

Cognitive Human Factors and the Use of Signature Features in Questioned/Known Signature Comparisons



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The Person/Environment Interaction



- **Human Factors (Ergonomics)**

The relationship between humans and their work environments.

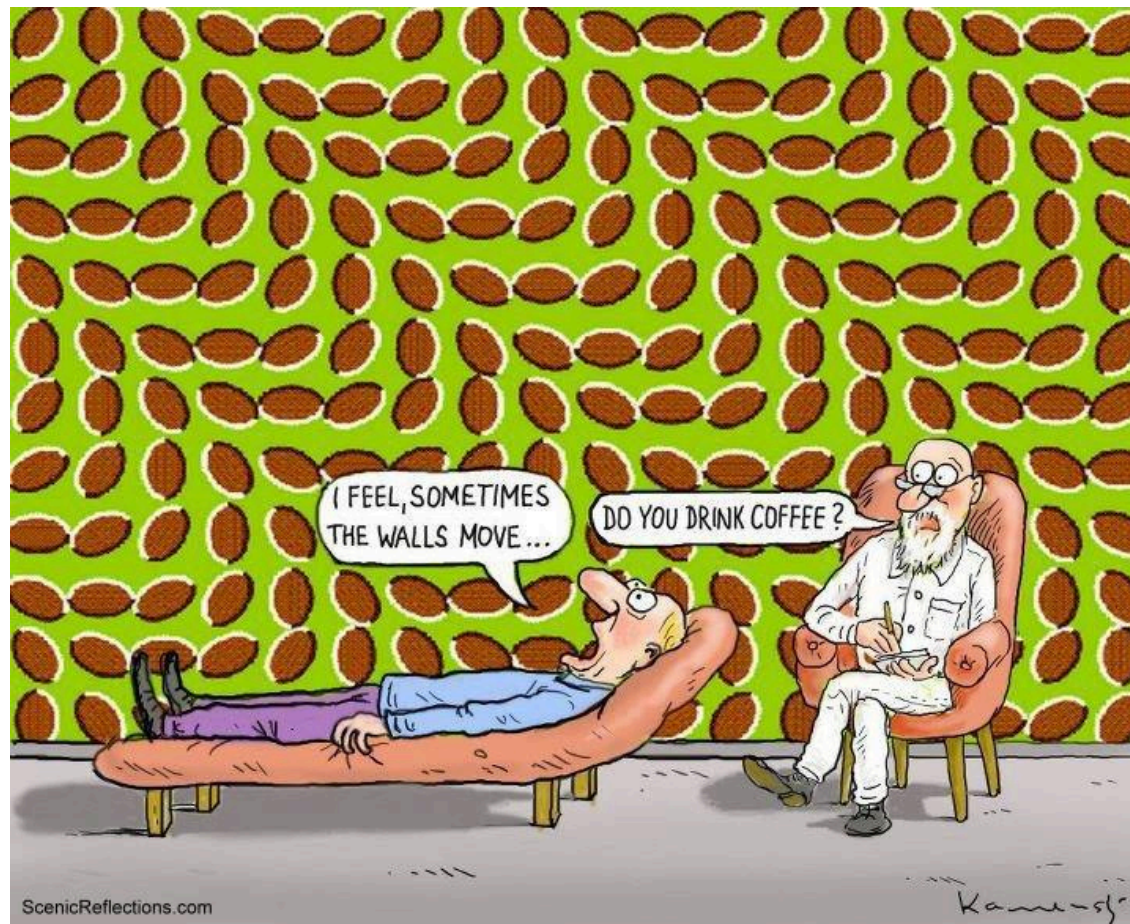
- **Cognitive Ergonomics**

Examining cognitive processes in the context of work and operational settings.

- **The Goal**

Improve task performance by systematic study human cognitive functioning and the environment.

Unconscious Cognitive Phenomena and Conscious Cognitive Processes

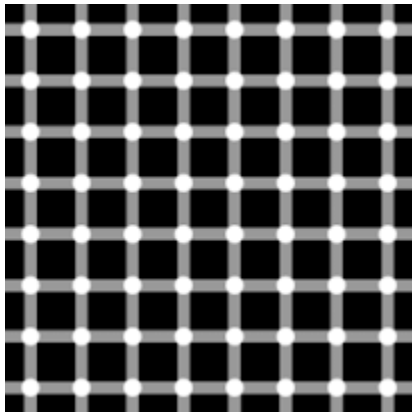


<http://businessboomcollective.com/0612/25-mind-blowing-optical-illusions/>

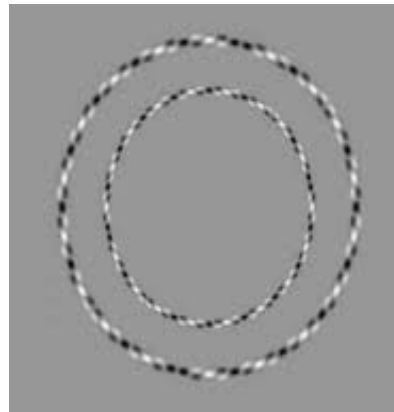
Lower-Order Processing: Illusions of Sensation



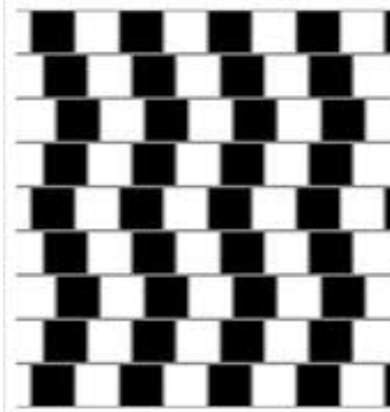
**Scintillating
Grid Illusion**
(Lingelbach, 1994)



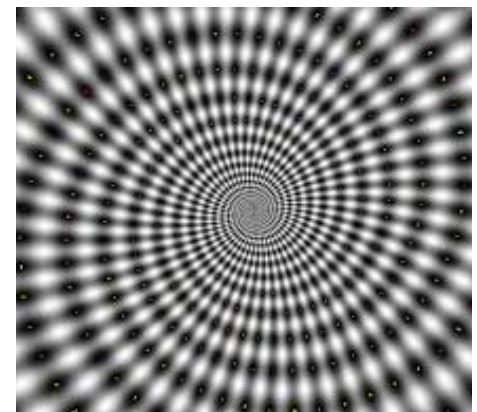
**Pinna's
Intertwining
Illusion (Pinna &
Gregory, 2002)**



**Café Wall
Illusion (Gregory
& Heard, 1979)**



**Twisted Cord (Fraser
Spiral) Illusion
(Fraser, 1936)**



Illusions of sensation result from neural activity generated when light waves strike receptor cells on the retina. These processes occur automatically.

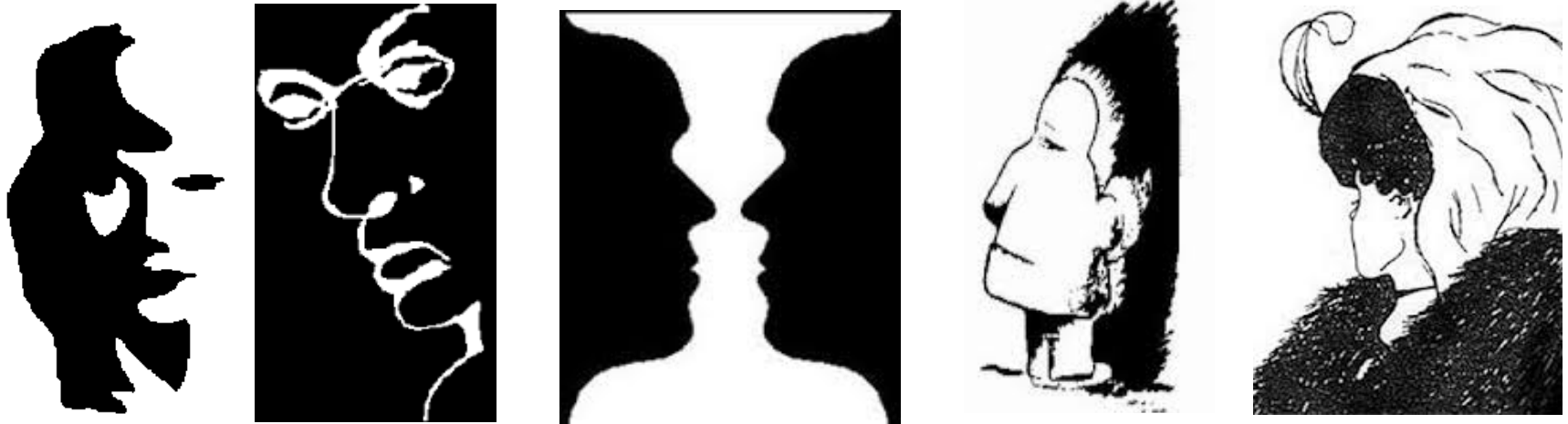
Higher-Order Processing: Illusions of Perception



Context exerts a powerful influence over how we interpret stimuli in the environment. Perceptual set for faces is so strong that we often perceive faces where there are none.



Higher-Order Processing: Illusions of Perception



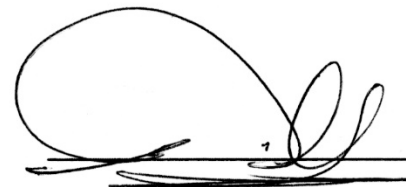
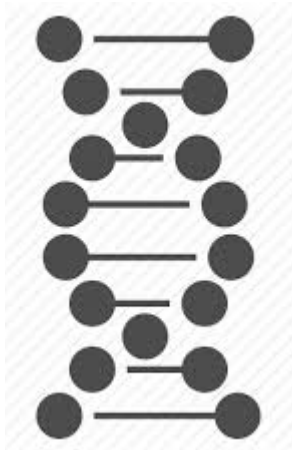
Perception = Sensation + Interpretation

Higher-order cognitive illusions are the result of unconscious inferences.

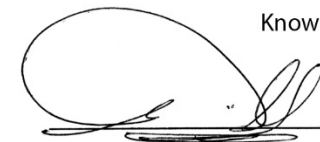
**Perception of ambiguous illusions
depends on *how attention is focused.***

Motivation Expectations Culture
Context Attitudes Emotions

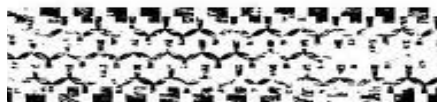
What Does This Mean When Evaluating Forensic Evidence?



Questioned



Known



General Research Question



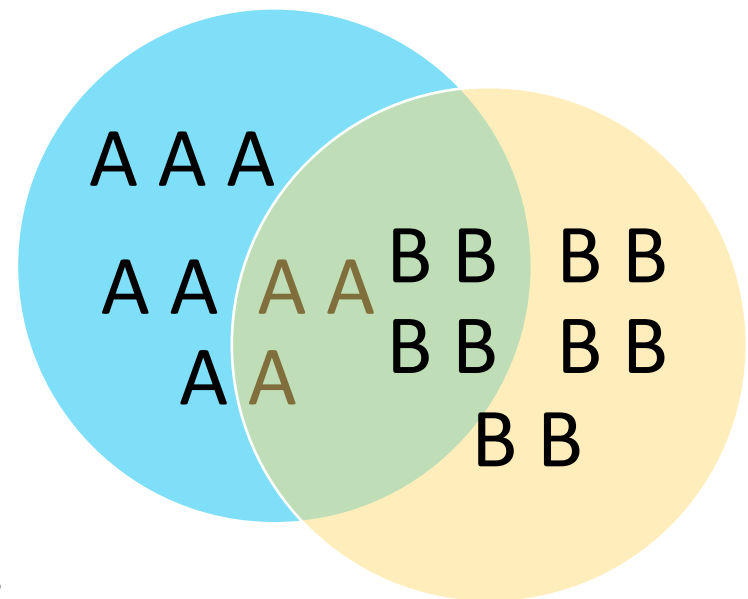
EBB EBB
EBB EBB

Can the identity of the writer of a handwriting specimen be reliably determined by visual comparison (given a sufficient number of writing characteristics)?

Modeling the Forensic Analysis Comparison Process



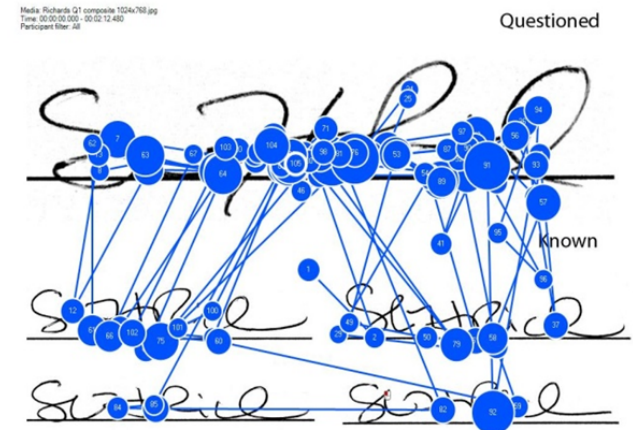
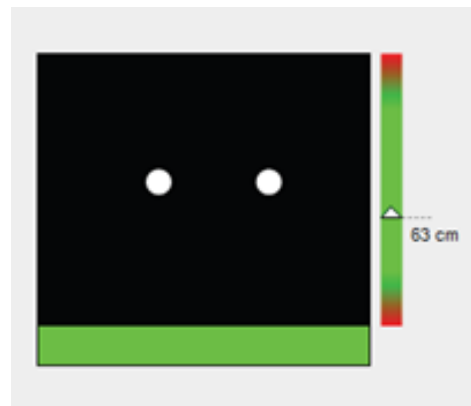
- Tversky's “Contrast Model” (1977)
 - Object recognition is a feature-matching process
 - Similarity depends on the proportion of features common to the two objects, and also on their unique features.



Eye-Tracking Technology and Data



- Tobii T60 Eye-Tracker
 - Records saccades, gaze duration, and gaze location by recording infrared light reflected from the retina



Questioned/Known Trials



- Eleven sets consisting of six signatures each
- Four knowns first displayed, followed by a separate slide with the Questioned/Known comparison
- Process decision (genuine, disguised, simulated, inconclusive)
- Confidence in authorship decision (next slide)

Known



Questioned



Known

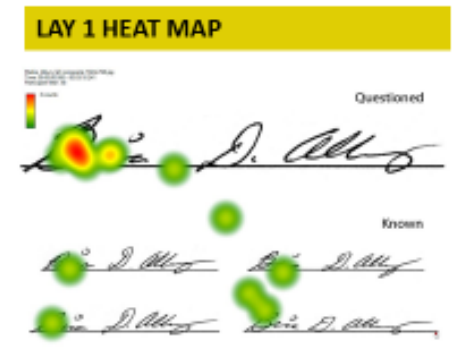
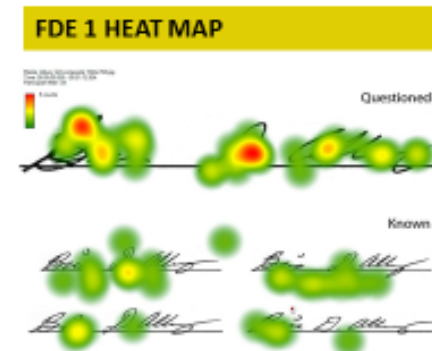
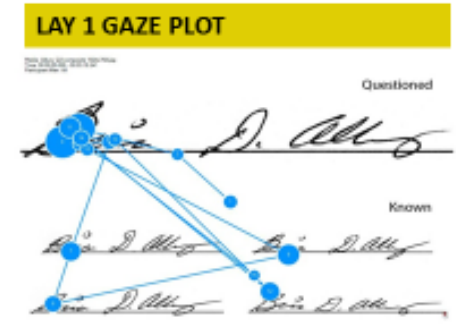


Qualitative Interviews



Digitally recorded and transcribed discussions covering:

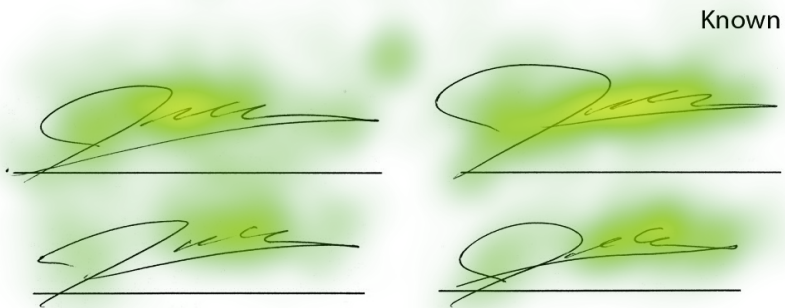
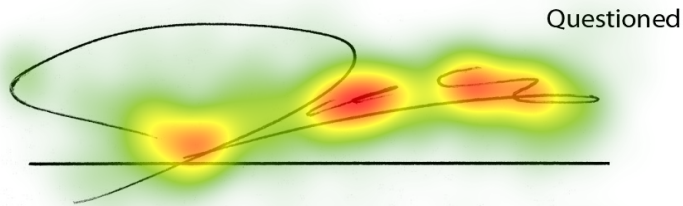
- What features of the signature were examined;
- How determinative features were in the overall decision;
- How much information the signature provided;
- The process by which decisions about signature authenticity were reached;
- Any other aspects of the research the examiner wished to discuss.



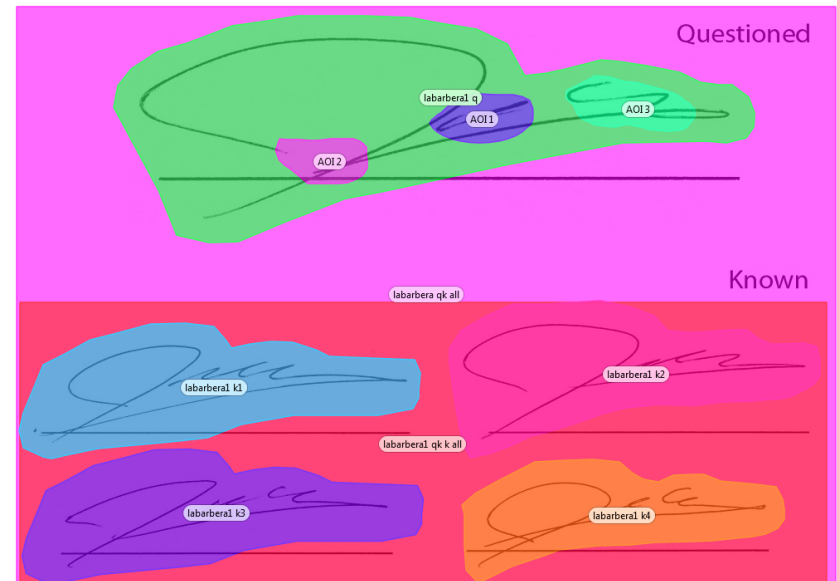
Identifying Features for Analysis



Jim LaBarbera Signature 1 Heat Map FDE and Lay Participants



Jim LaBarbera Signature 1 Areas of Interest



Examine this Signature



Questioned

Terry Lee

Known

Terry Lee

Terry Lee

Terry Lee

Terry Lee

Would you say that this TEXT-BASED signature is GENUINE or SIMULATED?

Questioned

Terry ll

Terry ll

Known
Terry ll

Terry ll

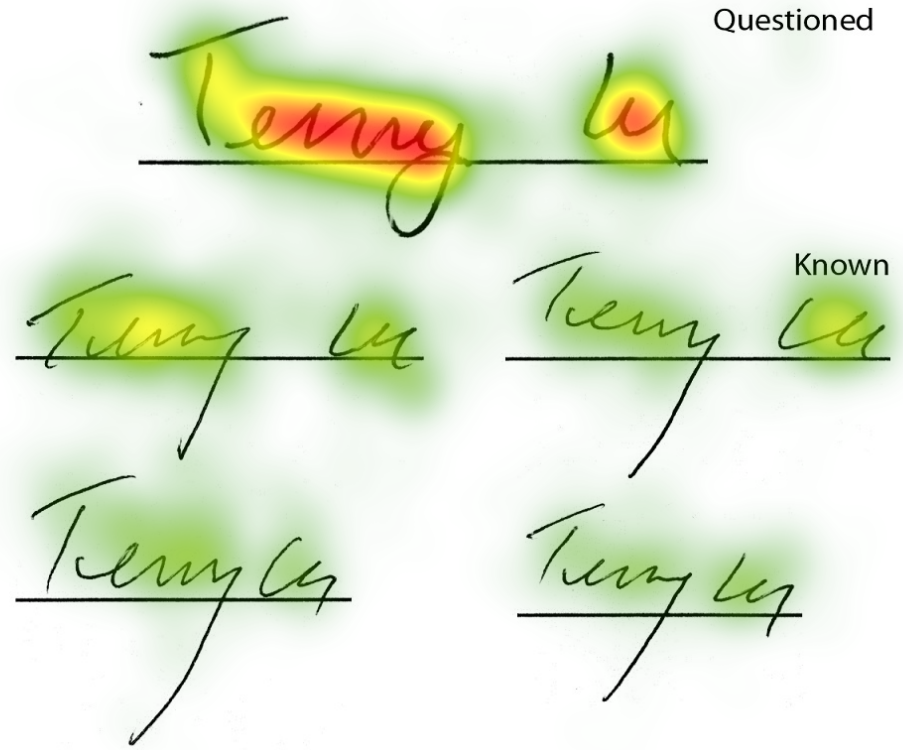
Terry ll

TERRY LU

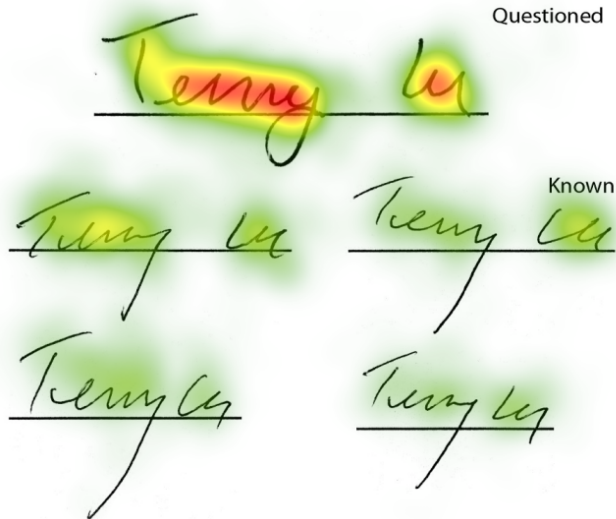
Signature 1

(Simulated)

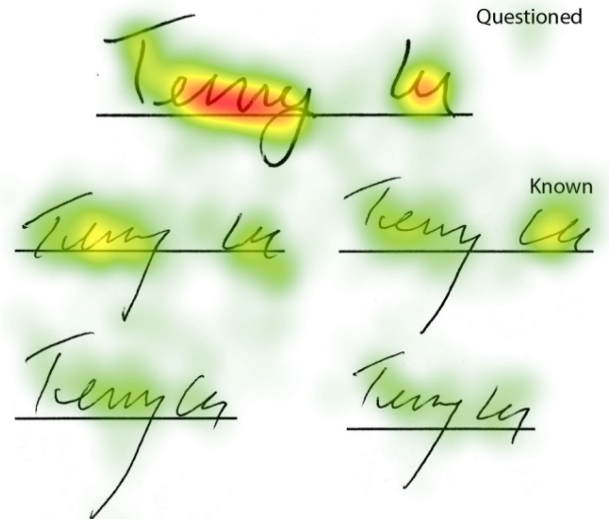
This signature is classified as a low complexity, text-based signature.



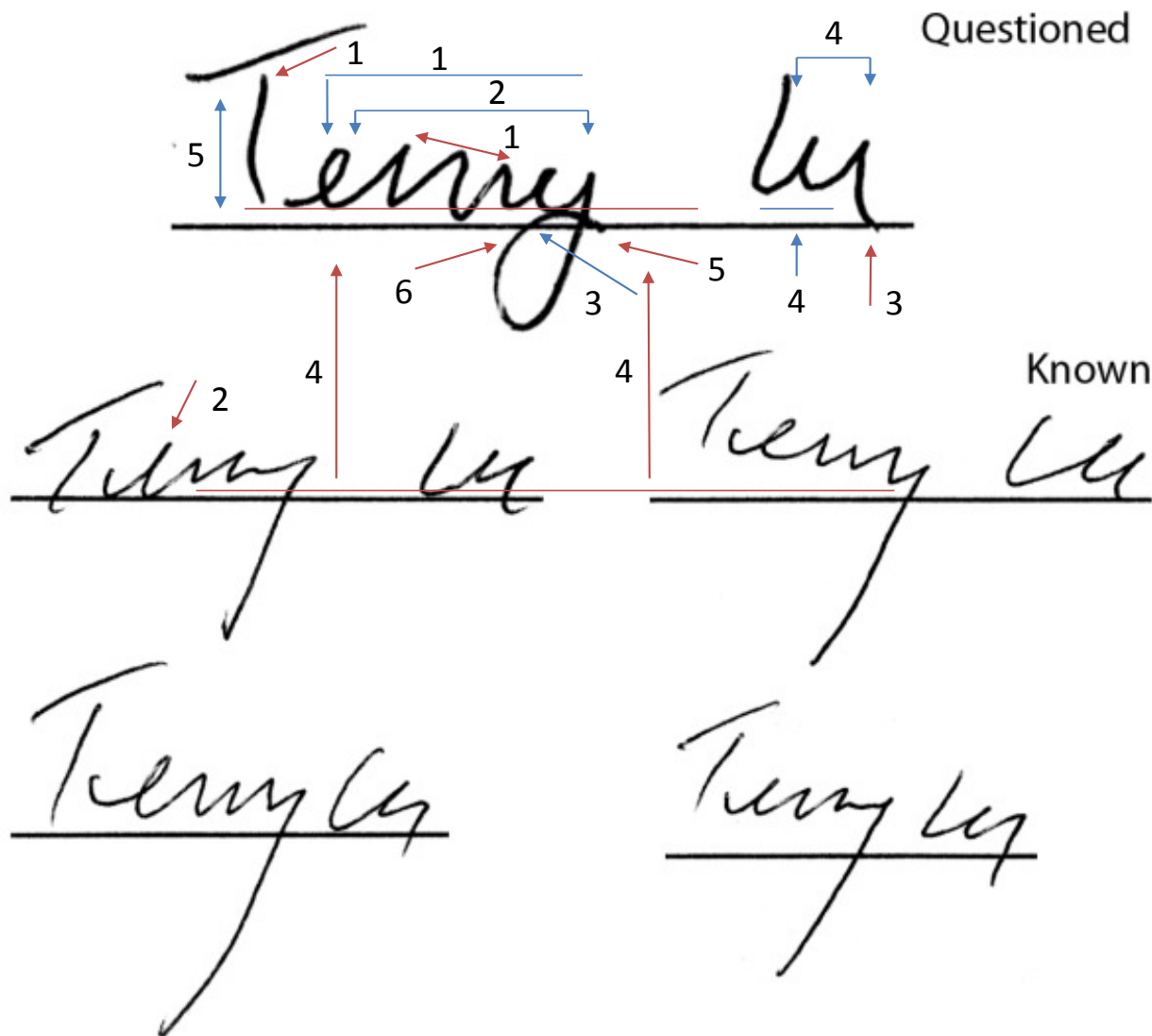
ALL FDE



ALL LAY



Salient Features for FDE and Lay Participants



Lu Results



Questioned

A handwritten signature "Terry Lu" written in black ink on a white background, underlined. The signature is slanted and appears to be a cursive or semi-cursive style.

Known

Two handwritten signatures "Terry Lu" written in black ink on a white background, underlined. The signatures are slanted and appear to be a cursive or semi-cursive style, identical to the questioned signature.

- **48 FDEs responded correctly** that the signature was non-genuine, and 1 responded that it was genuine.
- **38 Lay participants responded correctly** that the signature was non-genuine, and 5 responded that the signature was genuine.

This difference was not statistically significant

$p = .063, ns.$

Examine this Signature



Questioned

A large, handwritten signature in black ink on a white background. The signature is written on a horizontal line and appears to be "Ben D. Allig". The letters are somewhat irregular and show signs of being questioned.

Known

A smaller, handwritten signature in black ink on a white background, written on a horizontal line. It appears to be "Ben D. Allig".

A smaller, handwritten signature in black ink on a white background, written on a horizontal line. It appears to be "Ben D. Allig".

A smaller, handwritten signature in black ink on a white background, written on a horizontal line. It appears to be "Ben D. Allig".

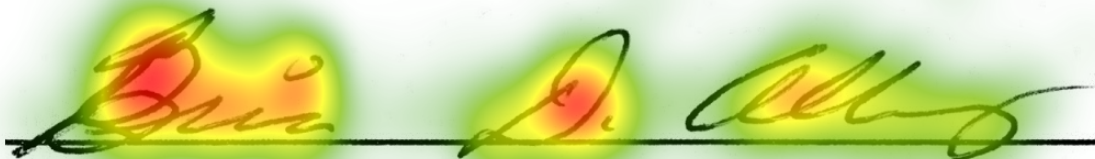
A smaller, handwritten signature in black ink on a white background, written on a horizontal line. It appears to be "Ben D. Allig".

Would you say that this MIXED signature is GENUINE or SIMULATED?

BRIAN ALBURY

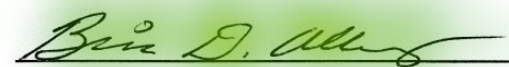
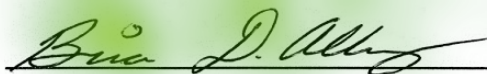
Signature 3 (Genuine)

Questioned



This signature is classified as a high complexity, mixed signature.

Known

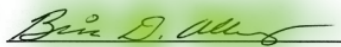
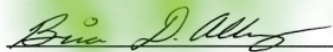


ALL FDE

Questioned

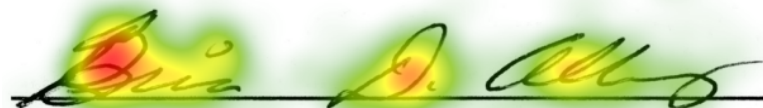


Known

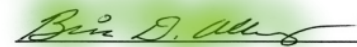


ALL LAY

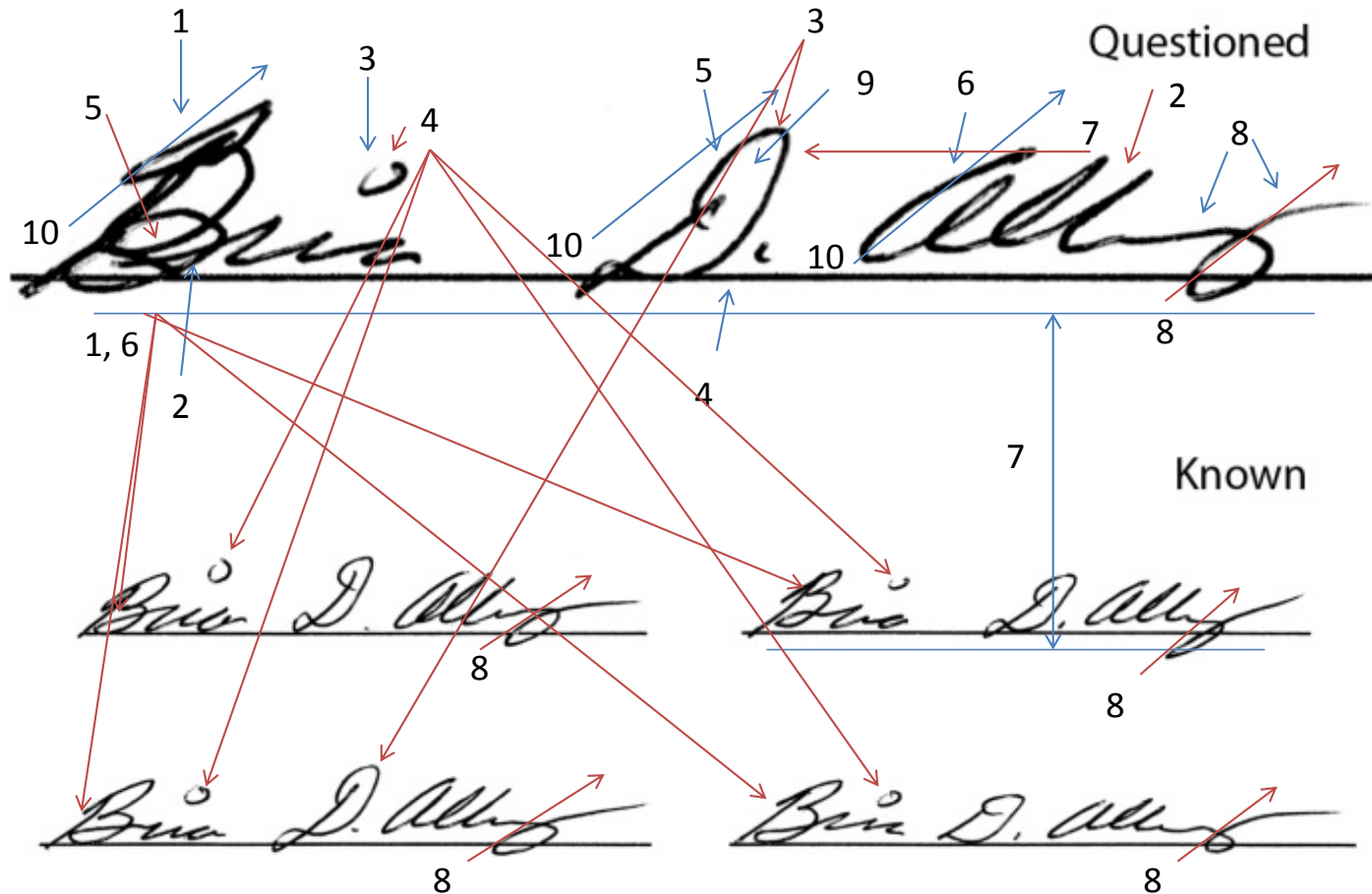
Questioned



Known



Salient Features for FDE and Lay Participants



Albury Results



Questioned

A large, stylized handwritten signature of "Brian D. Albury" written on a horizontal line. The signature is fluid and cursive.

- **19 of 49 FDES responded correctly** as genuine, 30 identified the signature as non-genuine.

Known

A smaller, clear handwritten signature of "Brian D. Albury" written on a horizontal line.

A second smaller, clear handwritten signature of "Brian D. Albury" written on a horizontal line.

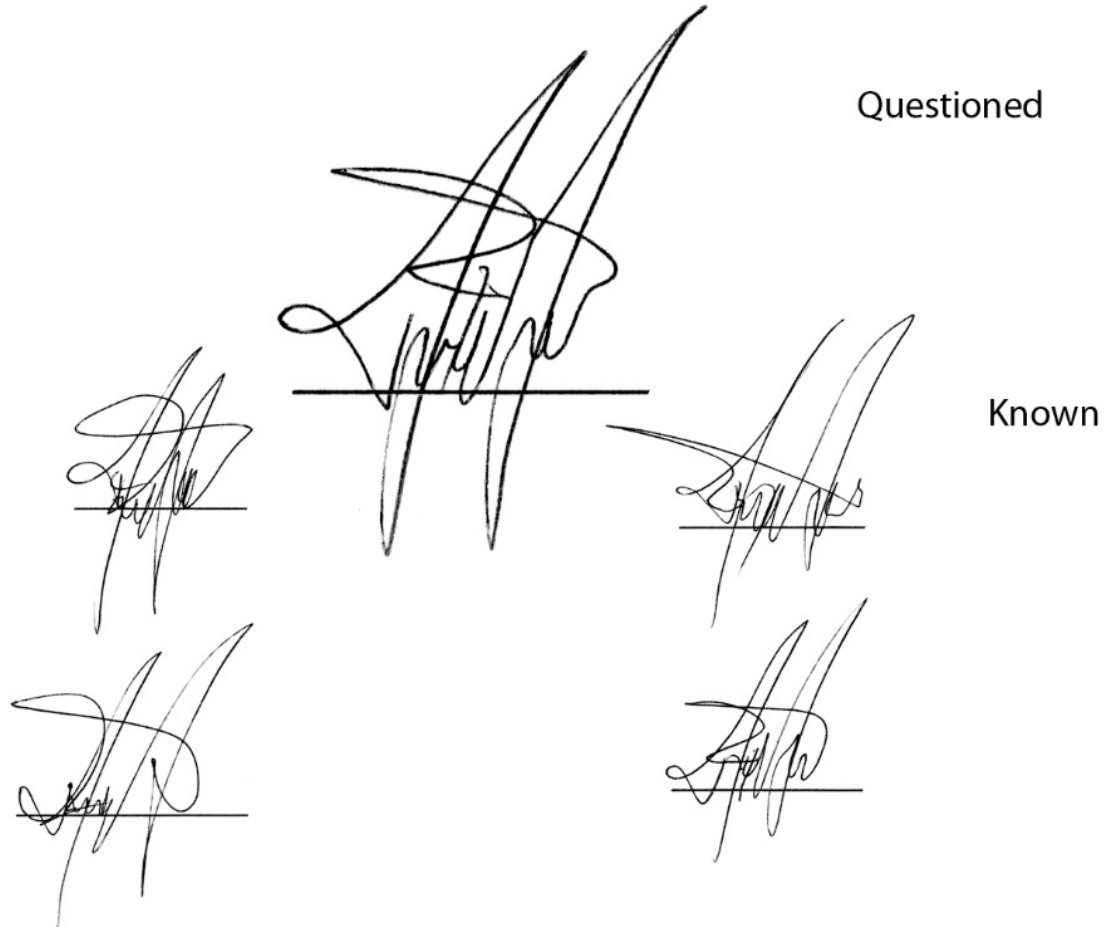
- **42 of 43 Lay participants responded correctly** that the signature was genuine, 1 identified the signature as non-genuine.

A third smaller, clear handwritten signature of "Brian D. Albury" written on a horizontal line.

A fourth smaller, clear handwritten signature of "Brian D. Albury" written on a horizontal line.

**This difference was statistically significant,
 $\chi^2 (1, N = 92) = 35.56, p = < .001.$**

Examine this Signature



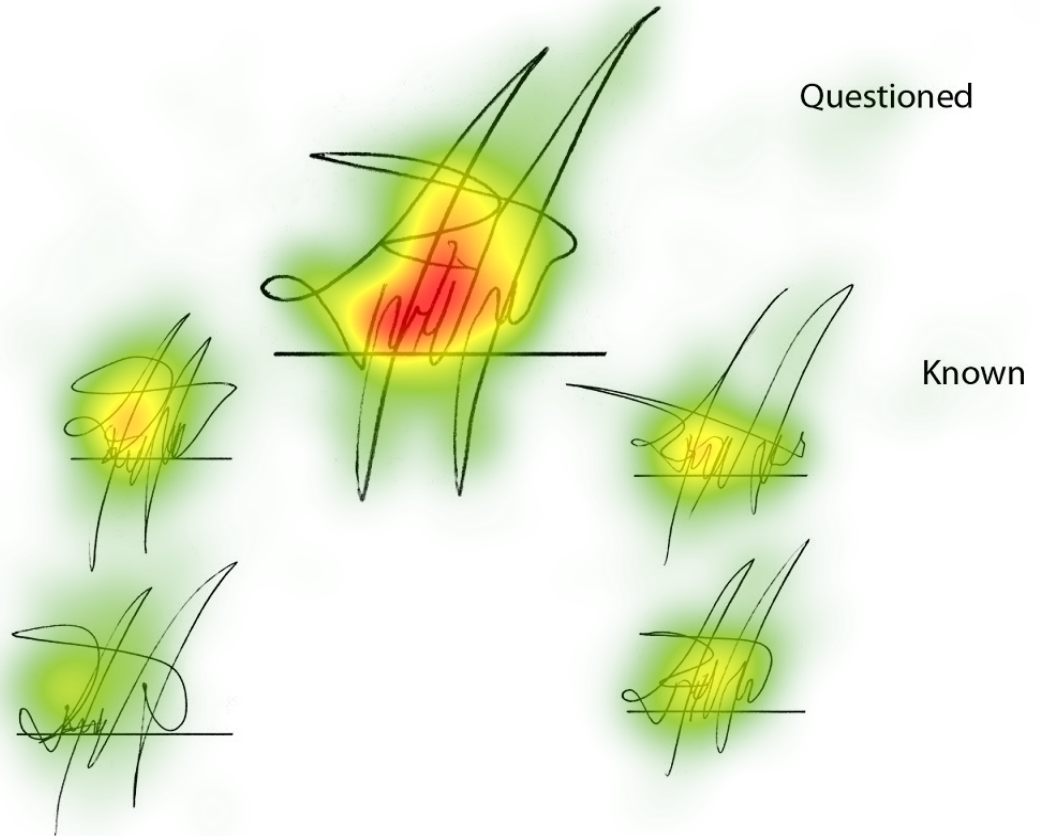
Would you say that this **STYLIZED** signature is **GENUINE** or **SIMULATED**?

VILCISE TIMA

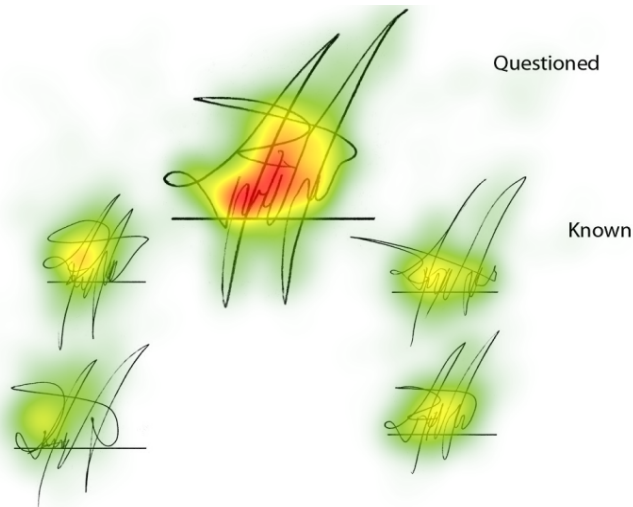
Signature 4

(Genuine)

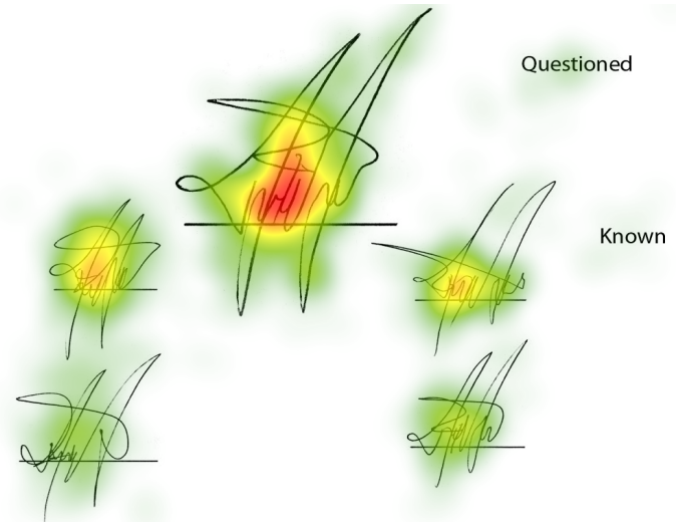
This signature is classified as a high complexity, stylized signature.



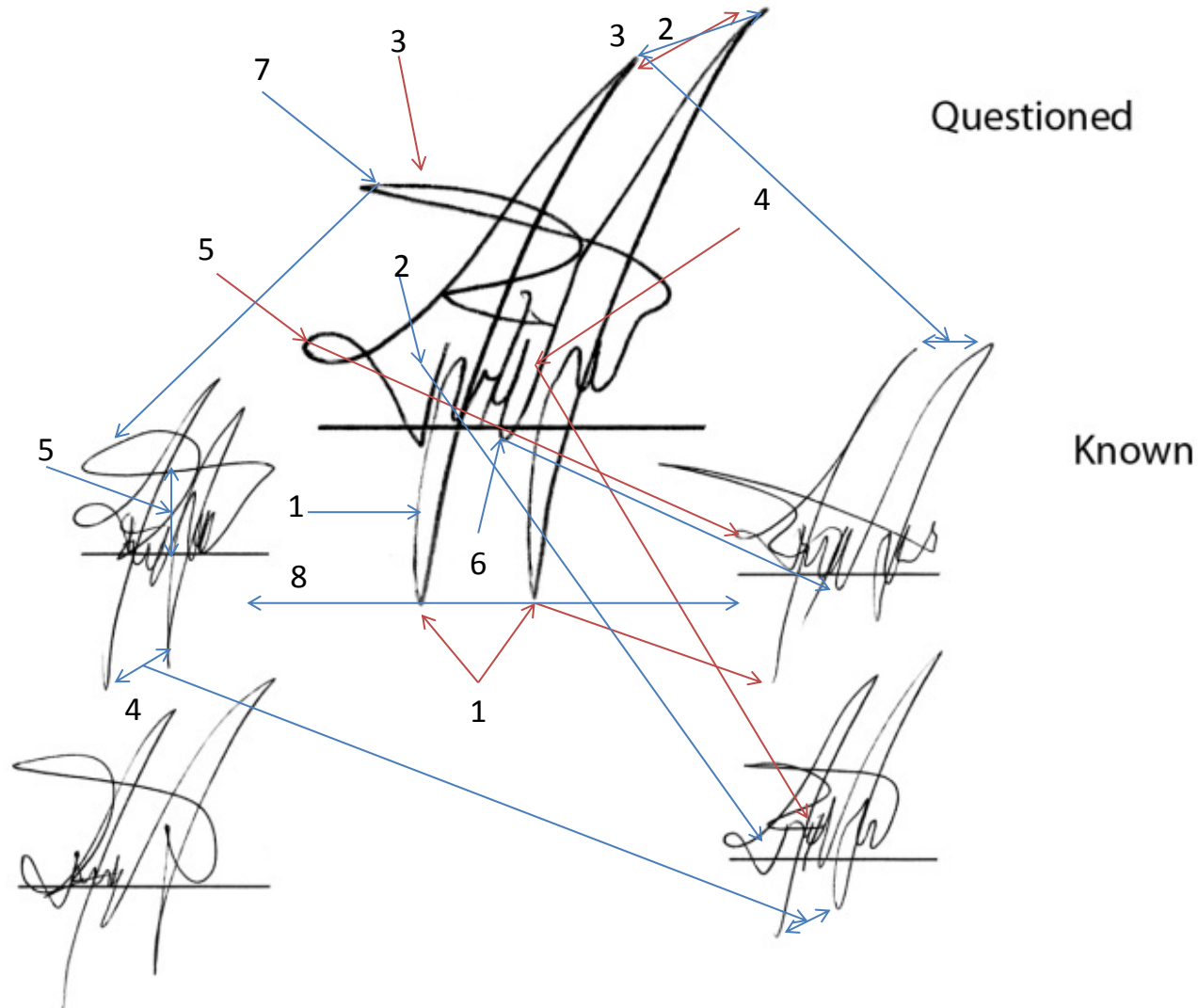
ALL FDE



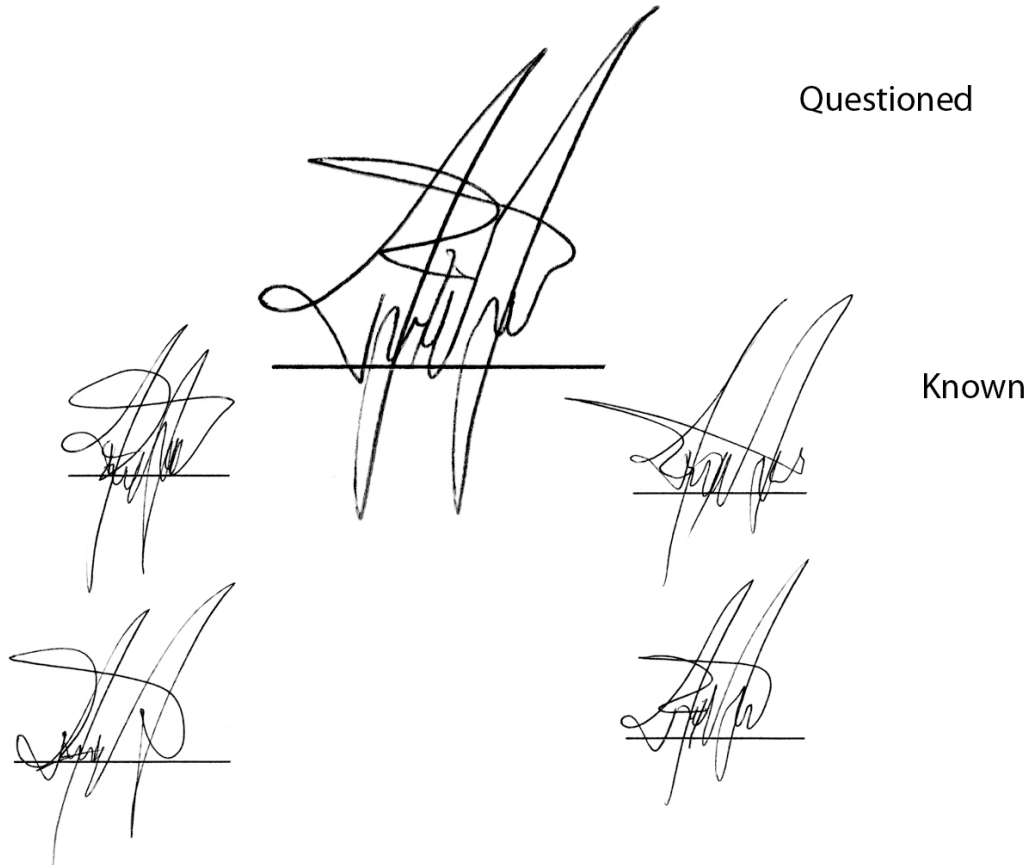
ALL LAY



Salient Features for FDE and Lay Participants



Tima Results



- **39 FDEs responded correctly** that the signature was genuine, and 9 responded that it was non-genuine. One FDE declined to respond.

- **42 Lay participants responded correctly** that the signature was genuine, and 1 responded that the signature was non-genuine.

This difference was statistically significant
 $\chi^2 (2, N = 92) = 7.15, p = .028.$

Top 5 Features Mentioned

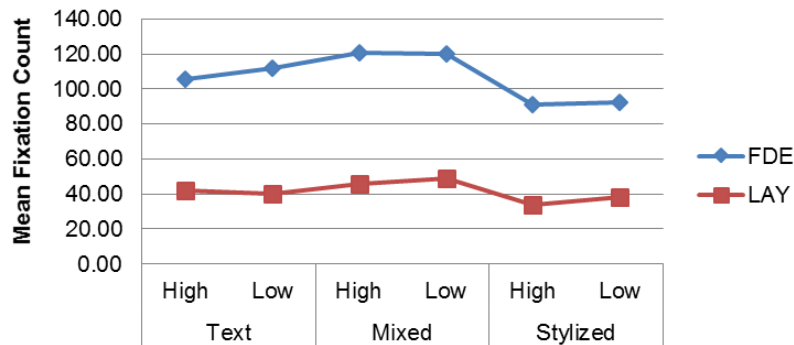


Albury 3 (Text-Based)			Lu 1 (Mixed)			Tima 4 (Stylized)		
Features	n	%Mention	Features	n	%Mention	Features	n	%Mention
Baseline alignment/ placement/ orientation	21	43%	Lower loop	20	41%	Stroke	13	27%
Initial/ beginning stroke	16	33%	Initial/ beginning stroke	17	35%	Initial/ beginning stroke	12	24%
Punctuation/ diacritic	15	31%	Staff/stem	15	31%	Line quality	11	22%
Shape	14	29%	Line quality	13	27%	Speed	10	20%
Stroke	14	29%	Pressure	13	27%	Execution	9	18%

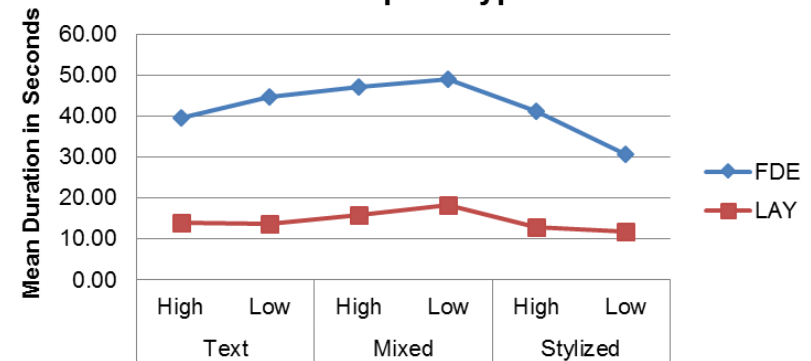
QK Eye-Tracking Metrics



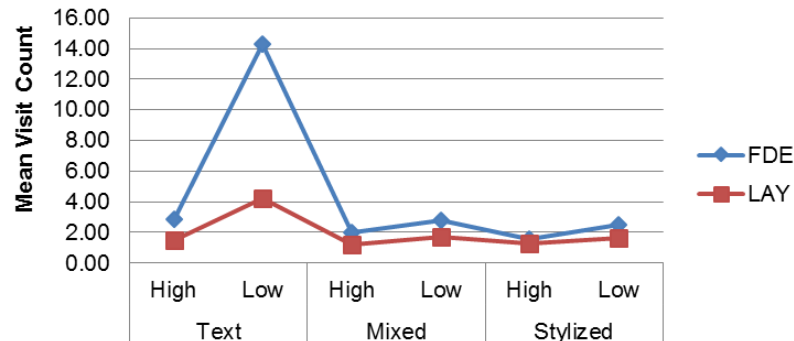
Fixation Count by Signature Type, Signature Complexity, and Participant Type



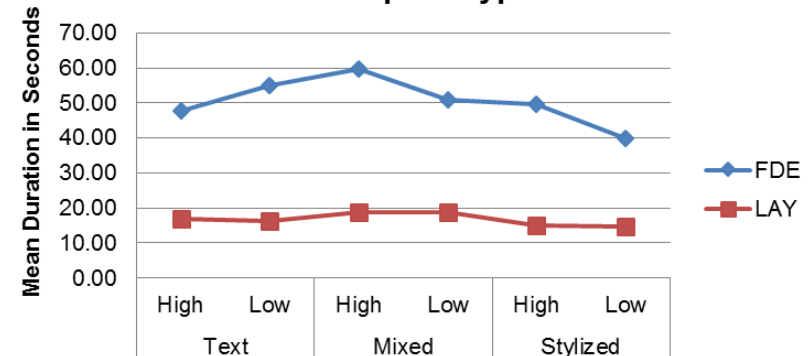
Fixation Duration by Signature Type, Signature Complexity, and Participant Type



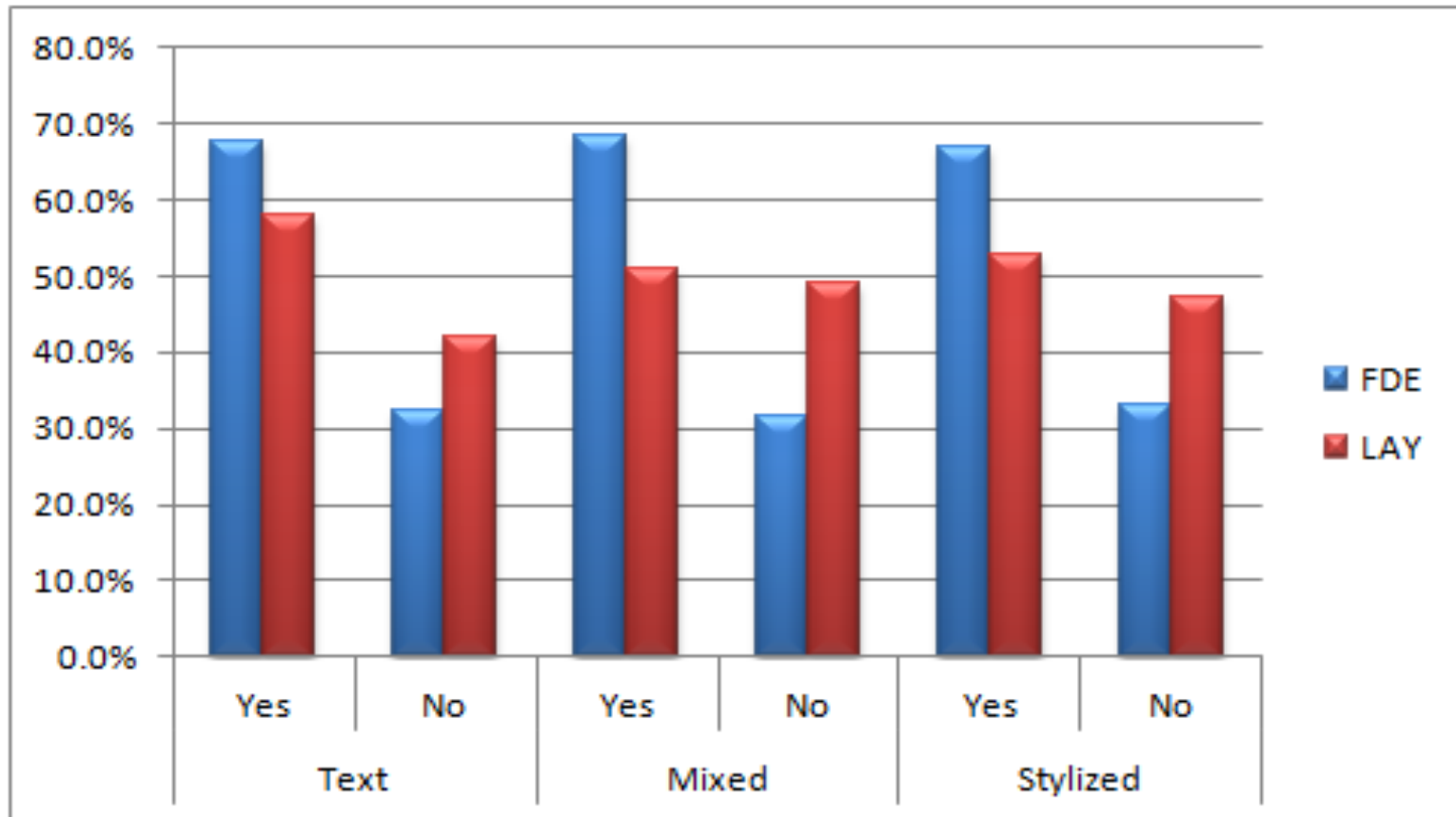
Visit Count by Signature Type, Signature Complexity, and Participant Type



Visit Duration by Signature Type, Signature Complexity, and Participant Type



Call Accuracy by Signature Type



Text: $\chi^2(1, N = 2,208) = 22.44, p < .001$

Mixed: $\chi^2(1, N = 2,208) = 71.68, p < .001$

Stylized: $\chi^2(1, N = 1,656) = 34.58, p < .001$