#### Michele Triplett, King County, WA RATING THE COMPLEXITY OF FINGERPRINT COMPARISONS

#### Risk of Error



#### Background

 Historically: The FP discipline has given discrete subjective conclusions, based on the examiners training and experience (ID/no ID).

2013 - 2015
2015 - 2017
2018 - 2019

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#### Complexity, Level of Association and Strength of Fingerprint Conclusions

By Michele Triplett<sup>[1]</sup>

#### Abstract

False convictions and false incarcerations have pushed the topic of forensic errors into the national spot light. Friction ridge comparisons (referred to as fingerprints for the remainder of this paper) are very accurate but errors have occurred. The strength of any conclusion needs to be indicated since criminal proceedings rely heavily on this type of information. The following paper discusses a possible explanation for errors and offers a more accurate and transparent approach for arriving at and reporting results. The proposed approach labels the complexity and demonstrable level of association found between two impressions which allow others to more accurately discern the strength of a conclusion.

#### **Rate/Measure the Factors**

- Shape/ridge flow, L1 detail
- Area of hand
- Orientation
- Focal points
- Feature type (ending ridge, bifurcation, dot, pore, edges, incipients), L2 L3
- Feature quantity
- Feature quality
- Intervening ridges between features
- Intervening ridge quality
- Feature rarity, pattern force area
- Distortion: pressure, twisting, movement, tonal reversal, tonal shifts, artifacts, overlapping ridges
- Contrast
- Spatial Relationship between features
- Repeatability
- Reproducibility
- Discrepancies, background noise, artifacts
- Simultaneous
- Training
- Experience

#### **Measure the Factors**

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- Training
- Experience

#### Simplifying 6 into 4 categories

- Area of hand
- Orientation
- Feature type
- Feature quantity
- Feature quality
- Intervening ridge quality
- Area/Orientation
- Feature type
- Feature quantity
- Overall quality

#### Previous Q/Q Graph



Method to Rate Complexity of a Comparison

 Measure the key factors of the comparison: (need parameters, not opinion)

- Area / Orientation (self evident?)
- Features Used (bifurcations or creases/pores)
- Clarity/Ambiguity (can others see it)
- Amount of data (limited or abundant)
   (Rarity of features is only needed when info is limited)

#### Factors for Complexity OF A COMPARISON (not the Conclusion)

FACTORS TO ASSESS							
AREA /	Self-evident (to others)	Not Self-evident					
ORIENTATION:							
ТҮРЕ	Primary (ending ridges,	Secondary (creases,	Tertiary (pores,				
(of features used):	dots, bifurcations)	incipient)	simultaneous)				
QUALITY (ambiguity/clarity):	Predominantly Clear (would be assessed the same by others)		Predom. Ambig.				
QUANTITY (of prim/sec features):	Abundant (more than needed; others may use different features)		Limited (others would have to use the same features)				
COMPLEXITY RATING:	All in column indicates	At least one in column raises to ADVANCED	At least one in column raises to COMPLEX				
If borderline, rate higher							

#### **Complexity Ratings Meanings**

- Basic (Standard TP Quality, lights-out)
  - Only need initial training
  - Self-evident A/O, bifurcations/ridge endings, clear, abundant
  - Easily reproducible by others with minimal training
  - Virtually no risk of error
- Advanced (Standard LP quality, palms)
  - Need advanced training (orientation clues)
  - Not self-evident A/O, nonstandard features, slight ambiguity, abundant
  - Easily demonstrable to all others
  - Virtually no risk of error for ID (risk of error for false exclusion)
- Complex (tonal shifts, past errors)
  - Predominant ambiguity and/or limited data
  - Not easily demonstrable
  - Higher risk of error; need more QA

#### Basic / Advanced / Complex



#### Basic / Advanced / Complex

 Overwhelming amount of clear data, easily repeatable

- Virtually no risk of error for ID
- Compelling amount of data, easily demonstrable
  - Virtually no risk of error for ID (risk of error for false exclusion)
- Low amount of quantity and quality, not easily demonstrable
  - Risk of error increases







#### QA (what is needed)

- Complexity determines the QA needed
  - Consultation
  - Documentation
  - Verification (as a review of correct application)
  - Extra QA (verification)
    - (Blind Verification is checking reproducibility, not if a conclusion is arrived at correctly or well supported)

#### Example regarding an injury:

ComplexityWhat Is Neededsurface woundneeds a bandageinternal bleedingneeding surgery

Not same QA for all (basic and complex)

#### Verification as Reproducibility

- Reproducibility is a scientific requirement for physical phenomenon, not for analytical conclusions.
- Blind is not better, blind checks reproducibility, does not check if method is applied correctly.
- Verification as a review of the basis, the conclusion, the complexity rating, and the QA (not independent assessment) –
- as with long division.

#### Verification

 Conclusion: Does it meet requirements for an ID? (need requirements)

Complexity: Are the features demonstrable?

• QA:

Does it meet requirements for QA (documentation)?

#### **Complexity Determines QA**

- Sasic: easily reproducible
  - Documentation isn't necessary
  - QA to check complexity is accurate (and confirm no documentation is needed)
- Advanced: easily demonstrable
  - Document area/orientation
  - QA to check complexity is accurate
- Complex: may be difficult to demonstrate
  - Full Documentation of similarities, dissimilarities, distortion
  - QA to scrutinize if the conclusion is supportable (scrutiny found errors)
  - May want management review

#### QA - Not the same for each situation

- Don't need to do a pre-analysis before a comparison for Basic to diminish bias, bias is an issue when information is ambiguous, it doesn't apply to BASIC comparisons (can do side by side).
- Requiring pre-analysis and full documentation for basic, to diminish bias, shows a lack of understanding of when bias is possible.

### Complexity and QA Determines the Conclusion

- Conclusions are based on data, not artificial/subjective thresholds:
  - -Fingerprints has been around for 100 years
  - -I have 20 years of experience
  - -Studies show low risk of error (overall, not specific)
  - -I'm 100% confident (but could be wrong)
  - -Consensus threshold (we all agreed, we voted)
  - -Operational decision (not scientific)
- Works for all pattern recognition (bitemarks) States the quantity and quality of the data, and a tested conclusion, not just someone's opinion.
- Rates the strength of ID's, not lumps all ID's together
- Turns a subjective opinion into a systematic method; turns pseudoscience into science

#### Parameter for ID

 An ID is when there is compelling justification (data) to satisfy others (hold up to scrutiny).

 Compelling justification is objective data and an accepted method (valid principles and accepted).

 Satisfy others is the scientific criteria for observational sciences (Einstein's Theory of Relativity)

# Verbal Scale of Conclusions (3 strengths for ID's) vs. "extremely strong support"

No comparis Impression v identified to another sou	son was rce	No association found Region and orientation cannot be determined; wide-range search did not result in a conclusion		The level of association would be considered rare but possible	F	The level of association would be considered non- duplicable; conclusion is easy to demonstrate	
EXCLUSION			INCONCL	USIVE			IDENTIFICATION
	No association Features are inconsistent when region and orientation can be determined	1	The level of association would be considered common		The level of association would be considered non- duplicable; conclusion is difficult to demonstrate		The level of association would be considered implausible to replicate; conclusion is easily repeatable

Verbal Scales for nonquantifiable conclusions

Broken Bones: hairline, compound

• Hospital Scale: stable, serious, critical

• Cancer: Stage 1, 2, 3, 4

Spiciness of food

#### Testing (QA) Determines the Acceptable Level of Association (the conclusion)

No comparis Impression v identified to another sour	son was rce	No association found Region and orientation cannot be determined; wide-range search did not result in a conclusion		The level of association would be considered rare but possible		The level of association would be considered non- duplicable; conclusion is easy to demonstrate	
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#### **Conclusion Scale**



#### **Reporting 3 Strengths for Identifications:**

- "The comparison is *Basic*. The level of association is overwhelming and easily repeatable by others."
- The comparison is Advanced. The level of association is compelling, easily demonstrable, and considered implausible to replicate."
- "The comparison is Complex. Testing against strong scrutiny determined the association to be persuasive and considered implausible to replicate."

#### **Advanced Comparisons**

 If an examiner misses an ID (in casework or on a test), it is not due to incompetence, due to the data, lack of area/orientation clues.

LPE may need additional training in the orientation clues.

Complexity and strength go hand in hand As Complexity  $\uparrow$ Strength  $\downarrow$ Risk of Error  $\uparrow$ QA  $\uparrow$  for the Strength  $\uparrow$ 

Strength is based on complexity and QA, not on the reproducibility

#### Difficulty vs COMPLEXITY

- Difficulty is based on the person (training, experience and ability) not on data (the comparison)
- Complexity is based on factors within the comparison
- Difficulty is subjective while rating the complexity WITH PARAMETERS is not.
- Rating the complexity in this manner reduces subjectivity.

### Assessing the complexity of the prints in isolation, both appear basic



#### Assessing Print Complexity (either)

FACTORS TO ASSESS			
AREA /	Self-evident (to others)	Not Self-evident	
ORIENTATION:			
TYPE (of features used):	Primary (ending ridges, dots, bifurcations)	Secondary (creases, incipient)	Tertiary (pores, simultaneous)
QUALITY (ambiguity/clarity):	Predominantly Clear (would be assessed the same by others)	Some ambiguity	Predom. Ambig.
QUANTITY (of prim/sec features):	Abundant (more than needed; others may use different features)		Limited (others would have to use the same features)
COMPLEXITY	BASIC	ADVANCED	COMPLEX
RATING:			

However, complexity changes during a comparison... making individual assessment irrelevant and unnecessary



#### Assessing Comparison Complexity

FACTORS TO ASSESS			
AREA /	Self-evident (to others)	Not Self-evident	
ORIENTATION:			
TYPE (of features	Primary (ending ridges, dots, hifurcations)	Secondary (creases,	Tertiary (pores, simultaneous)
used):			
QUALITY	Predominantly Clear (would be assessed the same by	Some ambiguity	Predom. Ambig.
(ambiguity/clarity):	others)		
QUANTITY (of	Abundant (more than needed; others may use		Limited (others would have to use the
prim/sec features):	different features)		same features)
COMPLEXITY	BASIC	ADVANCED	COMPLEX
RATING:			

#### Example: Assess the 4 factors



#### Factors for Complexity (not Conclusion)

FACTORS TO ASSESS			
AREA /	Self-evident (to others)	Not Self-evident	
ORIENTATION:			
TYPE (of features used):	Primary (ending ridges, dots, bifurcations)	Secondary (creases, incipient)	Tertiary (pores, simultaneous)
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QUANTITY (of prim/sec features):	Abundant (more than needed; others may use different features)		Limited (others would have to use the same features)
COMPLEXITY	BASIC	ADVANCED	COMPLEX
RATING:			

#### Verbally w/o chart

- Self-evident direction and orientation
- Galton points (primary features) and intervening ridges are utilized
- Ambiguity: others interpret features the same
- Amount: others may use different data BASIC

Conclusion is easily reproducible by others Little (virtually no) risk of error

# Strength of Conclusion: Overwelming Association, Low Risk of Error

No comparison Impression was identified to another source		No association found Region and orientation cannot be determined; wide-range search did not result in a conclusion	1	The level of association would be considered rare but possible		The level associatio would be considere non- duplicable conclusion easy to demonstr	of n d e; n is ate	
EXCLUSION			INCONCL	USIVE			IDENTIF	CATION
	No association Features are inconsistent when region and orientation can be determined	n	The level of association would be considered common		The level of association would be considered non- duplicable conclusion difficult to demonstra	of 1 1 is ate	The level of associatio would be considered implausible replicate; conclusion easily repeatable	of n d leto n is e

#### Example:



FACTORS TO ASSESS			
AREA /	Self-evident (to others)	Not Self-evident	
ORIENTATION:			
TYPE (of features	Primary (ending ridges, dots, bifurcations)	Secondary (creases, incipient)	Tertiary (pores, simultaneous)
used):			
QUALITY	Predominantly Clear (would be assessed the same by	Some ambiguity	Predom. Ambig.
(ambiguity/clarity):	others)		
QUANTITY (of	Abundant (more than needed; others may use		Limited (others would have to use the
prim/sec features):	different features)		same reatures)
COMPLEXITY	BASIC	ADVANCED	COMPLEX
RATING:			

# Verbal assessment (in lieu of chart)

- A/O self-evident
- Features: Ending ridges and bifurcations
- Features are ambiguous (not easily demonstrable as a result of tonal shifting)
- Amount: Others would use the same features since that's all that exists.

#### COMPLEX

Ambig. and limited data-not easily demonstrable Higher risk of error

#### Testing Determined Acceptable/Persuasive Level of Association, Higher Risk of Error

No comparison Impression was identified to another source	No association found Region and orientation cannot be determined; wide-range search did not result in a conclusion	The level of association would be considered rare but possible	The level associatio would be considere non- duplicabl conclusio easy to demonstr	of on ed e; on is rate
EXCLUSION	INCONG	CLUSIVE	î î	IDENTIFICATION
No association Features are inconsistent when region and orientation can be determined	n The level of association would be considered common	T a v c n d d d d d d	The level of association would be considered non- duplicable; conclusion is difficult to demonstrate	The level of association would be considered implausible to replicate; conclusion is easily repeatable

#### Example:



#### Assessing Complexity w/Chart

FACTORS TO ASSESS			
AREA /	Self-evident (to others)	Not Self-evident	
ORIENTATION:			
TYPE (of features	Primary (ending ridges, dots, bifurcations)	Secondary (creases, incipient)	Tertiary (pores, simultaneous)
used):			
QUALITY	Predominantly Clear (would be assessed the same by	Some ambiguity	Predom. Ambig.
(ambiguity/clarity):	others)		
QUANTITY (of	Abundant (more than needed; others may use		Limited (others would have to use the
prim/sec features):	different features)		same features)
COMPLEXITY	BASIC	ADVANCED	COMPLEX
RATING:			

#### Assessing Complexity w/o Chart

- Don't need chart but the chart reminds people WHY
- Without chart: Not TP (big dissimilarity)
- Not Complex: Lots of data
- Must be Advanced

#### Assessing Complexity w/o Chart

- Self-evident area and direction
- Use of L2 features and intervening ridges
- May not be easily repeatable (some may exclude on pattern type) due to ambiguity
- Abundance of data

Advanced Easily demonstrable Little (virtually no) risk of error for ID

# Compelling Association, Low Risk of Error

No comparison Impression was identified to another source		No association found Region and orientation cannot be determined; wide-range search did not result in a conclusion		The level of association a would be considered of rare but possible of a solution of the solut		The level of association would be considered non- duplicable; conclusion is easy to demonstrate	
EXCLUSION			INCONCL	USIVE			IDENTIFICATION
	No association Features are inconsistent when region and orientation can be determined	ı	The level of association would be considered common		The level of association would be considered non- duplicable; conclusion is difficult to demonstrate	Th as w co in re co ea re	ne level of sociation ould be onsidered oplicate; onclusion is asily opeatable

#### Example: Mayfield Left Index Complex, but why?



- A/O: not self-evident
- Features: ending ridges and bifurcations
- High ambiguity (practitioner or others may assess features differently)
- Amount: debatable

#### COMPLEX

Not demonstrable to the satisfaction of others (would not be an ID under this method)

High risk of error

#### Testing Determined Considerable (or Non-Acceptable) Level of Association, High Risk of Error as an ID

No compari Impression identified to another sou	son was o irce	No association found Region and orientation cannot be determined; wide-range search did not result in a conclusion	1	The level of association would be considered rare but possible	The lev associa would conside non- duplica conclus easy to demon	el of tion be tred ble; tion is
EXCLUSION			INCONCL	USIVE		IDENTIFICATION
	No association Features are inconsistent when region and orientation can be determined	1	The level of association would be considered common		The level of association would be considered non- duplicable; conclusion is difficult to demonstrate	The level of association would be considered implausible to replicate; conclusion is easily repeatable

#### **Example: Daoud**



- A/O: not self-evident
- Features: ending ridges and bifurcations
- High ambiguity (practitioner or others may assess features differently)
- Amount: debatable

#### COMPLEX

Demonstrable to the satisfaction of other ... low but acceptable level of association (would be an ID under this method)

Risk of error

#### Testing Determined Acceptable (Persuasive) Level of Association, Higher Risk of Error

No compariso Impression wa identified to another source	on as ce	No association found Region and orientation cannot be determined; wide-range search did not result in a conclusion		The level of association would be considered rare but possible	X	The level of association would be considered non- duplicable conclusion easy to demonstra	of n d ; n is ate
EXCLUSION			INCONCL	USIVE			IDENTIFICATION
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#### Mayfield vs Daoud

#### Non-Acceptable Level of Association (Inconclusive)

#### Low but Acceptable Level of Association

	No associ	ation					
	found	1947-1947					
No comparison			The level of	The le	velof		
	Regionar	Region and		associ	association		
Impression was	orientatio	n	wouldbe	wouldbe			
identified to	cannot be	cannot be		considered non-			
another source	determined;		rare but				
	wide-rang	ge	possible	duplic	able;		
	search die	dnot		conclu	ision is		
	result in a	3		easyte	D		
4	conclusio	n	×	demo	nstrate		
EXCLUSION		INCON	ICLUSIVE		IDENTIFICATIO		
N							
No assoc	ciation	The level of		The level of	The level of		
		association		association	association		
Features	sare	wouldbe		wouldbe	wouldbe		
inconsist	tent	considered		considered	considered		
when rep	gion	common		non-	implausibleto		
and				duplicable;	replicate;		
orientati	ion			conclusion is	conclusion is		
can be				difficult to	easily		
determin	ned			demonstrate	repeatable		
Complexity levels range from							
Complexity levels range from	No associ	ation					
No comparison	No associ found	ation	The level of	The le	velof		
No comparison	No associ found	ation	The level of	The le	velof		
No comparison	No associ found Region ar	iation	The level of association	The le associ would	vel of ation		
No comparison	No associ found Region ar orientatio	ation nd	The level of association would be considered	The le associ would consid	velof ation Ibe dered		
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No comparison Impression was identified to another source	No associ found Regionar orientatio cannot be determin wide_rapp	ation nd e ed;	The level of association would be considered rare but possible	The le associ would consic non- duplic	vel of ation Ibe Jered able:		
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No comparison Impression was identified to another source EXCLUSION No assoc Features	No associ found Region ar orientatic cannot be determin wide-rang search dii result in a conclusio	ation nd ed; ge dnot a n INCON The level of association would be	The level of association would be considered rare but possible	The le associ would consid non- duplic conclu easy to demo X The level of association would be	vel of ation Ibe lered able; ision is o nstrate IDENTIFICATIO The level of association would be		
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No comparison Impression was identified to another source EXCLUSION No assoc Features inconsist when rej	No associ found Region ar orientatic cannot be determin wide-rang search dii result in a conclusio	ation nd on ed; ge dnot a n INCON The level of association would be considered common	The level of association would be considered rare but possible	The le associ would consic non- duplic conclu easy to demo X The level of association would be considered non- duplication	vel of ation be lered able; usion is o nstrate <b>IDENTIFICATIO</b> The level of association would be considered implausible to readiate		
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# 3 Levels for Identifications3 Levels for Inconclusive2 Levels for Exclusions

No comparison Impression was identified to another source	No association found Region and orientation cannot be determined; wide-range search did not result in a conclusion		The level of association would be considered rare but possible	:	The level of association would be considered non- duplicable; conclusion is easy to demonstrate	
EXCLUSION	1000	INCONCL	USIVE			IDENTIFICATION
No association Features are inconsistent when region and orientation can be determined	ı	The level of association would be considered common		The level of association would be considered non- duplicable; conclusion is difficult to demonstrate		The level of association would be considered implausible to replicate; conclusion is easily repeatable

# Same conclusions but gives additional pertinent information.

No comparison Impression was identified to another source		No association found Region and orientation cannot be determined; wide-range search did not result in a conclusion		The level of association would be considered rare but possible		The level of association would be considered non- duplicable; conclusion is easy to demonstrate	
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# Based on defined parameters, not a database that exists in the mind of the examiner, based on their experience.

No comparison Impression was identified to another source		No association found Region and orientation cannot be determined; wide-range search did not result in a conclusion		The level of association would be considered rare but possible	F	The level of association would be considered non- duplicable; conclusion is easy to demonstrate	
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#### Identifications

A) Overwhelming Association, easily repeatable

B) Compelling Association, easily demonstrable

C) Persuasive Association, difficult to demonstrate but acceptable

#### Inconclusive

A) Considerable Association but not sufficient (to satisfy others)

B) Marginal or Common Amount of Association

C) No Association Found

#### Exclusions

#### A) No comparison, ID'd to another subject (logical deduction is a scientific method)

**B)** No Association Exists

#### Scale (Exclusion, Inconclusive, Identified)

No Comparison, ID'd to another subject
No Association

- No Association Found
- Marginal Association
- Considerable Association, not sufficient (investigative lead)
- Persuasive Association, <u>difficult to demonstrate</u>
- Compelling Association, <u>easy to demonstrate</u>
- Overwhelming Association, <u>easily repeatable</u>

#### **Benefits:**

- Not new, defined way to measure and articulate the basis for conclusions (FRE 702)
- QA Measures are dependent on complexity (when needed), not random (all verified, 10% technically reviewed)
- Limits personal interpretation, which limits subjectivity and bias (puts the onus on the method, reducing practitioner liability)
- More consistent conclusions because they are based on measurable criteria, not personal beliefs (follows science)
- Significantly reduces the need for conflict resolution
- Allows others to assess the relevance and risk of error
- Recognizes differences in strength of identifications

#### **Additional Benefits**

- Allows for RULES for when to exclude (when Basic)
- Allows us to critique the complexity of competency tests, proficiency tests, and certification tests (and ability to compare different tests)
- Allows for improved error rate studies
- Allows us to hypothesize without having to say, 'I'd have to see the print'.
- Allows us to judge the ability level of practitioners.
- Transparent and Professional
- Can start to use it informally without SOP changes
- Labels comparisons by complexity, not TP vs Latents
- Could perform lights-out latent prints for basic complexity <sup>©</sup>



Persistent Forensics Lab Problems Undermine Faith in Our Criminal Justice System, John Malcolm, 2016

"... the day when judges and jurors no longer trust the government's experts. That would be a dark day indeed, and if it happens, the government will have only itself to blame." I'm sure this gives you a lot to think about... feel free to contact me anytime.

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