and a General Purpose - NCS - Answer Sheet. The cover letter/informed consent form simply explained that participants had the right to withdrawal from the study without penalty, and briefly described the experiment. The writing sample sheet instructed the participants to copy two paragraphs in cursive on the attached sheet of lined notebook paper. The two paragraphs included every letter of the alphabet and the numbers 0-9, and were used by permission of E. Edward Peeples. "Questionnaire #1" included questions about participants' demographic characteristics, hand preferences, models of handwriting, handwriting instructions, and self-reported complaints from teachers of illegible handwriting (see Appendix A). The verbal script was designed to allow the researcher to do the following: determine who would receive course credit for participating, discover who needed pencils, and answer any questions about the experiment before it began. Also, because the research felt that all participants should have adequate desk space for writing and resting their writing arms, all experimental sessions were carried out in classrooms which did not consist of right-handed biased individual desks (i.e., desks with small surface areas and arm rests located only on the right side). In other words, the

classrooms used consisted of large tables with chairs placed around them or long counter-like tables with chairs mounted in fixed locations along one edge.

Procedure

The researcher began each experimental session by reading the verbal script. After answering questions and distributing pencils, the researcher instructed the participants to begin copying the writing sample. During the experimental session, the researcher and research assistant walked around the room, answering questions and collecting written samples. The researcher also scanned the room for participants who appeared to be struggling with the writing sample. (In one case, the researcher discovered a right handed participant trying to write with his left hand in an attempt to gain multiple course credits for the same experiment.) As each written sample was collected, it was scanned to determine if it included the required two paragraphs. Once all of the written samples were collected, the researcher returned to the front of the room and waited for the participants to turn in their questionnaires. As each General Purpose - NCS - Answer Sheet was collected, the researcher made a visual scan of the answer sheet to see that is was complete. The researcher then thanked each participant and answered any questions they had. After all participants had left, the researcher collected any materials participants left on the tables.

After all the data had been collected, the researcher and research assistant independently compared each writing sample to the Handwriting Scale of the Test of Written Language (TOWL) (Hammill & Larsen, 1983). Each sample was assigned a value from zero to ten based on comparison with five sample paragraphs. After both raters had scored each sample one time, the samples were set aside and later scored

again by both raters. In the end, each handwriting sample was given two ratings by each observer. It should be noted that the only identifying marks on the participants' writing samples were the subject numbers and these numbers did not indicate whether a particular sample was written by a left-handed or right-handed individual. Also, before the researcher and research assistant began rating actual participants' samples, they practiced rating twelve samples included with the TOWL until they were able to score these samples within one point (or standard deviation) of the correct rating (as stated in the TOWL manual).

Besides the four handwriting rankings, two other legibility factors were assessed by the researcher. The researcher analyzed each sample for "common letter malformations" (i.e. "a" written like and "o" or "ci," "l" written like an uncrossed "t") and assigned a score of the total letter malformation errors and the total number of types of errors in each sample. Four instances of each letter that might be malformed were observed to see if any/all of these instances were malformed. Also, a single instance of three numbers was also assessed. Participants received a letter formation error score of 0 through 43 (based on four instances of ten possible letter malformations and one instance each for three possible number malformations). Each participant also received a score from 0-13 based on the number of types of letter malformation errors the participant made.

An additional measure of legibility was built into the questionnaire itself. Participants were asked to indicate if teachers had complained that their handwriting was illegible at any of five educational levels ranging from preschool to college.

## Results

Frequency distributions of the models which subjects ranked in order of importance of teaching them how to write indicated that teachers and parent were the most important models when subjects were learning how to write. Primary models were listed as teachers 48.6%, and parents 42.8%. Secondary models were ranked as parents 44.2%, and teachers 42.0%.

The results of an ANOVA indicated that there was a significant main effect of sex and degree of handedness X observer rating and subject rating of legibility (Signif. of F=.000 & .015 for observer and subject ratings, respectively). However, the sex variable alone accounted for this main effect (Signif. of F=.000 & .001 for observer and subject ratings, respectively). When the sex variable was removed, degree of handedness had no significant relationship with observer rating or subject rating. Cell means for this ANOVA revealed that women write more legibly than men based on both the observer and subject ratings. Thus, the hypothesis that degree of handedness would vary significantly with legibility scores was proven false. Still, since there was no significant relationship between degree of handedness, the second hypothesis that left-handed writers would not have significantly different legibility scores was proven true.

An ANOVA using the paper/pen angle used by subjects X observer rating resulted in a significant difference between the legibility scores received by subjects who used one of the three different models (Signif. of F=.020). However, when subject ratings of legibility were compared to paper/pen angles used by subjects, the results were not significant (Signif. of F=.132). Cell means showed that subjects

who write using an angle paper position and noninverted hand posture had significantly more legible handwriting than that of subjects using an inverted hand posture or a straight paper/wrist posture. This partially failed to support the hypothesis that there would be no significant difference between the legibility scores of inverted and noninverted writers. However, it should be noted that in terms of observer ratings, subjects who used the straight paper/wrist posture did not have significantly better legibility scores than the inverted writers.

ANOVAs comparing the degree of assistance left-handed writers and right-handed writers received with their observer ratings of handwriting were insignificant. However, when comparing the amount of assistance left-handed writers received with subject ratings, results were significant (Signif. of F=.039), and the cell means indicated that having assistance at the halfway point (three of six forms of assistance were given) produced the least legible subject rating of the possible seven levels of help. The levels which fell above and below this level were scored with significantly more legible subject ratings. For right-handed subjects, the comparison with subject ratings was only slightly insignificant (Signif. of F=.113). Thus, the hypothesis that subjects who receive a great degree of assistance will have more legible handwriting was partially supported (especially for left-handed subjects) when the degree of assistance is higher than three (26 of the 30 left-handed writers reported 3 or more forms of assistance, while only four reported two forms of assistance and none reported zero or one form of assistance).

Surprisingly, Evidence of attempts to force subjects to write with a different hand did not decrease (or increase) their legibility rankings significantly.

There was no significant correlation between level of support and either observer or subject rating of legibility. In other words, whether or not left-handed scissors and desks were made available to left-handed students, did not affect their legibility rankings. Whether or not a person printed (instead of writing in cursive) on the writing sample was significantly related to their subject rating (Signif. of F=.072). Interestingly, the subject which printed had lower subject ratings of legibility. When printed versus nonprinted samples were rated by observers, the results were slightly insignificant (Signif. of F=.108), but the sample means indicated that printed subjects were rated as more legible.

Finally, there was no significant relationship between the number of left-handed models a left-handed subject had and their legibility scores.

## Discussion

### Early Analysis

Early factor analysis allowed the researcher to collapse four TOWL Handwriting Scale scores, two different letter formation scores, and five subject-reported legibility complaints into two factors described as observer rating and subject rating. After doing a factor analysis on the various legibility measures taken on each sample, it was discovered that 3 factors accounted for 79.2 % of the variance between samples. Of this, 53.6% could be attributed to Factor 1, 14.7% to Factor 2, and 10.9% to Factor 3. In addition, a rotated factor matrix on the individual components of measured legibility indicated that the components of Factor 1 (TOWL ratings, and types of letter formation errors) were based on observer ratings while the individual components of Factor 2 & 3 (Illegibility complaint totals) were based solely on subject-reported ratings.

A .8832 correlation between the number of types of letter formation errors and the total number of letter formation errors was observed. This led to the researchers decision to consider only the number of types of letter formation errors in further analysis. This letter formation scores was combined with the four TOWL scores to make up Factor 1

Further, the self-reported measure of teacher complaints of legibility problems in junior high correlated poorly with all three factors and was thus eliminated from further analysis. It was noted in the rated factor matrix that subjects tended to group their preschool/Kindergarten legibility ratings with their elementary school legibility ratings, and these correlated well with factor 2 (.8966 and .8456 respectively).

While, self-reported ratings of legibility in high school and college were also highly correlated with factor 3 (.8744 an .7760 respectively) and also grouped together. Because of these groupings, the researcher combined factor 2 and 3 into a single factor based on the self-reported legibility complaints with the exception of junior high complaints which was eliminated.

Testing of Hypotheses

Teachers and parents alike should note the importance they play in teacher children how to write. According to subjects, teachers or parents were their primary models 91.4% of the time, and secondary models 86.2% of the time.

Many of the insignificant results within this data analysis may be partially attributed to the limited sample size. With only 30 left-handed subjects in a pool of 138, many of the results become insignificant when this group of 30 is broken down into smaller groups. For example the ANOVA which assessed the significance of the degree of assistance left-handed writers received broke the left handed population of thirty into five groups (containing, 4, 11, 11, 2, and 2 individuals, respectively). In this case the legibility scores of individuals made up half of the cell mean in the smallest group of two. Therefore, if one score was elevated, it could easily affect the total cell mean. The insignificant correlation between the number of left-handed models a left-handed subject had and legibility scores may have also been affected by the limited sample size.

Sample size may have also affected the ANOVA assessing the significance of printing or nonprinting (although some results were significant). Of 138 subjects, only 11 subjects printed. Subject ratings that showed subject which printed had lower

legibility scores may be explained by teachers in various levels of academia discouraging the use of the printing style and focussing on the cursive style. Observer legibility ranking of the printed samples is also skewed by the fact that the TOWL Handwriting Scale is standardized and designed to test cursive samples only.

The question of the relationship between forced switch attempts and legibility scores could also have affected by sample size. Out of 138 subjects, only 22 indicated that someone had tried unsuccessfully to make them switch writing hands, and only 4 had been successfully forced to switch hands (i.e., they switch hands for writing).

Appendix A

Questionnaire #1

Subject No. _____

Directions: Fill in the appropriate circles on the provided Scantron sheet for each question. Please only select one answer for each question. Also, you **should** fill in "other" or "specify" answers **on** the questionnaire when requested.

Please fill in the appropriate circles for the subject number in the upper left corner of this page in columns N, O, & P in the Special Codes section on the Scantron Sheet.

Next, fill in the appropriate last two digits of the year you were born in the "YR." columns on the Scantron Sheet.

Also, please fill in the appropriate circle to indicate your sex.

Your major is in which College: (Fill in the circle corresponding to the number in parenthesis after the name of your College in the "GRADE or EDUC column of the Scantron Sheet).

Agriculture(0) Business & Administration(1)

Communications & Fine Arts (2) Education(3)

Engineering & Technology(4) Human Resources(5)

Liberal Arts(6) Science(7) Technical Careers(8)

Unsure(9) [specify major: _____]

1) Your year in college:

Freshman(A) Sophomore(B) Junior(C) Senior(D)

Other(E) [specify: _____]

2) Your race/ethnicity: Asian-American(A) African American(B)

Caucasian(C) Hispanic(D)

Other(E) [specify: _____]

Appendix A (continued)

3) Are you an international student? Yes(A) No(B)

4) Please indicate the number that best describes your family's economic status when you were a child.

| Poor | | | | Rich |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

5) You are: Left-handed(A) Right-handed(B) or Ambidextrous(C)

Please indicate the hand you primarily use when you . . .

| | | | |
|---|---|---|---|
| 6) Write a letter | Left(A) | Right(B) | Either(C) |
| 7) Draw a picture | Left(A) | Right(B) | Either(C) |
| 8) Throw ball at target | Left(A) | Right(B) | Either(C) |
| 9) Hold racquet in tennis, racquetball | Left(A) | Right(B) | Either(C) |
| 10) Hold toothbrush | Left(A) | Right(B) | Either(C) |
| 11) Hold knife when cutting something | Left(A) | Right(B) | Either(C) |
| 12) Hold hammer when hitting nail | Left(A) | Right(B) | Either(C) |
| 13) Hold match when striking it | Left(A) | Right(B) | Either(C) |
| 14) Use eraser on paper | Left(A) | Right(B) | Either(C) |
| 15) Take top card of a deck of cards | Left(A) | Right(B) | Either(C) |
| 16) Hold thread when threading needle | Left(A) | Right(B) | Either(C) |
| 17) Hold fly swatter | Left(A) | Right(B) | Either(C) |

Rank order the following list of people based on how helpful they were in teaching you how to write. (i.e. each number between 1 and 4 is assigned to one person. The number 1 indicates the person who helped you learn how to write more than any other person, 4 indicates the person who was the least helpful.)

| | Rank | |
|---|---|---|
| 18) | ___ | Your Brother(s)/Sister(s) |
| 19) | ___ | Your Parent(s) |
| 20) | ___ | Your Teacher(s) |
| 21) | ___ | Your Other [Specify: _____] |

Appendix A (continued)

Indicate how many of the following people primarily write with their **left** hand when writing on a piece of paper. (If none, leave blank. If 5 or more, fill in the circle for 5)

22) Your Brother(s)
23) Your Sister(s)
24) Your Mother/Stepmother
25) Your Father/Stepfather
26) Your Teachers in elementary school (please estimate if unsure)
27) Other model referred to in question #21.

Indicate how many of the following people primarily write with their **right** hand when writing on a piece of paper. (If none, leave blank. If 5 or more, fill in the circle for 5)

28) Your Brother(s)
29) Your Sister(s)
30) Your Mother/Stepmother
31) Your Father/Stepfather
32) Your Teachers in elementary school (please estimate if unsure)
33) Other model referred to in question #21.

For the following five educational levels if any instructor(s) said s/he had difficulty reading your handwriting mark choice A, if not mark choice B.

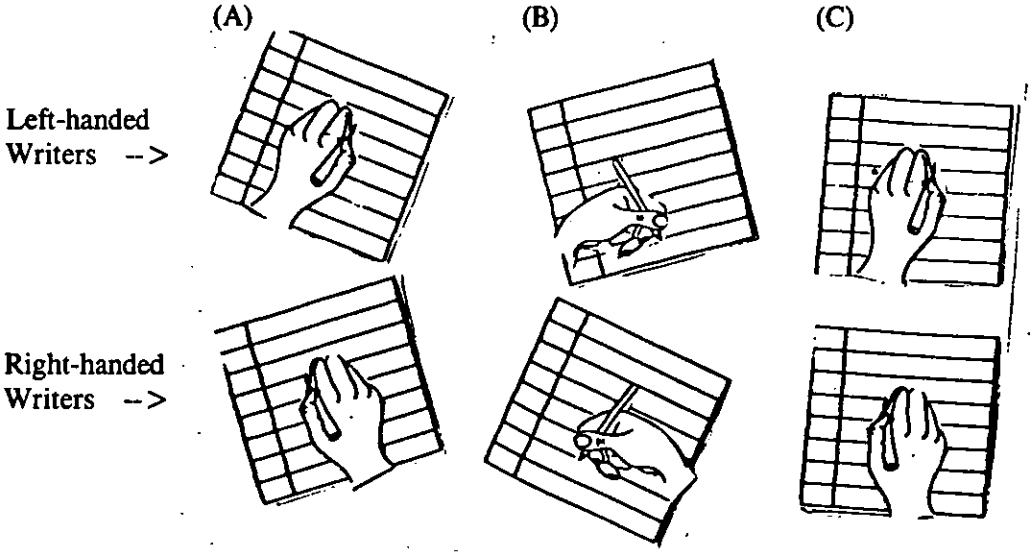
| | Instructor(s) had difficulty reading handwriting | |
|---|---|---|
| 34) Preschool/Kindergarten | Yes(A) | No(B) |
| 35) Elementary (Grades 1-6) | Yes(A) | No(B) |
| 36) Junior High (Grades 7-8) | Yes(A) | No(B) |
| 37) High School (Grades 9-12) | Yes(A) | No(B) |
| 38) College | Yes(A) | No(B) |

39) Did any of your writing models/teachers show you how to place your paper at a specific angle?

Yes(A) No(B)

Appendix A (continued)

40) If you answered "Yes" to question #39, which of the drawings below best represents the angle suggested by your primary model (ranked 1 in questions #18-21)? (If you answered "No" to question #39, fill in the circle for choice D)




41) Using the **above** drawings as a guide, which choice represents the angle you usually place your paper in before writing on it? (Note: this may or may not be a different choice than you selected in question #40.)

42) Did any of your writing models/teachers put tape on your desk to indicate a proper paper position?

Yes(A) No(B)

43) Did any of your writing models/teachers show you how to hold your pen/pencil in a specific angle when writing?

Yes(A) No(B)

44) Were left-handed scissors provided for the left-handed students in your elementary school?

Yes(A) No(B)

45) Were right handed scissors provided for the right-handed students in your elementary school?

Yes(A) No(B)

Appendix A (continued)

46) Did any of your writing models (including parents/brothers/sisters and teachers) ever try to make you switch writing hands? (i.e. try to make you write with your right hand instead of your left or try to make you write with your left hand instead of your right)

Yes(A) No(B)

47) If you answered "Yes" to question #46, do you currently write using the hand your model suggested?

Yes(A) No(B) Not applicable(C)

Questions #48-55 are to be answered by participants who write with their left hands.

Questions #56-57 are to be answered by ALL participants.

Were left-handed desks (with an arm rest on the left side when sitting down) and/or "rectangular top" (with a rounded rectangle desktop) desks made available to you in more than half of your classrooms at the following grade levels?

48) Preschool/Kindergarten Yes(A) No(B)
49) Elementary (Grades 1-6) Yes(A) No(B)
50) Junior High (Grades 7-8) Yes(A) No(B)
51) High School (Grades 9-12) Yes(A) No(B)
52) College Yes(A) No(B)

53) When you began learning how to write (most likely in early elementary school) were you ever grouped with other left-handed writers during writing instruction?

Yes(A) No(B)

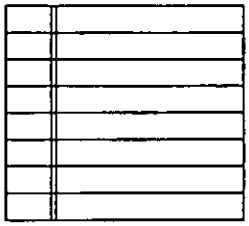
54) Were you provided with a sample of the alphabet written in cursive by a left-handed writer?

Yes(A) No(B)

Appendix A (continued)

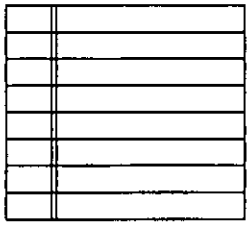
Below is a drawing of a typical spiral notebook and left-handed spiral notebook.

Standard Notebook



spiral -->

Left-handed Notebook



<-- spiral

55) Have you ever purchased a spiral notebook for left-handed writers?

Yes(A) No(B)

56) Did you feel that the researcher was asking you to remember too far into the past?

Yes(A) No(B)

57) If you answered "Yes" to question #56, what is the farthest educational level you can remember back to:

Preschool/Kindergarten(A) Elementary(B) Junior High(C)

High School(D) College(E)

**Thank you for your participation. Please give this questionnaire to the researcher.**

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