A Study on the Influence of Wearing a Glove on Handwriting by Chinese in Hong Kong

Yau-Sang Patrick Cheng

Forensic Handwriting and Document Examination Services Ltd. 2C, Tuen Mun Court, No. 2 Tsing Yung Street, NT, Hong Kong

A person's writing might be affected by a number of factors. These factors could be internal or external. This paper investigates the effects of wearing a glove when writing English cursive and block letters, Arabic numerals, Chinese, and when drawing geometric figures. Three types of gloves were chosen for the study: disposable glove, thin cotton glove, and thick cotton glove. Writing characteristics, line quality, and fluency of writing were not affected to any appreciable extent by the wearing of the 3 types of gloves. However, the influence of glove wearing on handwriting did affect writing pressure, size of words, word spacing, line spacing, and margin relationship. In addition, occasional pen slips and awkward lettering and strokes were noted in some handwriting samples. The results serve as a reference for document examiners when examining handwriting of a person writing or suspected of writing while wearing a glove(s).

Introduction

A person's handwriting might be affected by many factors. Some of these factors could be attributed to internal factors such as writing under the influence of alcohol (Beck 1985, Cheng 2004) or drugs (Foley 1979), tiredness (Harrison 1958), illness and old age (Hilton 1977), handedness (Franks and others 1985; Hayes 1998), or the care taken when writing. External factors that could affect a person's writing include the type of writing instrument used (Hilton 1984), the surface texture (Leung 1986), the writing surface being horizontal or the spacing confined (Morton 1980). It has been opined (Huber and Headrick 1999) that writing executed while wearing heavy or restrictive apparel in a cold environment may have effects on writing. This logically would be expected, since the thickness of the glove may hinder writing movement of the fingers. However, studies are required to demonstrate this postulation.

It appears from the literature that writing while wearing a glove has not been researched. It is understood that there are situations where a person might be required to write while wearing a glove. For example, a mechanic might need to write down his/her observations during the initial inspection of a vehicle. A forensic document examiner (FDE) may also write down observations while wearing gloves to avoid extraneous fingerprints. Also, weather may require glove wearing while making notes or filling out forms such as when reading an outdoor utility meter. The aim of this study was to ascertain the effects, if any, of wearing a glove while writing.

Method and Materials

Before providing handwriting samples, each participant in this study was asked to complete a questionnaire providing some statistical information. The participants numbered 71 and were comprised of professionals (28%), office staff (34%), technical (4%), retired (15%), students (2%), and other professions (17%). All were residents of Hong Kong, and most were also educated in Hong Kong (89%). Educational levels ranged from secondary (48%) to post-secondary technical (14%), and university (38%). Of the participants, 38% were male and 62% female; 98% were right-handed, while only 2% were left-handed; 38% claimed to write often, 55% claimed sometimes, and 7% claimed to write rarely; 76% offered that they never wore a glove while writing, 18% offered sometimes, and 5% offered that they rarely wore a glove while writing. Only 1 participant

Figure 1. Examples of gloves used by each research participant: thin cotton glove manufactured by Japan Home, household gloves manufactured by Japan Home, and thick cotton glove manufactured by Prosperity of China.

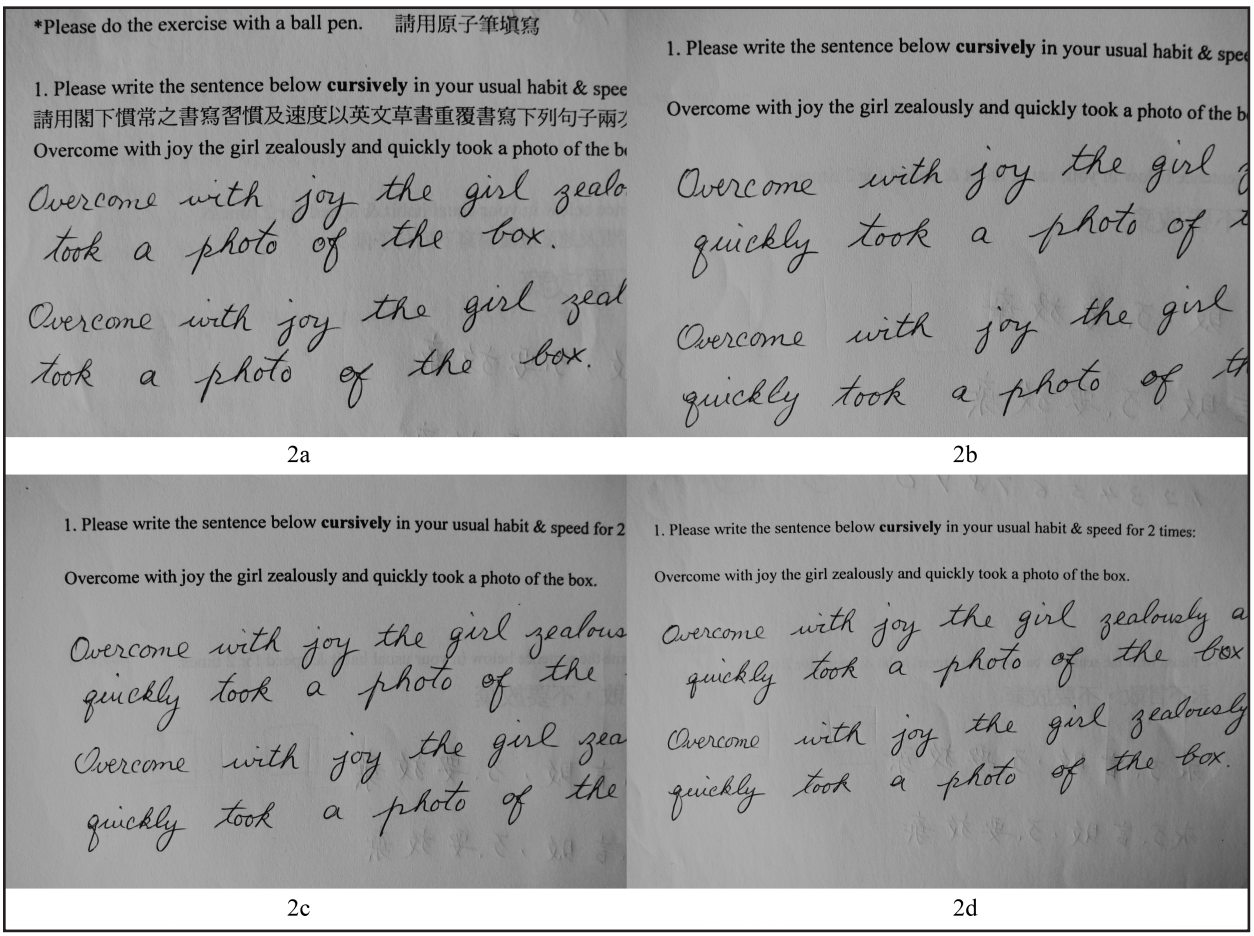

Figure 2. Examples of 1 participant's writing that demonstrates there were no appreciable differences in *line quality* or *writing characteristics* while writing with or without a glove: (2a) writing executed with a bare hand, (2b) writing executed while wearing a disposable glove, (2c) writing executed while wearing a thin cotton glove, and (2d) writing executed while wearing a thick cotton glove.

Description	Parameters
English, Arabic Numerals and Chinese	
Speed of Writing	Similar, slower, or faster
Writing Pressure	Similar, lighter, or heavier
Word/Character Size	Similar, smaller, or bigger
Word/Character Spacing	Similar, smaller, or bigger
Line Spacing of Sentences	Similar, smaller, or bigger
Change in Slant	Yes or no
Writing Relative to the Left Margin	Similar, closer, or away
Change in Alignment of Writing	Yes or no
Line Quality	Similar, worse, or better
Writing Characteristics	In agreement or not in agreement
Writing Mistake(s)	Yes or no
Circle, Square, Triangle	
Size	Similar, smaller, or bigger
Shape	Similar, worse, or better
Pressure	Similar, lighter, or heavier
Horizontal line, Vertical Line	
Length	Similar, shorter, or longer
Shape	Similar, worse, or better
Pressure	Similar, lighter, or heavier

Table 1. Writing features and parameters used in the analysis of the writing and drawing before and after glove-wearing.

acknowledged writing frequently while wearing a glove. Regarding age, 45% were between 40 and 49 years of age, 21% between 30 and 39, 18% were 50 or over, 14% were between 20 and 29, while 2% were under age 20.

Each participant was asked to use a ballpoint pen for the writing samples and follow the written instructions in a handout titled Handwriting Project (Appendix). The project consisted of writing naturally an English sentence cursively and another sentence in block letters, writing specific Arabic numerals, a Chinese sentence, then drawing several geometric figures. The participants were then requested to follow the same instructions 3 more times using 1st a disposable household glove on their writing hand, followed by the wearing of a thin cotton glove, and finally writing with a thick cotton glove (Figure 1). The disposable household glove and thin cotton glove were manufactured by Japan Home.

The writing samples from each participant's gloved-hand writings were compared and evaluated with their nongloved-hand sample by visual means and using a Zeiss Stemi DV4 stereomicroscope. The writing features considered for examination were *speed of writing*, *writing pressure*, *word/character size*, *word/character spacing*, *line spacing of sentences*, *change in slant of writing*, *writing relative to the left margin*, *change in alignment of writing (i.e., baseline)*, *line quality*, *writing characteristics*, and *writing mistake(s)*. The drawing features considered were *size*, *shape*, *pressure*, *horizontal line length/shape/pressur*e, and *vertical length/shape/pressure* (Table 1).

The evaluation of the *speed of writing* was done by observation of the presence or absence of

	Similar (%)	Slower (%)	Faster (%)
Cursive Writing			
Disposable Glove	98.6	0	1.4
Thin Cotton Glove	97.2	1.4	1.4
Thick Cotton Glove	97.2	1.4	1.4
Block Letter Writing			
Disposable Glove	100	0	0
Thin Cotton Glove	100	0	0
Thick Cotton Glove	100	0	0
Numeral Writing			
Disposable Glove	100	0	0
Thin Cotton Glove	100	0	0
Thick Cotton Glove	100	0	0
Chinese Writing			
Disposable Glove	98.6	1.4	0
Thin Cotton Glove	95.8	2.8	1.4
Thick Cotton Glove	93	5.6	1.4

Table 2. Percentage distribution of samples involving the *speed of writing* executed during glove-wearing.

	Similar (%)	Lighter (%)	Heavier (%)
Cursive Writing			
Disposable Glove	77.5	8.5	14
Thin Cotton Glove	56.3	12.7	31
Thick Cotton Glove	53.5	12.7	33.8
Block Letter Writing			
Disposable Glove	74.6	14.1	11.3
Thin Cotton Glove	53.5	16.9	29.6
Thick Cotton Glove	50.7	15.5	33.8
Numeral Writing			
Disposable Glove	76	14.1	9.9
Thin Cotton Glove	70.4	12.7	16.9
Thick Cotton Glove	63.4	16.9	19.7
Chinese Writing			
Disposable Glove	71.8	21.7	7.1
Thin Cotton Glove	59.2	22.5	18.3
Thick Cotton Glove	59.2	19.7	21.1

Table 3. Percentage distribution found in the *writing pressure* on the samples executed during glove-wearing.

	Similar (%)	Lighter (%)	Heavier (%)
Circle			
Disposable Glove	80.3	15.5	4.2
Thin Cotton Glove	77.5	15.5	7
Thick Cotton Glove	74.6	18.3	7.1
Square			
Disposable Glove	85.9	8.5	5.6
Thin Cotton Glove	85.9	8.5	5.6
Thick Cotton Glove	85.9	8.5	5.6
Triangle			
Disposable Glove	87.3	8.5	4.2
Thin Cotton Glove	87.3	8.5	4.2
Thick Cotton Glove	85.9	9.9	4.2
Horizontal Line			
Disposable Glove	87.3	11.3	1.4
Thin Cotton Glove	78.8	7.1	14.1
Thick Cotton Glove	76	8.5	15.5
Vertical Line			
Disposable Glove	87.3	8.5	4.2
Thin Cotton Glove	83.1	7	9.9
Thick Cotton Glove	83.1	5.6	11.3

Table 4. Percentage distribution found in the *writing pressure* of the samples with geometric figures and lines executed during glove wearing.

linkage of stroke or any abbreviation of strokes. The *line quality* and *writing pressure* variation were subjectively evaluated. The changes in *word/character size, word/character spacing, line spacing of sentences, change in slant of writing, writing relative to the left margin, change in alignment of writing* were considered present when an obvious or noticeable change in the features was observed. Writing mistakes could be readily determined.

Results and Discussions

The *speed of writing* was only very slightly affected by glove-wearing while writing cursive English or Chinese. *The speed of writing* while wearing a glove was not affected for block letter writing or Arabic numeral writing (Table 2).

The *writing pressure* was affected by glove-wearing—either lighter or heavier. The percentages of writing with heavier pressure increased in ascending order from disposable glove, thin cotton glove, then thick cotton glove. Heavier pressure was more pronounced for writing executed while wearing thick cotton gloves (Table 3). Samples involving light pressure executed while wearing gloves ranged from 8.5% (disposable glove/cursive writing) to 22.5% (thin cotton glove/Chinese writing).

The percentages of writing samples found with heavier pressure for circle, square, triangle, and vertical line (range 4.2% to 15.5%) were not as great when compared with those samples executed in English cursive and block letters, Arabic numerals, and Chinese (range 7.1% to 33.8%). The percentages of writing samples with heavier pressure on the horizontal line roughly paralleled those for the numeral and Chinese writing (Table 4).

	Similar (%)	Smaller (%)	Bigger (%)
Cursive Writing			
Disposable Glove	73.2	1.4	25.4
Thin Cotton Glove	71.8	0	28.2
Thick Cotton Glove	67.6	1.4	31
Block Letter Writing			
Disposable Glove	57.8	4.2	38
Thin Cotton Glove	59.2	2.8	38
Thick Cotton Glove	54.9	5.6	39.5
Numeral Writing			
Disposable Glove	73.2	0	26.8
Thin Cotton Glove	60.6	5.6	33.8
Thick Cotton Glove	59.2	7	33.8
Chinese Writing			
Disposable Glove	56.3	2.8	40.9
Thin Cotton Glove	59.2	1.4	39.4
Thick Cotton Glove	47.9	4.2	47.9

Table 5. Percentage distribution found in the *word/character size* on the samples executed during glove wearing.

	Similar (%)	Smaller (%)	Bigger (%)
Circle			
Disposable Glove	42.2	28.2	29.6
Thin Cotton Glove	29.6	36.6	33.8
Thick Cotton Glove	38	28.2	33.8
Square			
Disposable Glove	35.2	14.1	50.7
Thin Cotton Glove	29.6	19.7	50.7
Thick Cotton Glove	28.2	22.5	49.3
Triangle			
Disposable Glove	40.8	12.7	46.5
Thin Cotton Glove	39.4	15.5	45.1
Thick Cotton Glove	38	16.9	45.1

Table 6. Percentage distribution found in the *size* of the geometric figures on the samples executed during glove wearing.

	Similar (%)	Shorter (%)	Longer (%)
Horizontal Line			
Disposable Glove	33.8	35.2	31
Thin Cotton Glove	28.2	40.8	31
Thick Cotton Glove	29.6	38	32.4
Vertical Line			
Disposable Glove	43.7	25.4	30.9
Thin Cotton Glove	32.4	31	36.6
Thick Cotton Glove	33.8	31	35.2

Table 7. Percentage distribution found in the *length* of the lines on the samples executed during glove wearing.

	Similar (%)	Smaller (%)	Bigger (%)
Cursive Writing			
Disposable Glove	49.3	2.8	47.9
Thin Cotton Glove	50.7	2.8	46.5
Thick Cotton Glove	46.5	4.2	49.3
Block Letter Writing			
Disposable Glove	33.8	4.2	62
Thin Cotton Glove	38	7	55
Thick Cotton Glove	32.4	9.9	57.7
Numeral Writing			
Disposable Glove	38	5.6	56.4
Thin Cotton Glove	28.2	12.7	59.1
Thick Cotton Glove	21.1	18.3	60.6
Chinese Writing			
Disposable Glove	40.8	8.5	50.7
Thin Cotton Glove	45.1	11.3	43.7
Thick Cotton Glove	36.6	14.1	49.3

Table 8. Percentage distribution found in the *word/character spacing* on the samples executed during glove wearing.

	Similar (%)	Smaller (%)	Bigger (%)
Cursive Writing			
Disposable Glove	53.5	1.4	45.1
Thin Cotton Glove	43.7	0	56.3
Thick Cotton Glove	42.3	2.8	54.9
Block Letter Writing			
Disposable Glove	57.7	7.1	35.2
Thin Cotton Glove	49.3	18.3	32.4
Thick Cotton Glove	45	18.3	36.7
Numeral Writing			
Disposable Glove	39.4	8.5	52.1
Thin Cotton Glove	33.8	8.5	57.7
Thick Cotton Glove	26.7	12.7	60.6
Chinese Writing			
Disposable Glove	41.4	7.1	51.5
Thin Cotton Glove	39.4	8.5	52.1
Thick Cotton Glove	38	11.3	50.7

Table 9. Percentage distribution found in the *line spacing of sentences* on the samples executed during glove wearing.

	No (%)	Yes (%)
Cursive Writing		
Disposable Glove	97.2	2.8
Thin Cotton Glove	97.2	2.8
Thick Cotton Glove	97.2	2.8
Block Letter Writing		
Disposable Glove	98.6	1.4
Thin Cotton Glove	98.6	1.4
Thick Cotton Glove	98.6	1.4
Numeral Writing		
Disposable Glove	98.6	1.4
Thin Cotton Glove	100	0
Thick Cotton Glove	98.6	1.4
Chinese Writing		
Disposable Glove	98.6	1.4
Thin Cotton Glove	97.2	2.8
Thick Cotton Glove	97.2	2.8

Table 10. Percentage distribution found in the *change of slant* on samples executed during glove wearing.

	No Change (%)	Closer to Left Margin (%)	Away from Left Margin (%)
Cursive Writing			
Disposable Glove	64.8	5.6	29.6
Thin Cotton Glove	73.2	12.7	14.1
Thick Cotton Glove	71.8	11.3	16.9
Block Letter Writing			
Disposable Glove	77.5	5.6	16.9
Thin Cotton Glove	74.6	14.1	11.3
Thick Cotton Glove	74.6	11.3	14.1
Numeral Writing			
Disposable Glove	60.6	18.3	21.1
Thin Cotton Glove	67.6	15.5	16.9
Thick Cotton Glove	60.6	23.9	15.5
Chinese Writing			
Disposable Glove	67.6	8.5	23.9
Thin Cotton Glove	69.0	8.5	22.5
Thick Cotton Glove	64.8	15.5	19.7

Table 11. Percentage distribution of *writing relative to the left margin* on samples executed during glove-wearing.

Much of the *word/character size* of writing executed during glove wearing was found to be larger, especially for the Chinese handwriting, which ranged from 39.4% to 47.9%. By comparison, the decrease in size in writing while wearing a glove occupied a much smaller percentage, ranging from 0% to 7% for cursive, block letters, numerals, and Chinese writing.

Increase in *size* of the geometric figures executed while wearing a glove was also observed (range 39.5% to 50.7%). The percentages of samples executed during glove wearing with an increase in *size* were higher than those samples with a decrease in *size* in the square and the triangle (12.7% to 22.5%). However, for the circle, samples with an increase in size were roughly similar in percentages to those with a decrease in *size* (Table 6).

About 2/3 of the line samples executed while wearing a glove deviated in *length* when compared with those written with a bare hand. The percentages of these gloved-hand writing samples found to be shorter in *length,* and those found to be longer in *length* occupied roughly similar proportions (Table 7).

A large proportion of the samples executed during glove wearing showed an increase in the *word/character spacing*. The percentages of these samples with increased spacing were higher in the block letter and numeral writing, with a range of 55% to 62%. Samples of glove-wearing writing with smaller *word/character spacing* are much fewer relative to those with increased spacing, especially among the cursive and block letter writing. In the cursive and block letter categories of glove-wearing writing, the samples with the bigger spacing ranged from 6 times to 17 times more than those with smaller spacing.

Writing while wearing a glove showed bigger *line spacing of sentences* in almost half of the samples. Samples showing smaller line spacing were much fewer in the cursive, numeral, and Chinese writing (Table 9).

The great majority of the writing samples, more than 97%, did not show any *change in slant* while writing wearing a glove (Table 10).

	No (%)	Yes (%)
Cursive Writing		
Disposable Glove	100	0
Thin Cotton Glove	95.8	4.2
Thick Cotton Glove	93	7
Block Letter Writing		
Disposable Glove	95.8	4.2
Thin Cotton Glove	97.2	2.8
Thick Cotton Glove	91.5	8.5
Numeral Writing		
Disposable Glove	100	0
Thin Cotton Glove	98.6	1.4
Thick Cotton Glove	100	0
Chinese Writing		
Disposable Glove	98.6	1.4
Thin Cotton Glove	100	0
Thick Cotton Glove	98.6	1.4

Table 12. Percentage distribution found for *change in alignment of writing* on the samples executed during glove wearing.

	No (%)	Yes (%)
Cursive Writing		
Disposable Glove	97.2	2.8
Thin Cotton Glove	98.6	1.4
Thick Cotton Glove	95.8	4.2
Block Letter Writing		
Disposable Glove	98.6	1.4
Thin Cotton Glove	100	0
Thick Cotton Glove	100	0
Numeral Writing		
Disposable Glove	100	0
Thin Cotton Glove	100	0
Thick Cotton Glove	100	0
Chinese Writing		
Disposable Glove	98.6	1.4
Thin Cotton Glove	98.6	1.4
Thick Cotton Glove	98.6	1.4

Table 13. Percentage distribution for *writing mistakes* found in writing executed while wearing a glove.

Regarding *writing relative to the left margin*, more than 60% of the samples showed no change from nongloved writing to gloved writing.

Samples executed during glove wearing that showed a *change in the alignment of writing* were very small and ranged from only 0% to 8.5% (Table 12).

The *line quality* and fluency of glove-hand writing for all samples was similar to the bare-hand writing (Figure 2). No samples with better or worse line quality were observed. In addition, the *writing characteristics* of all samples of glove-hand writing were in agreement with those bare-hand writing samples. It was interesting to note that less than 5% of the glove-hand writing samples showed *writing mistakes* (Table 13).

One would expect any one of the following to be present in some of the samples executed by the participants wearing a glove: extra strokes, retouching of strokes, breaking of a continuous stroke, odd form of letter, additional dot or stroke, twisting of a stroke, addition of an unnecessary stroke, sudden change in the direction of a stroke, extra-long stroke, and crowded letters. In this research, occasional pen slips and awkward strokes could be found in some of the samples of writing executed during glove wearing. The percentages of samples showing pen slips were highest in the cursive English writing (22.5%). For a writer with pen slips or awkward strokes, the frequency of occurrence was limited to 1 or 2. Most of the participants' writing was not affected.

It was observed that the great majority of the samples with geometric figures and lines written with a gloved hand showed similar quality when compared with samples written without wearing gloves (Table 15).

Conclusions

From the examination results, it was observed that the *line quality, speed of writing,* and the details of writing such as change in *slant, change in alignment*, and *writing characteristics* are unlikely to be affected by the writer wearing a glove. What would be influenced by glove wearing, however, are the *writing pressure, word/character size,*

	No (%)	Yes (%)
Cursive Writing		
Disposable Glove	77.5	22.5
Thin Cotton Glove	69	31
Thick Cotton Glove	77.5	22.5
Block Letter Writing		
Disposable Glove	93	7
Thin Cotton Glove	86	14
Thick Cotton Glove	83	17
Numeral Writing		
Disposable Glove	98.6	1.4
Thin Cotton Glove	97.2	2.8
Thick Cotton Glove	98.6	1.4
Chinese Writing		
Disposable Glove	90.1	9.9
Thin Cotton Glove	90.1	9.9
Thick Cotton Glove	91.5	8.5

Table 14. Percentage distribution of pen slips and/or awkward strokes found in the samples executed during glove wearing.

	Similar (%)	Worse (%)	Better (%)
Circle			
Disposable Glove	94.4	4.2	1.4
Thin Cotton Glove	93	5.6	1.4
Thick Cotton Glove	91.5	7.1	1.4
Square			
Disposable Glove	97.2	1.4	1.4
Thin Cotton Glove	100	0	0
Thick Cotton Glove	98.6	1.4	0
Triangle			
Disposable Glove	98.6	1.4	0
Thin Cotton Glove	97.2	2.8	0
Thick Cotton Glove	94.4	5.6	0
Horizontal Line			
Disposable Glove	98.6	0	1.4
Thin Cotton Glove	97.2	2.8	0
Thick Cotton Glove	98.6	1.4	0
Vertical Line			
Disposable Glove	98.6	0	1.4
Thin Cotton Glove	94.4	5.6	0
Thick Cotton Glove	97.2	2.8	0

Table 15. Percentage distribution for the samples involving the quality of writing geometric figures and lines executed with a gloved hand.

word/character spacing, line spacing of sentences, and *writing relative to the left margin*.

The results of this research show that the *writing pressure* for more than 50% of writers remained the same while wearing a glove. Regarding cursive, block letters, numerals, and Chinese writing, many of the writers wrote larger while wearing a glove (25.4% to 47.9%, depending on the type of glove worn). Only negligible percentages of the participants wrote smaller (0 to 7%). *Word/character spacing* increases were found in about half of the samples executed while wearing a glove. *Line spacing of sentences* was increased in more than 33% of the these samples, particularly in cursive English (as much as 56.3%) and block letter writing (as much as 36.7%) and Chinese writing (as much as 60.6%).

While more than 60% of the participants maintained their margin relationship while wearing a glove, some did change their *writing relative to the left margin*. For this group of participants, more often they tended to write away from the left margin. While more than 97% of the participants did not make *writing mistakes* while wearing a glove, a number of participants had slips of pen and sudden jerks in their glove-hand writing. The percentages were highest for writing samples in cursive English (22.5%). The effect of the gloved hand tightly gripping the pen is the most likely cause of the occasional slippage and unusual stroke forms. The fact that the frequency of occurrence of pen slips was only limited to 1 or 2 per writer indicates that the writer was able to hold the pen quite steadily most of the time.

The quality of writing of the geometric figures and lines was only very slightly affected by glove-hand writing. In *size,* the figures executed with a gloved hand deviated slightly from forms written

by the bare hand. The increase or decrease in size appeared to be arbitrary, as did the size of the horizontal and vertical lines in the drawings. It was noted that the samples of the square and the triangle written with the gloved hand tended to be bigger than those written with the bare hand. The restriction in the movements of the fingers by the glove wearing is very probably the cause for the differences observed between the glove wearing while writing and the bare-hand writing.

It is hoped that this study has produced some answers regarding writing executed while wearing a glove.

Acknowledgement

The author would like to thank all of the participants who have kindly provided the samples for this research.

References

Beck, Jan (1985). Handwriting of the Alcoholics. *Forensic Science International*, Vol. 28, pp. 19-26.

Cheng, Yau-Sang Patrick (2004). A Study on the Influence of Light Social Drinking on Writing by Chinese in Hong Kong. *Journal of the American Society of Questioned Document Examiners*, Vol. 7, No. 1, pp. 48-60.

Foley, Robert G. (1979). The Effect of Marijuana and Alcohol on Handwriting. *Forensic Science International*, Vol. 14. pp. 159-164

Franks, J.E.; David, T.R.; Totty, R.N.; Hardcastle, R.A.; Grove, D.M. (1985). Variability of Stroke Direction between Left- and Right-handed Writers. *Journal of Forensic Science Society*, Vol. 25, pp. 353-370.

Harrison, Wilson R. (1958). *Suspect Documents.* New York: Frederick A. Prager, p. 297.

Hayes, James L. (1998). Characteristics of Left-Handed Writer. Presentation at the 56th Annual American Society of Questioned Document Examiners, Indianapolis, Indiana, August 8-12.

Hilton, Ordway (1977). Influence of Age and Illness on Handwriting Identification Problems. *Forensic Science*, Vol. 9, 161-172.

Hilton, Ordway (1984). Effects of Writing Instruments on Handwriting Details. *Journal of Forensic Sciences*, January 29, Vol. 1, pp. 80-86.

Huber, Roy A., Headrick, A.M. (1999). *Handwriting Identification: Facts and Fundamentals*. CRC Press LLC, p. 231.

Leung, S.C. (1986). A Case of Lipstick Writing on a Body. Presented at the Annual Meeting of the American Society of Questioned Document Examiners, Savannah, GA.

Morton, Susan E. (1980). How Does Crowding Affect Signatures? *Journal of Forensic Sciences*. Vol. 25, No. 1, January, pp. 141-145.