

Left-hand Writing vs. Right-hand Writing

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Determining whether a questioned text was written by a right- or left-hand writer can provide useful investigative information. Especially early in an investigation, such information can be a useful tool for rapid screening and narrowing the pool of potential suspects. In this study the writings of 30 left-hand and 30 right-hand writers were analyzed in order to find out if there are diagnostic characteristics upon which the document examiner can rely to establish the handedness of the writer. Direction of certain horizontal strokes and, to a lesser extent, the direction in which circular structures were formed were found to be useful indicators.

Introduction

Even though left-handers have existed as long as mankind has used writing as a means of communication, they have always been a minority. At least in Germany, the group of left-hand writers is a very young community.

Until the 1970s, children in Germany had to learn to write using only their right hands; left-handers were forced to suppress their handedness. The number of left-hand writers has increased gradually since the change about 30 to 35 years ago, when writing with the left hand became allowed in schools. As a result, the document examiner is more likely to be confronted with the question of whether a document is written with the left hand or with the right hand. Especially in the early stages of an investigation, this can be important to narrow down the pool of potential suspects and thus to accelerate the search and, for example, avert a danger pending from blackmail. This article addresses only natural left- and right-hand writing, not the case when the off-hand is used as a form of disguise.

The aim of this survey was to determine whether handwritten text reveals the handedness of the writer and to identify any distinctive features that a forensic document examiner can rely on to establish left-handedness vs. right-handedness.

In Figures 1 through 4, which show similar types of the handwritings of a left-hander and a right-hander, it is apparent that the answer to this question is not necessarily an easy one.

Methods

Participants, Equipment, and Materials

Thirty left-handers and 30 right-handers took part in the study. The left-handers consisted of 17 females and 13 males, age 16 to 41. The right-handers included 19 females and 11 males, ages 16 to 56.

To keep external influences on the writing results as low as possible, each writer was presented with the same writing conditions (Figure 5):

- A large desk pad
- Lined A4-sized (210x297 mm) paper posted on heavy cardstock
- A Bic Round Stic medium ballpoint pen for a specified portion of the writing

Each writer was videotaped to ensure objective capture of the writing movements. For the analysis of the specimen, a Leica MZ APO stereo microscope was used.

Procedure

A sample text was chosen that consisted of 174 words in 6 paragraphs, taking up almost 3/4 of an A4-sized page. The text was presented to the participants as a printed, single-spaced document (Figures 6.1 through 6.3).

In the 1st step, the writers were advised to copy the entire text. They were allowed to perform their habitual mode of writing, whether cursive or hand printing. The participants were also free to use their own writing instruments over the 1st

Liebe Christiane und lieber Max,
 wir verbringen unsern diesjährigen Urlaub
 Die Anzeige für den Bauernhof habe
 gefunden. Die Adresse lautet: <http://www.bauernhof.de>
 Der Hof von Bauer Herzog liegt zwischen
 Ortschaft sind es mindestens 5 km.
 26 Kühen, 49 Ziegen, 2 jungen Eseln
 absolut keine Langeweile auf.
 Bisher hatten wir Glück mit den
 Spaziergänge und kleinere Wanderungen
 konnten.
 Die Abende verbringen wir mit
 wir schauen uns etwas im Fernsehen
 sogar ein DVD-Player zur Verfügung
 was ich vermisste, ist der Internet-Anschluss

Figure 1. Left-hand male, age 18

gefunden. Die Adresse lautet: <http://www.bauernhof.de>
 Der Hof von Bauer Herzog liegt ziemlich einsam
 Ortschaft sind es mindestens 5 km. Aber mit
 49 Ziegen, 2 jungen Eseln und 3 Katzen kann
 lange weile auf.
 Bisher hatten wir Glück mit den Wetter, so
 gänge und kleine Wanderungen unternehmen
 Die Abende verbringen wir mit Musik und
 schauen uns etwas im Fernsehen an.
 sogar ein DVD-Player zur Verfügung.
 was ich vermisste, ist der Internet-Anschluss
 Ich denke mal, dass wir uns hier allerdin
 erholen werden. Dazu tragen außer der
 Jogging sicherlich die gute Luft, die
 gesunde Essen bei. Es gibt jeden Tag viel
 Sahne und Quark aus eigener Produktion
 Telefonisch sind wir über den Festnetzanschluss
 Bauernhofes: 06284 / 7300 957 zu erreichen
 Handy: 0171 / 8254 3649. Viele Grüße

Figure 2. Right-hand male, age 39

Ich denke mal, dass wir uns hier allerdings sehr gut
 erholen werden. Dazu tragen außer dem täglichen
 Jogging sicherlich die gute Luft, die Ruhe und das
 gesunde Essen bei. Es gibt jeden Tag
 viel frisches Obst, Sahne und Quark aus eigener
 Produktion.
 Telefonisch sind wir über den Festnetzanschluss des
 Bauernhofes: 06284 / 7300 957 zu erreichen oder
 über mein Handy:
 0171 / 8254 3649.
 Viele Grüße
 Walter und Petra

Figure 3. Left-hand female, age 16

Ich denke mal, dass wir uns hier allerdings sehr gut
 erholen werden. Dazu tragen außer dem täglichen
 Jogging sicherlich die gute Luft, die Ruhe und das
 gesunde Essen bei. Es gibt jeden Tag viel frisches
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 Viele Grüße
 Walter und Petra

Figure 4. Right-hand female, age 16

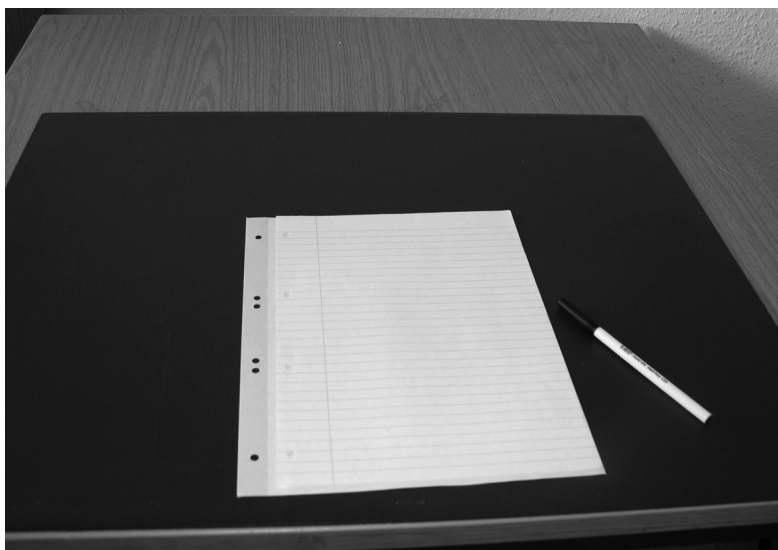


Figure 5. Each writer was presented with the same writing conditions: a large desk pad and lined A4-sized (210x297 mm) paper posted on heavy cardstock. A specified part of the sample had to be written with a Bic Round Stic medium ballpoint pen.

Hottau, 28.07.2004

Liebe Christiane und lieber Max,

wir verbringen unsern diesjährigen Urlaub auf dem Lande. Die Anzeige für den Bauernhof haben wir übers Internet gefunden. Die Adresse lautet: <http://www.Urlaub-auf-dem-Lande.de>.

Der Hof von Bauer Herzog liegt ziemlich einsam. Zur nächsten Ortschaft sind es mindestens 5 km. Aber mit 14 Pferden, 26 Kühen, 49 Ziegen, 2 jungen Eseln und 3 Katzen kommt absolut keine Langeweile auf.

Bisher hatten wir Glück mit dem Wetter, sodass wir viele Spaziergänge und kleinere Wanderungen unternehmen konnten.

Die Abende verbringen wir mit Musik und Lesen oder wir schauen uns etwas im Fernsehen an. Uns steht sogar ein DVD-Player zur Verfügung. Das einzige, was ich vermisse, ist der Internet-Anschluss.

Ich denke mal, dass wir uns hier allerdings sehr gut erholen werden. Dazu tragen außer dem täglichen Jogging sicherlich die gute Luft, die Ruhe und das gesunde Essen bei. Es gibt jeden Tag viel frisches Obst, Sahne und Quark aus eigener Produktion.

Telefonisch sind wir über den Festnetzanschluss des Bauernhofes: 06284/7300957 zu erreichen oder über mein Handy: 0171/82543649.

Viele Grüße
Walter und Petra

Figure 6.1. Sample text.

Paragraph to write in Printed Letters:

Ich denke mal, dass wir uns hier allerdings sehr gut erholen werden. Dazu tragen außer dem täglichen Jogging sicherlich die gute Luft, die Ruhe und das gesunde Essen bei. Es gibt jeden Tag viel frisches Obst, Sahne und Quark aus eigener Produktion.

Figure 6.2. Sample text to be printed.

Paragraph to write in Capital Letters:

ICH DENKE MAL, DASS WIR UNS HIER ALLERDINGS SEHR GUT ERHOLEN WERDEN. DAZU TRAGEN AUßER DEM TÄGLICHEN JOGGING SICHERLICH DIE GUTE LUFT, DIE RUHE UND DAS GESUNDE ESSEN BEI. ES GIBT JEDEN TAG VIEL FRISCHES OBST, SAHNE UND QUARK AUS EIGENER PRODUKTION.

Figure 6.3. Sample text to be written in capitals.

Writer Nr.:		Right-Hander/ Left-Hander f/m			
Feature	Evaluation			Specialties	
--Line Quality ° tension ° disturbances			other		
	low	good			
	yes	no			
--Writing Pressure	low	med	high		
° Absolute					
° Relative Up-stroke					
Down-Stroke					
Horiz. Strokes					
	arrhythmic		rhythmic		
-- Letter Connectivity					
° Writing speed	slow	med	fast		
° Connectivity between letters	low	med	high		
° Connectivity within letters	low	med	high		
-- Letter Forming	angle forms		bows		
	reduction		amplification		
	narrow		wide		
	garlands		arcades		
-- Writing Direction					
	↔		⇒		None
Horizontal strokes	separate	connected	separate	connected	separate but connected to the following.
Circular forms	counterclockwise ↺		clockwise ↻		No.8
Slant	backward		vertical	forward	
-- Vert./horiz. Expansion	low	med	high		
Majuscules					
Upper Zone					
Middle Zone					
Lower Zone					
Distances within letters					
Distances between letters					
Distances between words					

Figure 7. Evaluation Form.

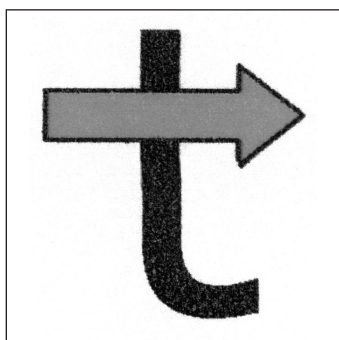


Figure 7.1. The cross stroke is separate from left to right.

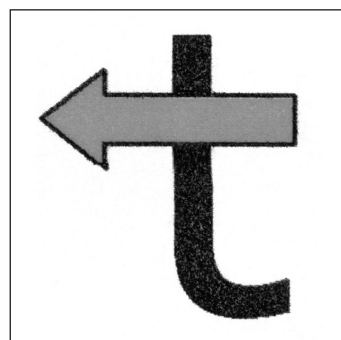


Figure 7.2. The cross stroke is separate from right to left.

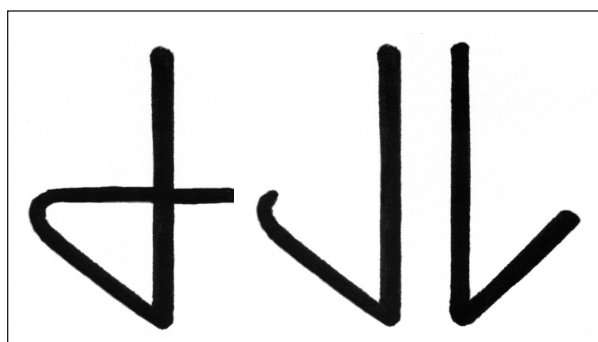


Figure 7.3. The finishing stroke goes from left to right. (Note: The down stroke doesn't end at the baseline but changes into an upward stroke which 1st aims towards the left but in the end turns to the right (left image) or shows signs of a turn to the right (middle image). The right image represents a 3rd version where the down stroke changes into an upward stroke towards the right.)



Figure 7.4. The finishing stroke goes from right to left. (Note: The down stroke doesn't end at the baseline but changes into an upward stroke which 1st aims towards the right but in the end turns to the left (left image) or shows signs of a turn to the left (middle image). The right image represents a 3rd version where the down stroke changes into an upward stroke towards the left.)

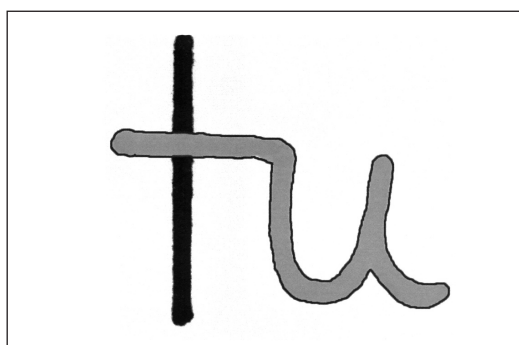


Figure 7.5. The cross stroke is set separately but creates a connection to the following letter.

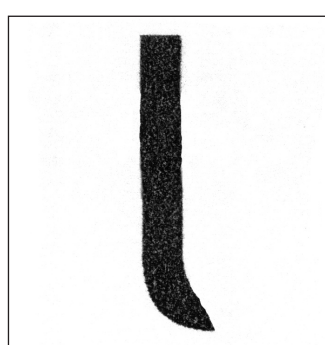


Figure 7.6. No cross stroke.

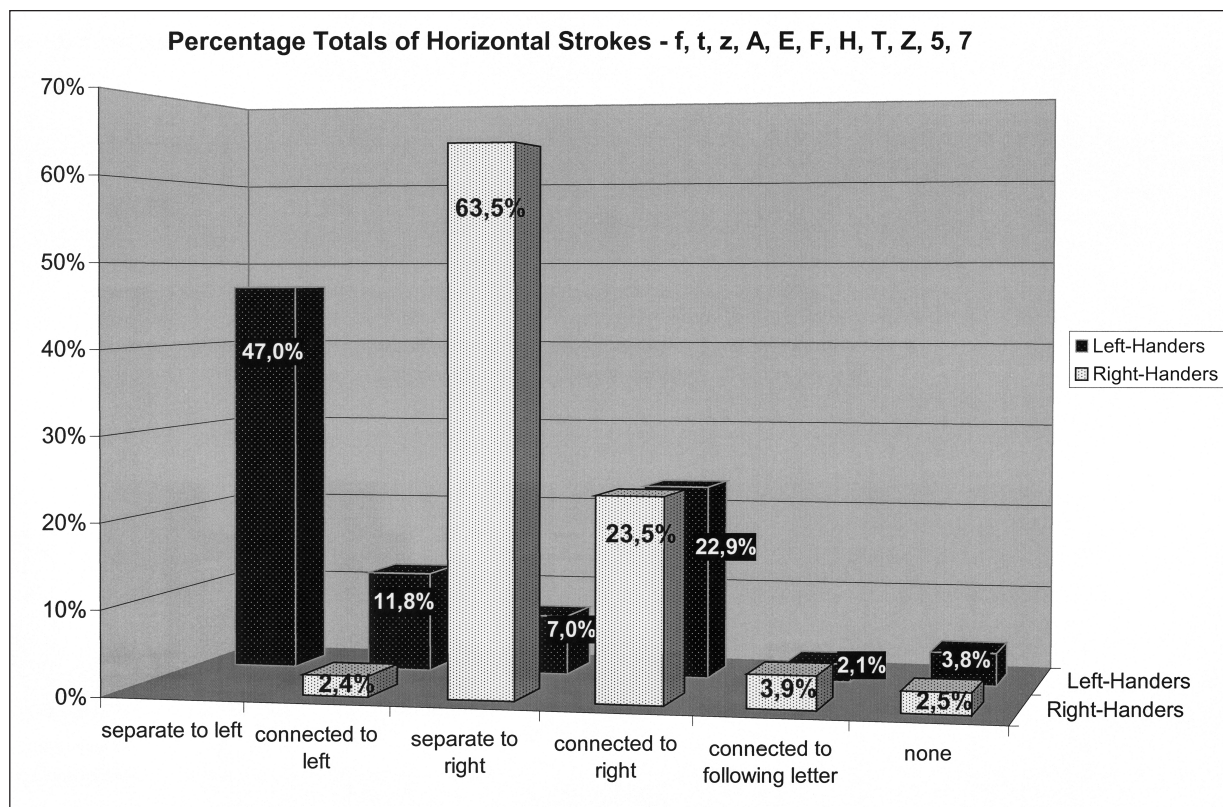


Table 1. Percentage totals of horizontal strokes “f,” “t,” “z,” “A,” “E,” “F,” “H,” “T,” “Z,” “5,” “7.”

4 paragraphs. For the purpose of standardization, they were then required to switch to the given ballpoint pen. In the 2nd step, the writers were asked to transcribe a paragraph from the sample text, once in manuscript printing and once in block capital letters.

Method Analysis

The examination was based on the “Grundkomponentenmodell graphischer Merkmale” (Basic Component Model of Graphic Features) by Lothar Michel, which is a standard method used by handwriting examiners in Germany.

The main features analyzed in this model are:

- Line quality
- Writing pressure
- Letter connectivity (including writing speed)
- Letter formation
- Stroke direction
- Horizontal/vertical dimension

To keep track of the findings and for evaluation purposes, a form (Figure 7) of the graphic components, including sub-features, was created.

Findings

Both groups, the left-handers and the right-handers, showed no differences in the features of:

- Line quality
- Writing pressure
- Letter connectivity (including writing speed)
- Horizontal/vertical dimension

Although more left-handers preferred arcades to garlands than the right-handers (24:12), left-hand writing and right-hand writing could not be distinguished on the basis of letter formation either.

However, in the stroke direction, noticeable differences showed between left-handers and right-handers; hence this feature became the focus of the analysis. The examination aimed at:

Cross Strokes, Respectively Horizontal Strokes

- Within the lower-case letters “f,” “t,” and “z”
- The upper-case letters “A,” “E,” “F,” “H,” “T,” and “Z”
- The numbers “5” and “7”

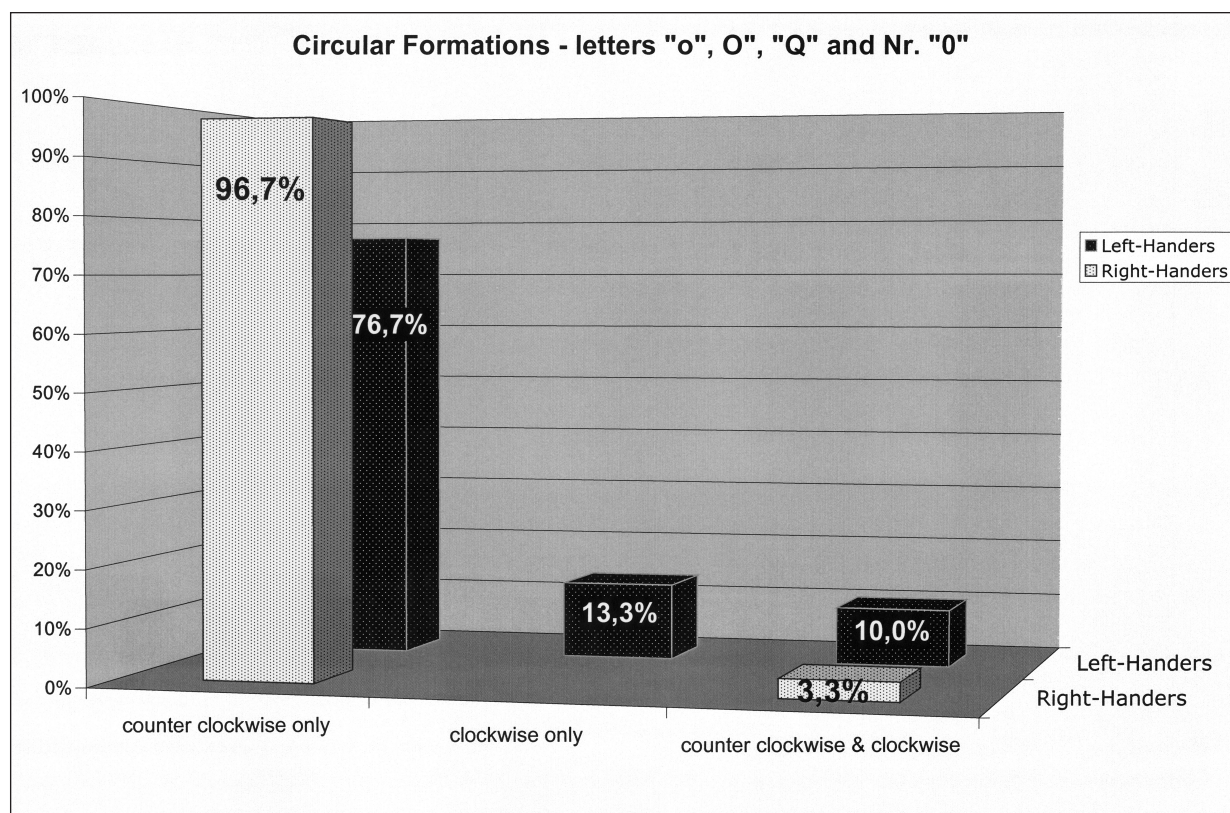


Table 2. Circular formations of letters "o," "O," "Q," and the number "0."

Since there is more than 1 way to produce cross strokes and horizontal strokes, the findings had to be classified in 6 categories (Figures 7.1 through 7.6).

In Table 1, the percentage totals of horizontal strokes in their 6 different variations is shown for the left-handers and the right-handers.

Although both groups demonstrated a tendency to write the strokes separately, 47.0% of the left-handers performed their strokes right to left, while 63.5% of the right-handers conducted a left-to-right movement. Highly significant is the fact that there is not a single right-hander performing a separate stroke from the right to the left, whereas 7.0% of the horizontal strokes in the group of the left-handers were done separately from the left to the right. One left-hand writer made 248 out of 251 cross strokes from left to right.

In the category "connected from left to right," both groups showed similar rates (22.9% left-handers and 23.5% right-handers).

Circular Formations

- The lower-case letter "o"

- The upper-case letters "O" and "Q"
- The number "0"

The circular formations were differentiated into 3 categories:

- Counterclockwise
- Clockwise
- Combination of clockwise and counter

As shown in Table 2, most of the writers in both groups preferred writing the circular formations counterclockwise.

Exclusive use of clockwise circles was found in the handwriting of the left-handers (13.3%); and, with the exception of just a single right-hander, (3.3%) the use of a combination of clockwise and counterclockwise movements was performed only by left-handers.

Writing Direction of the Number 8

Three different categories could be distinguished in the circle formations of the number "8."

- Loop starting counterclockwise
- Loop starting clockwise
- Separate circles

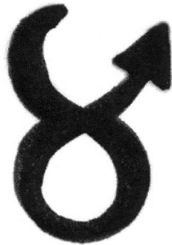
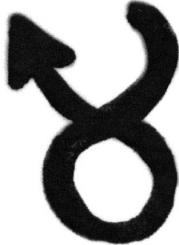
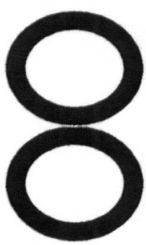
		
Left-hander 27 Right-hander 27	Left-hander 2 Right-hander 3	Left-hander 1 Right-hander --

Table 3. No conclusions could be gained through the inspection of the number “8” writing structure.

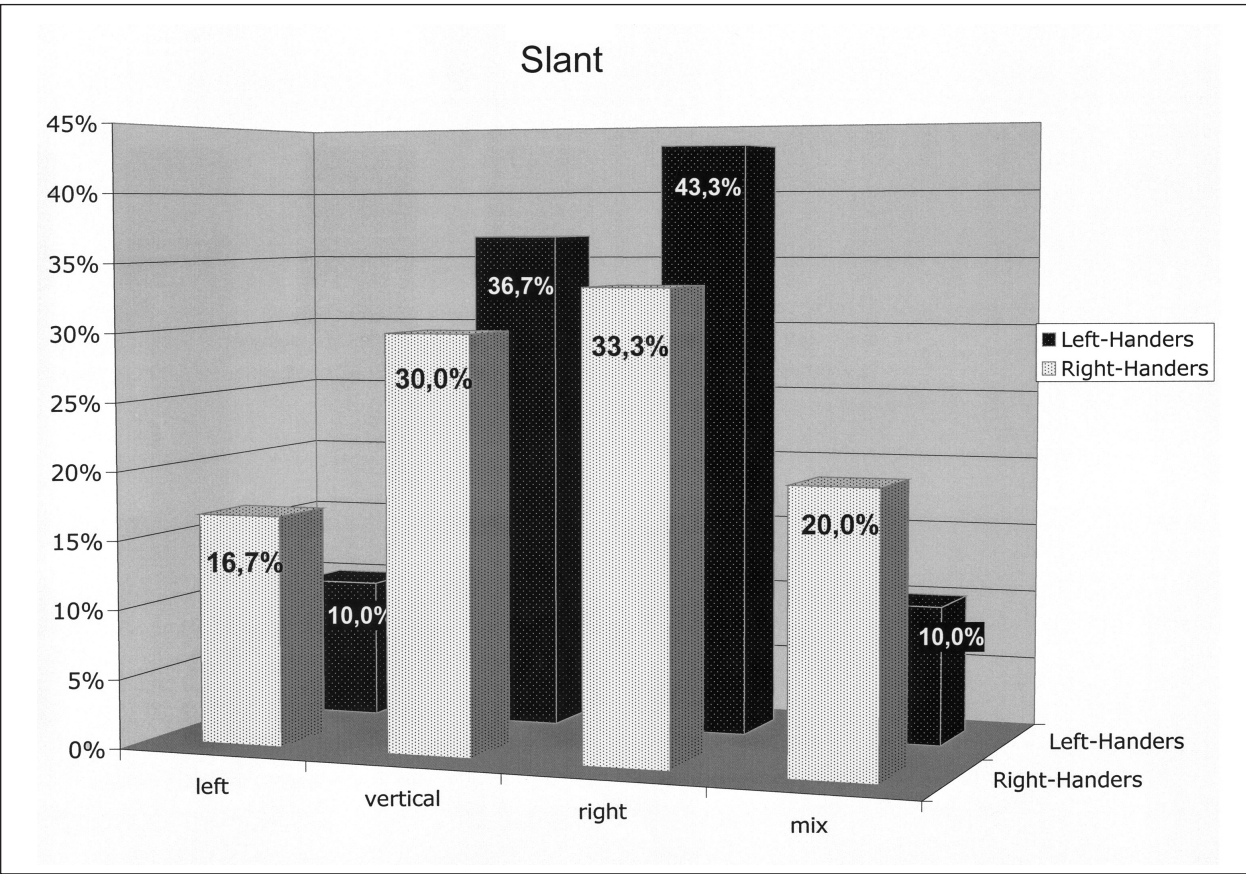


Table 4. Most writers in both groups wrote in a forward slant.

Table 3 shows that no conclusions could be gained by inspection of the writing structure of the number "8."

Slant

In this graphic feature, 4 categories were assigned:

- Backhand (left)
- Forward (right)
- Vertical
- Indifferent (mix)

Overall, most writers in both groups wrote in a forward slant.

It was somewhat surprising that more left-hand writers (43.3%) used a forward (right-hand) slant than right-hand writers (33.3%). Contrary to information found in literature, in this study there were more right-hand writers (16.7%) using a backhand slant than left-hand writers (10.0%).

Miscellaneous

In general, the illustrations indicate that the left-hand writers showed more variation in all of their letters and numerals, not just those chosen as the focuses of this study. For example, the writing of upper case "B"s by some left-hand writers were made with the bows starting at the bottom as well as an upper case "P," where the bow was formed in an upward movement. One left-hander started the numbers "2" and "7" at the bottom, and this person also wrote the "t"s (upper case and lower case) in upstrokes. A right-hander started her lower case "e" on the baseline.

Conclusions

This study suggests that writing stroke direction is the most reliable graphic feature for distinguishing between left-hand and right-hand writers. If a handwritten text shows separately formed cross strokes written from right to left, it is more likely that the writer is left-handed. No conclusions can be drawn if the separately formed cross strokes of a handwritten text show only conventional left-to-right movements.

Exclusive use of clockwise-formed circular formation is an additional indication that a text could have been written by a left-hand writer.

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