# Multi-laboratory evaluation of forensic voice comparison systems under conditions reflecting those of a real forensic case

## *forensic_eval_01*

*Geoffrey Stewart Morrison*

*Ewald Enzinger*

# Need for testing

- **In forensic voice comparison, calls for validity and reliability to be empirically tested under casework conditions date back to the 1960s, but still go widely unheeded.**

- **Across all branches of forensic science, there is now increasing pressure to validate performance before analysis systems are used to assess strength of evidence for presentation in court**
  - *Daubert v Merrell Dow Pharmaceuticals* [1993, 509 US 579]
  - National Research Council Report 2009
  - Forensic Science Regulator Codes of Practice 2014
  - ENFSI 2015 *Methodological guidelines for best practice in forensic semiautomatic and automatic speaker recognition*

# *forensic_eval_01*

- **Open to operational forensic laboratories and research laboratories**
- **Training and test data based on a real forensic case**
  - relevant population
  - speaking styles
  - recording conditions
- **Virtual Special Issue in *Speech Communication***
  - introductory paper includes rules
  - describe system and procedures in sufficient detail for replication
  - performance metrics and graphics
  - discussion and conclusion may include recommendations for practice
  - submissions accepted over a 2 year timeframe

# *forensic_eval_01*

- **Casework conditions vary substantially from case to case**
- ***forensic_eval_01* evaluates systems under conditions reflecting those of one real case**
- **Results should not be assumed to be generalisable to other case conditions**
- **For each case, the validity and reliability of the system employed should be assessed under conditions reflecting those of that case**

# Forensic Voice Comparison Case

- **Offender recording**

  Telephone call made to a financial institution's call centre

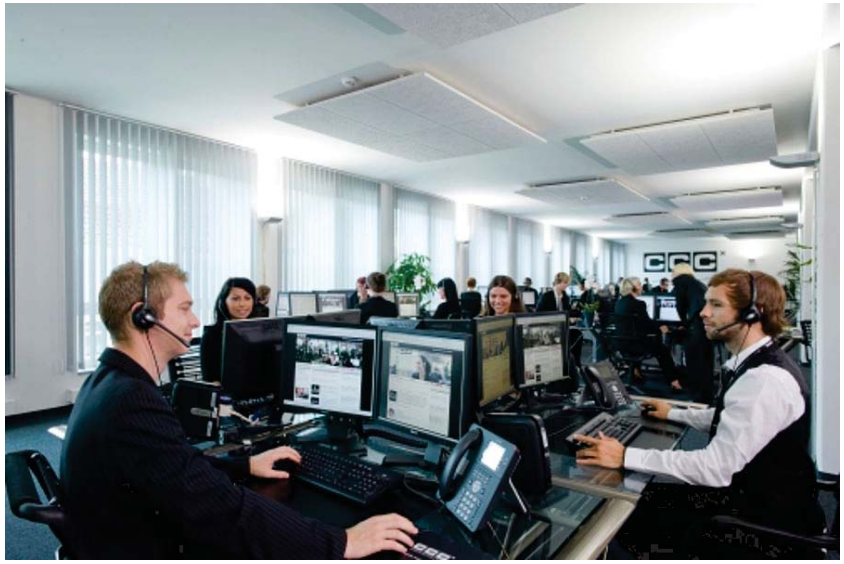
  – landline

  – call centre background noise babble, typing

  – saved in a compressed format

  – 46 seconds net speech

  – adult male Australian English speaker



- **Suspect recording**

  Police interview

  – reverberation

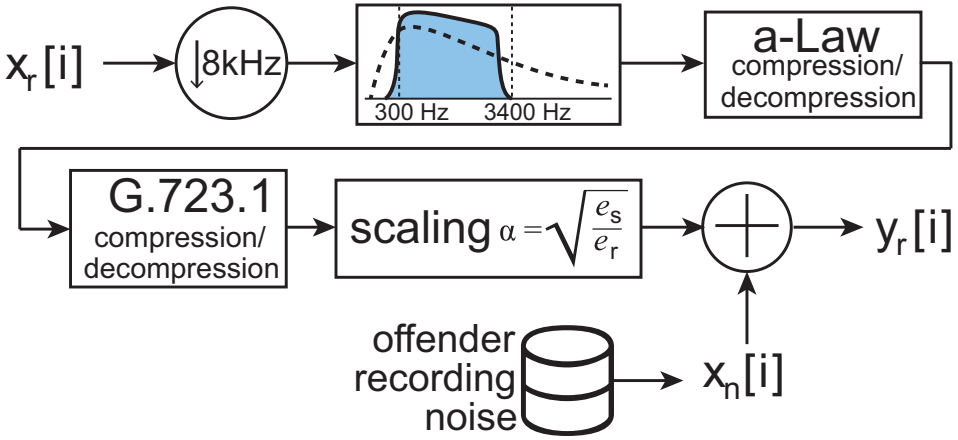
  – ventilation system noise

  – saved in a compressed format

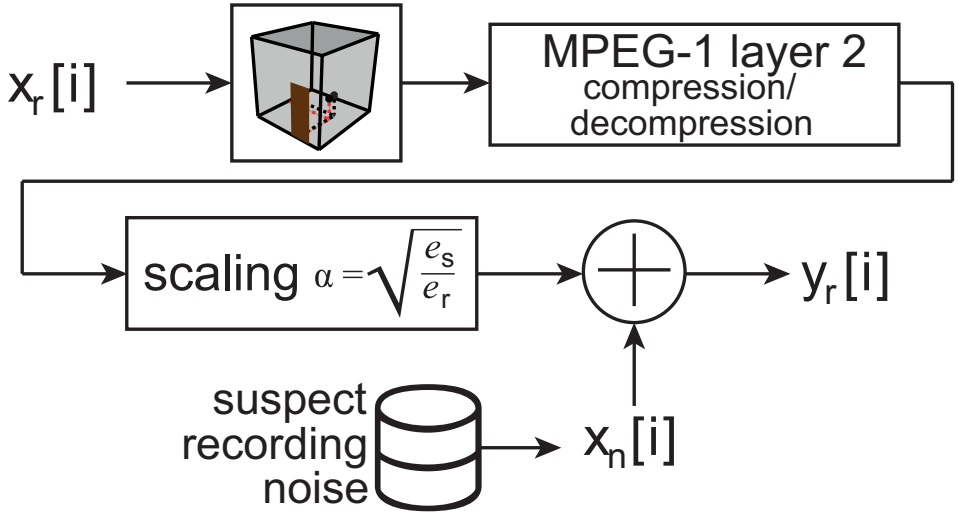
# Data

- Male Australian English speakers
- Multiple non-contemporaneous recordings per speaker
- Multiple speaking tasks per recording session
- High-quality audio

- Offender condition
  – information exchange task as input




- Suspect condition
  – interview task as input



# Data

- **Training data:**
  - 423 recordings from 105 speakers
    - 191 recordings in offender condition
    - 232 in suspect condition

- **Test data:**
  - 223 recordings from 61 speakers
    - 61 recordings in offender condition
    - 162 in suspect condition

# *forensic_eval_01*

- **preliminary results from systems already tested on the *forensic_eval_01* data**

# Enzinger & Morrison i-vector system

- 1st through 14th MFCCs + deltas
  - feature warping
- UBM
  - 512 Gaussians
- T-matrix
  - 400 or 200 dimensions
- i-vector domain mismatch compensation
  - canonical linear discriminant functions (aka LDA), 50 dimensions
- PLDA
  - full rank covariance for **B** and for **W**
- score to likelihood ratio conversion (aka calibration)
  - logistic regression

# Enzinger & Morrison i-vector system

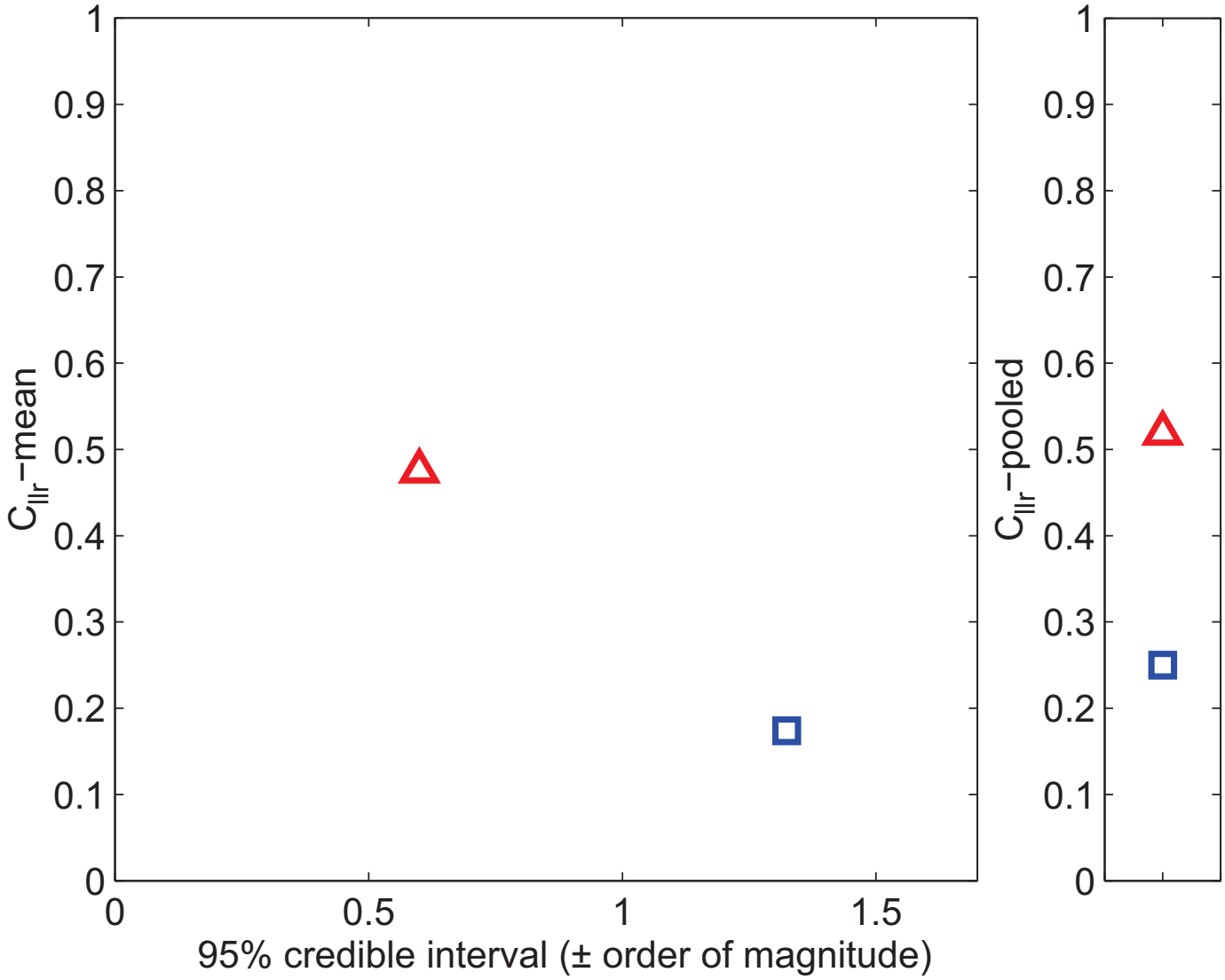
- **Generic data for training models which calculate scores**
- Generic data for training mismatch compensation models in i-vector domain
- **Case specific data for training score-to-LR model**

- **Case specific data for training models which calculate scores**
- Case specific + generic data for training mismatch compensation models in i-vector domain
- **Case specific data for training score-to-LR model**

# Enzinger & Morrison i-vector system

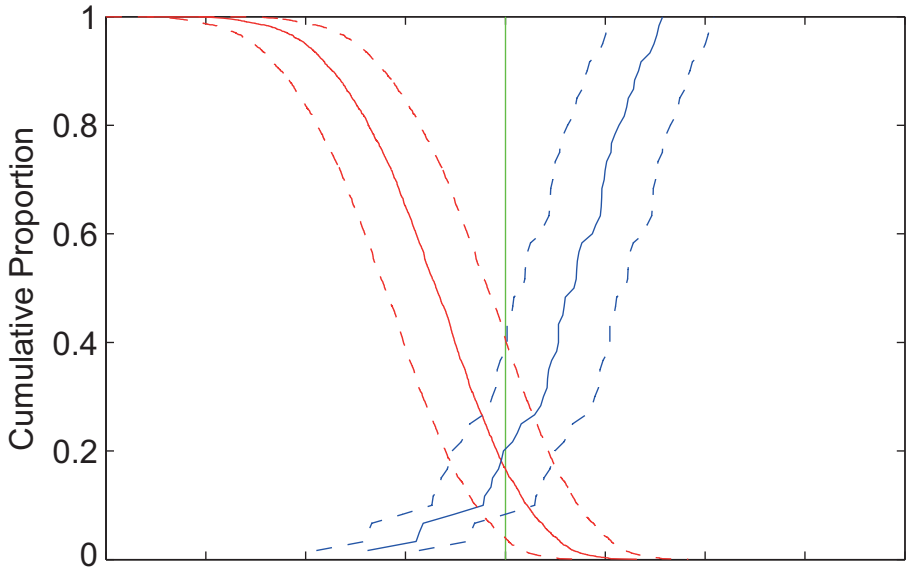
△ Generic data

□ Case specific data

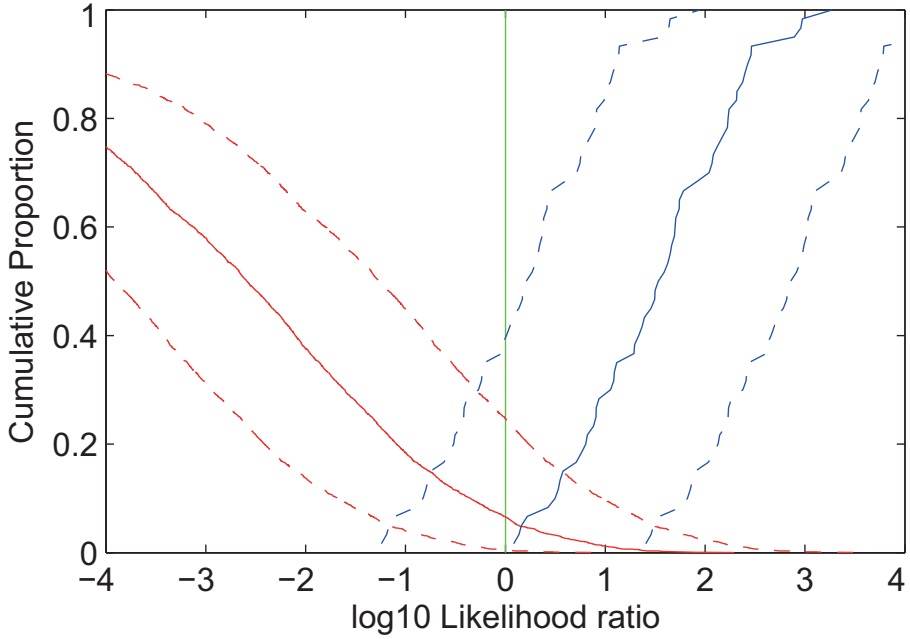


# Enzinger & Morrison i-vector system

- **Generic data**




- **Case specific data**



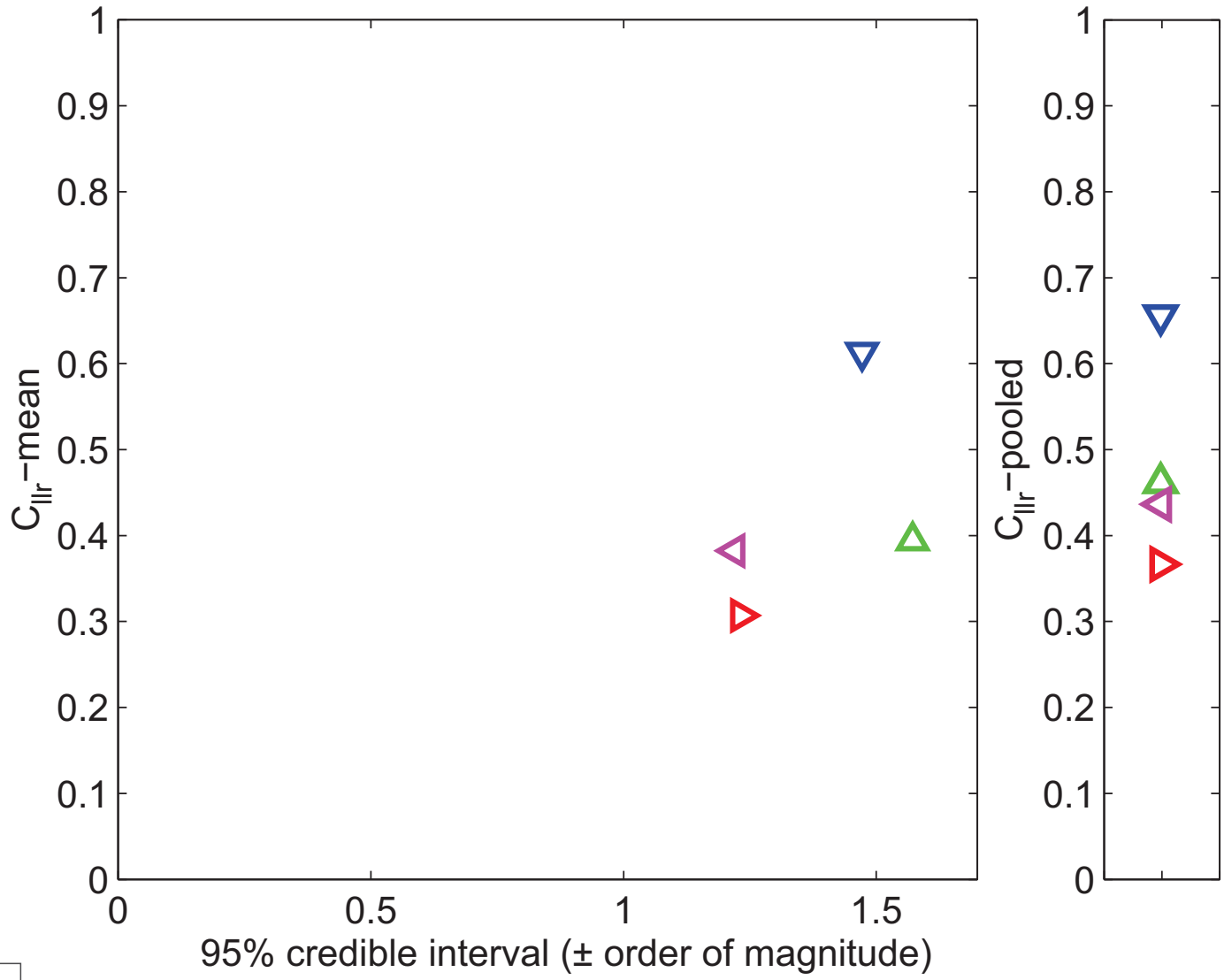
# Batvox v4.1

- evaluated by David van der Vloed, Netherlands Forensic Institute

- **reference population data**
  - all 105 speakers (1 suspect-condition recording per speaker)
  - 30 selected by Batvox

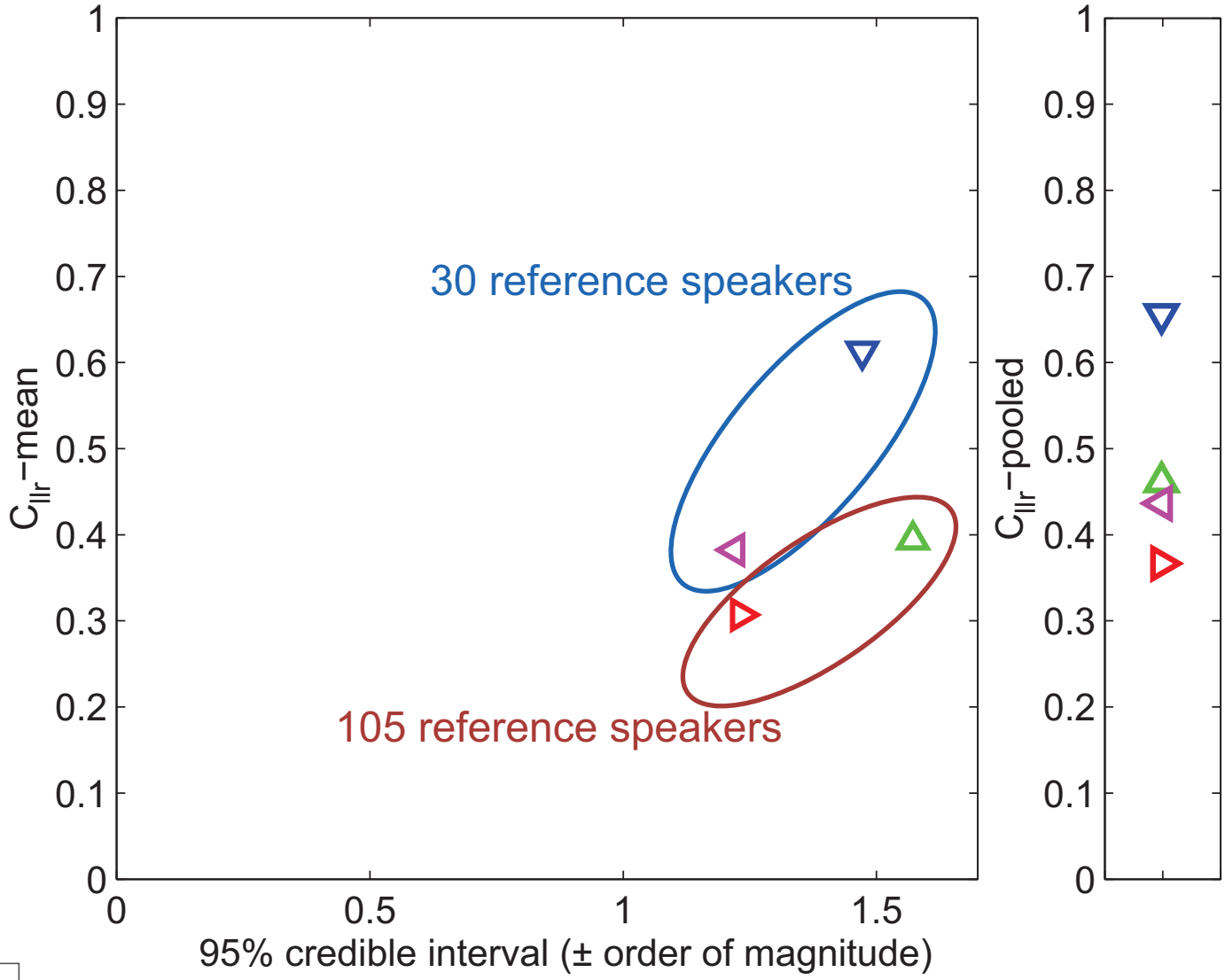
- **imposter data**
  - none
  - all 105 speakers (1 offender-condition recording per speaker)

# Batvox v4.1




all reference data + no imposter data
all reference data + imposter data
selected reference data + no imposter data
selected reference data + imposter data

# Batvox v4.1

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selected reference data + no imposter data
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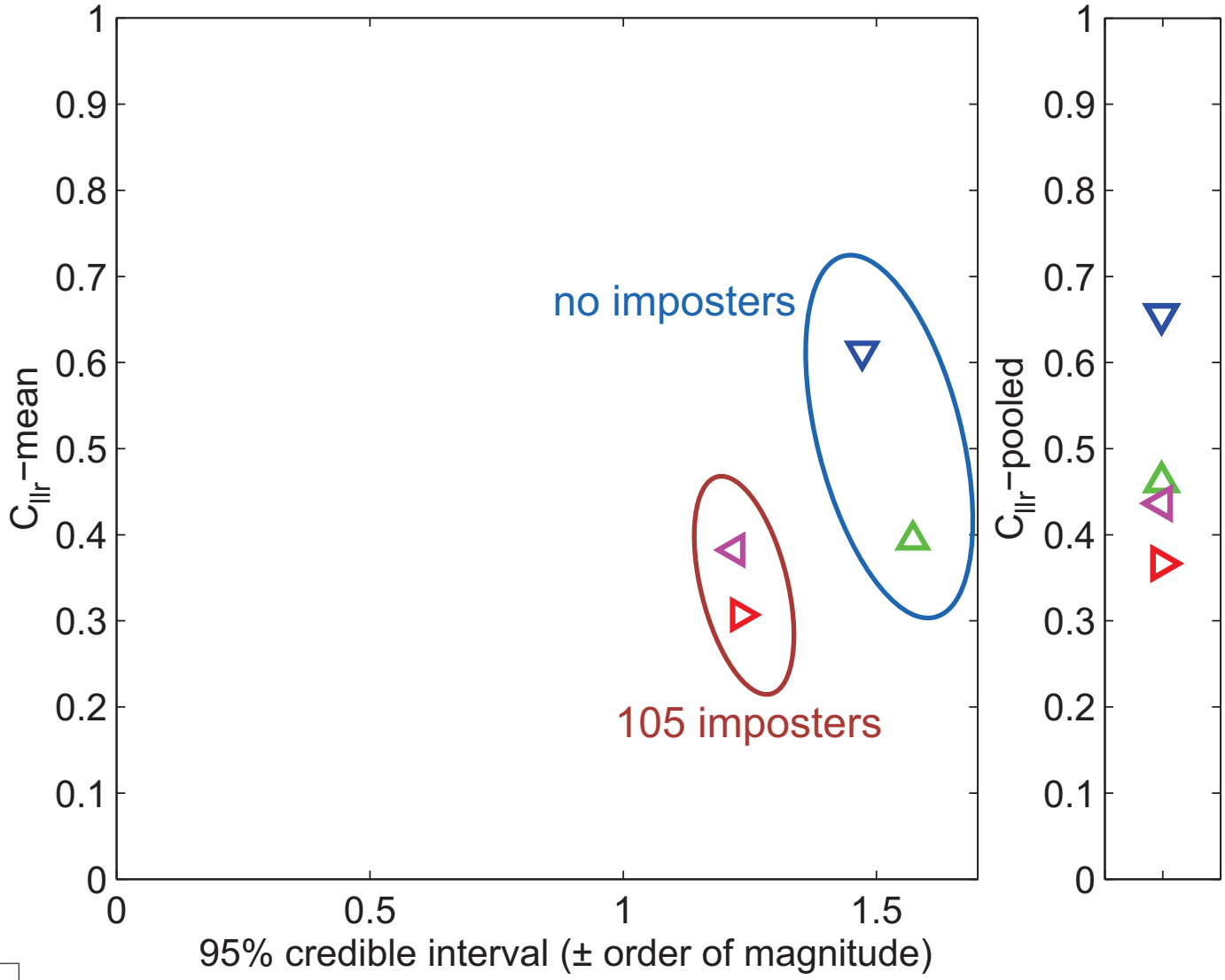


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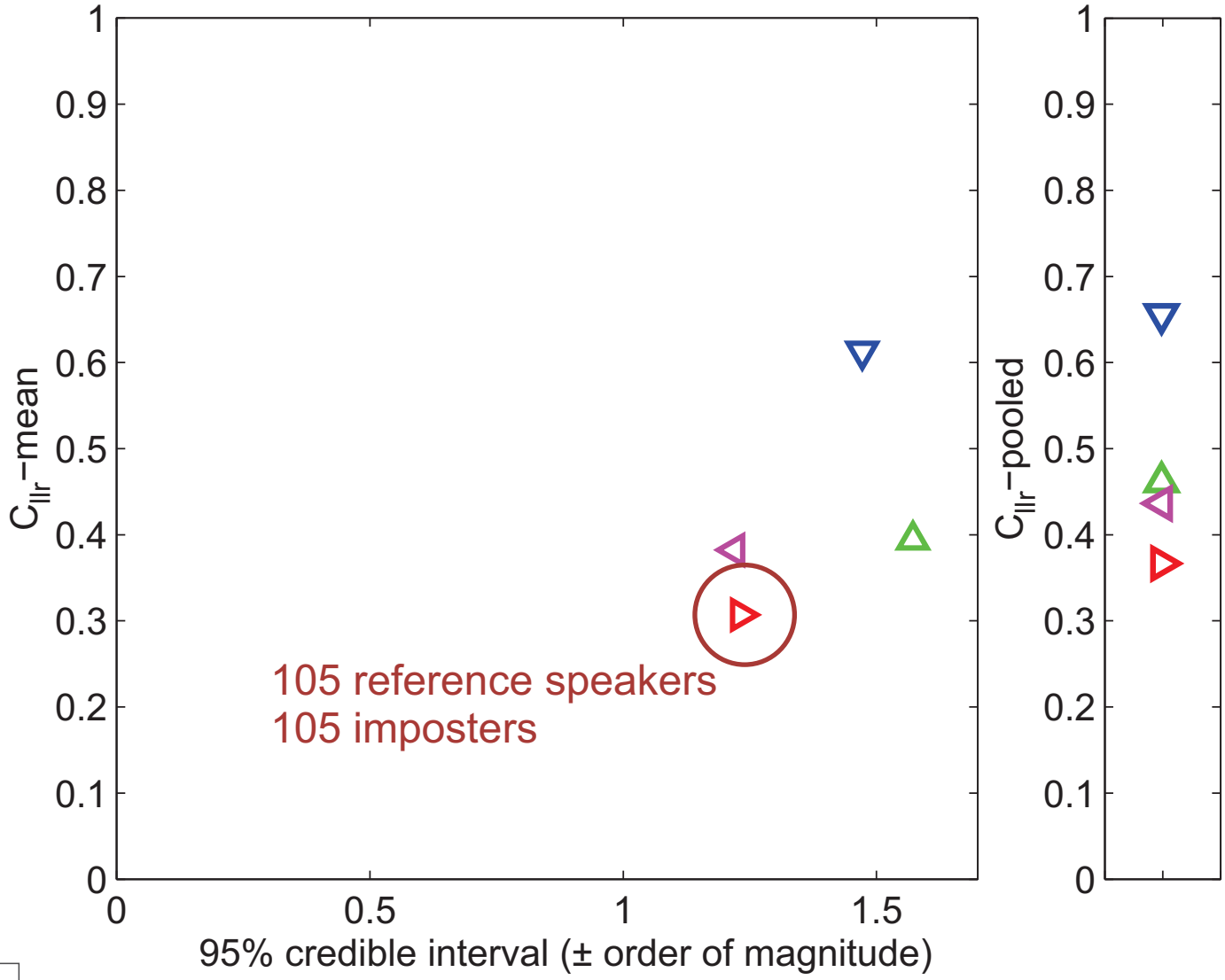
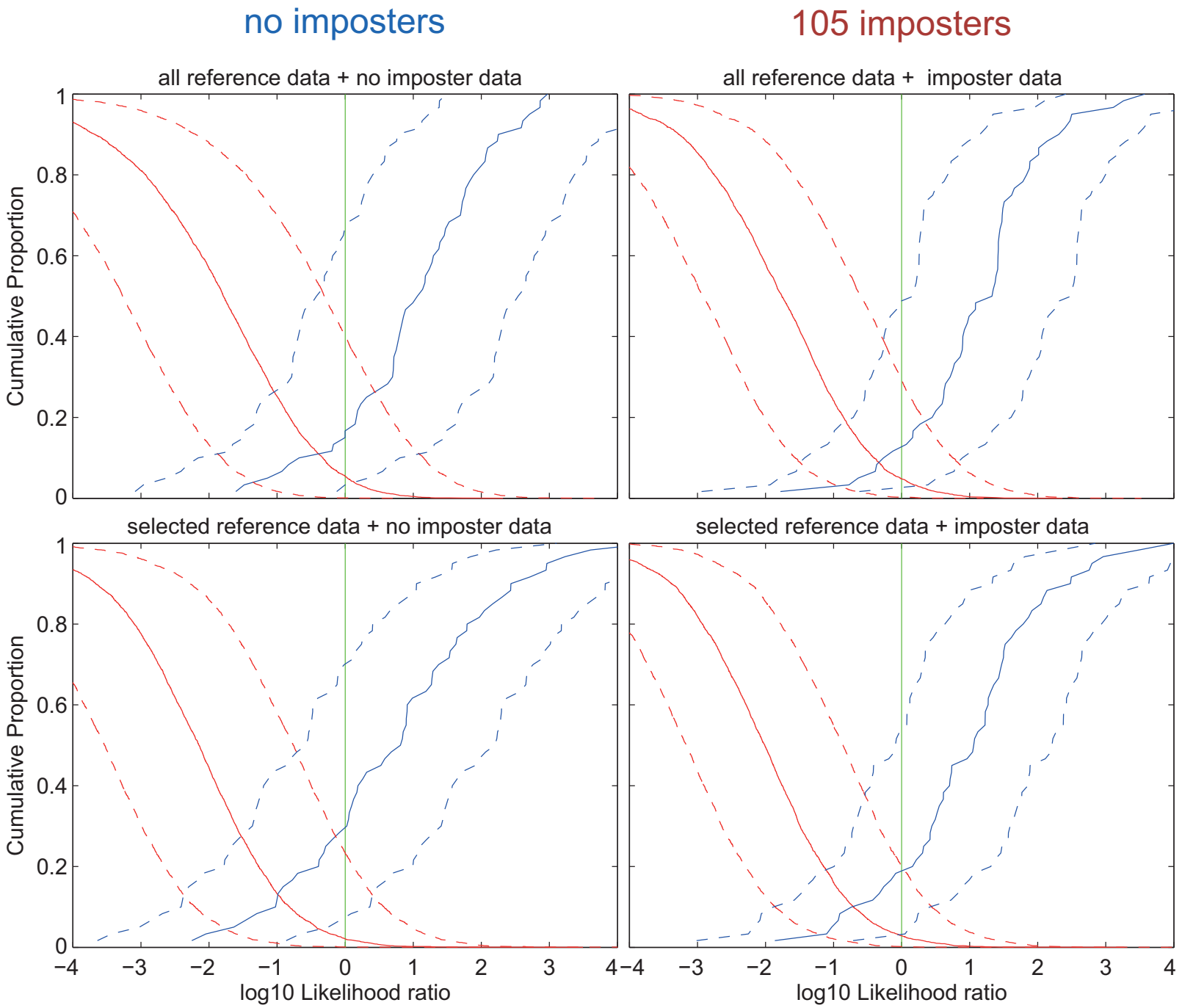



all reference data + no imposter data
all reference data + imposter data
selected reference data + no imposter data
selected reference data + imposter data

# Batvox v4.1

105
reference speakers

30
reference speakers



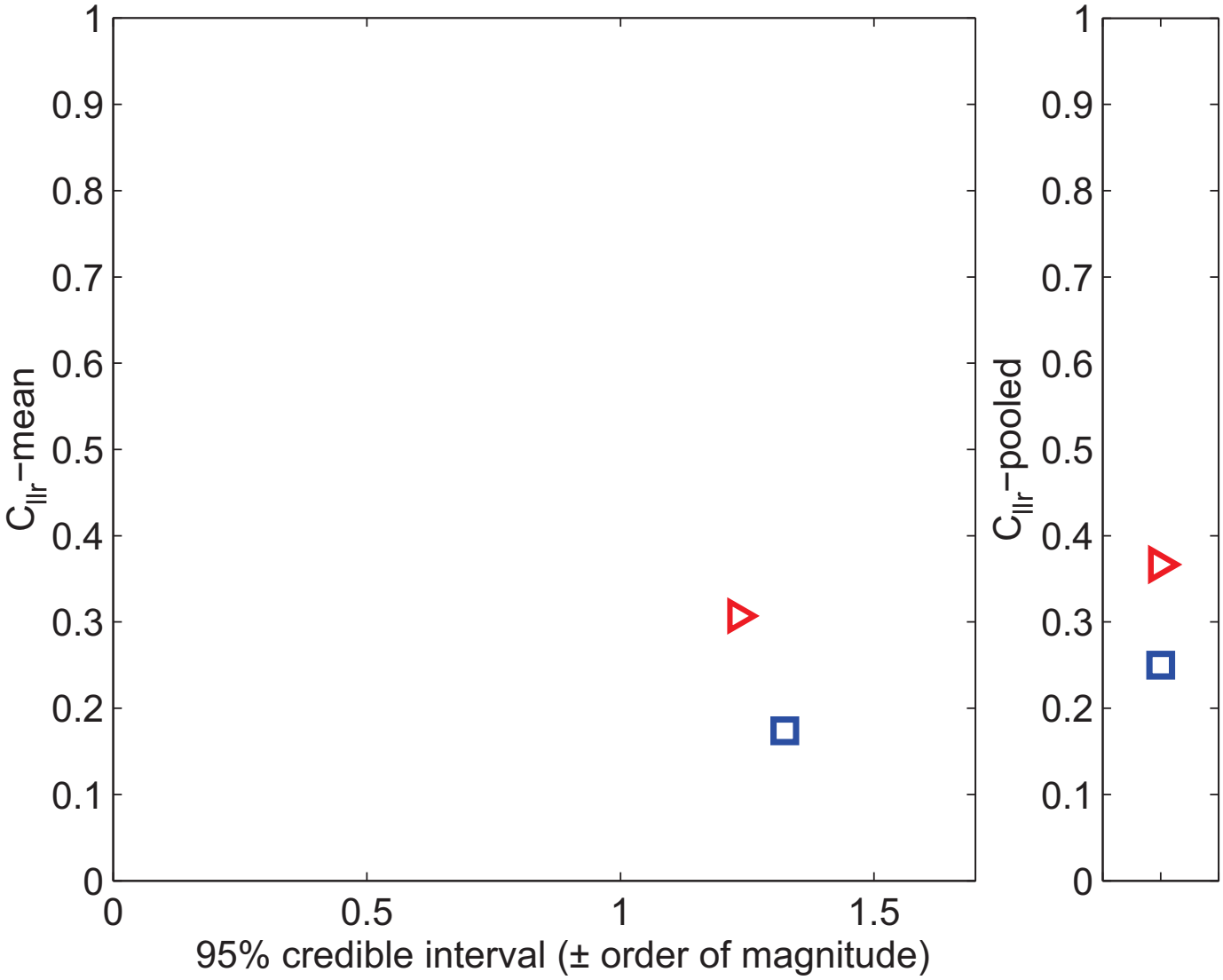
# Eskerrik Asko

http://geoff-morrison.net/

http://forensic-evaluation.net/

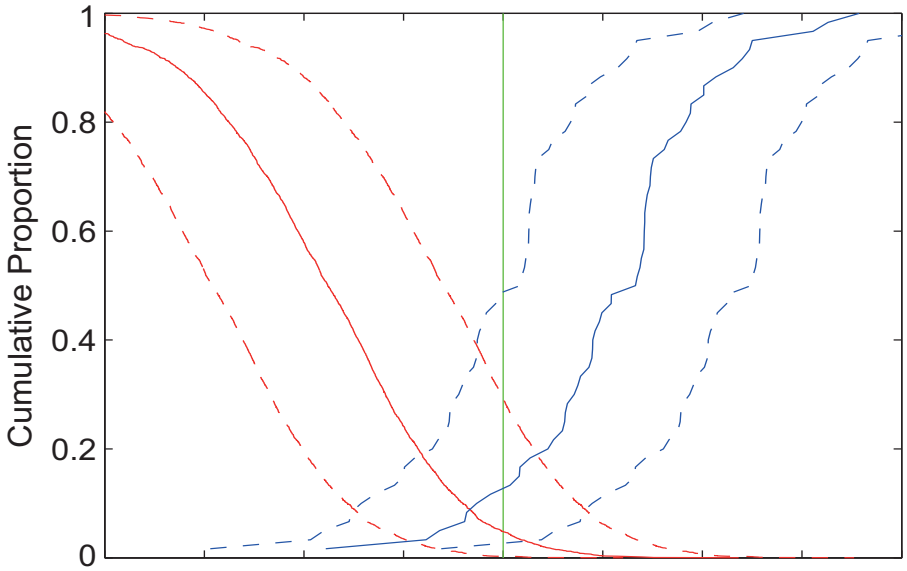
# Best of

- Batvox v4.1
- Enzinger & Morrison



# Best of

## Batvox v4.1




## Enzinger & Morrison