Contributors

to

Fingerprints

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IAI 100\textsuperscript{TH} Centennial Education Conference
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Series...

- This series focuses on individuals who have conducted research that has impacted the discipline of fingerprints in different ways.
  
  - Why examiners should be aware of their research
  - How it can be applied in court
Series...

- IAI 2014
  - Dr. William Babler

- IAI 2015
  - Glenn Langenburg
  - Cedric Neumann
  - Alice Maceo
  - Pat A. Wertheim

- Future:
  - Christophe Champod
  - Henry Swofford
  - John Vanderkolk
  - Tom Busey
  - NOBLIS/FBI
Series to Workshop...

• Two-Day workshop:
  “RESEARCH, RELEVANCE & TESTIMONY”
  www.evolveforensics.com
Dr. Glenn Langenburg

“Anatomy of ACE-V: Contributions of Dr. Glenn Langenburg to Fingerprints”
Forensic Background:

• FORENSICS – 15 YEARS
• Latent Prints
  – Minnesota Bureau of Criminal Apprehension Forensic Science Laboratory in St. Paul, Minnesota (BCA)
    • Currently - Supervisor of the Forensic Chemistry section (BCA)
• Forensic Consulting Business
  – Forensic Examination
  – Consulting
  – Training
Focus of Research:

- Forensic Statistics
- Sufficiency thresholds
- Probabilities
- Daubert Issues
- Cognitive Issues
Studies covered today:

• “The GYRO System – A Recommended Approach to More Transparent Documentation”

• “A Performance Study of ACE-V Process, A Pilot Study to Measure the Accuracy, Precision, Reproducibility, Repeatability, and Biasability of Conclusions Resulting from the ACE-V process”

• “Informing the Judgment of Fingerprint Analysts Using Quality Metric and Statistical Assessment Tools”
FIRST STUDY

• “The GYRO System – A Recommended Approach to More Transparent Documentation”
  – Glenn Langenburg
  – Christophe Champod
What prompted the study:

• Glenn’s thesis work -
  - A push for more transparency post NAS, legal cases, etc....
  - Annotating features based on levels of confidence
GYRO

- GYRO (Green Yellow Red Orange)
  - Offers a simple and efficient way for a LPE to document the analysis and comparison stages of the ACE-V process.
GYRO

• When a LPE documents, it should be in a way that another qualified examiner can determine what was done and interpret that data.
  – Should be done near/at the time of the initial examination (annotations, sketches, etc.)
  – Based on complexity
  – Retained with case notes
GYRO

- GYRO uses a color-coding system to convey the analysts degree of confidence in the existence of a feature and the degree of variation to which that feature may appear in a corresponding exemplar print.

- Green: High confidence
- Yellow: Moderate confidence
- Red: Low confidence
- Orange: Features noted during the comparison that were not noted during the analysis phase
Benefits of GYRO:

• Analysts level of certainty regarding a feature

• The amount of weight (based on clarity) the analyst will assign to the feature during the comparison phase

• The tolerance that has been assigned for that feature
RELEVANCE:

- **Examiner:**
  - A way to communicate
  - Reviewing analyst (technical or outside reviewer)
  - A way to dig a bit deeper into the analysis phase
  - Especially with complex prints
  - Tolerance
  - Enhanced Transparency

- **Court:**
  - Documentation
  - Enhanced Transparency
  - Data observed and how examiners make conclusions
SECOND STUDY

• “A Performance Study of ACE-V Process, A Pilot Study to Measure the Accuracy, Precision, Reproducibility, Repeatability, and Biasability of Conclusions Resulting from the ACE-V process”
  – Glenn Langenburg
Main focus of the study:

• Black box – not concerned with ‘how’ the analyst makes the decision (that would be a white box study)
• Concerned about giving a LPE latent prints, knowns and looking at the accuracy of their decisions
  – And how consistent and reliable those conclusions were
Consisted of:

- 6 analysts
- 130 Trials
- 3 Phases of Testing
Three phases:

- **FIRST**: Gave analysts trials under ACE conditions (just ACE).
  - It would be reported but not reviewed or verified by another analyst.

- **SECOND**: Was ACE-”V”
  - Now the analysts were working together and it was a non-blind procedure.

- **THIRD**: Repeatability
  - Did they consistently give the same answer they gave the first time.
RESULTS:

• 2.2 percent false-negative rate and a less than one percent false-positive rate.

• All false positive were caught at verification stage – none left verification stage.

• Six false negatives made by the original analysts and verifiers did not catch them.
RELEVANCE:

• **Examiner:**
  – We are fairly good at what we do!
  – High degree of accuracy with respect to IDs
    • Verifiers caught every false positive
  – Need more training with exclusions
    • Verification did not catch false exclusions

• **Court:**
  – We are fairly good at what we do!
    • Leave us alone! Haha 😄
  – If being challenged about the reliability of our decisions and how accurate we are, this is a great study to reference.
THIRD STUDY

• “Informing the Judgment of Fingerprint Analysts Using Quality Metric and Statistical Assessment Tools”
  – Glenn Langenburg
  – Christophe Champod
  – Thibault Genesay
Consisted of:

• Unlike Glenn’s Black Box study (using 6 analysts), this study had around 170-174 participants.
• 158 of them were case-working analysts at the time.
  – Some trainees participated
  – Some were classified as ‘other’
    • Management or analysts who used to do casework
White Box:

- 158 participants with 12 trials – difficult ones that Glenn had hand selected.
PiAnoS (Picture Annotation System)

- Participants were presented with images online.
  - They would log into the study through a system developed in Switzerland called PiAnos.
PiAnoS

• Using PiAnos, the participant would first annotate and analyze the print, then reach a conclusion
  – Submit their conclusion
Then they were presented with the exemplar:

- Conduct a comparison and mark the correspondence (if any).
- At the end, they would use a drop-down box to make their decision.

- So, they forced ACE-V on them.
White Box:

• In the Black box study, there was a range of latent prints (smudges all the way to very clear prints).
  – In the white box study, it was latents that were specifically right at the margins of decision making.
  • Glenn pre-tested 20 latents to experts than narrowed it down to the 12 most difficult.
    – Ones that were difficult and challenging.
12 trials

- 7 were from the same source
- 5 were from different sources
  - All hand picked from a database
    - Close non-matches
  - Spent months finding the best trials for this study
RESULTS:

• 6% false-negative rate and 2.2% false-positive rate.
  – To date, this study has the highest false-positive rate that’s been reported in these error-rate studies.
  • It makes sense given that Glenn hand selected these latents (difficult ones).
RELEVANCE:

- **Examiner:**
  - We are still fairly good at what we do
  - Consensus and accuracy during the analysis phase (amongst the examiners)
    - Perhaps a bit more caution is needed with complex and difficult latent prints
      - Exclusions – still need more training

- **Court:**
  - As with the Black Box, shows that we are reliable at our decision making (especially with IDs)
    - Not surprising regarding erroneous exclusions, considering level of difficulty
Glenn’s Thesis:

“A Critical Analysis and Study of the ACE-V Process”
Spare time....

Magician extraordinaire!
• Forensic Examination
• Consulting
• Training

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Thank you Glenn for your contributions!
“The Dawn Of Likelihood Ratios in Fingerprint Examination
Contributions of Dr. Cedric Neumann to Fingerprints
Statistics are used much like a drunk uses a lamppost: for support, not illumination.

Vin Scully
• Cedric has been involved with forensic science since 1998

– Considered a leading expert and researcher with the application of statistics to decision-making in forensic science.
Background:

• **Currently:**
  – Assistant Professor
    • Mathematics & Statistics Department
      – South Dakota State University

• **Publications:**
  – 32 peer reviewed articles
  – 1 Book chapter

• **Private Work:**
  – CEO of Two N’s Forensic, Inc.
Focus of Research:

• Assess the convergence of different methods to calculate likelihood ratios

• Development of more advanced methods for quantifying the weight of pattern and trace evidence
Studies covered today:

• “Quantifying the Weight of Evidence from a Forensic Fingerprint Comparison: A New Paradigm”

• Operational Benefits and Challenges of The Use of Fingerprint Statistical Models: A Field Study"
“Quantifying the Weight of Evidence from a Forensic Fingerprint Comparison: A New Paradigm”

- Cedric Neumann
- Ian W. Evett
- J. Skerrett
Journal of the Royal Statistical Society

• One of the worlds most distinguished and renowned statistical societies.
  – Both a learned society for statistics and a professional body for statisticians.
  • Where Dr. Francis Galton presented his research
RSS

• Statistical model
  – Accounted for distortion
  – Minutia distribution study

• Earlier studies were missing some of these components
What did this research do?

• Allowed Cedric, as a researcher, to begin to measure the significance of correspondence between features.
  – Latents being compared to minutiae in the known
    • Begin to estimate the weight of the evidence

*What’s the likelihood of observing these characteristics in some other individual*
No scientific place on the graph to place a minimum # of points (this supports that a point standard is not necessary)
More features of minutia are better (as the number of corresponding features gets larger, the chance of someone else being the source is smaller)

Range of LRs for each configuration (have to take into account each configuration on its own)

Continuous climb: no drastic increase of the value of the evidence at one number of minutiae (which would justify a point standard)
Key points

– First data on the probative value of forensic evidence with a reasonable model

– Associated comments from relevant individuals of the community

– Paper has been used in court
Impact of the Article

- Provides empirical data to support estimated weights of fingerprint associations
Intuitively, examiners have always known this:

- EX: When asked “how much is enough” or “would you identify a print off of 4 points, 5 points?” – usually we respond to “I’d have to see the print.”

- Before we could never demonstrate it, until this.
RELEVANCE:

• **EXAMINER:**
  – Provides the data that we did not have before
    • Large scale study
    • Supports that fingerprints are very discriminative and carry significant evidentiary weight
    • Supports that a point standard is not necessary

• **COURT:**
  – Good study to reference when asked about a ‘point standard’
  – Study has been cited in court:
SECOND STUDY

• “Operational Benefits and Challenges of The Use of Fingerprint Statistical Models: A Field Study”

• Cedric Neumann
  – Ismael Mateos-Garcia
  – Glenn Langenburg
  – Jennifer Kostroski
  – James E. Skerrett
  – Martin Koolen
BCA FIELD STUDY

- Conducted at BCA
  Unit was shadowed for 6 months

  - Two fold:
    - **First**: look at how much evidence was not being examined or reported on (not deemed ID or EXC)
      - Using a statistical model to evaluate the weight of these impressions could enable the reporting of additional evidence
    - **Second**: applying a statistical model to the identifications that were being made
Second study

- Contractors reviewed 315 cases – BCA (St. Paul)

- No disruption to their current casework
  - Lead Project Manager - brought in to carry out study
    - Latent Print Examiners (3)
    - One research assistant

- Only finger impressions were reviewed
  - Second level detail
  - No palm or plantar
Four phases were assessed:

- First:
  - Work flow was mapped
- Second:
  - Research team recovered and examined the fragments of friction ridge details and marks that were not considered to bear sufficient quantity of features for further examination by BCA examiners
- Third:
  - The weight of fingerprint evidence was quantified using a statistical model
- Fourth:
  - Assessing activity value of the impressions
3 main take-home points:

1) Most of the time the examiner had a large amount of data available (with respect to the IDs)

100 or so identifications rendered in approximately 5 months

- Applied statistical model to these IDs

- Average ID had a large amount of minutia available
  - Medium value was 17 points
  - <5% had less than 12 features
  - Only 2 had 8 points
3 main take-home points:

2) When analysts reported identification, the likelihood ratio (LR) was exceptionally high
   - So, the IDs were in the same ballpark of statistics as those like DNA
3 main take-home points:

• 3) Showed that we don’t necessarily need statistical model for ID/EXC when there is a significant amount of information (wouldn’t have provided more information)
  • But there is definitely interesting potential in INC (supporting the hypothesis)
    – Could quantify in those situations were you ‘think’ it’s that person but don’t have enough data to render a definitive conclusion.
RELEVANCE:

• **Examiner:**
  - Value in inconclusive decisions
    - Could quantify in those decisions when you ‘think’ it’s that person, but don’t have enough to render a definitive conclusion.

• **Court:**
  - **All IDs are not from fragmented impressions**
  - Don’t necessarily need a statistical model for ID/EXC
    - Wouldn't’ t have provided more information
  - Could provide a possible lead
    - with INCs leaning toward ID
Biggest contribution:

Cedric has helped the discipline shift towards a culture of transparency and statistics.
Thank you Cedric for your contributions!
Alice Maceo

“Dissecting Distortion & Palm Distributions: Contributions of Alice Maceo to Fingerprints”
Background:

• 18 years in forensics
  – Forensic Lab Manager – Latent Prints (2006 - present)
    • LVMPD
  – Private
    • Evolve Forensics
Biology to Forensics

• She knew she wanted to study biology at an early age
  – University of Alaska
    • B.S. Degree in Biology
• Forensics was not on the horizon until:

  – Started applying to various labs in Anchorage
    • As a thank you note for her interview with the Alaska State Lab, she wrote a poem...it may have mentioned cleaning toilets.
      – It was not Haiku, but it rhymed and it got the job!
Studies covered today:

• Research: Distortion of Latent Prints
• “Palm Prints”
  – Alice Maceo
  – Marnie Carter
  – Brooke Stromback
• “The Critical Stage of Friction Ridge and Pattern Formation”
  – Kasey Wertheim
  – Alice Maceo
Distortion Research

• Research in Distortion started with:
  – Around 2001...
    • Pat Wertheim’s class - “Analysis of Problem Latents” class

  – She started to look at images of identifications
    • Alice began to question what she was told by mentors about the issues were with prints
    • She could see the identification “through the noise” in the images
    • But the literature at that time had limited information as to how to interpret or describe the noise (distortion)
      » Being a 3 year old at heart ... distortion research began in earnest
Distortion Research

• Study design:
  • Four years to collect video and lifts
    – Filmed the skin and studied the effects of:
      » Movement
      » Pressure
      » Surface issues
      » Residue issues
Distortion Research

• Was showing a colleague her videos and he asked her to come to Holland to teach a class!
  – First two-day workshop

• Dec 2006 (Holland) – first class
  – Played a part in the Shirley McKie case
    • Results of research sought out by Arie Zeelenburg
    • Introduced as evidence in the SCRO inquiry
RELEVANCE:

• **Examiners:**
  – DISTORTION - critical component during the Analysis stage and distortion factors should be incorporated in your training
  – There is a fuzzy line between the interpretation of “distortion” and “dissimilarity”

• **Court:**
  – Transparency
  – Articulating the complexities of visual expertise and decision-making
FIRST STUDY

• “The Critical Stage of Friction Ridge and Pattern Formation”
  - Alice Maceo
  - Kasey Wertheim
    - JFI (2002)

- This paper was referred to post-Daubert
  • Establish a basis that fingerprints are unique and persistent
    - Assimilated research from various venues into one paper to provide a comprehensive story of the science behind the use of fingerprints as a means of identification
FOCUS OF STUDY

- To provide an enhanced understanding of the biological structure and development of friction ridge skin for the latent print examiner who is called upon to testify:
  - Permanence
  - Uniqueness
  - Pattern formation
OUTLINE

• Structure of the skin
• Principle of permanence
• Principle of individuality
• Ridge formations
• Pattern formations
• Genetic factors
RELEVANCE:

• **Examiners:**
  - Articulate uniqueness and permanency on all aspects of friction ridge development
  - Establish foundation for the use of fingerprints as a means of identification

• **Court:**
  - Collaborative study of previous studies
    • Corroborates uniqueness and permanency
SECOND STUDY

• “Palm Prints”
  – Alice Maceo
  – Marnie Carter
  – Brooke Stromback
    • Encyclopedia of Forensic Science (2013)

Why this research?

• Most recent literature by Tietze and Witthuhn was published in German
  – Although charts and graphs useful, didn’t have an English reference
FOCUS OF STUDY

• Distribution of various patterns on the palms:
  
  – 800 pairs of inked palms (left and right)
    • Collected from a database
      – Palms divided into three areas:
        » Interdigital
        » Hypothenar
        » Thenar
INTERDIGITAL:

• Interdigital region most complex (patterns)

• Out of all standards – 3 to 7 deltas present
  – Most common – 4 in LP and RP

• The more patterns present in the ID region, generally the higher number of deltas present

• Loops are the most common pattern in the ID region
HYPOTHENAR:

• No pattern present in 547/800 – LP

• No pattern present in 514/800 – RP

• Most common pattern found – ulnar loop
THENAR:

- Displays fewer overall patterns than the other regions
- Unique pattern – vestige
RELEVANCE:

- **Examiners:**
  - Palm prints routinely encountered
  - Study outlines findings in patterns in 3 regions of the palm
  - Can better inform their judgments regarding the rarity of level one features observed in a palm

- **Court:**
  - Support the discriminating power of palm prints
In addition to Distortion & Palms...

• Alice has adapted, published and presented on the following issues:
  
  – Suitability criteria
  
  – Management issues
SUITABILITY

- Introduce suitability criteria-
  
  • One of the first agencies to have a written suitability criteria for comparison
SUITABILITY

• Suitability Criteria implemented:
  – Manual Comparisons
  – AFIS

  – Criteria is independent of crime type
    • No difference on property vs. person crimes
    • Balance of efficiency and effectiveness
SUITABILITY

– Several agencies have used their model to incorporate into their SOPs
– Alice looked at data prior to implementing suitability criteria and after
  • No effect on the rate of identifying named suspects on cases
BENEFITS OF SUITABILITY CRITERIA

• Closes the gap amongst the examiners
  – Will always be variability amongst examiners – but this helps

• Technical review process has a standard to refer back to and can be demonstrated through documentation

• Court: clear standard to articulate the basis for the suitability decision

• Transparency for evaluation by accrediting bodies and independent experts.
Leadership in the field as a Manager

• **Management**
  
  – Policies and Procedures:
    • Streamline casework
    • Conflict Resolution
    • Errors
    • Defining ranges of inconclusive
    • Suitability criteria
What is coming...

• Documentation
  – What should we be documenting?
    • ACE-V
      – Analysis
        » Basis for suitability decision and conclusions
        » What level of documentation
          • Complexity of print

• Erroneous Exclusions
  – Examiner will have to do a case study
  – Lessons learned by sharing casework experiences
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Website: www.evolveforensics.com
Thank you Alice for your contributions!
Pat A. Wertheim

The “Cowboy” from Texas: Contributions of Pat A. Wertheim to Fingerprints
Background:

• 42 years in forensics
  – Patrol Officer, Detective, ID Officer
  – Patrol & Admin Sergeant
  – Latent Print Examiner

– Currently the Lead Physical Scientist Instructor
  • Fingerprints
    – USACIL
Publications & Private Cases

— Publications
  • Over 40 papers and articles

— Private
  • Taught for 30 years
    — FORIDENTS
  • Expert witness for several high profile cases
    — Shirley McKie (Erroneous Identification)
    — David Asbury (Erroneous Identification)
    — Alan McNamara (Fabrication)
    — Fred Van der Vyver (Fabrication)
    — Jackson Pollock (Forgery)
Expertise

• World-renowned expert on the topics of fabrications and forgeries of latent prints.
  – Has always had a passion in the quest for truth
Testimony

• First-ever Daubert Hearing for fingerprints
  – Rebuttal witness for Prosecution in Byron Mitchell case

• Extensive history of testifying

• Complex cases
  – Forgeries
  – Fabrications
  – Erroneous Identifications
Areas of Research

• Fabrications of latent prints
• Forgeries of latent prints
Studies covered today:

• “The Detection of Forged and Fabricated Latent Prints”
  – Pat A. Wertheim

• “Integrity Assurance: Policies and Procedures to Prevent Fabrication of Latent Print Evidence”
  – Pat A. Wertheim
FIRST STUDY

• “The Detection of Forged and Fabricated Latent Prints”
  – Pat A. Wertheim
Fabrication vs. Forgery

- Know the difference
  - And ‘who’ has been shown historically to conduct this unethical activity
- Historical cases to current
- Methods of each
- Protecting your credibility
- Documentation
- Need for examiners to be alert
  - Somewhat police ourselves

**Agencies must follow through with prosecution, re-examination of all cases possibly involved and notifying ALL appropriate parties**
RELEVANCE:

• **Examiners:**
  - Know the difference
  - Know the methods and how to detect
    • Police each other
  - Have thorough SOPs, QA measures – that leaves no room for unethical activity

• **Court:**
  - Know the difference
  - Do not attempt to hide any issues/errors in the case
  - May be questioned for the authenticity of the prints
SECOND STUDY

• “Integrity Assurance: Policies and Procedures to Prevent Fabrication of Latent Print Evidence”
  – Pat A. Wertheim
As a result of fabrications of latent prints across the U.S.....

• ...it is causing scrutiny amongst agencies, examiners and latent print evidence have been scrutinized on the stand for the authenticity of the evidence and prints examined.
Three areas examined to solving the problem:

- Hiring and retention of qualified, honest personnel.
- Department philosophy and work habits.
- Physical requirements on the documentation and preservation of latent print evidence.
The key to deterring this fraudulent activities is:

- Hiring and retention of qualified, honest personnel
  - Thorough backgrounds
  - Thorough training
  - Competing salaries (retain)
Management must play an active role with problem employees

- Dismissal of problem employees
  » Discipline follow-up with dishonesty
- Emphasis of integrity
  » Management should constantly reinforce
  » LPEs should be encouraged to join professional organizations and be involved
Independent Identification Unit

• Separate each function
  – Let the officers investigate
  – Let the LPEs conduct independent examination
    • Critical
  – Verifications
    • Conducted independently prior to releasing any information to investigators
Documentation of Latent Prints

• Photography
  – Photographing latents in place, prior to lifts, is the strongest deterrent to fabrication
    • ID tag in place (scale)
    • Thorough documentation prior and after lift
Latent Lifts

- Marking the lift prior to lifting
- Thorough documentation on the lift cards
- Thorough review by supervisor
  - Photographs
  - Case notes
  - Reports
RELEVANCE:

• **Examiners:**
  - Integrity of evidence can be scrutinized
  - Proper measures must be taken to deter fraudulent activity
    • SOPS, QA measures, accreditation, thorough training

• **Court:**
  - How will you defend yourself if your agency has not set SOPs, QA measures and/or are not accredited.
Ridgeology Course

- In addition to his research, Pat has taught his week long Ridgeology course over 80 times all over the world.
- Taught from 1986 to 2010.
- Estimated number of students – between 2,000 & 3,000.
- Quit the crime lab to ‘take his show on the road’ for four and a half years, 1997 to 2001.
Contact Info:

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Thank you Pat for your contributions!
“Speak boldly and with intellect. Never hush your voice for someone’s comfort. Speak your mind, make people uncomfortable.”
Thank you to all these contributors who started their research with uncomfortable questions... it is through their efforts that help our discipline to continually grow and evolve.

THANK YOU!