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The Frequency of Occurrence of Specific Handwriting Characteristics within a Limited Population

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This study was designed to determine how frequently a specific population continues to use the class characteristics of certain cursive words, numbers, or letter combinations from the learned copybook style or the frequency at which the population deviates from that copybook style. Nine different elements were evaluated, including three words, two numbers, two capital letters, and two letter combinations. For each of the nine elements, three to five class characteristics were classified according to the copybook style and a side by side comparison was conducted to determine if a research participant within the population studied retained the characteristics taught to them, or if they deviated from that style. The results were tabulated and calculated to determine the frequency with which the participants used or did not use the copybook style five years after graduating from high school.

Introduction

In 2009, Marie Durina from the San Diego County Sheriff's Department Crime Laboratory presented a paper entitled, "The Determination of Authorship from a Homogenous Group of Writers" to the American Society of Questioned Document Examiners. The paper was written to address the criticisms questioning the validity of the studies done by document examiners involving error rates and the uniqueness of handwriting. The criticisms specifically referenced the size of the population utilized, the type of exemplar samples employed, and the comparison methods used, such as computer programs. Upon reading Durina's research, this writer felt a comparative examination in addition to a statistical analysis would further strengthen the field of research in the area of forensic document examination.

The term "population" is a statistical term for the "entire finite or infinite aggregate from which samples are drawn" and for the purpose of this paper will refer to the group of research participants from whom samples were acquired.

Materials and Methods

The copybook referred to in this research, titled "*A Reason for Handwriting Student Workbook (Transition)*"[3], is published by The Concerned Group, Inc© of Siloam Springs, Arkansas and is an updated version of the copybook used to teach cursive to the population group. The company indicated that no changes to its cursive alphabet have occurred. This copybook utilizes the Palmer Method of cursive handwriting. The specific population used was a grade school class who were taught cursive in the second through fourth grade in the years 1994-1997. For the purposes of this paper, the population can be equated to a control group, as all of the participants were taught from the same copybook, by the same teachers, in the same years, and at the same school. Of the 44 members of this original handwriting class, 21 opted to participate in the experiment and were sent a research packet, and 17 actually returned the packets in time to be used in the research. The population in this case is admittedly small compared to other statistical research experiments; however, to find a population group at the disposal of the author who all share a common handwriting background, as this control group did, would be very difficult.

A five-page research packet was sent to the participating population members and instructions were given to complete it in only cursive handwriting. No hand printing was used in this study, if present, and all of the writing was considered requested writing. This packet included two

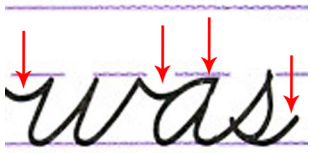
standard warm-up sheets; a paragraph designed to contain all uppercase letters, all lowercase letters, and 0-9 numerals; as well as two optional questions inquiring about the participant's personal experiences with handwriting and gauging its importance in today's classrooms.

Once the packets were returned, each page was scanned and filed according to the participant's name. Seventy-one pages in the copybook containing cursive handwriting were also scanned and filed. Using the Write-On® program, all the copybook pages and six participants' packets were transcribed and saved into the program. Using the program's index list of words or segments, the nine elements were chosen based on both their frequency of use and their availability in the copybook. For example, the word "Louisiana" was written extensively in the participants' packets as it indicated where most of the participants resided; however, it was not found in the copybook to be compared so it was not chosen. The nine elements consisting of words, numerals, capital letters, and lowercase letter combinations allowed for enough diversity to ensure that the research was not limited by only one set of letter forms. Once the nine elements were chosen, a spreadsheet was created listing the participant name and the class characteristic to be observed. Each element had three to five class characteristics based on a study of the copybook's model of the element. A list of the nine elements and the detailed character classifications are listed in Figures 1-9. Each element and classification with subsequent data can be found in Tables 1-9.

Figure 1 Description of class characteristics observed in the exemplars for "from".

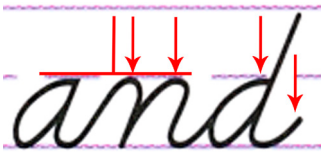
1. Does the ascending retrace of the lower half of the "f" meet the staff on the baseline?
2. Does the lowercase "r" have a bridge on top? The bridge can be defined as an evident line connecting the ascending and descending strokes of the "r"
3. Does the "o" have a counter clockwise retrace as a beginning stroke?
4. Does the ending stroke of the "m" progress upwards, away from the baseline?

Figure 2 Description of class characteristics observed in the exemplars for "was".



1. Does the "w" have a beginning stroke?
2. Is a connecting stroke present between the "w" and the "a"?
3. Does the "a" have a counterclockwise retrace beginning stroke? If there is no connecting stroke present, then the variation was considered to be not following the copybook style.
4. Does the ending stroke of the "s" progress upwards, away from the baseline? If there is a letter connected to the s, the characteristic was not considered in the comparison, such as the word "wasn't"

Figure 3 Description of class characteristics observed in the exemplars for "and".



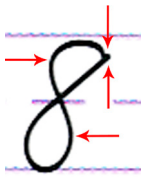
1. Is the height of the "a" and the "n" the same? Does the "n" have two proportional, rounded hump formations?
2. Does the "d" have a counterclockwise retrace outlining the bowl, without going into the bowl? If no connecting stroke exists between "n" and "d", then the variation was considered to be not consistent with the copybook style.
3. Does the ending stroke of the "d" progress upwards, away from the baseline?

Figure 4 Description of class characteristics observed in the exemplars for "2".

1. Is the copybook style formation of the "2" made with a flat bottom and with a caned staff?

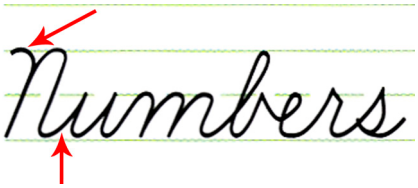
2. Is the flat or curly bottom parallel to and sitting on the baseline?
3. Is the beginning stroke a curved "candy cane" or is it cornered, resembling a "7"?

Figure 5 Description of class characteristics observed in the exemplars for "8".



1. Does the beginning stroke start on the right side, curving upward toward the left and then descending toward the right?
2. Does the end stroke ascend from the left to meet the beginning stroke on the right side of the number? If the end stroke is connected to next number, then the variation was considered to be not consistent with the copybook style.
3. Are the bowl sizes proportional?
4. Is the "8" created from two spherical strokes touching in the middle?

Figure 6 Description of class characteristics observed in the exemplars for "N".

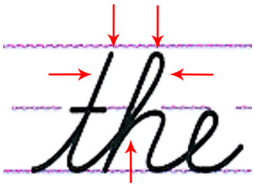


1. Is the copybook cursive formation of the capital "N" present, i.e. a one-stroke letter beginning with a descending staff, retracing back up the staff and making a large arch to the right?
2. Is the beginning stroke a curved "candy cane" staff?
3. Is a connecting stroke present when the capital "N" is within a word? If it stands as a single letter, not within a word, it was not considered in the comparison.

Figure 7 Description of class characteristics observed in the exemplars for "F".

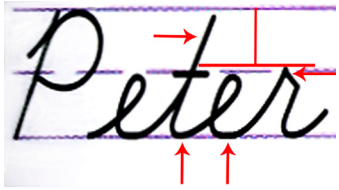
1. Is the copybook cursive formation of the capital "F" present, i.e. a letter beginning with a descending staff curving into a boat at the bottom left with a hat and crossbar?
2. Is the hat a separate, curved stroke?
3. Is the boat formed as a continuation of the beginning stroke starting from the baseline and curving upward to the left and then extending toward the right, ending before crossing the staff?
4. Are there 3 strokes employed? If it is a print "F", then the variation was considered to be not consistent with the copybook style.
5. Is there a lack of connecting stroke when the "F" is within a word? If it stands as a single letter not within a word, it was not considered in this comparison. If it is a print "F" and it was connected, it was considered a connection.

Figure 8 Description of class characteristics observed in the exemplars for "th".



1. Are the heights of the "t" and the "h" the same?
2. Is there an ascending loop on the "h"?
3. Is the arch of the "h" attached to the staff? If the arch is absent, then the variation was considered to be not consistent with the copybook style.
4. Is the "t" a retrace or a loop?

Figure 9 Description of class characteristics observed in the exemplars for "ter".



1. Is the height of the "t" taller than the "er"?
2. Is the "t" a retrace or a loop?
3. Does the lowercase "r" have a bridge on top?
4. Do the connecting strokes touch and are they in alignment with the baseline? If only 1 of the 2 connecting strokes is in baseline alignment, then the variation was considered to be not consistent with the copybook style.

Adobe Photoshop CS2® and the Write-On® program were used to group the nine elements for each participant. After grouping the elements, a packet containing all the elements from each participant's known writing was created to allow the researcher to easily look for each characteristic among that participant's element group. Each characteristic was compared independently.

Results

Guide to the Tables - In Tables 1-9, all 17 participants are listed in the 1st column with all subsequent columns containing the occurrences of each element. To calculate the relative frequency of occurrence of each characteristic for each of the nine elements, the number of the correct displays of each characteristic (F) was divided by the total number of occurrences (N). For example, looking at Table 8, if Participant 9's exemplars exhibited the presence of the retrace of the letter "t" in the letter combination "th" twenty-two times, but had a total number of twenty-seven separate "th" combinations, the characteristic would be designated as following the copybook style 22/27 times. This indicates that 5 out of 27 times the "t" made a loop instead of a retrace, a characteristic varying from the copybook model.

Calculations & Methodologies - Upon completion of the comparison for each element per person, the frequencies of occurrence were entered into a table according to each element (see Tables 1-9). The totals displayed at the bottom of each table refer to the total frequency of the participants retaining the copybook model characteristic. Therefore, using Table 1 "from" as an example, it was observed that 17 participants wrote the word "from" a total of 39 times. However, looking only at the first characteristic – placement of the "f" on the baseline – we see that only 5 people placed the cursive "f" on the baseline properly and only 8 times. Using the formula for relative frequency*[4] :

(Number of non-variations) / (total number of occurrences of non-variations + variations)

8/ (31+8) = 0.205 or 20.5%.

In the example above, the subjects only retained the copybook style characteristic 20.5% or about 1 out of every 5 times the word "from" was used. Looking at all four characteristics classified and using the multiplication rule to find the probability that two or more independent events❑ will occur, the frequency of one of the participants writing the word "from" like the copybook model is (0.205)*(0.179)*(0.513)*(.487) = 0.0092 * 100 = 0.92% or about 1%. That is to say, that they will only write the word "from" according to the copybook style, i.e. placing the "f" correctly on the baseline, making the correct letter formation of the "r", retracing the "o" in the counterclockwise direction, and having the ending stroke of the "m" move in an upward direction to the right, only about 1% of the time. Given that these are all class characteristics, the combination of all class and individual characteristics one encounters when evaluating questioned handwriting would make the amount of variation from the copybook style exponential. One can find the probabilities for each of the nine elements in their respective chart as the last line. If one were to multiply the total probabilities of each of those nine elements and their characteristics together (6):

(0.0092)*(0.0184)*(0.0105)*(0.0757)*(0.0403)*(0.044)*(0.00534)*(0.0442)*(0.0955) = 5.38xE-15 or 0.00000000000000538 or 1:185,873,605,947,955.39 odds or about 1 out of 185 trillion odds that a research participant within this population will write all nine elements correctly according to only a few of the class characteristics described in the copybook.

Each character observed in the nine elements was treated as being independent from other characteristics. The order that the letter combinations, "th" and "ter" were placed in a word was not considered of value in this study. The characteristics for those two elements were chosen based on their presence no matter where they were placed within a word.

Note: For Table 5: "8", the last characteristic observed was whether the participant used a different form of "8", specifically a two stroke form, where two circles are drawn on top of each other. About 85% of participants use a 2 stroke 8, deviating from the copybook style of a one stroke "8", approximately 85% of the time. This percentage was not used in the final calculation because it was a percentage of a deviation, not the percentage of the correct formation of the "8" found in the copybook model. The reader may

* The relative frequency calculation was completed for each characteristic of each element and can be found in Tables 1-9.

❑ The Multiplication Rule can be defined as "the probability that two or more independent events will occur is equal to the product of their individual probabilities"[3].

consider the data interesting but superfluous for the purpose of this study.

Conclusion

When describing the formative years of handwriting, many document examiners refer to the copybook as the primary source of handwriting instruction. They describe how, when students are first beginning to learn to write, most use a copybook to record line after line of letters and words. Making all the uppercase letters the same height, writing all the lowercase letters up to the mid-line, placing all the letters on the baseline became a repetitive activity that allowed the hand muscles and minds of the young students to learn how to control the handwriting to a legible

"from"	*1. Placement of "f" on baseline*	*2. Presence of "r" bridge*	*3. Counter-clockwise retrace of "o"*	*4. Ending stroke on "m"*
Participant 1	0/2	2/2	1/2	0/2
Participant 2	0/2	0/2	1/2	2/2
Participant 3	1/2	0/2	2/2	0/2
Participant 4	0/2	2/2	0/2	2/2
Participant 5	1/2	0/2	0/2	2/2
Participant 6	0/3	0/3	3/3	3/3
Participant 7	0/2	0/2	0/2	0/2
Participant 8	0/4	0/4	0/4	3/4
Participant 9	0/2	2/2	2/2	2/2
Participant 10	0/3	0/3	3/3	0/3
Participant 11	1/3	0/3	0/3	0/3
Participant 12	2/2	0/2	2/2	1/2
Participant 13	0/2	0/2	2/2	0/2
Participant 14	0/1	1/1	1/1	0/1
Participant 15	3/3	0/3	3/3	0/3
Participant 16	0/2	0/2	0/2	2/2
Participant 17	0/2	0/2	0/2	2/2
Total F/N	8/39 = 0.205	7/39 = 0.179	20/39 = 0.513	19/39 = 0.487
Probability that all four characteristics would be found in "from":				
(0.205)*(0.179)*(0.513)*(0.487) = 0.0092 * 100 = 0.92%				

Table 1 "from" The frequency of correct display of characteristic/Number of occurrences (F/N).

"was"	*1. Presence of beginning stroke on "w"*	*2. Connecting stroke between "w" and "a"*	*3. Counter-clockwise retrace of "a"*	*4. Ending stroke on "s"*
Participant 1	0/3	2/3	2/3	2/3
Participant 2	4/4	1/4	1/4	1/4
Participant 3	0/6	0/6	0/6	0/6
Participant 4	2/3	3/3	0/3	2/3
Participant 5	2/4	0/4	0/4	0/4
Participant 6	0/3	3/3	3/3	2/3
Participant 7	0/3	0/3	0/3	0/3
Participant 8	2/4	0/4	0/4	0/4
Participant 9	5/5	5/5	5/5	5/5
Participant 10	3/6	6/6	6/6	0/6
Participant 11	0/6	0/6	0/6	3/6
Participant 12	0/3	3/3	3/3	1/3
Participant 13	0/3	3/3	3/3	0/3
Participant 14	0/4	2/4	0/4	4/4
Participant 15	0/3	3/3	3/3	3/3
Participant 16	0/5	0/5	0/5	0/5
Participant 17	0/4	2/4	0/4	4/4
Total F/N	18/69 = 0.261	33/69 = 0.478	26/69 = 0.377	27/69 =0.391
Probability that all four characteristics would be found in "was":				
(0.261)*(0.478)*(0.377)*(0.391) = 0.0184 * 100 = 1.84%				

Table 2 "was" The frequency of correct display of characteristic/Number of occurrences (F/N).

"and"	*1. Same height for "a" and "n"*	*2. Full Formation of "n"*	*3. Counter-clockwise retrace of "d"*	*4. Ending stroke on "d"*
Participant 1	3/3	0/3	1/3	1/3
Participant 2	1/4	0/4	0/4	1/4
Participant 3	0/2	0/2	0/2	0/2
Participant 4	1/1	0/1	0/1	1/1
Participant 5	2/2	1/2	0/2	0/2
Participant 6	2/6	0/6	6/6	3/6
Participant 7	0/1	0/1	0/1	0/1
Participant 8	2/3	0/3	0/3	2/3
Participant 9	0/1	0/1	0/1	0/1
Participant 10	2/9	1/9	9/9	1/9
Participant 11	3/5	1/5	0/5	4/5
Participant 12	0/1	1/1	0/1	1/1
Participant 13	2/2	1/2	1/2	0/2
Participant 14	2/3	0/3	0/3	3/3
Participant 15	1/4	0/4	4/4	0/4
Participant 16	2/5	3/5	4/5	1/5
Participant 17	2/2	0/2	0/2	0/2
Total F/N	25/54 =0.463	8/54 = 0.148	25/54 = 0.463	18/54 = 0.333
Probability that all four characteristics would be found in "and":				
(0.463)*(0.148)*(0.463)*(0.333) = 0.0105 * 100 = 1.05%				

Table 3 "and" The frequency of correct display of characteristic/Number of occurrences (F/N).

"2"	*1. Copybook Formation*	*2. Baseline Alignment*	*3. Caned beginning stroke*
Participant 1	0/8	2/8	8/8
Participant 2	1/3	1/3	3/3
Participant 3	8/8	0/8	7/8
Participant 4	0/7	2/7	7/7
Participant 5	0/6	2/6	6/6
Participant 6	2/10	1/10	9/10
Participant 7	0/7	2/7	7/7
Participant 8	14/14	0/14	2/14
Participant 9	8/8	0/8	7/8
Participant 10	7/7	0/7	6/7
Participant 11	3/10	3/10	8/10
Participant 12	9/9	3/9	9/9
Participant 13	2/10	0/10	9/10
Participant 14	12/12	2/12	9/12
Participant 15	0/9	3/9	9/9
Participant 16	6/7	2/7	6/7
Participant 17	9/9	0/9	9/9
Total F/N	81/144 = 0.563	23/144 = 0.16	121/144 = 0.840
Probability that all three characteristics would be found in "2":			
(0.563)*(0.160)*(0.840) = 0.0757 * 100 = 7.57%			

Table 4 "2" The frequency of correct display of characteristic/Number of occurrences (F/N).

"8"	*1. Placement of beginning stroke*	*2. Placement of ending stroke*	*3. Proportional bowl size*	*4. 2 stroke "8"*
Participant 1	0/7	0/7	5/7	7/7
Participant 2	0/7	0/7	0/7	7/7
Participant 3	12/12	12/12	1/12	No
Participant 4	7/7	7/7	6/7	No
Participant 5	7/7	1/7	1/7	No
Participant 6	6/9	1/9	2/9	No
Participant 7	7/8	6/8	3/8	1/8
Participant 8	2/8	2/8	0/8	6/8
Participant 9	7/8	7/8	3/8	No
Participant 10	0/8	0/8	4/8	8/8
Participant 11	0/7	0/7	0/8	8/8
Participant 12	5/8	3/8	4/8	No
Participant 13	0/9	0/9	1/9	7/9
Participant 14	0/6	0/6	1/6	6/6
Participant 15	0/6	0/6	2/6	6/6
Participant 16	1/9	0/9	7/9	8/9
Participant 17	8/8	0/8	0/8	No
Total F/N	62/134 = 0.463	39/134 = 0.291	40/134 = 0.299	64/76 =0.842
Probability that all three characteristics would be found in "8" (Did not include the fourth characteristic; see Discussion of Results below):				
(0.463)*(0.291)*(0.299)= 0.0403* 100 = **4.03%**				

Table 5 "8" The frequency of correct display of characteristic/Number of occurrences (F/N).

"N"	*1. Copybook Formation*	*2.Copybook style beginning stroke*	*3. Presence of connecting stroke*
Participant 1	6/6	0/6	2/6
Participant 2	3/3	0/3	3/3
Participant 3	2/3	0/3	1/3
Participant 4	7/7	0/7	7/7
Participant 5	5/5	5/5	4/5
Participant 6	4/4	4/4	4/4
Participant 7	3/6	0/6	3/6
Participant 8	4/7	0/7	4/7
Participant 9	7/7	0/7	6/7
Participant 10	2/4	0/4	2/4
Participant 11	4/4	0/4	2/4
Participant 12	7/7	0/7	5/7
Participant 13	0/6	0/6	3/6
Participant 14	4/4	0/4	2/4
Participant 15	0/5	0/5	0/5
Participant 16	6/6	0/6	5/6
Participant 17	8/11	0/11	5/11
Total F/N	72/95 = 0.758	9/95= 0.095	58/95 = 0.611
Probability that all three characteristics would be found in "N":			
(0.758)*(0.095)*(0.611) = 0.044 * 100 = **4.40%**			

Table 6 "N" The frequency of correct display of characteristic/Number of occurrences (F/N).

"F"	*1. Letter formation*	*2. Presence of curved hat*	*3. Boat formation*	*4. Use of three strokes*	*5. Lack of connecting stroke*
Participant 1	3/7	0/7	0/7	1/7	7/7
Participant 2	0/4	0/4	0/4	0/4	3/4
Participant 3	4/4	3/4	3/4	4/4	4/4
Participant 4	9/9	9/9	0/9	2/9	0/9
Participant 5	0/8	0/8	0/8	0/8	8/8
Participant 6	5/8	5/8	0/8	5/8	2/8
Participant 7	8/8	0/8	0/8	0/8	8/8
Participant 8	0/3	0/3	0/3	0/3	2/3
Participant 9	12/12	12/12	9/12	12/12	10/12
Participant 10	0/9	0/9	0/9	0/9	9/9
Participant 11	2/7	2/7	0/7	2/7	2/7
Participant 12	10/10	10/10	0/10	10/10	0/10
Participant 13	1/4	1/4	0/4	1/4	3/4
Participant 14	3/3	0/3	0/3	0/3	3/3
Participant 15	12/12	0/12	0/12	12/12	12/12
Participant 16	9/9	0/9	0/9	0/9	0/9
Participant 17	8/8	0/8	0/8	0/8	6/8
Total F/N	86/125 = 0.668	42/125 = 0.336	12/125 = 0.096	49/125 = 0.392	79/125 = 0.632
Probability that all five characteristics would be found in "F":					
(0.668)*(0.336)*(0.096)*(0.392)*(0.632) = 0.00534* 100 = 0.534%					

Table 7 "F" The frequency of correct display of characteristic/Number of occurrences (F/N).

"th"	*1. Height of "t" and "h" the same*	*2. Loop on "h"*	*3. Arch attached to staff of "h"*	*4. Retrace of "t"*
Participant 1	6/29	25/29	29/29	16/30
Participant 2	8/32	0/32	27/32	29/32
Participant 3	0/27	8/27	11/27	27/27
Participant 4	16/21	21/21	18/21	16/21
Participant 5	12/26	3/26	7/26	16/26
Participant 6	12/35	4/35	0/35	24/35
Participant 7	11/32	2/22	12/32	32/32
Participant 8	3/26	1/26	5/26	23/26
Participant 9	12/27	27/27	27/27	22/27
Participant 10	12/33	2/33	20/33	23/33
Participant 11	8/37	21/37	28/37	36/37
Participant 12	9/24	24/24	12/24	20/24
Participant 13	0/28	7/28	11/28	24/28
Participant 14	1/26	25/26	24/26	17/26
Participant 15	0/25	25/25	7/26	0/26
Participant 16	12/22	3/22	2/22	15/22
Participant 17	6/27	8/27	15/22	0/22
Total F/N	128/477 = 0.268	206/477 = 0.432	255/477 = 0.535	340/477 = 0.713
Probability that all four characteristics would be found in "th":				
(0.268)*(0.432)*(0.535)*(0.713) = 0.0442 * 100 = **4.42%**				

Table 8 "th" The frequency of correct display of characteristic/Number of occurrences (F/N).

"ter"	*1. "t" taller than "er"*	*2. Retrace on "t"*	*3. Formation of "r"*	*4. Connecting strokes on baseline*
Participant 1	7/7	4/7	7/7	3/7
Participant 2	6/6	4/6	4/6	4/6
Participant 3	4/8	7/8	2/8	2/8
Participant 4	7/7	7/7	6/7	1/7
Participant 5	5/5	5/5	0/5	3/5
Participant 6	5/5	1/5	0/5	2/5
Participant 7	3/5	4/5	0/5	0/5
Participant 8	3/3	3/3	1/3	0/3
Participant 9	9/9	7/9	3/9	8/9
Participant 10	9/9	6/9	2/9	4/9
Participant 11	6/6	6/6	0/6	1/6
Participant 12	6/6	6/6	0/6	2/6
Participant 13	6/6	5/6	0/6	0/6
Participant 14	6/6	2/6	4/6	4/6
Participant 15	5/5	5/5	0/5	3/5
Participant 16	8/8	7/8	2/8	5/8
Participant 17	5/5	5/5	0/5	4/5
Total F/N	100/106 =0.943	84/106 = 0.792	31/106 = 0.292	46/105 = 0.438
Probability that all four characteristics would be found in "ter":				
(0.943)*(0.792)*(0.292)*(0.438) = 0.0955 * 100 = ***9.55%***				

Table 9 "ter" The frequency of correct display of characteristic/Number of occurrences (F/N).

degree. Chosen because of their collective formative years of handwriting, the population used in this research was treated as a control group because they shared a common background in handwriting, including being taught in the same school, with the same teachers, with the same copybook, and at the same time. The copybook used for that class employed the Palmer Method and required the students to write the letters, numbers, and words repetitively looking to the model at the beginning of each page or line to represent the "correct" way of writing according to that copybook's style (Attachment 2). This allowed the author to objectively observe the handwriting characteristics to determine whether the group did retain a significant percentage of the copybook style they were taught.

As one can see from the data represented above, the frequency of occurrence of characteristics written in the copybook style is exponentially low (approximately 1 in 185 trillion odds), and therefore, so is the probability that an individual within a small population would follow the class characteristics taught in the copybook. In other words, the possibility that any of the participants studied would write like each other or even use the same combination of class characteristics that they were taught is also exponentially low. The intent of this research is to demonstrate one of the theories of forensic handwriting examination: given sufficient quality and quantity of handwriting for assessment, no two writers are found to posses the same combination of handwriting characteristics. This research strengthens

that theory. This would verify that even if two writers were taught with the same copybook, with the same teacher, in the same school, at the same time, it can most likely be shown that each individual's handwriting has enough variations from each other and from the learned copybook style to be identifiable.

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References

[1] Durina, Marie E. (2009) The Determination of Authorship from an Homogenous Group of Writers. Presented at the American Society of Questioned Document Examiners. Dearborn, MI; August, 2009.

[2] Population. (n.d.). Collins English Dictionary - Complete & Unabridged 10th Edition. Retrieved March 04, 2011, from Dictionary.com website: http://dictionary.reference.com/browse/population.

[3] A Reason for Handwriting Student Workbook (Transition), The Concerned Group, Inc. Siloam, Springs, AR 2004. pp. 105-176.

[4] Nelson, Keith (1993) Technical Summary CILD-27, The Theory of Probability, U.S. Army Crime Laboratory.

[5] Way, Annette, et al (2010) Frequency Occurrence of Variation as a Tool for (Dis) Association of Handwriting. Presented at the Southeastern Association of Document Examiners. Duluth, GA; April 2010.

[6] Muehlberger, R.J., et al (1976) A Statistical Examination of Selected Handwriting Characteristics, Journal of Forensics Science, Vol. 22, No. 1. January 1977, pp. 206-215.

[7] Miller, J.T. (1972) Departure from Handwriting System, Journal of Forensic Science, Vol. 17, No. 1, January 1972.

[8] Nelson, Thomas A. (2002) Farm Animals & Forensics: What Are the Odds? Presented at Midwestern Association of Forensic Sciences. Milwaukee, WI; September 2002.

[9] Zimmerman, J. (1998) Counting handwriting characteristics, International Journal of Forensic Document Examiners, Vol. 4, pp. 318-322.

Attachment 1

The following is a copy of the research packet sent to the participants to complete and send back.

Greetings Everyone,

Thank you again for participating in my research project as a part of my training to become a Forensic Document Examiner for the Florida Department of Law Enforcement's Questioned Document Section. The forensic discipline of Questioned Documents is the practice of applying scientific investigation to items associated with criminal acts involving documents, handwriting, and/or instruments that create or alter documents/handwriting. For example, we work with cases including bank robberies, threats, and death investigations.

Included in the packet are two warm-up forms (pages 1 and 2) designed to help the examiner learn a little about the handwriting of the subject including which hand you often use, whether or not you wear glasses, and also to help "warm-up" your hand for the task ahead. On page 3 is a paragraph for you to copy on the ruled lines provided. Pages 4 and 5 have optional questions for you to answer about your handwriting experiences. Please feel free to write anything significant that comes to mind about learning to write, the class, instruction, or copybook used.

As promised, the following will take you approximately 30 minutes to finish. I have enclosed a self-addressed, stamped envelope for you to mail back the packet when it is completed. Please complete this task in a comfortable upright seated position. Also, please use the same pen throughout and write in cursive as that is the specific method of handwriting I need for the project.

Please email me at katesavoie@fdle.state.fl.us or call (850) 595-2115 if you have any questions. I would like to note that your name and any other information you provide will be completely confidential and will not be published at the completion of the project. Thank you for your assistance and I hope everyone is doing well.

Best Regards,

Kate Savoie
Crime Laboratory Analyst

Handwriting Warm-Up Sheet

Full Name _____

Address _____

Date of Birth _____ Place of Birth _____

Level of Education _____ Occupation _____

Present Employer _____

1. Which hand do you normally write with? _____
2. Can you write with both hands? _____
3. Have you had any illnesses or injuries which may affect your writing? If so, explain.

_____

4. Do you wear glasses? _____ If so, are you wearing them now? _____
5. Do you write more often in cursive or hand printing or a combination of both? _____
6. Who taught you cursive handwriting? _____
7. How old were you/which grades were you in when you learned cursive handwriting? _____

By signing below, you are granting Kate Savoie permission to use your handwriting exemplars as a part of a research project that may be published. No private information such as names, addresses, etc. listed above will be published. Thank you for your participation.

_____ _____

Signature Date

Handwriting Warm-Up Sheet

Name	Albert Charles Bagley
Address	Elizabeth H. Dickerson
City, State, Zip	Harry George Fredericks
Place of Birth Date of Birth	Irving K. Littlejohn, Jr.
Age Sex	Catherine Lee Jefferson
Handedness	Mrs. Nancy Gail McIntyre
Place of Employment (or last employment)	Phillip Max O'Donnell
Occupation or Trade	Roberta Candice Quincy
Write the following words and names in the space provided	Trixie Ann Smithfield
One Two Three Four	Frank B. Youngblood, Sr.
Five Six Seven Eight	Mr. Ralph Winston Upshaw
Nine Ten Twenty Thirty	José Xavier Vasquez
Forty Fifty Sixty Hundred	Peggy Kay Zimmerman
Cash Deposit Charge	12875 North Beachwood Ave.
Sincerely, Love, Truly yours,	34690 West Cervantes St.

Signature with Right Hand	Date
Signature with Left Hand	Date

July 17, 2010 - The Bronx Zoo in New York held a contest sponsored by Papa Vick Pizza Quick to name their new male Rhinoceros who was born on June 24th. Most of the area schools and youth organizations sent in their votes. It came down to the final 3 names: St. Josephine School for Young Women entered the name "Anthony" after the patron saint of animals. Xavier University voted for "Oscar" after the well-known circus Rhinoceros from Hampton, Connecticut who could balance a 6-foot turquoise Statue of Liberty on his head. "Deimos" the Greek god of Fear was chosen by Boy Scout Troop 9865 from East Kent. Over 3784 votes were cast on Friday afternoon. Boy Scout Troop 9865's choice, "Deimos" won with 47% of the vote. All was well on Saturday as Deimos the Rhinoceros hosted the boys as they ate pizza while watching the young rhino play quietly in his pen.

Please use the space below to describe anything significant that you remember about handwriting class, specifically learning cursive. For example: Was it more difficult for you to learn cursive than hand printing? Why? What do you remember as being the most difficult letter or letter connection to make in cursive?

Currently there is a trend of schools no longer teaching handwriting or decreasing the time spent on it in class, do you believe that handwriting (including cursive should still be taught in schools?

Attachment 2

The following is a sample from the copybook, **A Reason for Handwriting: Transition**.