

# Using the Statistical Functions of Write-On<sup>2</sup> Software to Assess Natural Variation in Handwriting

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## What is Write-On<sup>2</sup> Software?

- It is a database that assists FDE's in the collection, dissection and analysis of data. It is also an aid in the presentation of forensic results.
- Over the years FDE's have used it primarily for the comparison of handwriting.
- Once the handwriting images and typed transcript have been associated and entered into the database, sophisticated searches of the questioned and sample documents can be made.

## What is Write-On<sup>2</sup> Software?

- The searches generate occurrence charts which allow for the side-by-side comparison of words, letters, numerals, symbols and punctuation as individual characters or as combinations.
- This facilitates a complete assessment of natural variation as every occurrence of a given word or character combination is illustrated for both the questioned and specimen material.
- The program maintains a record of all saved searches enabling the FDE to revisit any comparison.

# Illustration of the Word Index from which searches can be launched

The index tallies the number of occurrences within both the questioned and specimen documents and provides a total count.

Test	#	Word	Q	K	O	Total
Active Cases	1	to	3	34	0	37
1851 - Feedback Lette	2	and	3	16	0	19
Documents	3	they	3	7	0	10
Questioned	4	are	3	4	0	7
Employee	5	I	2	6	0	8

9	wherever	2	0	0	2
10	Ontario	2	0	0	2
11	the	1	38	0	39
12	is	1	16	0	17
13	on	1	15	0	16
14	of	1	11	0	12
15	that	1	11	0	12
16	you	1	8	0	9
17	Sarah	1	8	0	9
18	will	1	8	0	9
19	s	1	6	0	7
20	with	1	5	0	6

31	416	1	2	0	3
32	time	1	2	0	3
33	but	1	2	0	3
34	destinations	1	1	0	2
35	full	1	1	0	2
36	Specialist	1	1	0	2
37	always	1	1	0	2
38	day	1	1	0	2
39	who	1	1	0	2

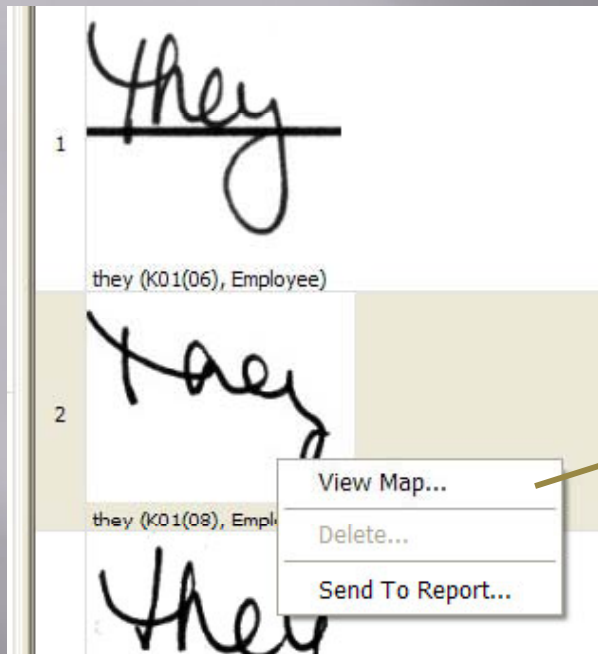
# Example of an occurrence chart generated when

searching for the word "they"

3 words were found in the questioned and 7 in the specimens



# Location of an occurrence within a document



from LGA, the pax must  
consider transborder, the  
ask if they are sta  
going on internationally  
VIC - they (pax) must  
~~go outside of~~  
page, put them on  
d proceed to L2 se

The image shows a handwritten document with several lines of text. The word 'they' is highlighted in yellow in the second line. A yellow arrow points from the 'View Map...' option in the context menu of the first image to this highlighted 'they'. The text continues with 'going on internationally', 'VIC - they (pax) must', and a crossed-out line 'go outside of'. The final lines are 'page, put them on' and 'd proceed to L2 se'.

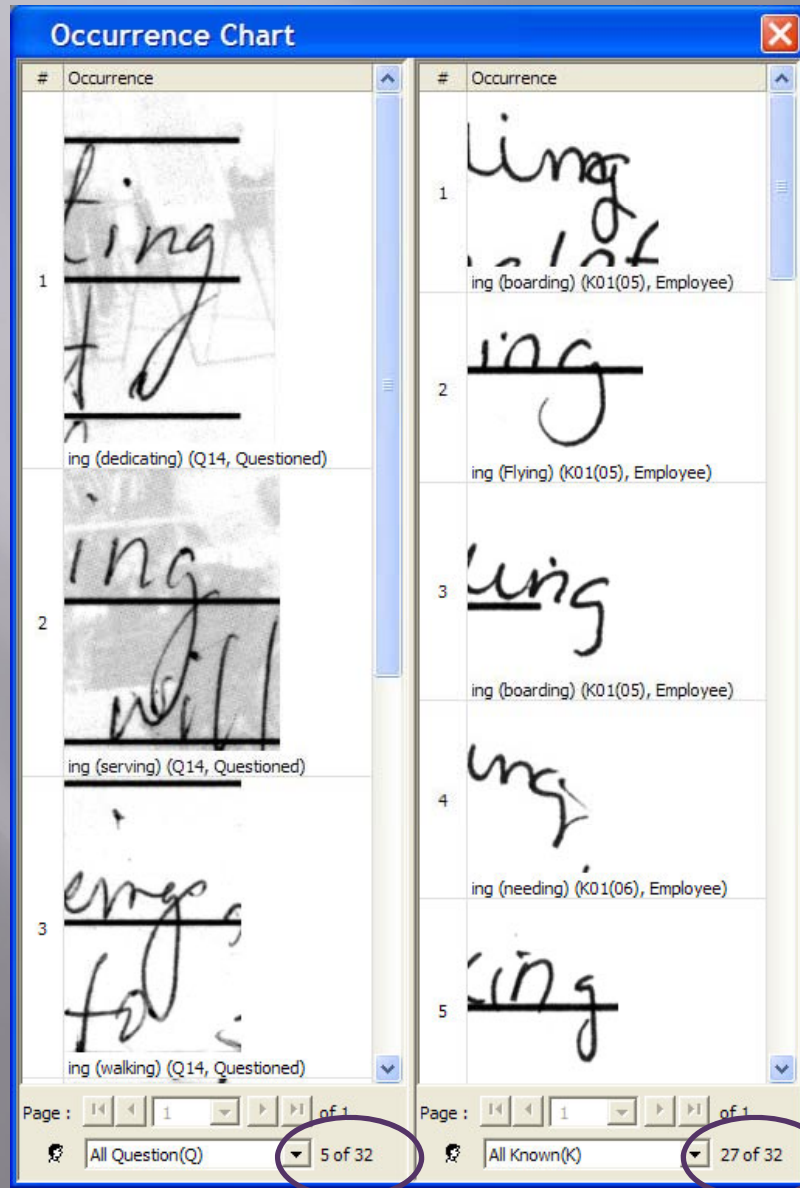


# Illustration of the Segment Index from which searches can be launched

Test	#	Segment	Q	K	O	Total
Active Cases	58	ei	2	2	0	4
1851 - Feedback Lette	60	en	1	44	0	45
Documents	120	EN	0	2	0	2
Questioned	123	En	0	1	0	1
Employee	20	er	10	78	0	88
Word Index	119	ER	0	2	0	2
Segment Index	26	es	6	38	0	44
Searches	118	ES	0	2	0	2

5	i	31	325	0	356
40	I	3	21	0	24
67	ic	1	21	0	22
110	IC	0	3	0	3
76	ie	1	11	0	12
116	iE	0	2	0	2
127	IE	0	1	0	1
19	in	10	80	0	90
126	IN	0	1	0	1
128	In	0	1	0	1
34	ing	5	27	0	32
37	io	4	25	0	29

# Example of an occurrence chart generated when searching for the “ing” segment




5 segments were found in the questioned and 27 in the specimens



# The Search List displays a record of all searches previously saved

The list includes the search string and the number of occurrences within the documents.



Test	#	Name	String	Q	K	O	Total
Active Cases	1	th(2)	th	11	101	0	112
1851 - Feedback Letter	2	they(1)	they	3	7	0	10
Documents	3	th(1)	th	10	85	0	95
Questioned	4	SARAH(1)	SARAH	8	2	0	10
Employee	5	nd(1)	nd	4	39	0	43
Word Index	6	&(2)	&	1	8	0	9
Q authors	7	A(1)	A	1	110	0	111
K authors	8	tion(1)	tion	3	19	0	22
O authors	9	□y(2)	□y	3	59	0	62
Segment Index	10	!(1)	!	1	1	0	2
Searches	11	&(1)	&	2	8	0	10
Reports	12	ing(1)	ing	1	26	0	27
2222	13	F(1)	F	5	17	0	22
2233	14	D(2)	D	1	32	0	33
2202	15	D(1)	D	1	164	0	165
Inactive Cases	16	An(1)	An	2	93	0	95
	17	H(1)	H	1	17	0	18
	18	B(1)	B	2	23	0	25
	19	L(2)	L	1	35	0	36
	20	Ll(1)	Ll	2	23	0	25
	21	L□(1)	L□	1	27	0	28
	22	L(1)	L	1	35	0	36
	23	to(1)	to	1	49	0	50

# How accurate are we in finding all occurrences of a given letter combination within the sample material?

## MAFS 2012 Workshop Scotopic Test Results

Participant #	"en" Occurrences - 24		"ti" Occurrences - 14	
	Reported	Error Rate (%)	Reported	Error Rate (%)
1	20	16.7	11	21.4
2	22	8.3	13	7.1
3	24	0.0	12	14.3
4	17	29.2	12	14.3
5	20	16.7	12	14.3
6	20	16.7	13	7.1
7	21	12.5	12	14.3
8	22	8.3	13	7.1
9	24	0.0	14	0.0
10	26	-8.3	12	14.3
11	20	16.7	14	0.0
12	20	16.7	10	28.6
13	21	12.5	12	14.3
Overall	277	11.2	160	12.1

Notes:

1. Only Participant #9 had 100% correct on both tests (7.7% rate of success)

## What can we learn from this experiment?

- Even with a small amount of sample material occurrences of a given letter combination can be missed. This impacts on an assessment of natural variation.
- The likelihood of missing an occurrence can increase depending on what is being searched for and where it might be found within a word.

## What can we learn from this experiment?

- In the case example I have been presenting the letter combination “on” appears 4 times within words in the questioned document and 71 times in the 19 sample documents.
- The “on” combination appears at various positions within a word - that is, at the beginning, within and at the end. It is quite possible that one or more instances would be overlooked when manually searching the documents.

# Examples of words containing the “on” combination

The image displays two side-by-side windows titled "Occurrence Chart". Each window lists handwritten words with their corresponding "on" combinations. The left window is filtered for "All Question(Q)" and shows 4 of 75 items. The right window is filtered for "All Known(K)" and shows 71 of 75 items.

Window	Item #	Handwritten Word	on (Combination)
Left (All Question(Q))	1	on	on (on) (Q14, Questioned)
Left (All Question(Q))	2	information	on (information) (Q14, Questioned)
Left (All Question(Q))	3	destinations	on (destinations) (Q14, Questioned)
Left (All Question(Q))	4	someone	on (someone) (Q14, Questioned)
Right (All Known(K))	1	information	on (information) (K01(05), Employee)
Right (All Known(K))	2	dynamic	on (information) (K01(06), Employee)
Right (All Known(K))	3	phone	on (phone) (K01(06), Employee)
Right (All Known(K))	4	button	on (button) (K01(06), Employee)
Right (All Known(K))	5	Section	on (Section) (K01(07), Employee)

## How does Write-On<sup>2</sup> alleviate this potential problem?

- The program ensures that the user knows exactly how many instances of a search string are found in the questioned and sample documents.
- Once a search is launched the resulting Occurrence Chart shows each one of these examples and guides the examiner to their location within the documents
- The Occurrence Charts can be printed for side-by-side comparison and preparation of case notes.



## Avoiding pointless searches

- Write-On<sup>2</sup> alleviates searching for characters, or combinations, that are found in the questioned writing but absent from the specimens, thereby saving the FDE time.

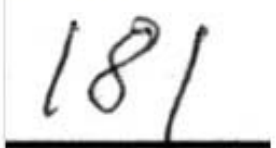


#	Segment	Q	K	O	Total
18	EN	2	9	0	11
19	3	2	8	0	10
20	l	2	0	0	2
21	on	2	0	0	2
22	n	2	0	0	2
23	1	1	33	0	34
24	D	1	30	0	31
25	0	1	23	0	24
26	ON	1	13	0	14
27	W	1	9	0	10
28	P	1	9	0	10
29	AN	1	6	0	7
30	AY	1	6	0	7
31	AL	1	3	0	4
32	IE	1	3	0	4
33	Z	1	3	0	4
34	FF	1	2	0	3
35	IC	1	1	0	2
36	s	1	0	0	1
37	i	1	0	0	1
38	t	1	0	0	1

Do you have enough examples of a particular character or combination within the specimens to reflect the range of natural variation?

#	Segment	Q	K	O	Total
51	0	2	24	0	26
43	1	3	15	0	18
70	2	1	18	0	19
52	3	2	24	0	26
45	4	3	12	0	15
41	5	3	19	0	22
38	6	4	18	0	22
55	7	2	16	0	18
81	8	1	2	0	3
79	9	1	6	0	7
2	a	40	448	0	488
27	A	5	119	0	124
31	al	5	45	0	50
107	AL	0	4	0	4



### Occurrence Chart ✕

#	Occurrence	#	Occurrence
1	 8 (181) (Q14, Questioned)	1	 8 (8) (K03(02), Employee)
		2	 8 (8) (K03(02), Employee)

Page : 1 of 1

All Question(Q) 1 of 3

Page : 1 of 1

All Known(K) 2 of 3

## Demonstrating flawed examination procedures by an opposing expert

- Ms. Discol claims on page 23 (page 24 in the English translation) that Feature #32 (“X”) is not assessable in the questioned writing and therefore it was not evaluated.
- A quick search in Write-On<sup>2</sup> shows that this letter could have been considered in the examination as there are examples within the specimen material, which are illustrated in the next slide.

# Demonstrating flawed examination procedures by an opposing expert

The image displays two side-by-side windows titled "Occurrence Chart".

The left window shows a single occurrence of the handwritten characters "XA". Below the image, the text "x (ALEXANDER) (Q1, Questioned)" is displayed and highlighted with a yellow box. The window's footer shows "Page : 1 of 1" and a filter dropdown set to "All Question(Q) 1 of 4".

The right window shows three occurrences of the handwritten character "X". Each occurrence is labeled with a yellow box: "x (exclusive) (D4 (19), Diab)", "x (ext) (D4 (19), Diab)", and "x (LENNOXVILLE) (D4 (10), Diab)". The window's footer shows "Page : 1 of 1" and a filter dropdown set to "All Known(K) 3 of 4".

There are 3 occurrences of the "X" within the specimens.

## Demonstrating illogical reasoning by an opposing expert

Ms. [REDACTED] ultimately goes on to dismiss all seven “differences” by declaring that:

*“These differences are thus actually natural variations of the form of certain characteristics and therefore do not constitute dissimilarities that would exclude the writer of the exemplar from being the writer of the questioned documents because all of the characteristics cannot appear in such a small writing sample.”*

## Demonstrating illogical reasoning by an opposing expert

- One of the differences alluded to by Ms. [REDACTED] is the “P”. A search in Write-On<sup>2</sup> reveals the presence of 25 examples within the specimen material.
- How can one claim that a questioned characteristic is just a variation when that feature is not seen in 25 occurrences of that particular letter?



# Demonstrating illogical reasoning by an opposing expert

The image displays two side-by-side windows titled "Occurrence Chart". Each window contains a list of handwritten occurrences with their corresponding labels and filters.

#	Occurrence	Label
1		P (PANADRIYU) (Q1, Questioned)
2		P (cyPRUS) (Q1, Questioned)

#	Occurrence	Label
1		P (Parole) (D4 (12), Diab)
2		P (COOPERSTOWN,) (D4 (10), Diab)
3		P (COPTY) (D4 (10), Diab)
4		P (CYPRUS) (D4 (10), Diab)
5		P (PRESENT) (D4 (10), Diab)
6		P (BISHOPS) (D4 (10), Diab)
7		P (REPUBLIC) (D4 (1), Diab)

At the bottom of each window, there is a page navigation bar. The left window shows "Page : 1 of 1" and a filter dropdown set to "All Question(Q)" with "2 of 27" items. The right window shows "Page : 1 of 1" and a filter dropdown set to "All Known(K)" with "25 of 27" items.