

Error Treatment in Forensic Authorship Attribution



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Outline



- Forensic Problems in Pattern Evidence
- Forensic Linguistics
- Case Studies
- Ideal Attributes of Forensic Science
- Application to Forensic Linguistics
- Recommendations for Practice

National Academy of Science (2009)



- *“With the exception of DNA, no forensic method has been rigorously shown to have the capacity to consistently, and with a high degree of certainty, demonstrate a connection between evidence and a specific individual or source.”*

New York Times (March 30, 2015)



- *“For years, ... many forensic practitioners have offered either unvalidated evidence or grossly exaggerated the value of the evidence.”*
- Pattern evidence singled out – bite marks, shoe prints, bullets, and hair.
- *“The other forensic disciplines never underwent the extensive basic and applied research, voluminous peer review, and [FDA] approval.”*

Ouch.

Forensic Linguistics -- Authorship Analysis



- Also “pattern-based evidence.”
- Focuses on the analysis of disputed writings when physical evidence (handwriting/papers) unavailable.
- Basic theory:
 - *“At any given moment, a writer picks and chooses just those elements of language that will best communicate what he/she wants to say.”* (McMenamin, 2011)
 - Identify choices consonant or discordant with any given authorial candidate – identify the candidate.

McMenamin (2011) – *Ceglia v. Zuckerberg*



- Ceglia sued Zuckerberg over part ownership of Facebook.
- Key evidence in complaint were emails allegedly by Zuckerberg
- Dr. McMenamin retained to compare known writings by Zuckerberg with disputed email.
 - Compared 11 indicia of authorship; 9 showed differences
 - Statistical significance unclear; specific reason for these indicia also unclear
 - Conclusion that Zuckerberg not author

McMenamin's report



- Indicia used

Apostrophes	Suspension pts.	“Backend”
“Internet”	“Cannot”	Run-on sentences
Sentence openers	Sentence-initial “Sorry”	Pronoun referents
If ... “,”	Closing “thanks”	

Grant (2013) – R. vs. Birks



- Amanda's body found in a (2009) fire.
- Prosecution theory: Husband killed her, set fire, sent text messages from her phone to establish alibi for self.
- Dr. Grant retained to determine author of text messages: Amanda or Christopher.
- Similar process:
 - Compared 18 indicia of authorship; detailed analysis to ID case-specific indicia (e.g. “wen” [AB], “wiv” [CB], “dnt” [CB])
 - Conclusion that Christopher, not Amanda, author

Coulthard (2012) -- *Anonymized*



- Dr. Coulthard asked to opine on probable author of email. Physical evidence confines to 4 people.
- Analysis focused on short phrases. E.g., “employees or unsuccessful competitors”
 - Chance of overlap of 4 word phrase near zero, as established by Google norms.
 - Of six central vocabulary choices, exactly one candidate could be shown to make all six.
- Dr. Coulthard’s phrasing: “The linguistic features ... are [are not] *compatible with* [other data]. These features are [are not] *distinctive*.”
- Possible approach using formal measures of vocabulary overlap (e.g. Jaccard distance).

Juola (2013) - Rowling



- Pseudonymously published detective novel *The Cuckoo's Calling*. Anonymous tip linked to J. K. Rowling, author of “Harry Potter” series.
- Open-class problem!
- Computer-assisted analysis
 - Collect ad-hoc distractor set
 - Embed documents in high-dimensional feature space, apply machine learning methods
 - Use rank-order statistics to estimate likelihoods
 - Multiple analyses with different features (characters, words, phrases) to boost accuracy

Methodological issues



- Wide variety of approaches, but which is best?
- Can we validate approaches meaningfully?
- Cheng (2013) “wish list” of attributes:
 - Widely adopted, predefined algorithm (preferably automated)
 - Large, random sample of known exemplars
 - Well understood theoretical underpinning
- Central claim : FL has (most of) these
 - May provide model for other disciplines

Well-defined algorithm



- Automatic authorship analysis has long history. Several programs available, including JGAAP (Juola, *in litt.*) at www.jgaap.com
- Formal protocols have been suggested, incl. Juola (2014), *Digital Humanities*

Known exemplars



- Plagiarism Action Network (PAN) has held TREC-style competitions every year since 2011 for authorship analysis
 - Establish performance baselines as well as established problem sets
 - Typical problem: 1-5 training documents, test document
 - Multiple genres, topics and languages
- **2015 competition (forthcoming):**
 - 1265 problems, 3701 docs, 641 words/doc (avg)
 - Top performer on English: AUC 0.811, c@1 0.757
 - 8 candidates beat 2014 silver medalist

Theoretical underpinnings



- McMenemy theory of linguistic choice commonly accepted
- Psycholinguistic evidence supports in that people ignore superficial choices, instead construct meanings.

Theoretical underpinnings (2)



- Results from PAN provide empirical baseline for statistical assumptions. E.g. assuming 30% error rate for one test (taken from table) 9% error rate for paired independent tests, 2.7% for tripled tests,...
- Rowling analysis (e.g.) used four tests which all showed similar result. Easy to calculate error probability (see Juola, 2014).
- Ensemble methods enhance accuracy and reliability
- Yields Daubert-style error measures as well as error mitigation

Recommendations for practice



- Need to test methods, not practitioners
 - Can even be done with “intuitionist” analyses as long as participants can describe and carry out different approaches
- Use automated methods where practical (reduce human error)
- Third-party method validation in non-adversarial setting

Compare to Handelsman's wish list



- **Cheng (2013) :**

- Widely adopted, predefined algorithm (preferably automated)
- Large, random sample of known exemplars
- Well understood theoretical underpinning

- **Handelsman (keynote) :**

- Quantification
- Controls
- Databases for comparison
- Statistical probabilities
- Blind testing

Conclusions



- Chang (2013): “*Unlike most forensic fields, which arose long before the invention of DNA typing and the decision in Daubert, forensic linguistics will blossom within a modern scientific evidence framework.*”
- These same practices can be applied more generally in other types of evidence.

Thank you!



Comments and Discussion welcomed!

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