Goals of this project

- Investigate how socio-cognitive human factors influence identification decisions of forensic evidence through human laboratory experiments.
- Inform current statistical models and tools with results from experiments to improve human identification decisions across forensic domains.
- Explore how actionable models of decision making can be integrated with statistical models of Forensic evidence.
Identification Decisions

- Making a classification based on examination of physical evidence.
- An examiner determines whether an evidentiary sample (e.g., from a crime scene) is associated to a source sample (e.g., from a suspect)
  - Non-match, Exclusion
  - Match, Identification (above a critical threshold)
  - Inconclusive

Identification decisions are ubiquitous
Forensic Science is more complex

- Examination of physical evidence
  - Feature comparison, often through visual processing (perception & attention processes)

- Classification decision
  - Match identification based on similarity processing (memory & decision making)

Process in identification decisions
In any forensic domain (with or without help of statistical tools) a HUMAN makes identification decisions.

Human is always in the loop

Humans are vulnerable to recognition, cognitive, and social biases.
Perception and Attention

Free examination

Estimate the material circumstances of the family
Give the ages of people

Remember the clothes worn by people
Implications to Forensic Science

- Visual identification is NOT determined by the stimulus alone
- Visual identification depends on the questions the observer has in mind
- Attention is selective:
  - Focus on some information while ignoring the rest
  - Attention is guided by *expectations*

Inter-reliability of fingerprinting (Dror, 2015, 2016)

Lack of consistency across experts:
Different experts observe largely different minutia from the same fingerprints

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<tr>
<th>Expert</th>
<th>Latent fingerprint</th>
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<td>Expert 10</td>
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| Min | 9  | 9  | 15 | 6  | 7  | 3  | 7  | 9  | 4  | 5  |
| Max | 30 | 21 | 29 | 14 | 16 | 12 | 19 | 24 | 12 | 17 |
| SD  | 5.89| 4.01| 4.93| 2.49| 2.45| 2.32| 4.25| 5.15| 2.23| 3.54|
| Range| 21 | 12 | 14 | 8  | 9  | 9  | 12 | 15 | 8  | 12 |
Lack of consistency with the same expert:
Same expert observe different minutia from the same fingerprints in 2 different times

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<tr>
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Match identification and similarity
Implications to Forensic Science

- Decisions are influenced by past experience.
- Experience creates expectations
- Experience is shaped from memory:
  - We remember the most frequent cases
  - We forget
  - We mix up cases (judge by similarity)
- We tend to recall (and judge more probable) things that occur more frequently, more recently, and are more similar to the current cases.
  - With experience the brain picks up regularities in the information it receives and then uses them to guide future information processing.

Cognitive Biases: A serious problem in forensic domains

- Confirmation Bias
  - Identification decisions can be influenced by knowledge about other forensic examiners’ decisions (Dror, Charlton & Peron, 2006; Kassin, Dror, Kakucka, 2013)
  - FBI scientists have shown that examiners typically alter the features that they initially mark in a latent print based on comparison with an apparently matching exemplar.
- Contextual Bias
  - Examiners’ judgments can be influenced by irrelevant information about the facts of a case (‘target suspect’) (Dror et al., 2011)
  - Criminal stereotypes are a source of bias in forensic evidence (Smalarz et al., 2016)
- Continue investigation of systematic biases in forensic domains
Ok we are biased, now what?

Where do biases come from?
- understanding of the processes that produce the biases

What are possible interventions?
- Debiasing examiners
  - Analyses of incentives
  - Information presentation and feedback (e.g., nudges reduce errors; restructuring the task to make it compatible to the thought process)
  - Learning and training
    - Can we improve identification decisions through learning/training interventions?
    - Can we produce long-term reductions in cognitive biases?

Debiasing in forensic domains
Can we improve identification decisions?

- Madhavan & Gonzalez (2006)
- Madhavan, Gonzalez & Lacson (2007)
- Lacson, Gonzalez & Madhavan (2008)
- Brehnnan, Madhavan & Gonzalez (2009)
- Gonzalez, Thomas, & Madhavan (2009)
- Madhavan & Gonzalez (2010)
- Gonzalez & Madhavan (2011)

* X-ray images of individual items provided by the Dept. of Homeland Security

Effects of categorical diversity on identification decisions Gonzalez & Madhavan (2011)

Low categorical diversity

High categorical diversity

Transfer targets

Training and transfer exemplars were equally difficult to find.

Similarity scaling methods helped define the categories
Conclusions

- In making identification decisions in forensic domains a human (examiner, analyst, investigator) is in the loop
- Identification decisions will be subject to human information processing, experience, similarity judgments, expectations…
- We cannot escape subjective judgment; but we can understand where biases come from and design effective interventions
- Interventions through learning and training are likely to be most permanent.