

When You Think You Are Done

- More Fingerprint and Face Steps for Success

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Illinois Division, IAI

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Alternate Title for This Presentation:

Smart Additional Steps to Solve
More Current Cases, and Some Cold
Cases, with Fingerprint and Face
Evidence

Presenter's Short Bio

- Has worked in human identification field the past 45 years, including 36 years' service in three different US Government organizations.
- Has routinely interfaced with government laboratories on six continents, and lived/worked more than seven years as a forensic scientist in Asia and Europe.

No Agency Can Do Everything in Every Case

Processes/examinations/searches are decided in an attempt to best satisfy three goals:

- Accuracy
- Thoroughness
- Timely Support

...with frequent compromises in thoroughness to help balance the other two goals.

Example of “Acceptable Compromise” in Thoroughness

- Latent Print Certification Examination (or similar journeyman-level testing) often permits missing as much as 15% of the possible matches (e.g., 10 correct idents out of 12 possible idents with zero erroneous idents) during a six-hour (or longer) proctored test.
- Okay to sacrifice thoroughness within acceptable accuracy and timeliness parameters.

Common Sacrifice of FP Search Thoroughness

- Selecting only 5 or 10 (versus 10 or 20), candidates to be returned for latent print searches may solve 15% more cases annually when it permits reviewing 100% more latent print search results (double casework completion).
- Some latent print matches will always be missed in AFIS, finding the optimal thoroughness sacrifice (relative to accuracy and timely support) better serves society overall.

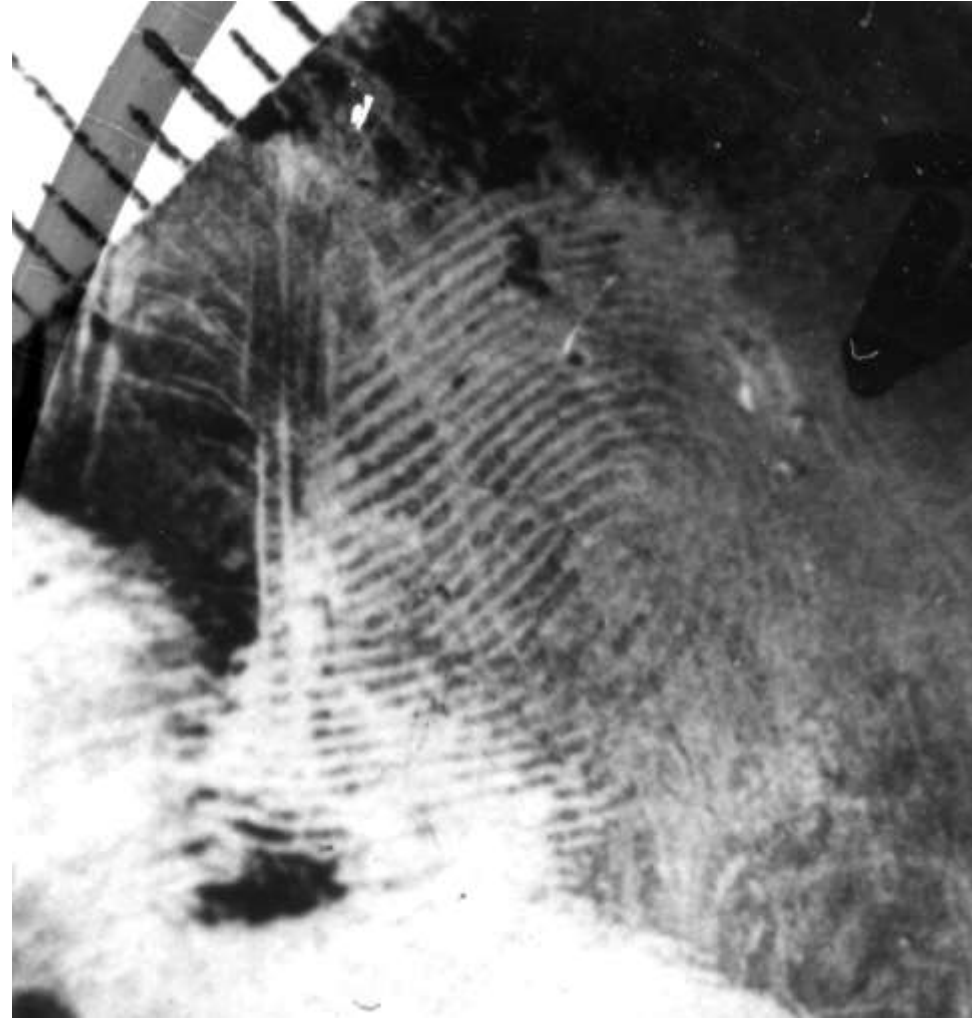
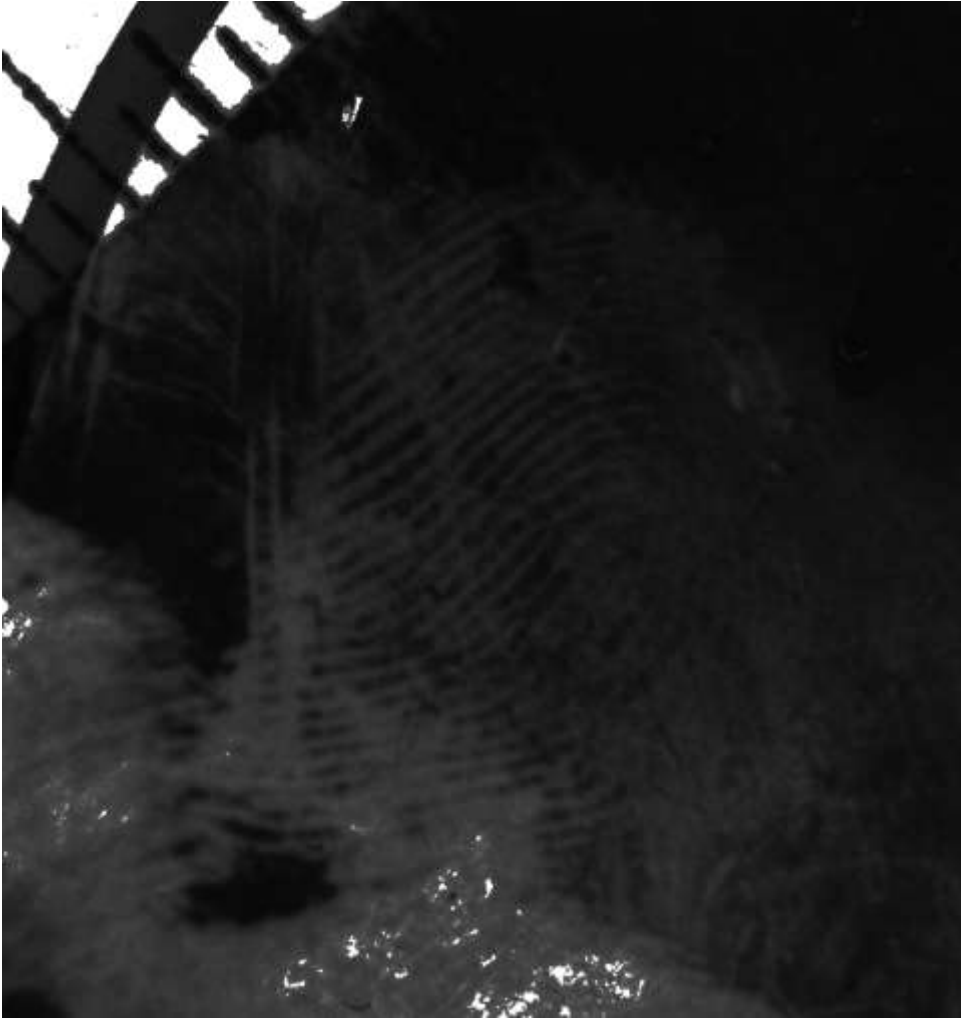
Thoroughness in Digital Imaging

- Most humans, including LP Examiners, can only see 16 to 32 shades of gray.
- Additional identifiable ridge detail can often be harvested through digital image scanning of cold case lifts and cold case photo negatives (or paper photos in the absence of negatives)

Thoroughness in Digital Imaging (Cont.)

- Simple digital image processing such as histogram equalization, HDR processes, and/or pseudo-color assignment can reveal previously undetected ridge detail.
- ULW's image processing capabilities can detect new ridge detail, e.g., combine difference of Gaussian, histogram equalization and binary on faint or overly dark impressions.

Sample Before and After Image Processing



Thoroughness in Digital Imaging (Cont.)

The presenter's experience with federal and state labs found fingerprint spatial resolution (image size) errors happen as often as 5% in the absence of systematic QA review... and as frequently as 20% when images are transferred between agencies (especially by well-meaning investigators).

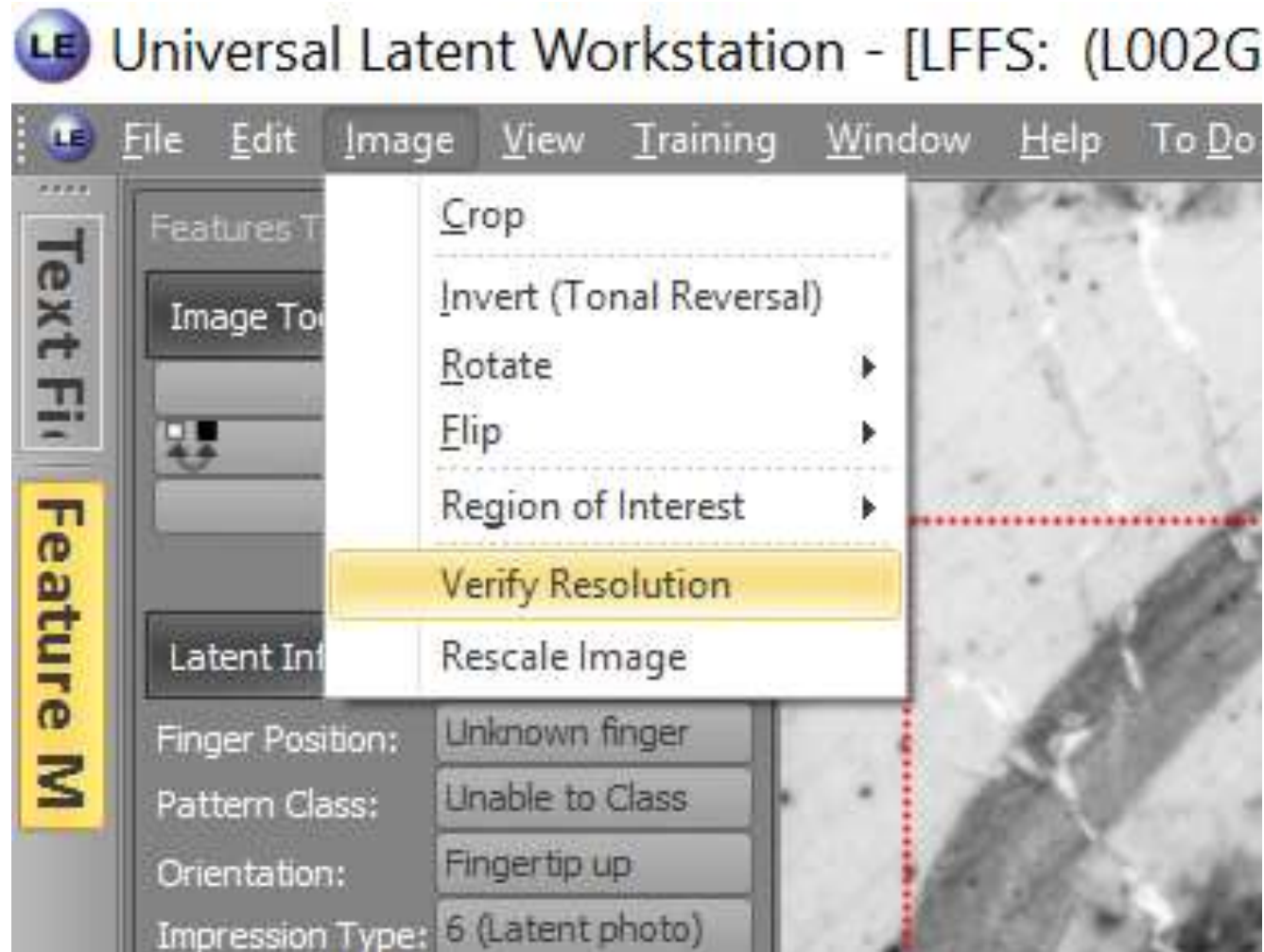
Thoroughness in Digital Imaging (Cont.)

- The image meta-data values for pixels per inch (ppi), file names ending with 1Kppi, and other descriptors are often inaccurate.
- Most AFIS algorithms can handle 20% ppi variance without missing latents having “enough” (i.e., many) corresponding minutiae, but the matching score can sometimes nose dive to cause a miss, especially if greater than 20% variance.

Thoroughness in Digital Imaging (Cont.)

- Pay attention to pixel horizontal and vertical values in LP images.
- View image file size and dimension lists (latents and tenprints) to see obvious anomalies.
- In ULW, use the image resolution verification tool to detect frequent 500 vs. 1000 ppi errors

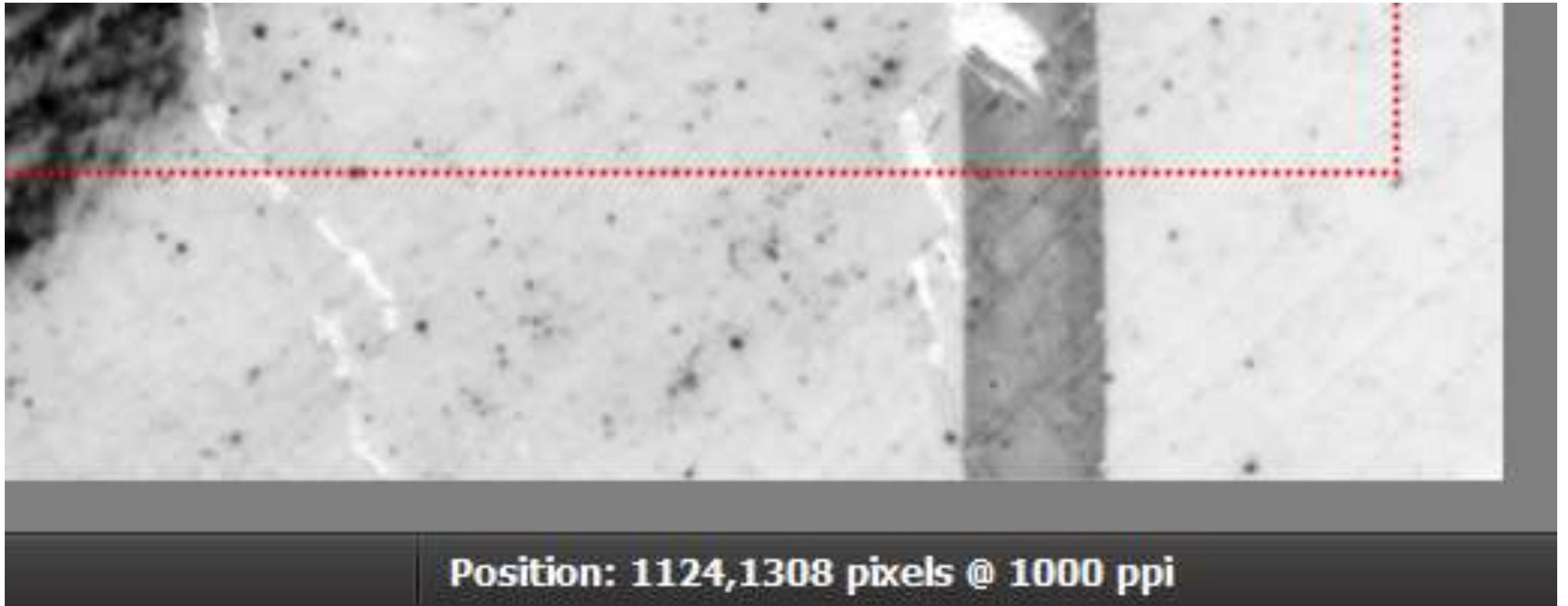
In ULW's Menu, Select Image -> Verify Resolution



Then compare your latent print to the resulting pop-up window with sample 500 and 1000 ppi ridge detail



Hovering the Cursor in the Bottom Right Corner in ULW Shows Horizontal and Vertical Pixel Counts



Tenprint PPI Anomalies in Dimensions

Type	Size	Dimensions
TIF File	21,757 KB	8100 x 10100
TIF File	21,757 KB	8100 x 10100
TIF File	16,790 KB	8100 x 10100
TIF File	16,790 KB	8100 x 10100
TIF File	2,466 KB	1296 x 1944
TIF File	2,466 KB	1296 x 1944
TIF File	2,466 KB	1296 x 1944
TIF File	2,466 KB	1296 x 1944
TIF File	2,466 KB	1296 x 1944
TIF File	601 KB	629 x 968
TIF File	601 KB	629 x 968

Tenprint PPI Anomalies in EFTS File Size

- Remember that the **devil is in the numbers**.
- 500 ppi EFTS tenprint files of rolled and flats from paper cards compressed at 15:1 (wsq) average **666** Kb in size.

Investigators Often Put Scales on a Non-1:1 Photo

- Checking the ppi using a scale in a photo often gives false values... especially for cold cases involving paper photos... or cases transferred between agencies (which can involve paper photos or printouts which were imaged with a scale lying on the printout or paper photo)

The Gold Standard for Latent Spatial Resolution

- At 500 ppi, the AVERAGE pixel count from the middle of one ridge to the middle of an adjacent ridge for an adult averages 11 pixels.
- At 1000 ppi, the AVERAGE pixel count from the middle of one ridge to the middle of an adjacent ridge for an adult averages 22 pixels.

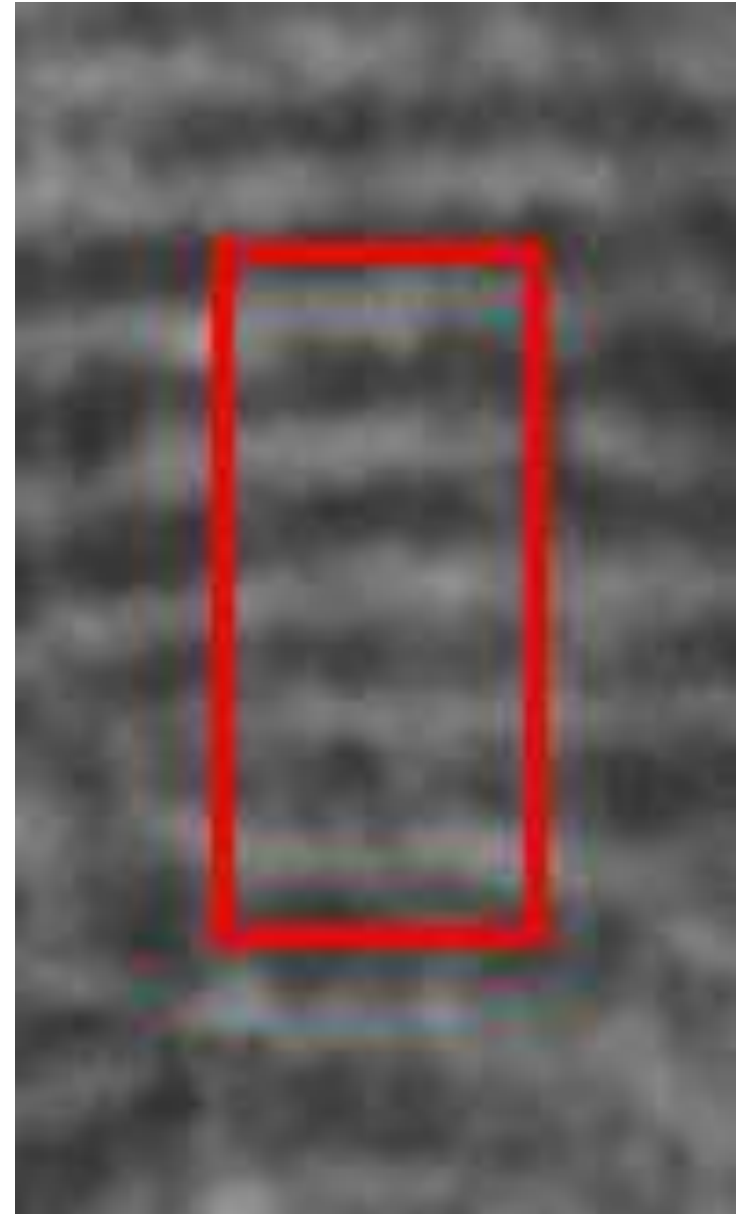
The Gold Standard for Latent Spatial Resolution (Cont.)

- Choose “normal” looking ridges to measure if part of the latent appears to have wider or narrower ridges due to pressure distortion causing thin furrows, etc. Ridges near the joint at the base of a finger may also be wider than other ridges in a fingerprint.

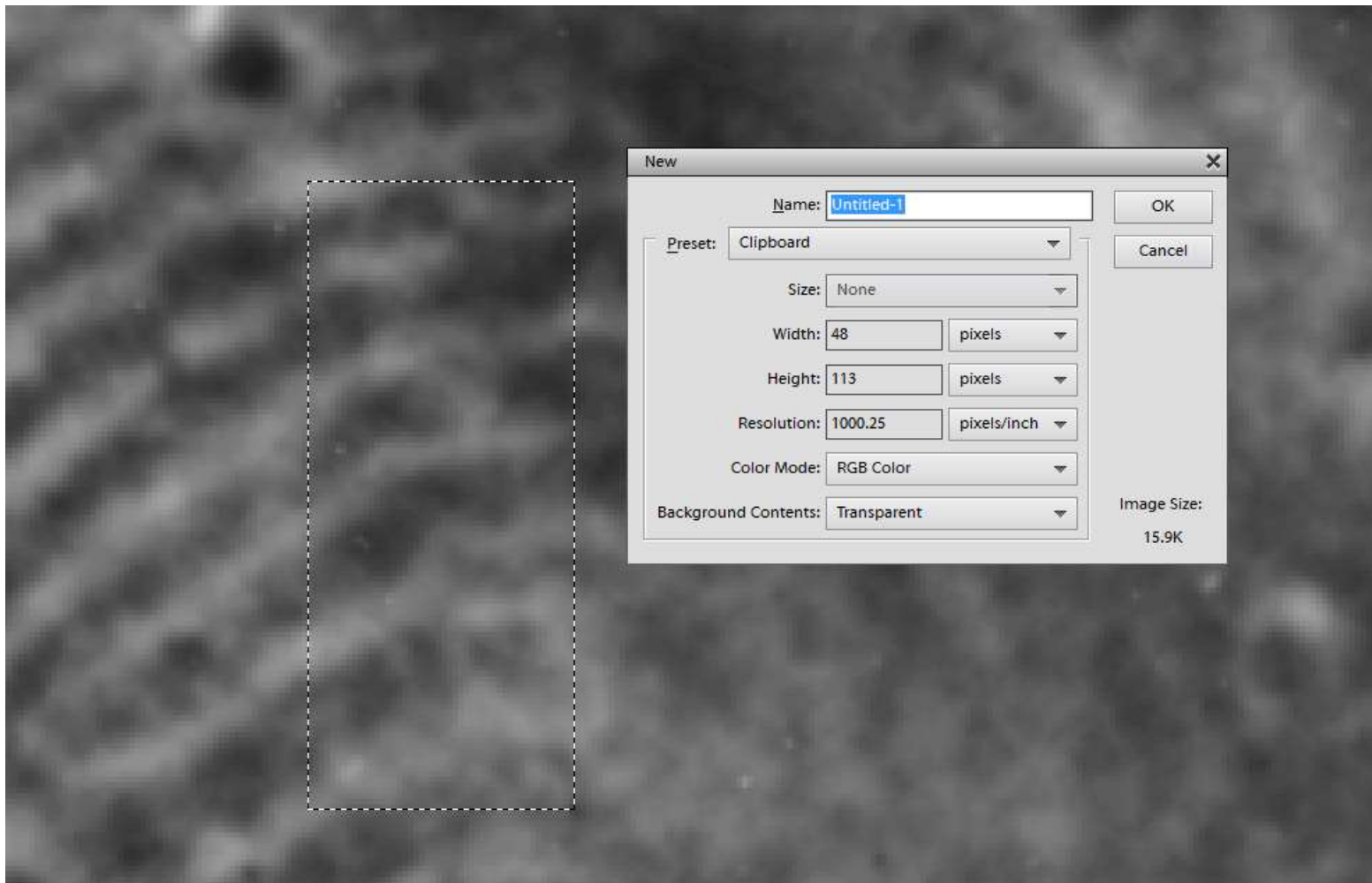
The Gold Standard for Latent Spatial Resolution (Cont.)

- You will seldom find exactly 11 pixels at 500 ppi or 22 pixels at 1000 ppi. Thumbs tends to have larger ridges, ring and little fingers have smaller ridges.
- You are looking for something in the ballpark close... not one-fourth or four-times the expected 11 or 22 value.

Start in the middle of a ridge, cross five furrows and stop in the middle of a ridge, then copy and paste the selection to see the pixel count without having to manually count (press control-c, then control-n in Photoshop).

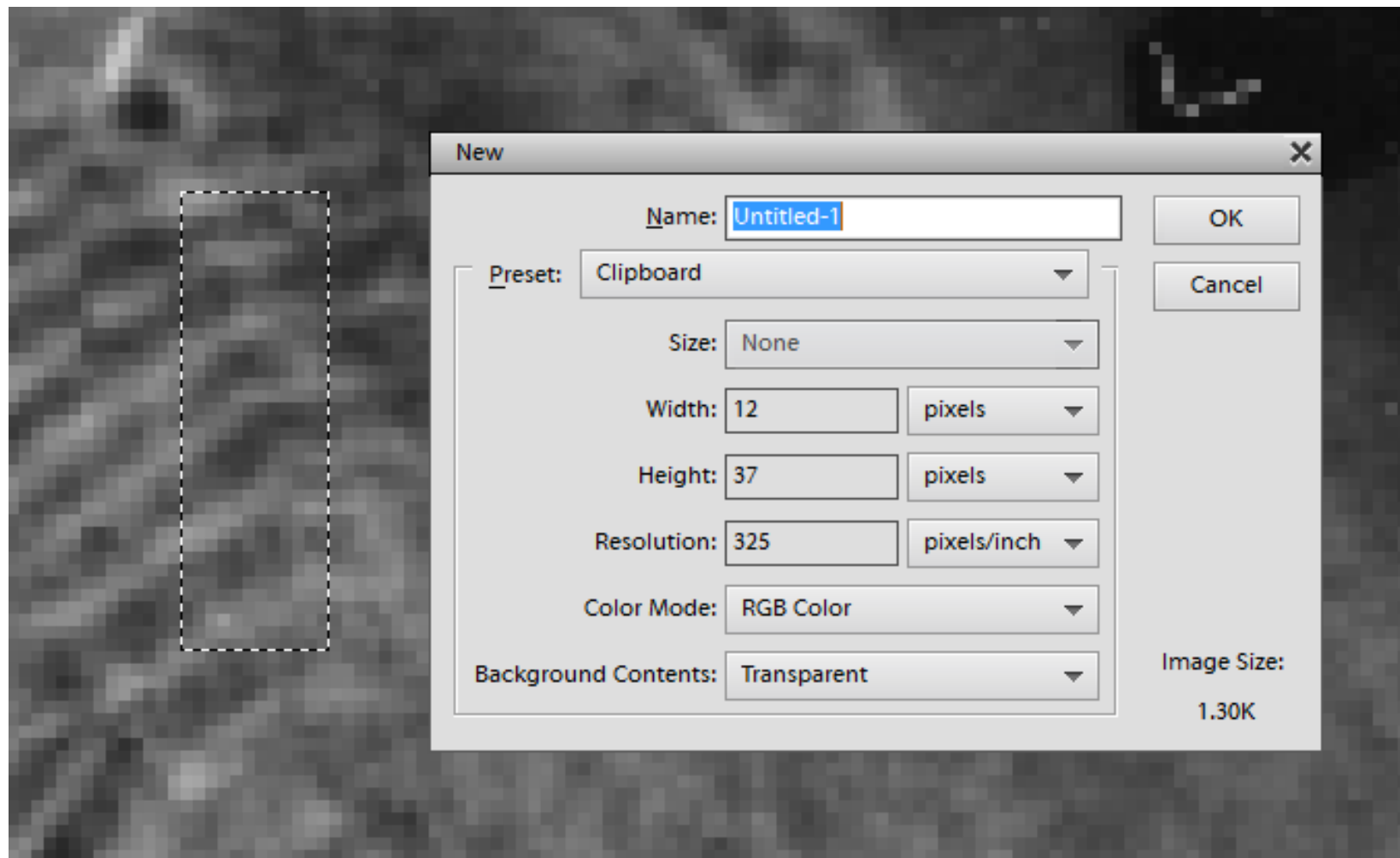


The Gold Standard for Latent Spatial Resolution (Cont.)



Good (113 pixels across 5 ridges at 1000 ppi)

The Gold Standard for Latent Spatial Resolution (Cont.)



Bad (37 pixels across 5 ridges at 1000 ppi)

The Gold Standard for Latent Spatial Resolution (Cont.)

- If the ppi is far from 11 or 22 (or completely unknown) you can often achieve AFIS accuracy by resizing the image to average 11 or 22 pixels.
- Cold case children's latent prints (e.g., finger-painting or other latent prints collected from an abduction crime scene decades ago) will NOT hit against the adult's prints today without resizing.

Post-Super Glue Fuming

- Cyanoacrylate-developed ridge detail lasts almost indefinitely on specimens and is great for harvesting additional cold case latent prints decades later.
- Powder “rubbing” (different from dusting for prints) should be the last step, but is also the most often overlooked step. Expect additional identifiable latent prints at least 5% of the time if powder rubbing was not done in a cold case.

Post-Super Glue Fuming (Cont.)

- If only visible light and dusting powder (with or without follow-up powder rubbing) were used, there is an excellent chance to detect additional impressions using luminescent dye stains (R6G is one of the best, but others also work).
- RUVIS is valuable for finding previously undetected latent prints on cold cases where only visible light, dye stains, and powders (including powder rubbing) were used.

AFIS Thoroughness

- Re-launching latent prints periodically will detect many identifications impossible when only relying on daily TP/LP searches (AKA ULMs).
- If you can afford a mini-AFIS in your Latent Print Unit to supplement your agency's giant NEC, Morpho, or Cogent AFIS, you can often leverage it to achieve hits difficult or impossible with systems tailored for supporting large-scale daily tenprint throughput.

AFIS Thoroughness (Cont.)

- For suspects from serial murders/rapes, launch each of their 20 rolled and flat record prints as LP-LP searches. This has proven especially valuable in some EU labs for solving additional cold cases.
- Leverage tenprint examiners, office administrative/clerical workers, or summer hires to help with latent print re-launch activities.

AFIS Thoroughness (Cont.)

- If you have a mini-AFIS (or have spec'd special requirements in your latest AFIS rebuild), be sure to leverage “double-dipping” to data mine suspects hundreds of SRL candidates deep for multiple LPs from the same crime.
- You do not manually compare the top 500 or 1000, etc., best matches for each print.
- You use correlation logic to lead you to identifications otherwise impossible to detect.

AFIS Thoroughness (Cont.)

- With the double-dipping concept, the same suspect's finger matched in positions 288, 472 and 162 (for example) from three latent prints of one crime scene means nothing... maybe his left index finger is similar to the true donor's right thumb.
- **HOWEVER**, if two or three **DIFFERENT** fingers from the same suspect match latents from one crime – he/she just won the lottery and is worth manually comparing against the case.

AFIS Thoroughness (Cont.)

Be sure to search state/national/regional and international AFIS databases. DHS' huge AFIS (larger than the FBI's) is often overlooked, but contains over 100 million foreign persons who should be searched against your latent prints.

AFIS Thoroughness (Cont.)

Tips for searching additional databases, including DHS and Interpol, are posted at onin.com in the 27 April 2016 Illinois Division, IAI presentation about Fingerprint and Face Criminal Justice Repositories.

AFIS Forensic Intelligence

- Studies have shown latent prints considered “unsuitable” for ID by CLPEs can be searched in giant databases (over 50 million persons) as lights out LFIS searches ...and those prints will sometimes provide a ground truth true match in the number one candidate position.

AFIS Forensic Intelligence (Cont.)

- Recommend saving every latent print with five or more ridge endings or bifurcations in legible consecutive ridge detail.
- It may solve current or cold cases by providing investigators an investigative lead.

AFIS Forensic Intelligence (Cont.)

- Launching four unsuitable five-point latent prints from one crime scene and finding the same person listed among the top ten candidates might be a lead... if two different fingers of the same person show up in the top twenty candidates – they just won the lottery.

AFIS Forensic Intelligence (Cont.)

- In the future, there WILL BE probability algorithms approved by the relative scientific community to provide the probability a suspect may have made such small latent prints (considered unsuitable for so-called positive ID).

Unknown Latent Print Mirror Imaging

- Latent prints may be mirror imaged due to transfer (e.g., contaminated matrix transferred on a plastic bag).
- Latent prints on the sticky surface of tape may have been “lifted” when the tape was applied.
- Latent prints on car windows or plastic bags may have been photographed “through” the surface in a manner causing mirror imaging.

Unknown Latent Print Mirror Imaging (Cont.)

- Rubber lifter photos may or may not have been properly reversed. Markings on a paper photo in cold cases may be confused with markings on a rubber lifter and cause erroneous mirror imaging.
- Thin papers such as flash paper or cigarette rolling papers may be impossible to know insofar as side of deposition. They often need to be searched both ways.

Other Latent Print Processes

- Hints previously listed in this presentation are some of the most successful and frequently overlooked steps for reliably harvesting additional latent prints from cold cases.
- There are numerous other steps which can be considered, especially additional porous surface, blood, and other specialized substrate and/or matrix processes.

Facial Image Thoroughness

- Be sure to search local/state/national/regional and international face databases.
- Tips for searching additional databases, including over 500 million faces accessible to the FBI, and the 180+ countries submitting faces to Interpol, are posted at onin.com in the 27 April 2016 Illinois Division, IAI presentation about Fingerprint and Face Criminal Justice Repositories.

Facial Image Thoroughness (Cont.)

- Although less than 40% of persons imaged in most facial recognition (FR) automated databases (DMV, passport, visa photos, etc.) are wearing glasses, if your suspect is wearing glasses in the probe image, then typically 80% of the faces in the resulting candidate list will be wearing glasses.
- The true match can miss if the suspect wearing glasses is not also wearing glasses in their gallery image.

Facial Image Thoroughness (Cont.)

- Many agencies are unaware it is permissible to alter facial images to improve the chances for a successful match in facial recognition databases.
- Using Photoshop to remove glasses is a valuable way to identify persons who would otherwise be missed if their gallery image in a face database is without glasses.

Facial Image Thoroughness (Cont.)

- If the suspect is wearing dark sunglasses, FR algorithms will typically fail to generate a template for searching.
- Several agencies have successfully used Photoshop to remove dark sunglasses and then add unrelated eyes (of another person) to enable the FR algorithm to build a template and achieve successful matches in huge databases.

Facial Image Thoroughness (Cont.)

- Other pose, illumination, expression, and occlusion problems can be mitigated with Photoshop and other imaging software.
- Just as occurs with fingerprints, post-automated search comparisons (after considerable probe image manipulation) are made using the original image(s) collected and not faces with artificially added eyes, or after bandanas, hat brims or dark hair bangs, etc., are removed.

FP and Face Horizontal/Vertical Ratio Errors

- Horizontal to Vertical ratio errors (often accompanied by ppi errors) are frequently introduced when images are shared/transferred between agencies.
- Facial images are especially prone to compression degradation, aspect ratio and other image anomaly problems during insertion in apparently normal or high-resolution wanted flyers, investigation reports, etc.

Think Outside the Box

- This presentation only scratches the surface of things to consider for solving additional current and cold cases while balancing accuracy, thoroughness and timely support.
- Of course, reality will inevitably temporarily negate reasonable processes while management attempts to satisfy public/political interests in high profile cases.

Questions?

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