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PAPER

GENERAL; CRIMINALISTICS

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Emotional Experiences and Motivating Factors Associated with Fingerprint Analysis

ABSTRACT: In this study, we investigated the emotional and motivational factors involved in fingerprint analysis in day-to-day routine case work and in significant and harrowing criminal investigations. Thematic analysis was performed on interviews with 13 experienced fingerprint examiners from a variety of law enforcement agencies. The data revealed factors relating to job satisfaction and the use of skill. Individual satisfaction related to catching criminals was observed; this was most notable in solving high profile, serious, or long-running cases. There were positive emotional effects associated with matching fingerprints and apparent fear of making errors. Finally, we found evidence for a need of cognitive closure in fingerprint examiner decision-making.

KEYWORDS: forensic science, expertise, motivation, emotion, satisfaction, qualitative, thematic analysis, need for closure

Fingerprint analysis has been a cornerstone of forensic investigation for well over 100 years. Such is the trust in fingerprint evidence that it is rarely questioned by the public and judicial system. Indeed, in the vast majority of cases, latent print examiners' findings and conclusions are unchallenged and accepted at face value. Many people arrested and charged as a result of fingerprint evidence will often admit to crimes based solely on the knowledge a fingerprint match has been confirmed. Many arrestees feel under intense pressure to confess (1), so the presence of forensic intelligence only serves to intensify that pressure. The validity of fingerprint science and the trust placed in the evidence is based on the biological uniqueness of friction ridge skin and the methodology of fingerprint identification that is considered to produce correct matching with zero error rates (2). Yet latent print examination, considered unquestionable and scientific, is now coming under increasing scrutiny in the courts (2). Errors in the analysis of fingerprint evidence in high profile cases around the world (3,4) have resulted in legal council, media, and public attention focusing on the core issue of what is to be considered one of the most reliable and valid forensic sciences (5).

The McKie case is one of the most notorious of all the recent controversies in latent print examination. Shirley McKie was arrested for perjury for stating under oath during a murder trial that a thumb print that was matched to her was not hers (4). McKie was only vindicated after latent print examiners from other agencies around the world challenged the validity of the identification. In contrast to the Mayfield case where the error has been acknowledged, to this day, there are experts in latent fingerprint analysis who still disagree whether it is hers or not. This inability to reach an agreed conclusion raises a number of issues such as, "can anyone actually be certain that Shirley McKie didn't make the print in question given the need for, and lack of any consensus over the conclusions reached by opposing opinions of latent print examiners?" (2).

The erroneous fingerprint identification by FBI latent print examiners of Brandon Mayfield as part of the forensic investigation of the 2004 Madrid Bombings was another highly contentious case (6). Mayfield's fingerprints were alleged to have been identified against those found on a bag of detonators found in Spain after the bombings took place. However, because of subsequent reanalysis carried out after the Spanish authorities questioning the accuracy of the identification, the FBI fingerprint experts conceded that they had been incorrect in their original analysis. These cases, as well as other errors and controversies, have resulted in fingerprint analysis coming under attack from both the judiciary and academia. Some (2,5) have questioned the very underlying scientific assumptions made by fingerprint experts.

Fingerprint examination has now been a topic of scientific inquiry in academia, the criminal justice system, and the forensic science community (7–10). The U.S. National Academia of Science has created an independent forensic science committee to assess the present and future needs of forensic science (11).

Comparing two fingerprints involves examining a specific target area of friction ridge detail on one print and searching for a matching correlation of friction ridge detail on another print. Once enough characteristics have been matched by the examiner, then they may conclude the pair of prints is a match (12,13).

Fingerprint identification involves visual search and processing of visual information. Scientific studies show that the interpretation and selection of visual information can be greatly affected by emotional state. Examples of this are that biases of cognition result in preferential processing of visually threatening stimuli (14), processing of facial expressions corresponds to the emotional state of the perceiver (15), and even ambiguous sounds can be processed and interpreted in a way that correlates to the person's emotional state

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(16). Such top–down processing effects enable context and background knowledge to influence the selection and processing of information (12,14). For details, see past research examining the relationship between emotions and fingerprint analysis which showed that contextual information-like emotional background stories of crimes and explicitly disturbing photographs from crime scenes may affect how fingerprints are matched. This research demonstrated that the decisions and conclusions may differ dependent upon the context in which the evidence was presented. The results indicated that participants were more likely to match different but ambiguous pairs of fingerprints in the highly emotional condition (15).

Further studies examined whether fingerprint examiners could objectively focus solely on feature information in fingerprints without being misled by extraneous information such as context (8). Fingerprints were used that had previously been examined and assessed by latent print examiners to make positive identifications against suspects. Then, the same examiners were presented with the same fingerprints again, but this time given a context that strongly suggested that they were a no-match, and hence the suspects could not be identified. Within this new context, most of the fingerprint experts made different judgments, thus contradicting their own previous identification decisions (9). Additional research demonstrated that fingerprint experts were vulnerable to biasing information even when they were presented with relatively subtle and routine day-to-day contexts, such as corroborative [or conflicting] evidence of confession to the crime. The results were similar to the earlier experiments; it was found that context influenced the judgment of the experts. Thus, it appears that contextual information does not need to be extreme and unique to influence experts in their fingerprint examination and judgment (10).

Contextual information is only one of many cognitive influences that may affect fingerprint expert performance. Other influences may be need for cognitive closure, emotional rewards, belief perseverance, escalation of commitment, conformity, motivated perception, self-fulfilling prophecies, cognitive dissonance, wishful thinking, diffused responsibility, framing, and a whole set of established cognitive and psychological phenomena (17,18). In this study, we focus on investigating two such influences: *need for cognitive closure* (simplistically stated, it is the psychological need to bring a decision-making process to a definitive conclusion and termination so as to avoid ambiguity or unresolved issues) and *emotional experiences* (simplistically stated, the feelings [or expected feelings] associated with fingerprint analysis, including reward when one finds a match as well as fears associated with the possibility of making an error).

Kruglanski et al. (19,20) find that participants motivated to avoid closure generate the largest number of hypotheses, in contrast to those motivated for a need for closure who produced the fewest hypotheses. As the need for closure is higher, quicker judgments are attained with higher confidence associated with those decisions. High need for closure leads to the "*unfounded confidence paradox*." This paradox arises when there is reduced information processing but at the same time higher confidence in those judgments and conclusions. Thus, a need for cognitive closure may lead to lower decision thresholds, but increased confidence. However, Ask et al. (21) found only partial support to the hypothesis that investigators with a high need for closure are less likely to acknowledge observations that are inconsistent with their belief of guilt. It is, therefore, important to investigate whether the need for closure plays a role in fingerprint analysis.

The need for closure also enhances a desire for consensus (20), thus adopting the "path of least resistance" to achieving agreement with others. This may entail, for example, derogating those who hinder consensus and complementing those who facilitate it (20). This is important and relevant to the area of fingerprint, because the need for closure does not only potentially affect the initial analysis, but may be critical to the verification stage at ACE-V (12) as well as arbitration.

Given that fingerprint examiners' decision-making can be affected by extraneous influences such as emotional response, context, and motivations, then the apparent presence of emotions or motivations in fingerprint examination will be indicative that these influences play a role in fingerprint analysis. Conversely, if emotions and motivations were absent from day-to-day experiential work of fingerprint examiners, then that would support that they are not affected by them. As yet there has been no investigation into the emotional experiences of operational fingerprint examiners. This study is a step in examining these issues, and it is hoped it will yield valuable insights into the potential role of emotions and motivations on decision-making. The qualitative study reported here enabled an examination of the views of fingerprint examiners without the restraint of preconceived theory or experimental restrictions. The aim of this study was to highlight and understand the work of fingerprint experts from a new perspective.

Although qualitative studies have been used in other domains, to the best knowledge of the authors, there has never been a qualitative study investigating the emotional and motivational experience within the fingerprint domain. There are a number of important issues associated with this research. Prior to this study, it was only possible to speculate about the emotional experiences of fingerprint examiners. The top–down contextual and motivational (and many other cognitive mechanisms) effects often occur without consciousness (22). As a result, we cannot expect participants to be aware of any information processing effects. Therefore, we undertook individual interviews in an attempt to obtain a broad range of views and then perform thematic analysis on the findings in an attempt to uncover trends in the responses of the participants. Thus, determining themes and underlying similarities in the experience of the decision-makers. Similar research methods were evident in Hermsen and Have's (23) study, in which semi-structured individual interviews were conducted. They attempted to determine the specific moral and emotional considerations and arguments that might arise from people who must decide whether or not to withhold treatment in a palliative care scenario. They similarly studied a relatively small participant base and as such looked across various care-giving environments to get broad, underlying characteristics. The aim of our study is to find broad themes that occur across the whole sample and not differences between participants. By observing themes that were discussed by each and every participant, so we could derive themes that can be generalized to the larger forensic community.

Method

The aim of this study was to qualitatively investigate themes about emotional and motivational factors that relate to the latent fingerprint examiner's experience.

Participants

Thirteen participants were interviewed from a variety of law enforcement agencies who were all latent fingerprint examiners, each with at least 7 years' experience. The participants included those involved in the investigation of daily volume crime such as burglary and vehicle theft, others who dealt with the more rare investigations of rape, murder, or armed robbery, as well as senior officers and managers with a number of years' experience. The

broad range of the participants' experiences decreased the chance of deriving participant or role-specific themes. All participants were fully trained latent print examiners and performed fingerprint comparison analysis daily. Each interview lasted approximately 30 min.

Design and Materials

A semi-structured interview technique was employed, which involved the use of an interview guide (see appendix A). This method was used in preference to a fully structured interview as heavily structured interviews tend to constrain participants' responses toward the researchers preconceived ideas. Rather the more open-ended structure allowed participants to respond in a naturally ambiguous way. It has been suggested that when participants are offered multiple options, they tend to constrain their responses between options and as a result we can miss some important areas of internal conflict (24). Furthermore, structured questions can impose ideas and we may lose vital areas of interest that would otherwise be missed, for example how people make sense of their experience.

The interview questions encouraged participants to talk about the various different aspects of their work from the mundane to the more serious and disturbing casework where potentially emotional feelings are engendered, and to attempt to probe any expression of affect that arose. All participants were asked to talk about three aspects of their work:

- Day-to-day fingerprint analysis processes.
- Particularly harrowing or difficult cases.
- What it meant to them as individuals to be involved in latent print identification.

During these interviews, more direct and probing questions were asked to gain further information and resolve any potential misinterpretations by the interviewer. Probing also facilitated the interviewee's own understanding of the framework of meaning without imposing the researcher's assumptions (25). It was also important that the questions were not so nondirective that they actually led to more constraint on the participants, as they may spend more time and energy guessing what the interviewer wanted to know (26). We attempted to find a balance between nondirective general questions that might elicit emotional responses and more direct prompts to examine discussion points in more detail.

Procedure

The interviews were conducted at various operational fingerprint laboratories away from the noise and distraction of the operational environment. Before the interviews, participants were given information and consent forms and were informed of the general nature of the study. All participants were guaranteed anonymity. All the interviews were recorded, so the interviewer could be sure that all information was captured. The interviews were subsequently transcribed verbatim, using; "…" to signify pauses, "CAPITALS!" to signify exclamations, "[xxxx]" to signify named or identifiable persons, and "[text within brackets]" for clarification. Also, notes were taken during the interview about how the interviewee appeared, how the interview was progressing, and other appropriate events during the interview.

Analysis

Using thematic analysis protocol, codes were assigned to various segments of the text (see appendix B). It was not clear what the findings would be, and there was little in the way of guidance from past research. As a result, specifics were inductively coded, whereby individual categories were generated from the interview text itself rather than from specific theory (27). Initially, the coding was very broad to encompass anything which had emotional content. Then, as subsequent themes appeared, they were broken down into separate codes; for example, distinguishing positive emotions from negative ones. It was important to be cautious not to generate too many categories. Consequently, a few broad, general themes were chosen as this allowed much greater generalization. It was also important to this particular study that both latent and manifest content was coded. Although this involves a certain amount of interpretation by the researcher, it was hoped that any clarifications made during the interview and the concurrent notes made would avoid inaccurate interpretation.

Reliability is vital in any qualitative study. It was important that the coding was both stable and consistent, and that it had good reproducibility (28). There is another reliability measure, namely accuracy, which refers to the extent that the coding corresponds to a previously generated standard or norm, that provides the strongest form of reliability (29). However, as this is a new area of study, there are no standards to compare it against. As a result, it was not possible to measure accuracy reliability. However, it is hoped that the themes from this study might be used to gauge further qualitative studies investigating the emotional or motivational experiences of forensic or criminal investigative personnel. Inter-rater reliability was tested by two independent analyses. Only agreements above 0.65 were considered (30). If sufficient reliability was not apparent, further refinements to the coding were performed to increase reliability. To ensure the stability of the initial codes, they were rated twice on two separate occasions. This ensured test–retest reliability and inter-rater reliability.

After the assessment of percentage level of agreement between the raters, it was found that there was an overall coding agreement between raters of 0.74. Allowing for chance coding agreements, a further statistical analysis was performed. An overall free marginal (where raters are not forced to assign a certain number of cases to each themed category) Cohen's Kappa of 0.69 was achieved (31,32). It was decided that this met the level of reliability required to ensure the themes highlighted in this article were representative and reliable.

Results

The data revealed five main themes associated with emotion and fingerprint analysis: reward, motivation, satisfaction, fear, and need for closure. These themes were broken down into separately coded categories: job satisfaction and pride associated with the use of skill; motivation, satisfaction and hope, associated with catching criminals and solving crime; the expression of satisfaction and motivation associated with working on more serious or long-running cases; the feelings directly associated with searching for and finding matches; expressions indicating a need for closure on casework and emotional feelings associated with making mistakes.

The Fingerprint Analysis Process

As a precursor to the discussions held with the fingerprint examiners, each participant was given an opportunity to explain the identification process of fingerprint analysis and to go into some detail regarding the methodology of comparing fingerprints. It was considered important that this is reported within this study. As will be highlighted later, there was objectivity in their methodological description (see examples later) which was in stark contrast to the emotive language and motivations observed later.

"…you will run through a series of questions in your mind; quality over quantity, clarity within the mark, the tolerance that you will give to it, what volume of detail have you got? Can you see ridge flow, can you see ridge pattern, what features are there within there, i.e., are there any ridge characteristics? Can you see a scar? Can you break it down even further because in relations to the clarity can you see a particular shape or ridges or pores within there? Anything else which is detail which is going to be useful you to enable you to make a comparison."

"…assess the value of the marks…we got three basic categories…no value…which means there is so little information in the mark you can never individualize it…then you move on to a mark that is suitable for a direct comparison."

"…have a look at that mark to see what available information is on that mark….to see if there is any idea of which finger that mark came from…any other indications…left hand…–right hand…. Then I would look at the fingerprint form then if I don't know which finger straight away to compare it to…If there was no clear indication, I would compare all ten fingers and analyze the mark from the mark to the fingerprint form looking for anything that looks similar…any points or characteristics that show in both impressions…I build up in my mind what characteristics are similar and I will keep going until I have identified…or not identified."

Job Satisfaction Related to Skills

There was a great deal of pride and "job satisfaction" exhibited by the fingerprint examiners interviewed associated with the process of fingerprint analysis and the science associated with friction ridge skin. There was a sense of pride in the skills they had learned and a real sense of civic duty and making a difference to society.

"…from a personal perspective I thoroughly enjoy it [the job] because it involves patience, it involves tenacity, and it involves you really having to concentrate and focus, and the reward comes at the end of the day when you can actually walk away saying 'I've done absolutely everything I can.' "

"…using your skill and expertise gives you that bit of drive and feeling, 'yeah I've done something no one else can do,' and makes you feel worthwhile and feel, you know, you can't be replaced [laugh]."

"…the thing I still like about this job is the idea that when I get home and I have had a frustrating day and things aren't going right… you at least know that all my efforts are going to have a tiny but important part of improving society… improving life generally for people a little bit…"

"…you are doing something useful and you have developed a skill or a talent that is being used and that gives you a sense of satisfaction…"

"…you are believed in…you are in a position of importance …it's a nice feeling…"

"…I am proud of my position in it…proud of what I have achieved."

"I am very proud of the service that we do for the public."

The increase in computer technology in fingerprint analysis has resulted in some fingerprint examiners feeling undervalued as specialists, which could be seen as an obvious drain on morale. Intriguingly, however, there was not a sound consensus on the true value of technology in the domain. Indeed, some of the comments from examiners were contradictory in nature, some feeling technology de-skilled them, while others got heightened feelings of pleasure from using technology to search for cold cases.

"…which is a shame because we use computer technology more and more and more so it removes the ability of fingerprint officers to use their brain and actually use their skill."

"Searching has always given more satisfaction…One to one suspects doesn't give you the same buzz I suppose as a search on ident 1."

Satisfaction with Crime Solving

The sub-category of satisfaction demonstrates how the clinical and scientific job of matching details and patterns within fingerprints has a very human element associated with a personal interest in solving crime and catching criminals.

"…I think there will generally be a … very…a lot of …pleasure about it if the case is resolved to a successful conclusion, with a successful conviction, I think that would be a natural thing. If the case remains open then there will always be work to be done. There is always a potential of finding someone."

"I mean, I was beginning to give up hope of ever matching this fingerprint, I thought, 'oh they'll get it in DNA' they'll, they'll, they'll, find someone and say, 'there we go, that, that's the…the perpetrator,' and it won't even match this fingerprint and all my time would be wasted."

"We catch more in here than the Police officers do on the street and the Police officers are praised and get more money and things [laugh]"

"…they don't realize the work that's gone on behind the scenes and it's nice, it, it is really satisfying, it sounds really sad, but catching people. You don't really see the name or the person you just see that fact that you're hopefully solving a crime."

"….the whole case was identified to people they wanted it identified to…it was a good result…. That sticks in my mind because I got good feedback from the police officer and the OIC."

These comments demonstrate that matching fingerprints is not just a laborious task of visual search and comparison of details. It appears that analysts feel a direct link between finding matches and actually solving crime. This has significant importance, because it suggests that the frame of mind of the examiner is variable in different cases being processed depending on the importance of catching the perpetrator.

Satisfaction Associated with Case Importance

There were specific comments concerning the experience of reward linked to working on more serious, or longer running cases.

"…for me personally working a long protracted case it is rewarding because you know you are working towards an end goal."

"…that [the feeling] was, that was great, I mean, to be involved in such a high profile case and finally get a match."

"…well it depends on the type of work that you do. Print to print analysis, just so many of those going on it [feelings of satisfaction] doesn't really happen. But again it depends on the severity of the crime. If you're getting volume crime like car theft, or shop lifting, or whatever, and then you get identifications on that, then it's okay. If you haven't had any in a while in a week or for a month, then it's really good.[…] If it's a more serious offense then it makes you feel even better, er, even more, um, happy with your job,…"

"…the scale of the crime that they were doing was very significant and to actually be a part of that was great, it was really nice, all the benefits are you're actually catching some one up, quite high up the food chain so, it is, really, a really nice feeling."

There were some interesting counters to these statements where the severity of the case was said to be irrelevant, and that both volume crime and the more serious crimes like murder were treated the same way.

"The fact of the matter is, it doesn't matter what the offence is. What we are focusing on are the crime scene marks and the end result, again, is to complete your analysis, your comparison, and verification to the best of your ability, using your skill."

"It doesn't matter, really, the size of the case, you know."

In contrast, participants also made comment that:

"That's not to say that the same commitment doesn't go with each job but, you, you know, everyone will do more work for a murder than they would for a shop lifting."

"…you know, especially with a serious case you are liable to get a lot more suspects and you are still going to have to look at that piece even if you have a strong feeling that it belongs to somebody else other than the person you are looking at…You still have to look just in case because no one wants to be in the position of ignoring something.

"Major crime sounds glamorous but you don't actually get out there and see much of the major crime…it's just a pile of work and I actually enjoy the small cases better…the day to day volume crime I actually enjoy better."

"…these big cases that start off…I think the worst ones are the drug related which create masses and masses of work and often you are not involved on the investigation side…You might get a few dribbles of information but often you don't get that much…So you are ploughing through great piles of work…It's a job…it's what you are there for…but it's not as exciting as people might think."

This discrepancy may not have been found under a structured or questionnaire study and demonstrates the effectiveness of an open-ended interview technique. One participant responded to direct probing of the differences between volume and other crime. It led to a direct sounding answer:

"I don't argue that volume and other crimes are consciously treated differently and indeed the actual process of matching fingerprints is, as stated, identical, whether it has come from a murder or from a house burglary."

However, it does appear that although they are treated the same with a consistent level of "*commitment,*" and using the same comparison techniques, the end result has different impact, and the desire to find a match appears to be stronger depending on the crime severity.

Feelings Associated with the Act of Finding a Match

Apart from direct job satisfaction and desires, there were lower level emotional responses associated with finding small areas of similarity within two fingerprints that corresponded or determination that two prints matched. There was a wide range of responses, from descriptions of feeling a "buzz" as a direct response of matching the prints, to an emotional outburst in one case.

"…that feeling when you know you've identified someone because all the features correlate."

"…oh it's a buzz. It's a definite buzz. […]. When you get one, especially from the search, the buzz is there."

"…I was getting used to turning over every set of fingerprints I saw because the palm prints are on the back and thought "heyup, what's that? and it was like 'WAHEY!' and a really, really good, really good feeling."

This suggests that not only are there motivational factors associated with solving crime but there are direct emotional feelings associated with finding fingerprint matches. Furthermore, there are indications of emotional responses during the process of matching prints as well, i.e., before a definitive conclusion has been reached. There are descriptions of a build up of "*recognition,*" and increases in "*confidence*" and "*encouragement,*" which appear to enhance the "*feeling of a match.*"

"I was just beginning to get the feeling that it was a match…"

"…You pick your initial target, you know your first feature you're going to look for, and then you look through you prints and you recognize it. That gives you a little encouragement, you know, I've got something to focus on, somewhere to start, um, […] and…you know, every time you see something you recognize your confidence builds in the fact that it's a match, and the end point is "can I build my confidence to absolute confidence." You know, "can I eliminate all doubt in my mind whether these two prints came from the same finger, and it's a process of eliminating doubt."

This finding describes minor positive emotional responses of recognition as a result of seeing areas of agreement during a comparison. There are small emotional rewards of matching individual targets within the whole fingerprint before a tipping point is reached.

"…then all these recognition events pile up in you brain until you, you, in a way you've got no choice but to come to the conclusion that they were made by the same source. It just becomes overwhelming and it's just like seeing your friend down the pub…I know who that is."

This report by our examiners of the feeling of accumulating evidence until a specific level of confidence is met confirms the theoretical decision-making threshold, "winner-takes-all," model (33). This suggests that forensic fingerprint examiners use this type of decision mechanisms to make their judgments. Specifically that evidence accumulates over time to a specific, but malleable, level where a decision can be made, rather than a normative model of evidence deduction and an objective judgment. Therefore, prints are not said to match, because logical deduction has proven them to, but that for the examiner concerned, their subjective level of confidence or their "decision threshold" has been met by the accumulation of evidence.

It should further be noted that it was reported that different examiners appeared to have different decision thresholds. A decision-maker with a lower threshold will result in faster decisions as they require less evidence before the same degree of confidence is met. Whereas, a higher threshold results in slower decisions as more evidence must be accumulated.

> "Some people are just naturally slow where everything has to be done perfectly, they have to dot every 'I' and cross every 'T', check every little bit of scrap. Where other people would be a lot more cavalier about it, but be quicker and perhaps get more idents,… I don't know…"

> "… everyone perceives things differently …the levels of information they are looking at varies between person to person…confidence levels vary…I tend to think I am pretty much middle of the road…I won't go over the top and count every single characteristic in a palm impression but at the same time I am looking to find a suitable amount to satisfy myself."

This explains how a system that is supposed to be objective can result in differences in opinion between examiners. The primary concern is whether or not contextual biases and external pressures might influence these threshold levels for the fingerprint examiner, i.e., to what extent are these threshold levels determined by normative, objective prescription, or by subjective, context-dependent mechanisms.

Fear

There was a strong sense of fear associated with making mistakes in fingerprint examination. When asked, examiners for the most part asserted that to make an erroneous match was the very worst thing an examiner could do insofar as a person would be wrongly arrested. While there was also an expression of fear in making a false negative call, there seemed to be less emphasis placed on this type of error. In fact, some suggested that misses were just a part of being human. There also appeared to be a value placed on the fear associated with either a false negative over a false positive. For example, because generally there seemed to be a primary fear of making a false positive judgment, this appeared to weight the attitude of the examiner toward a more conservative demeanor.

> "I know everyone is human and you can make errors but I would probably feel awful like I can't do my job properly."

> "…I think 'is it my judgement that's wrong…or someone else's?'…but then you have to remember that fingerprints is opinion…it's not an exact science…it's our opinion"

> "a wrong ident,…you are doing something badly wrong… That's what I would be more worried of doing."

> "You should not miss,…should not have a wrong ident…A wrong ident is out of the question…I don't think it should happen…It happens…Unfortunately it happens."

> "To actually miss an identification could hurt the individual as much as making an erroneous identification…But obviously the implications behind the two will be slightly different…I suppose there is a tendency to believe that the cardinal sin is a wrong identification…Missed identifications may not necessarily lead to problems…"

> "Fear? Only fear of making a wrong decision…I think. I think that's the fear. So you just wanna be sure that you have made the right decision so you will probably err on the side of safety because it's better to let the ident go than to make the wrong ident."

> "The management, certainly when I was training, would make it quite an official thing…You have to sign a sheet saying you missed it and put any comments down…The manager who had started it off would put some comments down and would go down on file so if you did another one soon afterwards it would be brought out and it would be a far more serious thing…You weren't allowed many misses before it got serious and that's as a trainee."

Closure

It was clear from the data recorded that the examiners interviewed expressed, in general terms, a desire to avoid ambiguity and to see cases through to conclusion. Some examiners displayed feelings of frustration at not being able to finish things up. In addition, there was a desire to account for all the evidence and to seek out a definitive solution to the casework. In short, there was strong evidence of a need for closure.

> "…its annoying…It's like ohhhhh…I got that one little bit left…."

> "I would like to finish it up…maybe I'm a bit of a perfectionist occasionally …I need to complete everything."

> "Once I start something I like to finish it…and it's nice to finish it…and as a fingerprint expert it's nice to have a case wrapped up."

> "You would like to have a result in a case…i.e.…that the mark's been identified to a suspect or the mark has been eliminated…Whereas, the mark's not being identified or eliminated is hanging in the air…you would like a result either way…"

> "The chances of being able to account for every single piece are slim…it's nice when you can do it."

> "You like to…because it clears the job up…if you identify the eliminee…they could have a record…have their prints previously on file…at least that is the job cleared up…and that's the important thing…"

> "It's nice if there aren't unnecessary marks on the database…because they are being searched against unnecessarily …it's nice to know that that job is finished…all the marks

have been checked and assigned to whatever outcome and you know you don't have to revisit that job."

"It gives you a better sense of closure."

Discussion

There were a number of significant findings as a result of this study. Some important motivational and emotional factors appeared to be an integral part of the working life of fingerprint examiners. There was a considerable amount of pride and satisfaction associated with the skills they had learned and used daily. In addition, there was a significant personal interest in catching criminals or solving cases, especially when it related to high profile, long-running, or serious crimes. Experts described the process of looking for matches in emotional terms and, specifically, described matching in terms of "feeling" and reaching a specific threshold at which they can make a final determination. Scientific analysis of fingerprints and the comparison and evaluation of such material has always been assumed to be an objective process, yet clearly there are subjective elements introduced by human factors and their interaction with the methodology for comparing fingerprints.

These findings are very important as they indicate specific cognitive mechanisms. For example, the Madrid bombing case (3,6) was a very high profile and important event. The investigators working on that case were highly motivated to get "a result" and close the case. That is not to say that they would have intentionally falsified matching the two prints. Rather, they may have reached the decision that the two prints matched sooner based less on evidence that they may have ordinarily required. The combination of a strong underlying motivation to find a match or close the case, as well as smaller emotional feedback, when finding small similarities between the two prints, might have had an effect on subsequent information selection and processing which may have resulted in the decision threshold being lowered. The experts would feel that they had performed their job accurately and correctly, because a subjective feeling of confidence would have been experienced.

Given that participants generally viewed major crime as being more rewarding, this may act as an emotional amplifier by increasing the potency of the emotional rewards and moving them closer to the threshold at which a conclusion is reached. This would result in decision thresholds being met with different levels of evidence depending on the context and the type of crime. If this was to be the case, then the chance of erroneously matching prints might increase as a result of context, such as case severity or drive for closure.

That said, there was an expression of fear and consequence in making an erroneous match. This fear of error may result in more conservative decision thresholds which would entail incorrect non-identification conclusions. Examiners seemed to feel that missing an identification was less important than falsely identifying an individual. Some examiners acknowledged, however, that to have too many false negatives would be detrimental to the professional standing of any examiner. It is just as important to understand why examiners miss identifications as it is to understand how erroneous identifications arise. Both are incorrect conclusions.

Another key area of interest in this study was the apparent need for fingerprint examiners to achieve closure on casework. While there is existing literature that suggests that fingerprint examiners are vulnerable to the effects of context and top–down cognitive processes, it is interesting that there also appears to be a wider socio-psychological phenomenon evidenced within the fingerprint profession. Many of those interviewed appeared to make comment suggestive that they possessed a high need for closure. People with a high need for closure may have a stronger desire to obtain a definitive answer, as opposed to uncertainty and ambiguity. People with a high versus low need for closure may prefer the company of those with similar attitudes and philosophies and feel positively disposed toward those who allow for consensus. Similarly, those who require need for closure may feel negatively toward those who deviate or jeopardize consensus. People with high need for closure may make correct judgments so long as the cues initially seized upon were correct. However, people with a high need to avoid closure may also commit errors if they too readily unfreeze correct judgments through excessive openness to misleading or irrelevant information. In other words, fingerprint examiners might be vulnerable to error through a heightened need for closure that may either impact upon verification and arbitration discussions by arriving at an erroneous consensus by associating with ones who are likely to agree with them or, conversely, may miss identifications, because they were unable to come to the right conclusion, because they literally looked at the mark for too long and effectively talked themselves out of it. People under a heightened need for closure may seize on information appearing early in a sequence during a fingerprint comparison and freeze on it, ignoring or unfairly weighting subsequent information within the fingerprints that may offer an alternative hypothesis. People with high need for closure may process less information within the fingerprint before committing to a judgment and generate fewer competing hypotheses to account for the available data.

To put it in terms of the threshold theory, high need for closure results in a lower decision threshold, and therefore less information is required before the decision-maker can close the case and make a judgment. It is the "seizing and freezing" (19) that may be central to the notion that contextual information can bias decision-making.

It is possible that decision-making thresholds of fingerprint examiners are dynamic along an elastic continuum that is dependent upon certain factors including: the cost of error, motivation to be accurate, time pressure, the importance of the case, the context in which evidence is framed, the individual traits of the examiners themselves, such as need for closure, as well as the environmental conditions, and culture within which fingerprint examinations take place, such as background noise and interference. It is this theoretical framework of malleable decision thresholds that might explain how biasing factors affect the decision process in some scenarios but not in others. So while contextual influences are broadly observed in fingerprint analysis and scientific studies, it will be important to understand at what point contextual bias impacts upon the actual conclusions of the examiners. Bias and cognitive influences affect the decision process but not necessarily the decision outcome.

The aim of the above discussion is to stimulate further research rather than to deliver a final conclusion. However, this study presents some exciting questions about the nature of top–down effects and contextual influence, and the possible catalysts that may exacerbate such phenomenon. In future research, it would be valuable to look in more detail at the concept of need for closure in fingerprint examiners. For example, need for closure may bias the fingerprint examiners' choices and preferences to facilitate attaining closure. Need for closure may or may not be a generic feature of fingerprint examiners, and this will need to be investigated. If the phenomenon is present, may it be mitigated or amplified under environmental noise, when the task is unpleasant or dull or when the individual is fatigued? It might be the case that need for closure is emphasized and appreciated in the domain of fingerprint analysis. This may be especially true when verification protocols suggest that an agreement of opinion is routinely expected.

As with any research, there are potential weaknesses as well as strengths in this study. For example, the lines of questioning could have gone into more detail about the correlation between

methodological objectivity and how participants felt this process was affected by the emotions and motivations highlighted. This could be an area for further study.

What is certain as a result of this study is that fingerprint examiners not only are emotionally driven and motivated to achieve results for themselves, their employees, the police, and wider society, but also are influenced by more subtle psychological factors such as need for closure that exert leverage upon the decision-making thresholds of examiners that may, in the right circumstances, lead to erroneous conclusions should the context and the motivation be strong enough. Only by understanding these phenomena will it be possible to mitigate against future error and methodological breakdown of fingerprint analysis, as well as design and implement effective and robust recruitment, selection and training environments that are able to provide best practice for examiners and to satisfy public confidence in not only fingerprint examination but also other forensic domains as well.

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Appendix A

Schedule for study interviewing experts about the process of finger print matching.

1. Greet and give consent/information form.
2. Offer opportunity to ask questions.
3. Begin interview.

Lettered Questions indicate main questions, the sub questions are prompts only to be used if needed. This is only a guide; any questions or probes which seem relevant at the time may also be asked.

A) Could you describe the process of a day to day finger print analysis?

i. i.e., procedure you follow?

ii. What do you do after that?

iii. Can you tell me more about that?

iv. Discuss how performance is measured?

B) Could you describe the last time you matched a finger print?

i. Avoiding specifics is there anything in particular you remember about the case?

ii. How did you feel about that/succeeding in matching the prints?

iii. Can you describe how you reach that definitive conclusion as to match or exclusion?

iv. Describe how you feel when you find what you think is a good match and then you discover anomolies?

C) Could you describe the last time you didn't match a finger print?

i. What did you do after that?

ii. Can you tell me more about that?

iii. How did you feel about that/not succeeding in matching the prints?

iv. Is it possible to have close non matching fingerprints?

D) Could you think back to a case that you strongly recall

i. Perhaps significant a case in which you did or didn't find a match?

ii. How did you feel beforehand?

iii. What do you do after that?

iv. Can you tell me more about that?

v. How did you feel about that?

vi. How did you feel afterwards?

E) Could you describe a time when you were working on a particularly difficult or harrowing case?

i. How did you feel beforehand?

ii. What do you do after that?

iii. Can you tell me more about that?

iv. How did you feel about that?

v. How did you feel afterwards?

F) Could you describe the sort of day to day pressures you experience?

G) Can you describe the checks and balances in a bureau that ensure quality and what ensures mistakes do not occur?

Is a missed identification worse or better than making an erroneous match?

Do examiners ever disagree on matters of exclusion or identification?

How are such disputes resolved?

Have you ever had an identification disputed? How did you feel?

4. Give debriefing form.

5. Give another opportunity to ask questions.

Appendix B

Themes and Sub-themes		Description	Examples
Satisfaction with skill use		Expression of satisfaction with their job, skills, and successful procedures or strategies.	It's doing something slightly out of the ordinary…it's doing something that I know can help other people…
So doing this and knowing I am helping someone else….does give you a bit of a buzz			
Satisfaction with crime solving	Catching criminals	Expression of hope and satisfaction with catching criminals or disappointment in not providing evidence for a conviction	The whole case was identified to people they wanted it identified to…it was a good result….that sticks in my mind because I got good feedback from the police officer and the OIC.
	Type of case	Expression of expectation because of type of case	It's a job that you do…although it is still interesting….it also depends on the type of cases….if it's a high… serious case or something like that…a murder or rape or armed robbery…I think it would be different to the other tedious cases…
			On a serious case you…or you think rather that the mark that you have identified could be the murderer or the rapist ….
Feeling of getting a match		Expression of emotional feelings associated with searching for and/or finding matches	I'd say you do get a gut feeling as well…erm…you just know…and I know I have put ones forward with five…six… and people have gone you need more than that… and I know it..I'm satisfied it is…there is nothing wrong with it..I am satisfied it is
Closure		Expressions associated with factors that may indicate a motivated need for closure on casework… prefers order and predictability and is decisive and close minded feeling discomfort with ambiguity.	Would be nice if the person in custody did go identified..admitted it… done and dusted…
Done and dusted….that a crime has been solved…if it's ident and they admit to it because they have it put in front of them…its another crime solved…			
Fear of error		Expression of emotional feelings associated with making mistakes	I know everyone is human and you can make errors but I would probably feel awful like I can't do my job properly