Human Factors in Identification Decisions: Cross-cutting Interdisciplinary Research

Cleotilde (Coty) Gonzalez

Dynamic Decision Making Laboratory
Social and Decision Sciences Department
Carnegie Mellon University
www.cmu.edu/ddmlab

1

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.

2

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

3

Identification decisions are ubiquitous

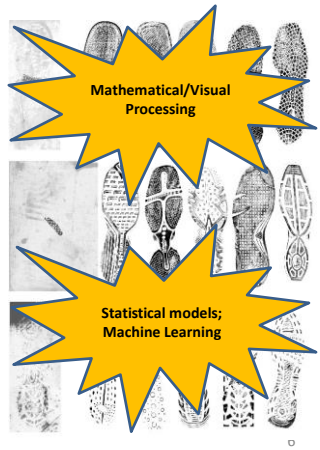
Forensic Science is more complex

5

Process in identification decisions

- Examination of physical evidence
  - Feature comparison, often through visual processing (perception & attention processes)
- Classification decision
  - Match identification based on similarity processing (memory & decision making)

Technology-supported decisions



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

- **Examiner**
- **Laboratory Director**
- **Crime investigator**

7

Human is always in the loop

Humans are vulnerable to recognition, cognitive, and social biases

8

Perception and Attention

Yarbus, A. L. (1967).
Eye movements during perception of complex objects, in L. A. Riggs, ed., `Eye Movements and Vision', Plenum Press, New York, chapter VII, pp. 171-196.

Free examination

1

Estimate the material circumstances of the family

2

Give the ages of people

3

Remember the clothes worn by people

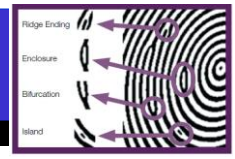
5

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*

15

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

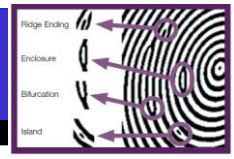


Lack of consistency across experts:
Different experts observe largely different minutia from the same fingerprints

Expert	Latent fingerprint									
	A	B	C	D	E	F	G	H	I	J
Expert 1	22	9	15	8	9	3	8	11	7	10
Expert 2	21	11	25	7	10	9	9	10	6	5
Expert 3	19	9	18	10	7	9	15	19	6	6
Expert 4	21	21	29	14	12	9	8	9	4	8
Expert 5	17	16	15	11	16	9	7	12	5	5
Expert 6	20	14	22	9	10	7	13	18	7	9
Expert 7	22	17	15	10	10	8	11	24	8	11
Expert 8	9	9	19	6	9	8	18	16	9	10
Expert 9	30	15	25	10	12	12	19	22	12	17
Expert 10	25	13	18	13	12	10	13	15	7	10
Min	9	9	15	6	7	3	7	9	4	5
Max	30	21	29	14	16	12	19	24	12	17
SD	5.49	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

16

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



Lack of consistency with the same expert:
Same expert observe different minutia from the same fingerprints in 2 different times

Expert	Latent fingerprint									
	A	B	C	D	E	F	G	H	I	J
Expert 1	1	1	4	1	1	2	3	2	0	1
Expert 2	8	3	5	1	1	2	2	5	2	2
Expert 3	1	3	3	3	6	4	9	9	1	2
Expert 4	2	3	2	5	0	1	1	0	0	1
Expert 5	6	2	2	3	4	1	3	3	0	3
Expert 6	9	4	2	1	4	6	0	5	1	1
Expert 7	0	4	5	2	4	3	3	7	0	0
Expert 8	3	1	4	0	6	2	1	4	2	0
Expert 9	4	3	9	0	4	4	3	1	1	3
Expert 10	1	0	0	1	4	1	4	1	0	0
MEAN	3.5	2.4	3.6	1.7	3.4	2.6	2.9	3.7	0.7	1.3

17

Match identification and similarity

18

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.

26

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**

27

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

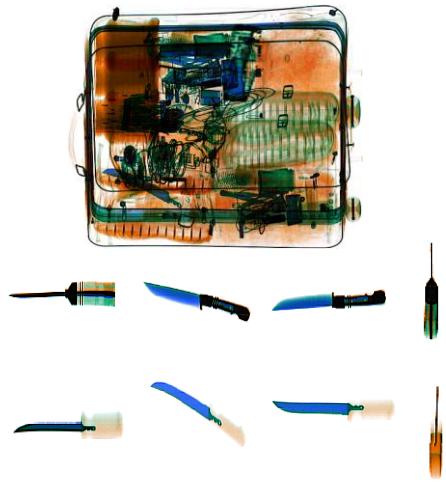
28

Debiasing in forensic domains

- 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?

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)
- Madhavan, Lacson, Gonzalez, & Brennan, (2012)

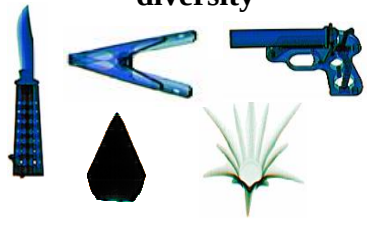


*X-ray images of individual items provided by the Dept. of Homeland Security

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

Low categorical diversity

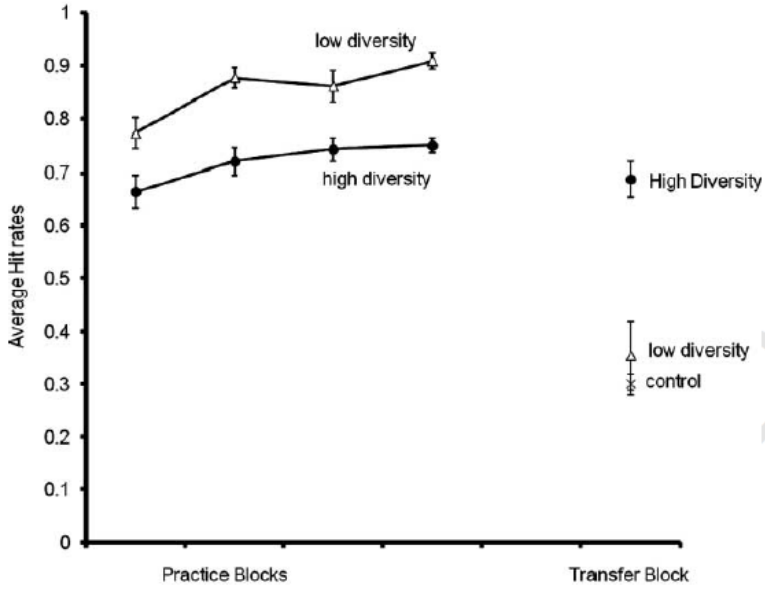
High categorical diversity



Transfer targets

Training and transfer exemplars were equally difficult to find.

Similarity scaling methods helped define the categories



32

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 scape 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.

33