Using the Statistical Functions of Write-On² Software to Assess Natural Variation in Handwriting

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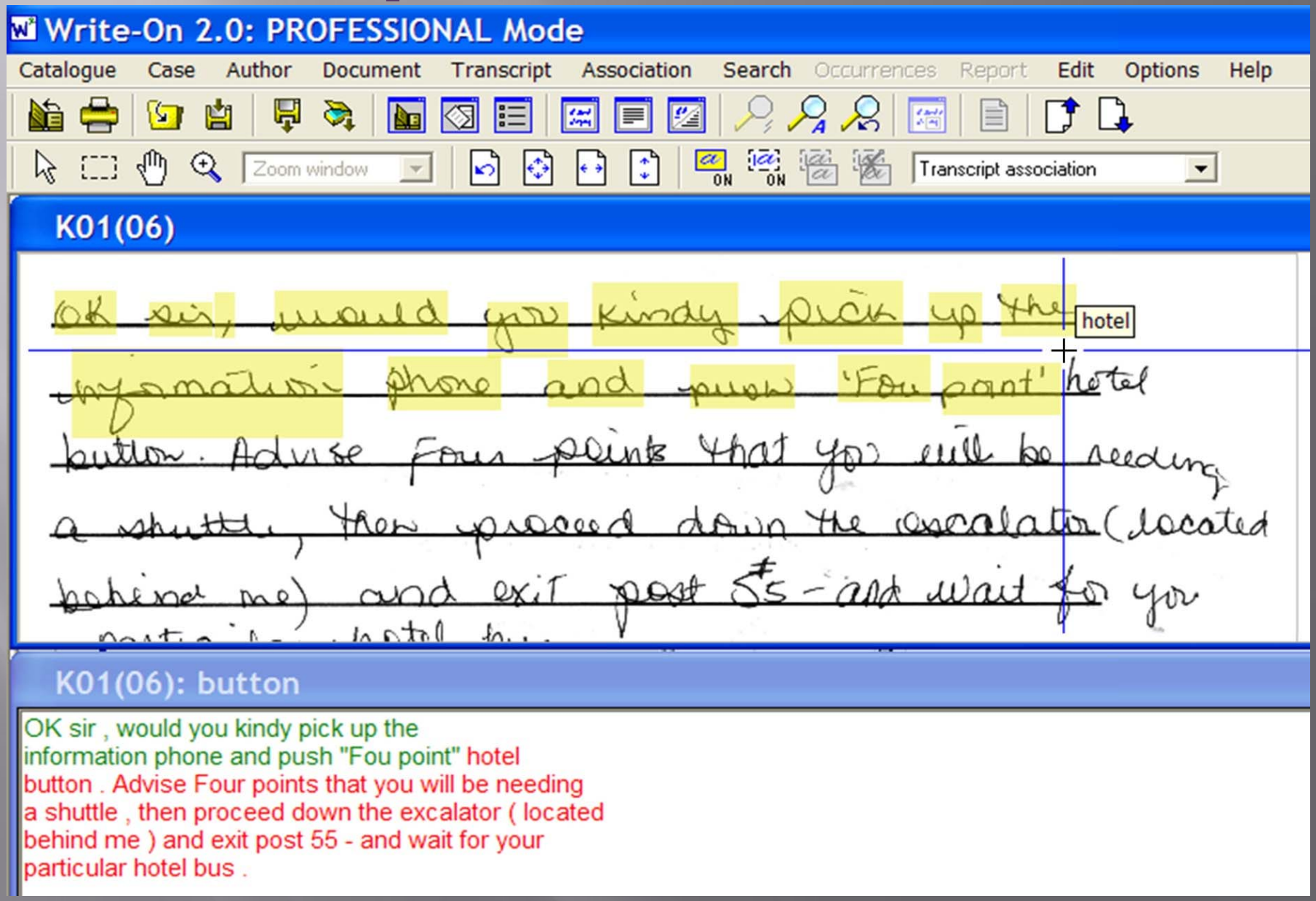
What is Write-On^2 Software?

- 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.

Example of Some Associated Text

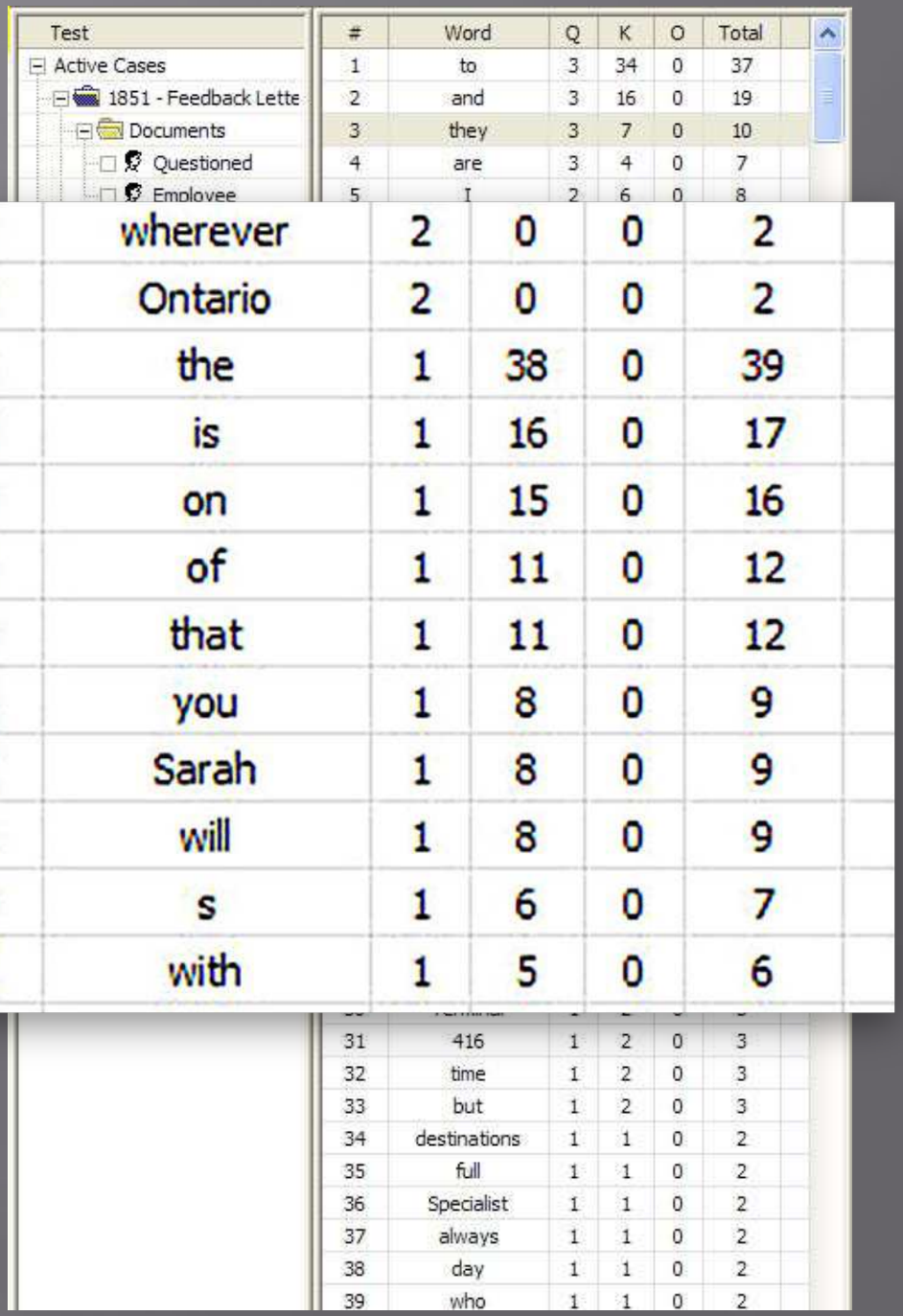


What is Write-On^2 Software?

- 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

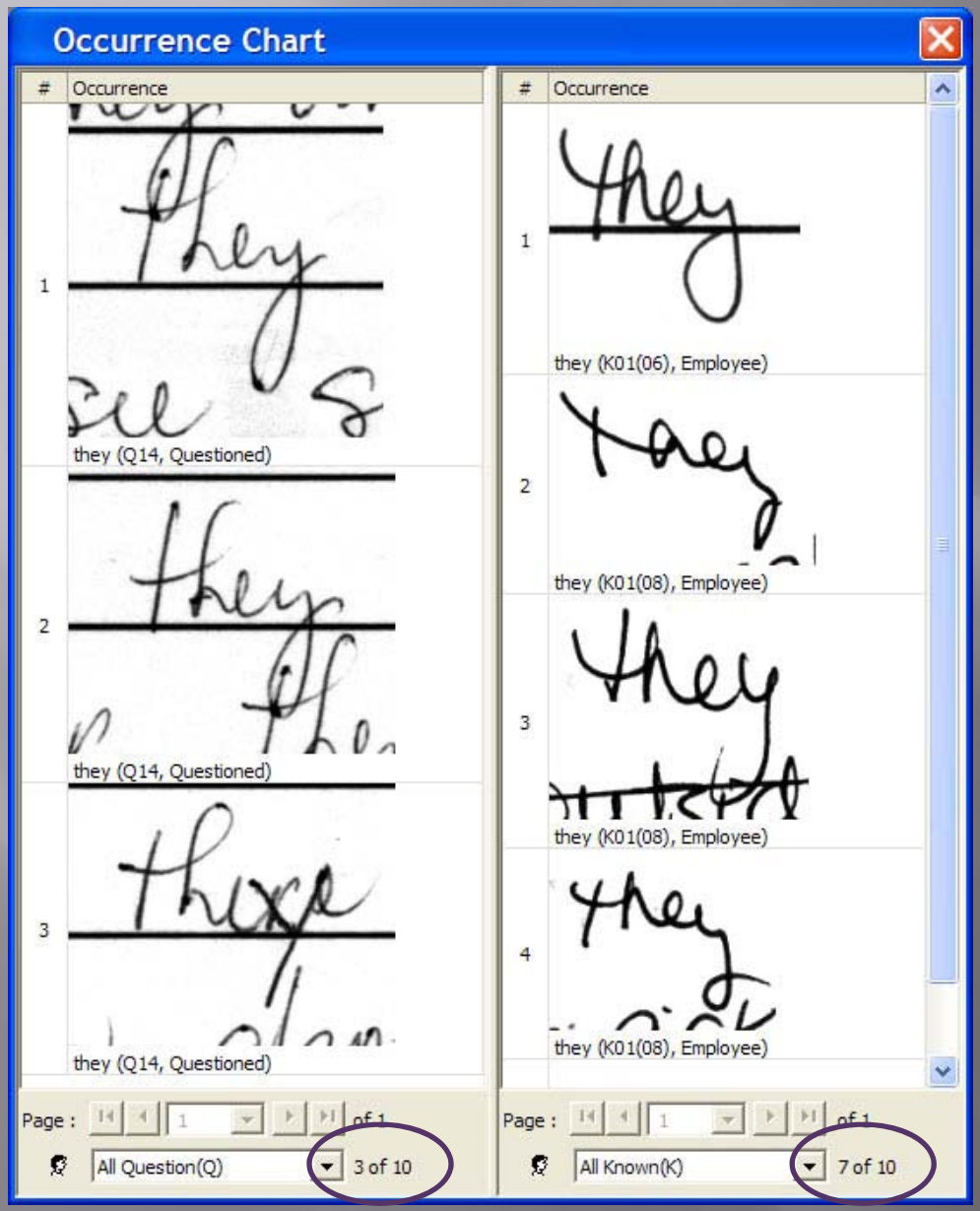
The index tallies the number of occurrences within both the questioned and specimen documents and provides a total count.



Test
- Active Cases
  - 1851 - Feedback Lette
    - Documents
      - Questioned
      - Employee

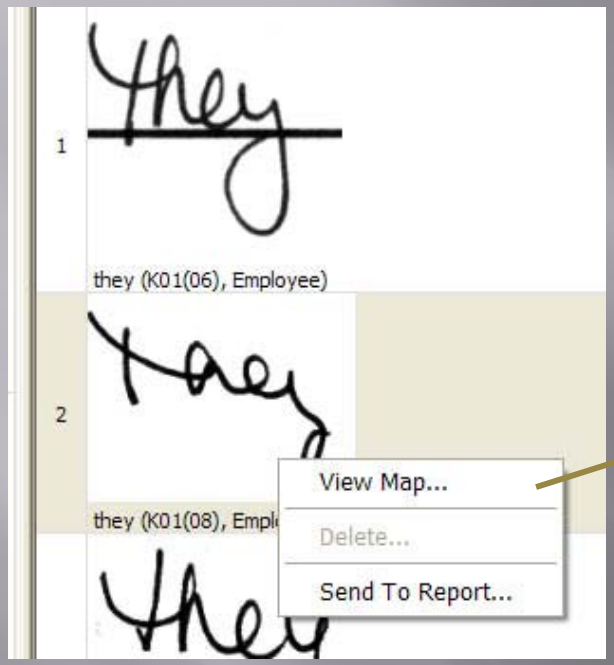
#	Word	Q	K	O	Total
1	to	3	34	0	37
2	and	3	16	0	19
3	they	3	7	0	10
4	are	3	4	0	7
5	I	2	6	0	8
9	wherever	2	0	0	2
10	Ontario	2	0	0	2
11	the	1	38	0	39
12	is	1	16	0	17
13	on	1	15	0	16
14	of	1	11	0	12
15	that	1	11	0	12
16	you	1	8	0	9
17	Sarah	1	8	0	9
18	will	1	8	0	9
19	s	1	6	0	7
20	with	1	5	0	6
31	416	1	2	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



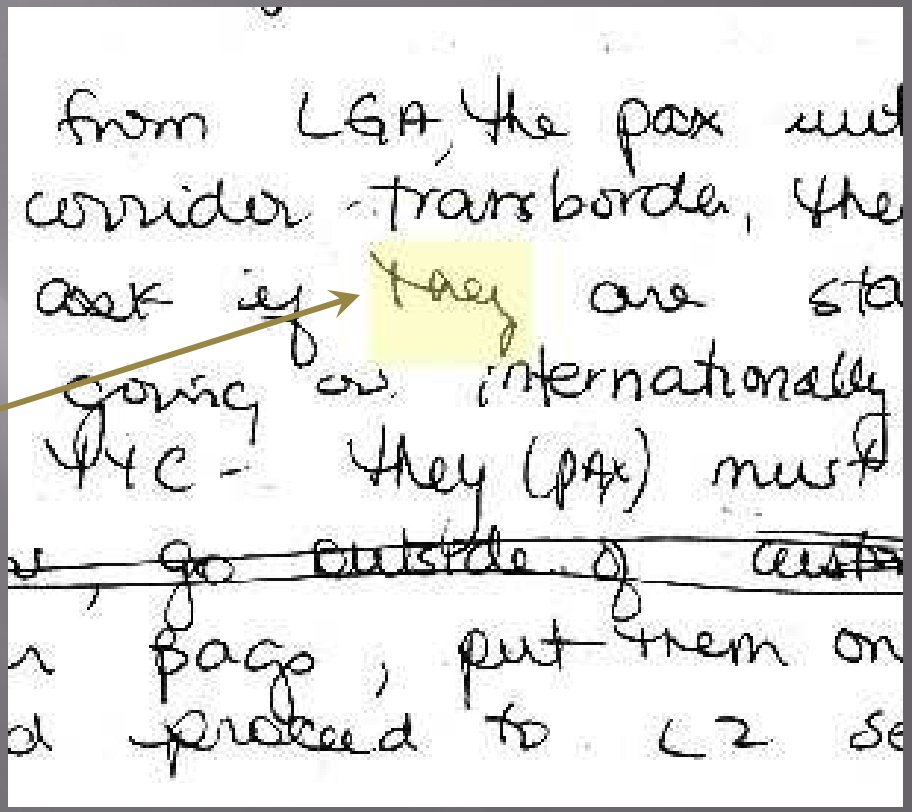
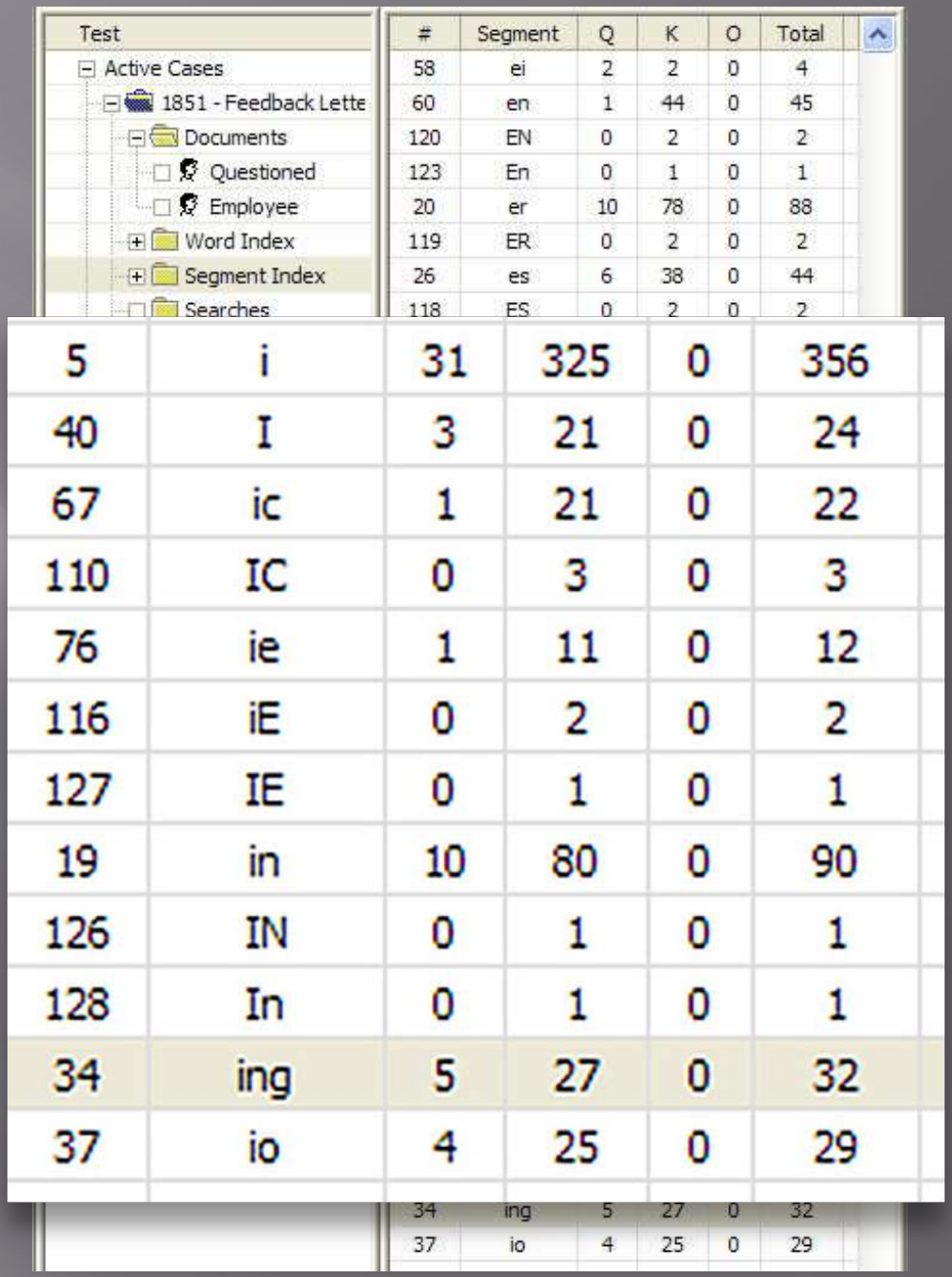
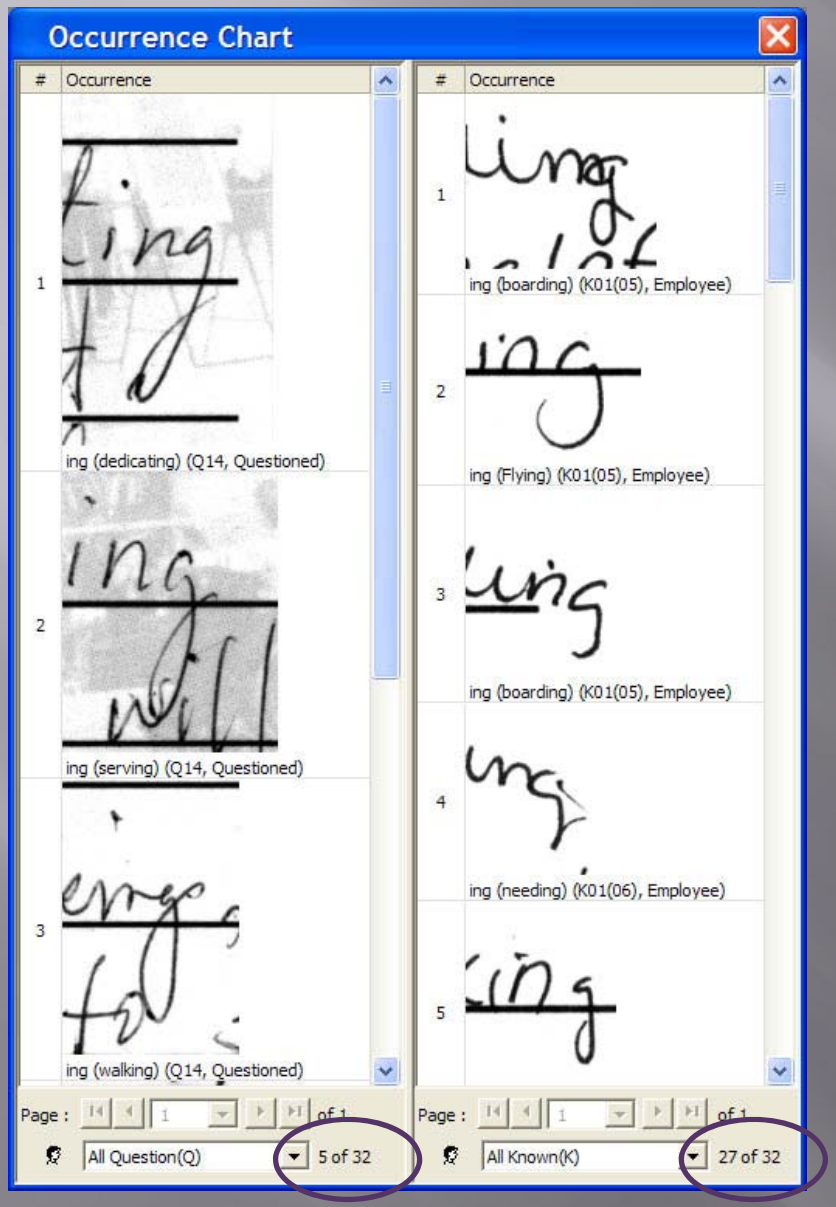


Illustration of the Segment Index from which searches can be launched



#	Segment	Q	K	O	Total
58	ei	2	2	0	4
60	en	1	44	0	45
120	EN	0	2	0	2
123	En	0	1	0	1
20	er	10	78	0	88
119	ER	0	2	0	2
26	es	6	38	0	44
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

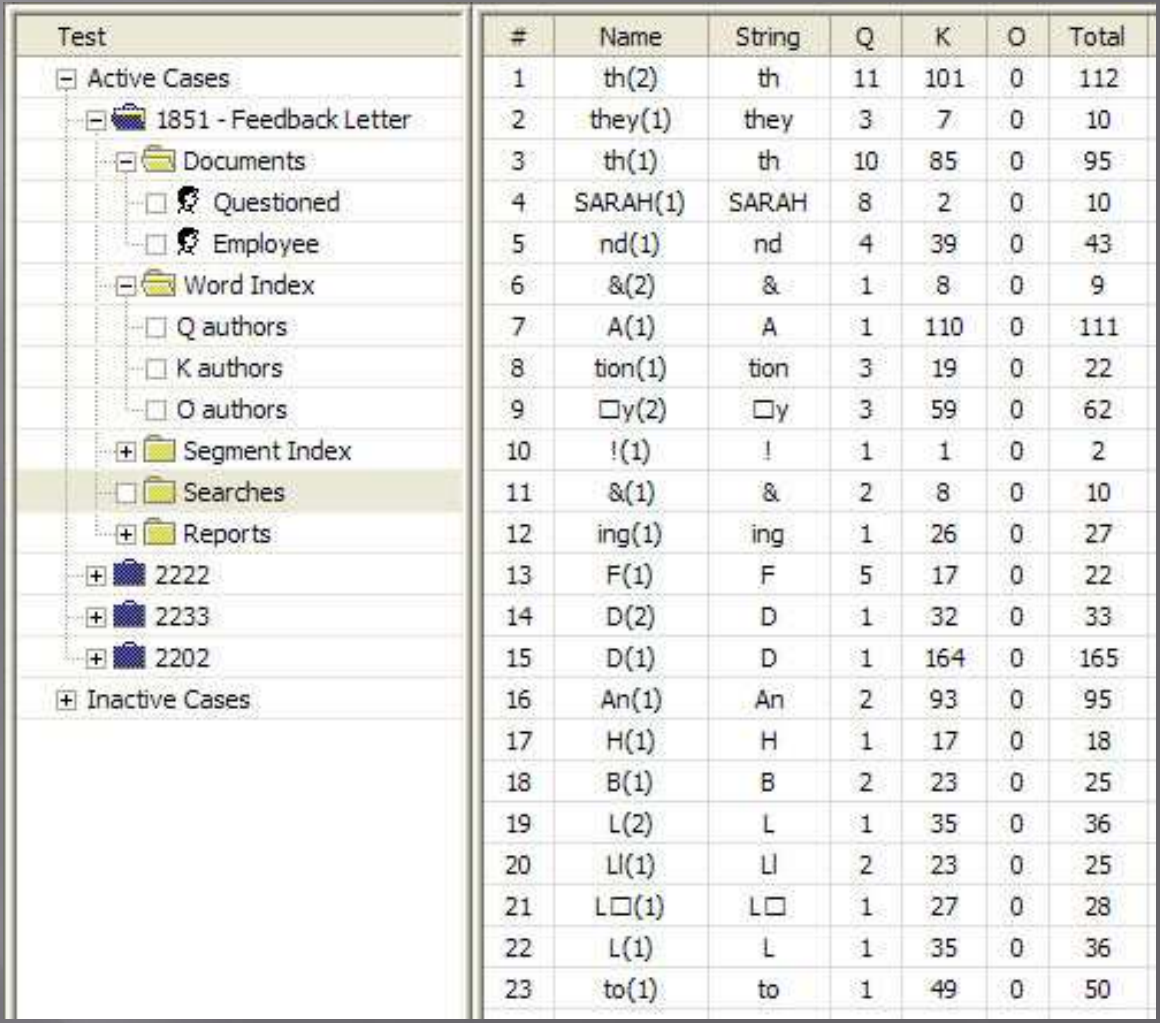
Example of an occurrence chart generated when searching for the "ing" segment



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.



#	Name	String	Q	K	O	Total
1	th(2)	th	11	101	0	112
2	they(1)	they	3	7	0	10
3	th(1)	th	10	85	0	95
4	SARAH(1)	SARAH	8	2	0	10
5	nd(1)	nd	4	39	0	43
6	&(2)	&	1	8	0	9
7	A(1)	A	1	110	0	111
8	tion(1)	tion	3	19	0	22
9	□y(2)	□y	3	59	0	62
10	!(1)	!	1	1	0	2
11	&(1)	&	2	8	0	10
12	ing(1)	ing	1	26	0	27
13	F(1)	F	5	17	0	22
14	D(2)	D	1	32	0	33
15	D(1)	D	1	164	0	165
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

Note: Only Participant #9 had 100% correct on both tests

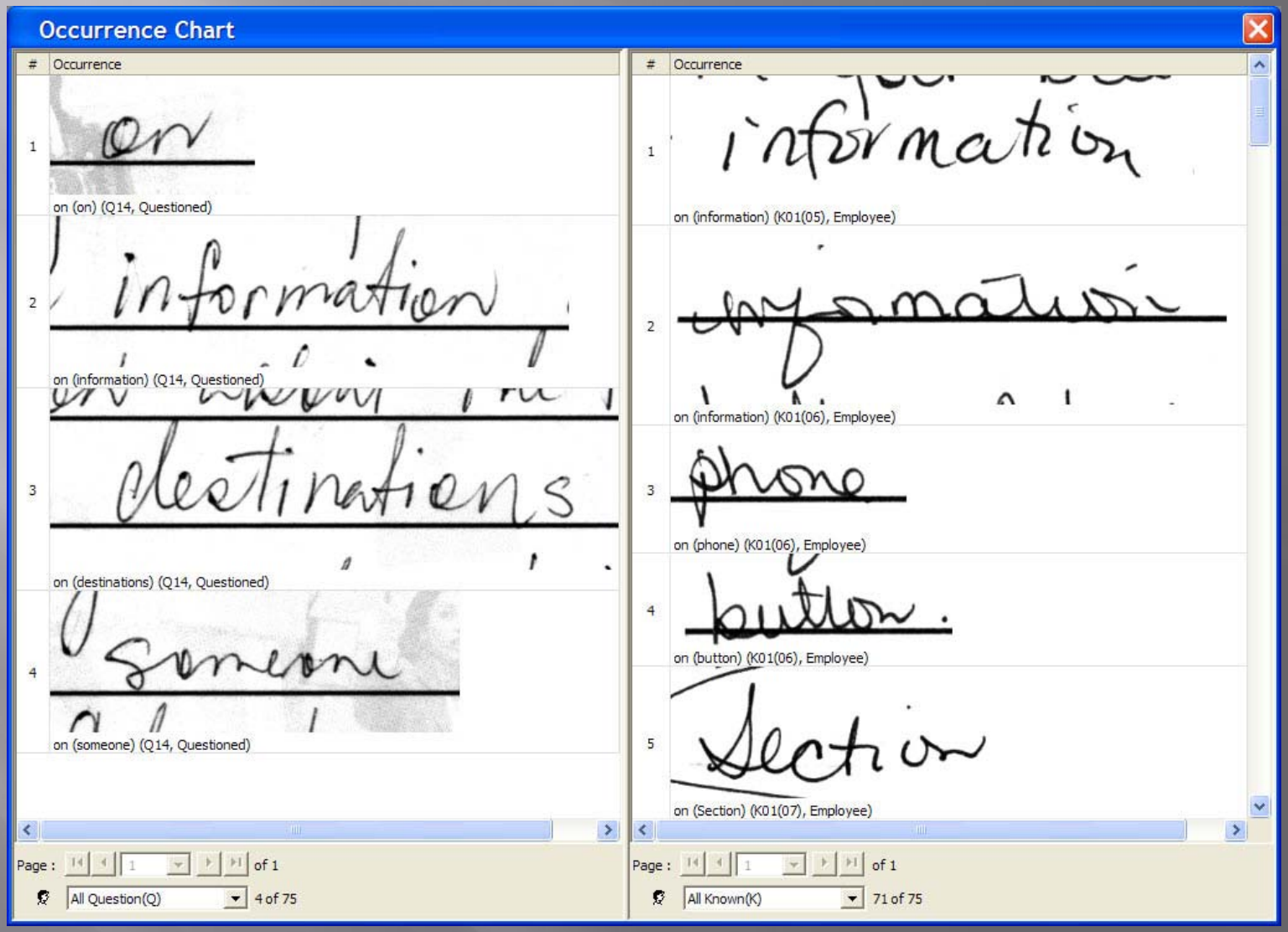
What can we learn from this experiment?

- 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



How does Write-On^2 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.

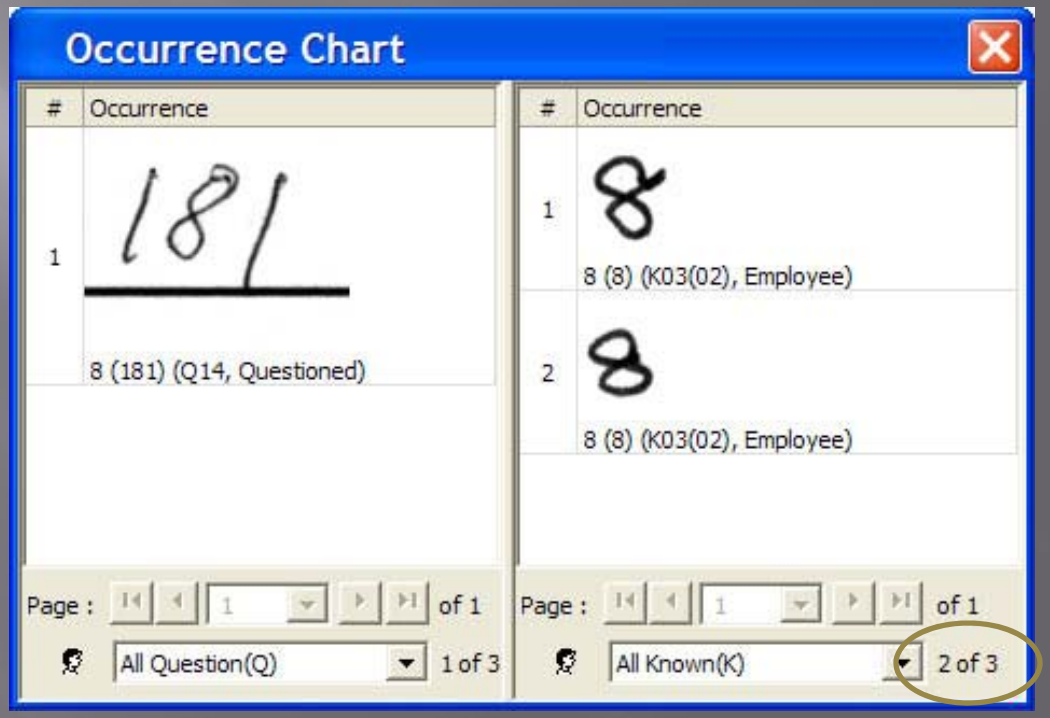
Avoiding pointless searches

- Write-On^2 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?

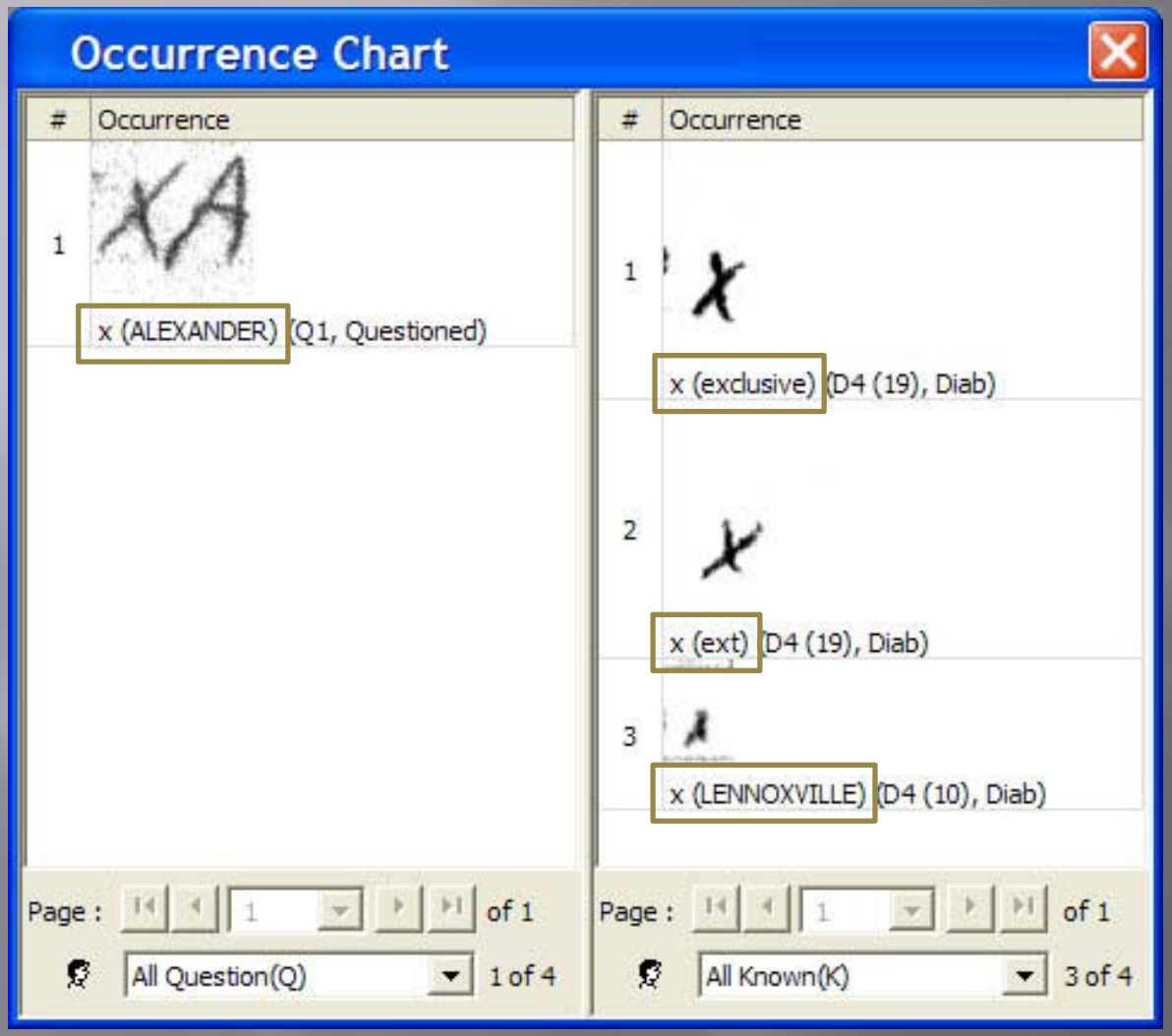
#	Segment	Q	K	O	Total
51	0	2	24	0	26
43	1	3	15	0	18
70	2	1	18	0	19
52	3	2	24	0	26
45	4	3	12	0	15
41	5	3	19	0	22
38	6	4	18	0	22
55	7	2	16	0	18
81	8	1	2	0	3
79	9	1	6	0	7
2	a	40	448	0	488
27	A	5	119	0	124
31	al	5	45	0	50
107	AL	0	4	0	4



Demonstrating flawed examination procedures by an opposing expert

- Ms. [redacted] 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[2] shows that this letter could have been considered in the examination as there are examples within the specimen and questioned material, which are illustrated in the next slide.

Demonstrating flawed examination procedures by an opposing expert



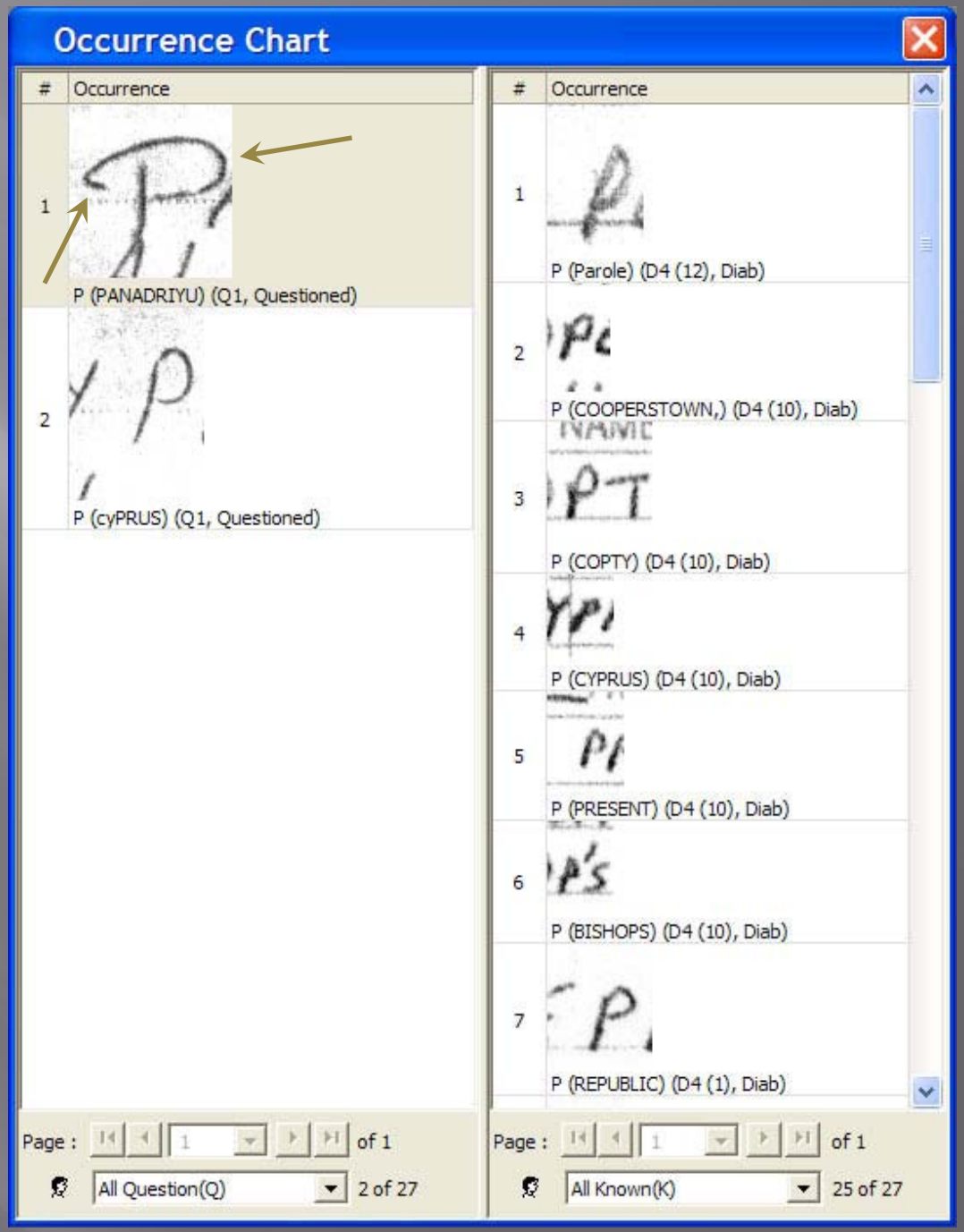
There are 3 occurrences of the “X” within the specimens and 1 in the questioned document.

Demonstrating illogical reasoning by an opposing expert

Ms. Bisotti 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^2 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