Cognitive Human Factors and Call Accuracy in Limited-Information Signature Identification Tasks

*Paper Presented at the Forensic Science Error Management International Forensics Symposium, Washington, DC, July 2015*

*Tierra M. Freeman, PhD & Mara L. Merlino PhD*  
Division of Behavioral and Social Sciences, Kentucky State University

*Victoria Springer, PhD & Veronica Blas Dahir, PhD*  
Center for Research Design and Analysis, University of Nevada, Reno

*Derek Hammond, BA*  
US Army Criminal Investigations Laboratory, Forest Park, GA

*Adrian Dyer, PhD*  
Royal Melbourne Institute of Technology, Melbourne, Victoria, Australia

*Bryan Found, PhD*  
Victoria Police Forensic Services Department, Macleod, Victoria, Australia
This project was supported by Award No. 2010-DN-BX-K271, awarded by the National Institute of Justice, Office of Justice Programs, U.S. Department of Justice. The opinions, findings, and conclusions or recommendations expressed in this publication/program/exhibition are those of the author(s) and do not necessarily reflect those of the Department of Justice.
Evaluating Questioned Signatures

As you look at these signatures, what questions come to your mind?
Watch Closely—
What Do You See?
Effortful and Automatic Cognitive Processing

• **Top-Down (Large-Chunk) Processing:**
  • Starting with the larger concept and working down to the finer details

• **Bottom-Up (Small-Chunk) Processing:**
  • Starting with the fine details of and then building upward until we have a solid representation of it in our minds.
Look Again—
What Do You See?

Oleg Shuplyak
Single-Signature Trials

- Five sets, consisting of six signatures each
- Process decision (genuine, simulated)
- Confidence in authorship decision (not at all confident – extremely confident)
- **Purpose:** Isolation of features that are indicators of internal signature consistency.
Tachistoscope/Extended View Protocol

- **REALLY, REALLY ISOLATING SIGNATURE FEATURES**
- Four sets consisting of five signatures (10 right side up, 10 upside down)
- Rapid presentation of signature (1 s)
  - Process decision (genuine, simulated) and confidence
- Extended presentation of signature
  - Process decision (genuine, simulated) and confidence
Examine this Signature

Would you say that this TEXT-BASED signature is GENUINE or SIMULATED?
TEDDE HAMILTON (Genuine)

This signature is classified as a high complexity, text-based signature.
Hamilton Results

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

• **21 Lay participants responded correctly** that the signature was genuine, and 22 responded that the signature was non-genuine.

This difference was statistically significant
\[ \chi^2 (1, N = 92) = 10.19, p = .001. \]
Examine this Signature

Would you say that this MIXED signature is GENUINE or SIMULATED?
This signature is classified as a low complexity, mixed signature.
• **24 FDEs responded correctly** that the signature was non-genuine, and 24 responded that it was genuine. One FDE declined to respond.

• **25 Lay participants responded correctly** that the signature was non-genuine, and 18 responded that the signature was genuine.

This difference was statistically significant

$$\chi^2 (1, N = 91) = 0.61, p = .437, ns.$$
Examine this Signature

Would you say that this STYLIZED signature is GENUINE or SIMULATED?
GARY FEILMEIER
(Simulated)

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

ALL FDE  

ALL LAY
Feilmeier Results

• 49 FDEs responded incorrectly that the signature was genuine, and 0 responded that it was non-genuine.

• 30 Lay participants responded incorrectly that the signature was genuine, and 13 responded that the signature was non-genuine.

This difference was statistically significant

$$\chi^2 (1, N = 92) = 17.25, \ p < .001.$$
## FDE/Lay Participant Overall Call Accuracy

### Overall Correct Call T-Test Analysis Results by Experimental Protocol

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Participant</th>
<th>t</th>
<th>df</th>
<th>p</th>
<th>M</th>
<th>SD</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questioned/Known</td>
<td>FDE</td>
<td>6.74</td>
<td>87</td>
<td>&lt; .001</td>
<td>45.00</td>
<td>6.12</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>Lay</td>
<td>35.58</td>
<td>7.06</td>
<td>43</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single Signature</td>
<td>FDE</td>
<td>5.66</td>
<td>87</td>
<td>&lt; .001</td>
<td>20.26</td>
<td>2.65</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>Lay</td>
<td>16.74</td>
<td>3.2</td>
<td>43</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tachistoscope</td>
<td>FDE</td>
<td>2.98</td>
<td>87</td>
<td>.004</td>
<td>13.61</td>
<td>1.81</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>Lay</td>
<td>12.44</td>
<td>1.88</td>
<td>43</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extended View</td>
<td>FDE</td>
<td>3.77</td>
<td>87</td>
<td>&lt; .001</td>
<td>14.78</td>
<td>1.81</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>Lay</td>
<td>13.35</td>
<td>1.77</td>
<td>43</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NUMBER OF YEARS AS A PROFESSIONAL FDE UNRELATED TO:**

- # correct single signature process calls
- # correct questioned/known comparison calls
- # correct tachistoscope calls
- # correct extended view calls
Overall Tscape/Extended View Call Accuracy by Signature Type, Participant Type, and View
Future Directions

• Expertise
  • Cognitive Stage
    • Committing to memory a set of facts relevant to the skill (declarative encoding)
  • Associative Stage
    • Detect and eliminate errors in initial understanding
    • Strengthen connections among the elements of the skill (declarative encoding and procedural knowledge)
  • Autonomous Stage
    • Central cognition drops out and the procedure becomes more automated and rapid

• The Comparison Process
  • What are the characteristics of the comparison process?
  • How does the interaction between attention, perception, and comparison process relate to decision making?

• Judgment
  • What is the utility and practicality of probability- vs. frequency-based judgment?
  • What are the metric properties of the 9-point, 7 point, or 5-point decision scale?
Special thanks to our colleagues from the U.S. and Canada for their invaluable assistance with the planning and pilot stages of our project, and to those FDEs who have given their time and expertise as project participants.

PI: Mara L. Merlino, Ph.D.
Department of Behavioral and Social Sciences, Kentucky State University
(502) 597-5053 mara.merlino@kysu.edu

Co-PI: Tierra M. Freeman, Ph.D.
Department of Behavioral and Social Sciences, Kentucky State University
(502) 597-5932 tierra.freeman@kysu.edu

Validity, Reliability, Accuracy, and Bias in Forensic Signature Identification
FINAL TECHNICAL REPORT: NIJ Award Number: 2010-DN-BX-K271