



What do forensic analysts consider relevant to their decision making?[☆]

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ABSTRACT

In response to research demonstrating that irrelevant contextual information can bias forensic science analyses, authorities have increasingly urged laboratories to limit analysts' access to irrelevant and potentially biasing information (Dror and Cole (2010) [3]; National Academy of Sciences (2009) [18]; President's Council of Advisors on Science and Technology (2016) [22]; UK Forensic Science Regulator (2015) [26]). However, a great challenge in implementing this reform is determining which information is task-relevant and which is task-irrelevant. In the current study, we surveyed 183 forensic analysts to examine what they consider relevant versus irrelevant in their forensic analyses. Results revealed that analysts generally do not regard information regarding the suspect or victim as essential to their analytic tasks. However, there was significant variability among analysts within and between disciplines. Findings suggest that forensic science disciplines need to agree on what they regard as task-relevant before context management procedures can be properly implemented. The lack of consensus about what is relevant information not only leaves room for biasing information, but also reveals foundational gaps in what analysts consider crucial in forensic decision making.

1. Introduction

Forensic analysts are tasked with making critical judgments in the criminal investigative process. Specifically, they are responsible for identifying important attributes of evidence (e.g., latent print minutia), conducting analyses, interpreting results of their analyses, reaching conclusions, and clearly conveying their results to others. Such decisions can be cognitively demanding and require substantial training, time, and effort. To complicate matters, analysts are often exposed to wide-ranging contextual information (e.g., suspect criminal history, victim race). For example, latent print examiners often have access to case details beyond the fingerprints themselves, and forensic toxicologists often receive information beyond isolated fluid or tissue samples [18,22]. Such information may be less of a concern in disciplines whose analysis and interpretation is handled entirely by instruments; but in most forensic science disciplines, analyses and subsequent interpretations heavily rely on human perception and judgment. At the same time, research across forensic science disciplines has shown that irrelevant contextual information can bias analyses, even though analysts are generally unaware that such information is influencing their decisions [3,11,18,22]. Indeed, even DNA analysis, believed by many to be

relatively immune to human biases, has been shown to be vulnerable to irrelevant contextual information [4].

The fact that forensic science analyses rely on human perception and judgment makes them vulnerable to contextual information that influences cognitive processes (i.e., contextual effects). Much of the literature on contextual effects in forensic science has focused on latent fingerprint analyses given its substantial reliance on human visual processing. Studies have demonstrated that exposure to comparison prints [1], automated ranking systems [7], suspect confessions [2], other examiner opinions [16], and highly emotional stimuli [5] can influence evaluator decisions regarding latent prints. For example, Dror and Charlton [2] found that when the latent print examiners re-evaluated the same prints they had previously evaluated, but with new contextual information (e.g., they were informed either “the suspect confessed to the crime” or “the suspect has an alibi”), two-thirds of examiners changed one of their conclusions.

The influence of contextual information is not limited to latent print analyses; studies have found evidence of similar contextual effects in handwriting analysis [14], bloodstain analysis [15], bite-mark analysis [21], and forensic anthropology [17]. Even certain DNA analyses (e.g., complex mixtures) appear susceptible to contextual effects. In one

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study, DNA analysts who interpreted a mixture analysis with minimal biasing contextual information did not reach consensus and the majority came to a different conclusion than the experts who examined the same evidence in the context of an actual criminal trial (i.e., with more contextual information; [4]). Taken together, research reveals that contextual information can influence analysts' expectations and cognitions, which in turn influence conclusions, especially when cases are ambiguous or complex.

Given the well-documented potential for contextual information to bias analyses, scholars, government agencies, and national authorities have called for laboratories to implement context management procedures (e.g., [6,22]). Moreover, the National Commission on Forensic Science (NCFS; 2015) recently recommended that, “forensic science service providers should rely solely on *task-relevant* information when performing forensic analyses...[and] laboratories should take appropriate steps to avoid exposing analysts to *task-irrelevant* information” (pp. 1–2). The NCFS defined task-relevant information as any information:

Necessary for drawing conclusions: i) about the propositions in question, ii) from the physical evidence that has been designated for examination, [and] iii) through the correct application of an accepted analytic method by a competent analyst. (pp. 2–3).

In other words, information is *task-irrelevant* if it does not inform the specific proposition in question (e.g., Do these two prints originate from the same source?) or informs this question through any means *other than* an appropriate analysis of the physical evidence in the analyst's domain of expertise. Regarding latent print analysis, the commission provided four examples of information they believed to be *task-irrelevant*: a suspect's criminal history, a suspect's confession, implications stemming from other physical evidence, and other latent print examiners' conclusions/identifications regarding the same suspect.

There is growing consensus that laboratories need to enact context management procedures to limit analysts' exposure to irrelevant and potentially biasing information [6,19,22,23,24]. However, before laboratories can enact recommended context management procedures—such as those that limit access to task-irrelevant information—it is critical to identify *which* information is task-relevant versus task-irrelevant. The NCFS (2015) established a working definition of task-relevance and provided some concrete examples of task-irrelevant information for one forensic science discipline. Nevertheless, given the complexity of criminal investigations and the breadth of information available to forensic analysts, there may be disagreement about the relevance of certain types of information. Indeed, the NCFS acknowledges that the task-relevance of information varies according to forensic analysis type (e.g., latent print analysis vs. tool mark analysis) and according to phases of criminal investigation. To date, no research has examined what types of information forensic analysts consider task-relevant versus task-irrelevant, or whether those determinations vary among individual analysts.

The importance of agreeing what is relevant versus irrelevant in forensic decision making is critical to minimize bias by controlling what information should be provided to the forensic examiners. But at a more foundational level, the question of what information is relevant to the forensic decision is a fundamental question that goes beyond the issue of bias: It defines the basic parameters and information underlying decisions by forensic analysts.

1.1. Current study

The present study surveyed forensic analysts regarding the task-relevance (to their discipline) of different categories of information. We included types of information commonly found on evidence submission forms [10] to assess analysts' perceptions of information to which they would typically be exposed. Through this study, we sought to determine 1) what information forensic analysts consider essential versus

irrelevant, 2) whether there is consensus among analysts, and 3) whether analyst opinions comport with the definition of task-relevance provided by the National Commission on Forensic Science. Understanding analysts' perceptions of task-relevance and how they relate to formal guidance (i.e., NCFS [19]) is important for several reasons. At a basic level, examining analyst opinions provides insight into how forensic conclusions are made and what types of information inform such conclusions. Understanding perceptions of task-relevance is also a critical first step in developing context management procedures, informing efforts to minimize contextual bias by limiting exposure to task-irrelevant information, and monitoring analyst compliance with such procedures. Finally, and most broadly, examining consensus analyst perceptions of task-relevance has the potential to reveal important areas of strength and areas for improvement within forensic science disciplines.

2. Method

2.1. Participants

In total, we collected data from 189 practicing forensic analysts who attended one of five separate trainings. We removed six participants from analyses because they provided unintelligible and/or incomplete responses on the survey ($n = 2$) or because they did not identify as a forensic analyst (e.g., administration, police officer; $n = 4$). Our final sample consisted of 183 forensic analysts, the majority of whom were women ($n = 118$, 65%; did not respond: $n = 8$, 4%). The average age of participants was 39 years ($SD = 8.9$; range = 24 to 74). Most analysts identified themselves as either Caucasian ($n = 96$; 53%) or Asian/Pacific Islander ($n = 44$; 24%). Fewer participants identified themselves as Hispanic/Latino ($n = 19$; 10%), Multiracial ($n = 6$; 3%), or African American ($n = 4$; 2%). A few participants endorsed an unspecified ($n = 2$; 1%) ethnicity or did not provide an ethnicity ($n = 12$; 6%).

Most participants who responded to the demographics survey held a Master's degree ($n = 86$; 49%) or Bachelor's degree ($n = 76$; 43%), although a small number also held a doctoral degree ($n = 9$; 5%). A small minority of analysts had not received a Bachelor's degree ($n = 4$; 2%). On average, analysts reported almost 10 years of work experience ($M = 9.9$ years; $Mdn = 8$; $SD = 7.4$) in their primary discipline. However, there was significant variability in work experience with analysts reporting between 0.5 years and 34 years of experience within their disciplines.

Regarding specific disciplines, most participants identified their primary discipline as belonging to one of four broad categories of forensic science: Biology ($n = 84$; 46%), Pattern Evidence (i.e., latent print analysis, firearm and tool mark analysis, questioned documents, and trace evidence; $n = 43$; 24%), Chemistry (i.e., forensic, drug, and environmental chemistry, toxicology; $n = 32$; 18%), or Crime Scene Investigation ($n = 12$; 7%).¹ A minority of participants endorsed a primary discipline that did not fall within one of the aforementioned domains, and we categorized their primary discipline as Other (e.g., environmental forensics, anthropology; $n = 6$; 3%). Additionally, some analysts did not identify a primary discipline ($n = 6$; 3%). All planned analyses evaluating the influence of analysts' primary discipline focused on those within the four broad forensic science disciplines. A significant number of analysts ($n = 73$; 40%) endorsed multiple forensic science disciplines, with crime scene investigation ($n = 38$; 52%) as the most common secondary discipline. However, we focused on analysts'

¹ We could not obtain census data detailing the demographics of forensic analysts within crime laboratories. However, the most recent census of publicly funded crime laboratories in America [8] indicates that analyses relating to controlled substances (81% of all laboratories), latent prints (63%), and biology (62%) are the most common among crime laboratories.

primary discipline in all analyses.

2.2. Measures

2.2.1. Procedure

Participants completed a three-part survey addressing topics relating to 1) attitudes regarding the acceptability of error types, 2) estimates of error rates within forensic science disciplines, and 3) perceptions of task-relevance regarding available case information. For the purposes of the current study, we focus on results from the third part of the survey (for additional information on parts one and two, see [28]).

2.2.2. Survey

In part three of the survey, we asked participants to describe the importance of different types of information when performing the specific duties of a forensic analyst (i.e., “analyzing evidence in your discipline”). We listed 16 types of information regarding case (e.g., offense type), suspect details (e.g., suspect name), and victim details (e.g., victim race), most of which are commonly found on evidence submission forms [10]. Analysts responded to each type of information by indicating whether they believed such information was “*Essential*,” “*Irrelevant*,” or “*Not essential, but [they] would review this if available*.”

2.2.3. Demographics form

The survey also included a demographics form requesting participant age, gender, ethnicity, and highest educational degree received. Additionally, participants indicated their primary discipline, any ancillary disciplines, and how many years they had worked in their primary discipline.

3. Results

3.1. Perceptions of task-relevance by primary discipline

Analysts' perceptions of the relevance of certain types of information to their analyses varied between and within their primary disciplines. Figs. 1–4 depict analysts' task-relevance perceptions according to their primary disciplines.

3.1.1. Near-Consensus

As demonstrated in Figs. 1–4, analysts rarely achieved an absolute consensus opinion (i.e., 100% agreement) regarding the task-relevance of certain types of information. However, analysts did achieve near-consensus opinions (i.e., $\geq 75\%$ agreement) in some instances. Forensic biology and chemistry analysts achieved near-consensus in 9 of 16 types of information (i.e., 56% of items). Pattern evidence analysts achieved near-consensus in 14 of 16 types of information (i.e., 88% of items; Method of Evidence Collection and Case Synopsis were the two exceptions). Finally, crime scene investigation analysts achieved near-consensus in 4 of 16 types of information (25% of items; Description of Evidence, Method of evidence Collection, Offense Type, and Case Synopsis).

3.1.2. Exclusionary consensus

Although analysts rarely reported unanimous perceptions of task-relevance, there were instances in which analysts uniformly agreed that certain categories of information were either *not essential* or *not irrelevant* (e.g., no analysts designated the information type as “*Essential*”). No forensic biology analysts indicated that any of the following three items were essential to their duties: Name of the investigating officer, Suspect ethnicity, and Victim ethnicity. Similarly, no pattern evidence analysts identified any of the following five items as essential: Eye witness account(s), Suspect's statement, Suspect's confession, Victim name, and Victim ethnicity. No chemistry analysts identified any of the following four types of information as essential: Eye witness account(s), Suspect criminal history, Suspect's confession, and Victim age. Finally,

no crime scene investigators described suspect or victim age as essential and, conversely, none described evidence description and case synopsis as irrelevant.

3.1.3. Majority opinion

We defined majority opinion within a discipline as occurring if most analysts (i.e., $> 50\%$) agreed on a classification for a particular type of information. Biology analysts reached a majority opinion on 13 of 16 types of information (i.e., 81% of items; Offense type, Case synopsis, Eyewitness account[s] were the exceptions). Pattern evidence analysts reached a majority opinion regarding all types of information on 88% of items with only two failing to yield a majority opinion: method of evidence collection and case synopsis. Chemistry analysts similarly reached a majority opinion with two exceptions (i.e., Method of evidence collection, Offense type). Finally, crime scene investigators reached a majority opinion on 12 of 16 types of information (i.e., 75% of items; Name of investigating officer, Suspect ethnicity, Suspect's alibi, Victim name were the exceptions).

3.1.4. Lack of consensus

Analysts appeared particularly divided in their perceptions of task-relevance regarding several types of information. We defined a lack of consensus in task-relevance perceptions as existing when approximately 20% or more of analysts within a discipline endorsed each relevance category (that is, similar proportions of participants identified the information as *essential*, *irrelevant*, and *not relevant but would review*). Such differences—in our view—suggest a lack of meaningful consensus or even shared perspective, because substantial portions of analysts maintained very different perspectives on whether the information was relevant (indeed, some considered it essential while others considered it irrelevant). A majority of forensic biology analysts did not identify offense type as either essential or irrelevant and there was no consensus regarding the relevance of the method of evidence collection among pattern evidence analysts. Similarly, chemistry analysts were almost equally divided in their perceptions of the relevance of both offense type and method of evidence collection. Crime scene investigators did not reach a consensus regarding the relevance of an investigating officer's name or a victim's name. Taken together, the current findings suggest that forensic analysts generally struggled to agree on the task-relevance of case information, specifically the method of evidence collection and offense type.

3.1.5. Similarity to national commission on forensic science [19] guidelines

A final research question involved the degree to which participant responses seemed similar to guidance from the NCFS (2015), who specifically defined task-relevance (see earlier in this manuscript) and provided explicit examples of information that is unambiguously *irrelevant*, at least to latent print examiners (i.e., a suspect's criminal history, a suspect's confession, implications stemming from other physical evidence, and other latent print examiners' conclusions/identifications regarding the same suspect). As detailed in Figs. 1–3 most forensic analysts² labeled information regarding a suspect's criminal history (90.0% to 92.8%), statement (55.6% to 75.6%), or confession (66.3% to 80.5%) as irrelevant. Yet a sizable minority indicated that they would review a suspect's criminal history (6.0% to 10.0%), statement (24.4% to 39.5%), or confession (19.5% to 30.1%) if available. That is, they explicitly conveyed they would consider information that the NCFS identified as irrelevant.

²In this section, we distinguish forensic analysts (who usually have a specialized role addressing evidence only within their specialty of biology, pattern evidence, or chemistry) from crime scene investigators because a broader range of information may be genuinely relevant to the latter group.

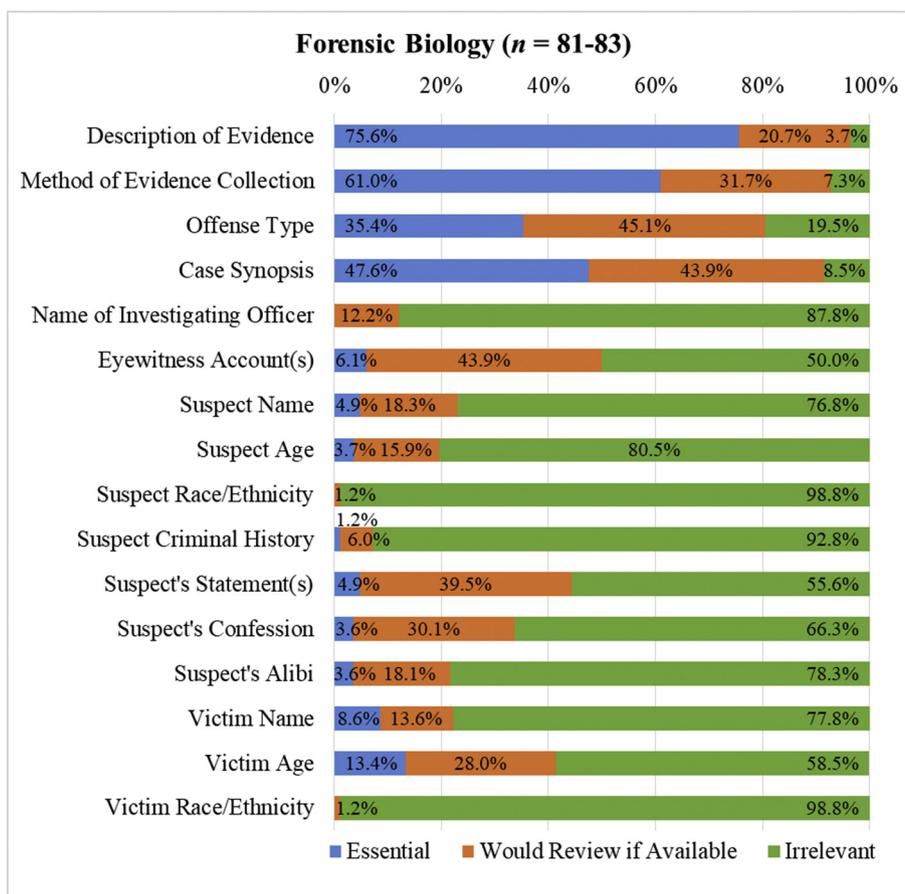


Fig. 1. Perceptions of Task-Relevance by Forensic Biology Analysts. n = 81 to 83.

4. Discussion

4.1. What information is task-relevant and is there consensus among analysts?

Overall, there was little absolute consensus among forensic analysts regarding the task-relevance of various information. Among four forensic science disciplines and 16 types of information (64 total ratings of task-relevance), analysts achieved 100% agreement in only three instances (4.7%; i.e., chemistry analysts' perceptions of suspect and victim ethnicity as irrelevant, and crime scene investigators' perceptions of method of evidence collection as essential). Conversely, they appeared fairly evenly divided in their perceptions of six (9.4%) other types of information, typically concerning the case (e.g., offense type, method of evidence collection). In 45 of 64 items (i.e., 70.3%), there were some directly contradicting opinions (i.e., some analysts reported the information was essential and some reported it was irrelevant, even if one was a clear minority and the other was a clear majority).

This does not mean that there were *no* similarities in analyst perceptions across disciplines. Within disciplines, a majority (> 50%) of analysts agreed on the task-relevance of information in most instances (n = 53; 82.8%), and no analysts offered directly contradicting perceptions (i.e., essential AND irrelevant) in 19 (29.7%) instances. Further, analysts achieved near-consensus opinions (i.e., ≥75% agreement) in 36 (56.3%) instances. Across all disciplines, some patterns emerged regarding the types of information that analysts most frequently agreed upon. Analysts were generally more likely to agree on the task-relevance of information relating to a suspect or victim than they were to agree on the relevance of case information. In particular, analysts were most likely to agree that information regarding a suspect or victim was irrelevant to their analyses. In contrast, 8 of the 11

instances in which analysts did not reach a majority opinion regarding task-relevance involved case information. Although this lack of consensus is noteworthy, the current results do indicate that most analysts (with the exception of crime scene investigators) showed fair agreement in labeling much suspect and victim information as irrelevant (a significant exception was their attention to suspect statements, confession, and to a lesser extent, alibi, discussed later).

Regarding analyst agreement within forensic disciplines, pattern evidence analysts appeared to have the highest rate of consensus (typically labeling information task-irrelevant) whereas crime scene investigators seemed to have the most disagreement among analysts. Crime scene investigators also emerged as distinct from other disciplines in their perceptions. Specifically, these investigators were much more likely to deem information (case information in particular) essential to their analyses than were other disciplines. This distinction appears reasonable because crime scene investigation is a fundamentally different process than other disciplines. Crime scene investigation analysts *gather* information for analysis and other forensic science analysts *analyze* information. This distinction in duties likely explains the differences in perceptions of task-relevance and the general lack of consensus among crime scene investigation analysts. It may be that such analysts deem more information essential to their task because they are striving to gather as much information as possible while preserving the crime scene and evidence throughout the investigative process. Moreover, the specific “task” at hand for crime scene investigation analysts is likely broader and less defined than the tasks of other analysts. Consequently, more types of information may be relevant to crime scene investigation, and there may be more disagreement in what is perceived as relevant, compared to other forensic disciplines.

The apparent lack of consensus regarding the task-relevance of

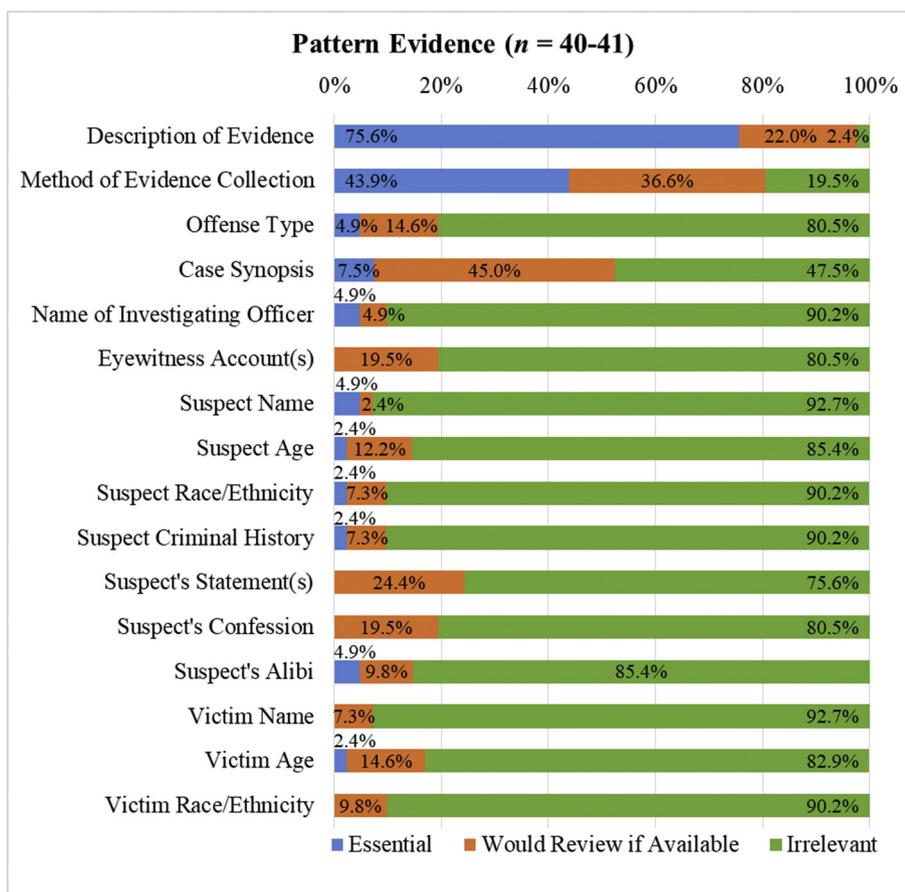


Fig. 2. Perceptions of Task-Relevance by Pattern Evidence Analysts. n = 40 to 41.

common information to forensic science analyses has important implications for attempts to control contextual bias in laboratories. There have been numerous calls for context management procedures to screen out potentially biasing task-irrelevant information (e.g., [6,22]) but laboratories may not uniformly agree on which information is necessary and which information should be excluded. Indeed, our findings suggest that analysts in laboratories across the country would likely be exposed to different information types if context management procedures were implemented based on practitioner input, simply because practitioner input appears to vary considerably. For example, an equal number of chemistry analysts deemed knowledge of offense type as essential and irrelevant; such differences would likely result in inter-laboratory inconsistencies in what “task-irrelevant” information is screened out in context management procedures. Although the current findings do not suggest that analyst opinions will form the basis of context management procedures, it is easy to envision a future in which such procedures are implemented with analyst input.

4.2. Do analyst perceptions align with formal guidelines on task-relevance?

The National Commission on Forensic Science [19] recently detailed a formal definition of task-relevance. Given this definition, one might expect little variability in analyst perceptions regarding whether certain information is or is not task-relevant. Variance across disciplines should be expected but intra-discipline variance would seem less likely in light of calls to limit task-irrelevant information. If the field cannot agree on what is task-irrelevant, forensic science disciplines will struggle to consistently enact procedures preventing exposure to such information.

Of course, we are not in a position to conclusively state which information types in the current study should be considered task-relevant or task-irrelevant according to each forensic science discipline.

However, there is a strong rationale that “Evidence description” and “Method of evidence collection” seem to be the only types of information derived “from the physical evidence that has been designated for examination,” thus meeting the second criterion in the NCFS's definition to be considered task-relevant. Consistent with this premise, these two information types were typically the only pieces of information that the majority of analysts within a disciplines agreed were essential to their analyses (however, chemistry analysts did not agree that method of evidence collection was essential and crime scene investigators agreed that other types of information were also essential). While this agreement is encouraging, analysts' perceptions of these information types were far from uniform and there was significant variability in perceptions of other information types.

Although we cannot evaluate the “accuracy” of analysts' perceptions for most types of information, we recognize that information regarding a suspect's criminal history is task-irrelevant to latent print analysis according to the explicit example provided by the NCFS [22]. In line with this, 90.2% of latent print examiners in the current study opined that such information was irrelevant to their analyses. Again, the results can be interpreted in two ways. On one hand, the vast majority of examiners' perceptions are consistent with the NCFS's guidance but, on the other hand, a significant minority of examiners (≈ 10%) indicated they believed such information was essential or they would review the information if available. A similar pattern emerged in forensic biology and chemistry, although approximately one in three crime scene investigators (33.3%) indicated they believed information about a suspect's criminal history was essential or would review the information if available. Furthermore, the NCFS [19] specifically identified a suspect's confession as task-irrelevant to pattern analysts, but significant portions of analysts (19.5% to 33.7% of analysts) reported that they believed such information was essential or that they would consider the suspect's

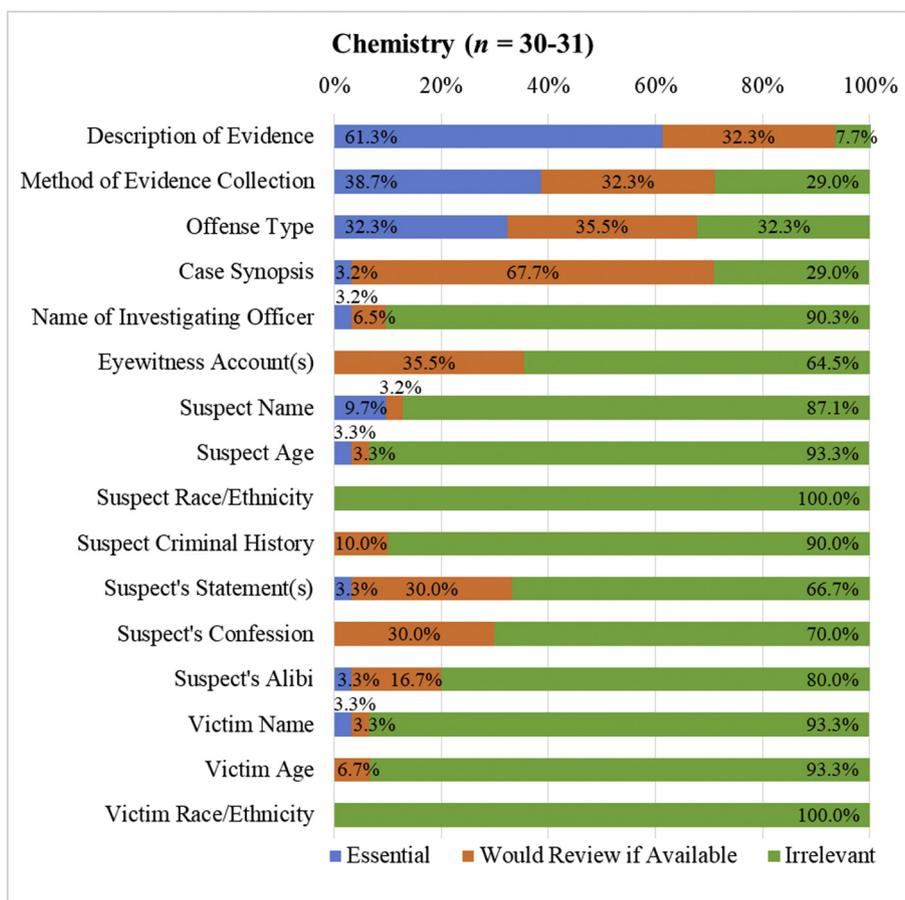


Fig. 3. Perceptions of Task-Relevance by Chemistry Analysts. n = 30 to 31.

confession if available. This interest in task-irrelevant information may be particularly problematic given the well-documented potential for confession evidence to taint (or shape the interpretation of) other ambiguous evidence. Indeed, research has demonstrated that jurors and judges consider confessions among the most influential types of evidence, even when such confessions are coerced or inadmissible [12,13,27]. Moreover, studies show that confession evidence can influence the judgments of handwriting analysts [14] and polygraph examiners [9]. Beyond a suspect's confession, many analysts in the current study also reported they would consider the suspect's alibi or statements, although we know of no reason these would be relevant to analyzing physical evidence in most cases.

4.3. Limitations

We did not provide a formal definition of task-relevance in the current study because we were specifically studying analysts' perceptions of relevance to analyses in their discipline. While this methodology allowed us to examine discrepancies between authoritative guidelines (NCFSS, 2015) and practitioner perspectives, it does not preclude the possibility that different analysts were commenting on relevance with respect to different stages of the criminal investigation process. Some analysts may have deemed information essential for administrative purposes (in contrast to our specific question) whereas other analysts may have more strictly adhered to our instructions advising participants to address “your task” specifically.

Another limitation of the current study is that we do not know why analysts believed certain types of information to be essential or irrelevant. Anecdotally, we know that many analysts cite administrative reasons (e.g., expedited processing) for some types of information (e.g., offense type). However, no study has empirically assessed this topic. An

initial step toward resolving differences in perceptions is exploring the causes of such differences and, for this reason, it is critical that future research explores the rationale behind analyst beliefs. Additionally, future research may expand the current findings by examining the opinions of forensic team leaders and laboratory managers as these individual will likely have significant input regarding how context management procedures are implemented.

Finally, it is important to note that people do not always accurately describe their cognitive processes or decision-making strategies because such processes are often complex and not fully within awareness (e.g., [20]). Indeed, analysts may, in actuality, review types of information in everyday practice that they labeled irrelevant and/or they may actually disregard information they classified as essential. Self-report does not always reflect actual behavior. For many reasons, our results should be replicated with additional analysts representing additional laboratories. Research methods beyond self-report (e.g., observations and experimental designs) may also shed light on what information analysts actually use.

4.4. Conclusion

Research has demonstrated that system-wide failures to catch judgment errors among forensic analysts are a pressing concern within the criminal justice system [25]. Therefore, efforts to manage context effects are critical to the advancement of forensic science. Delineating which information is task-relevant and task-irrelevant to forensic science analyses is a key component in managing such effects. The current study reveals that analysts in most forensic science disciplines generally do not regard common information about the suspect or victim as essential to their analytic tasks. However, there was significant variability among analyst perceptions and across disciplines, and significant

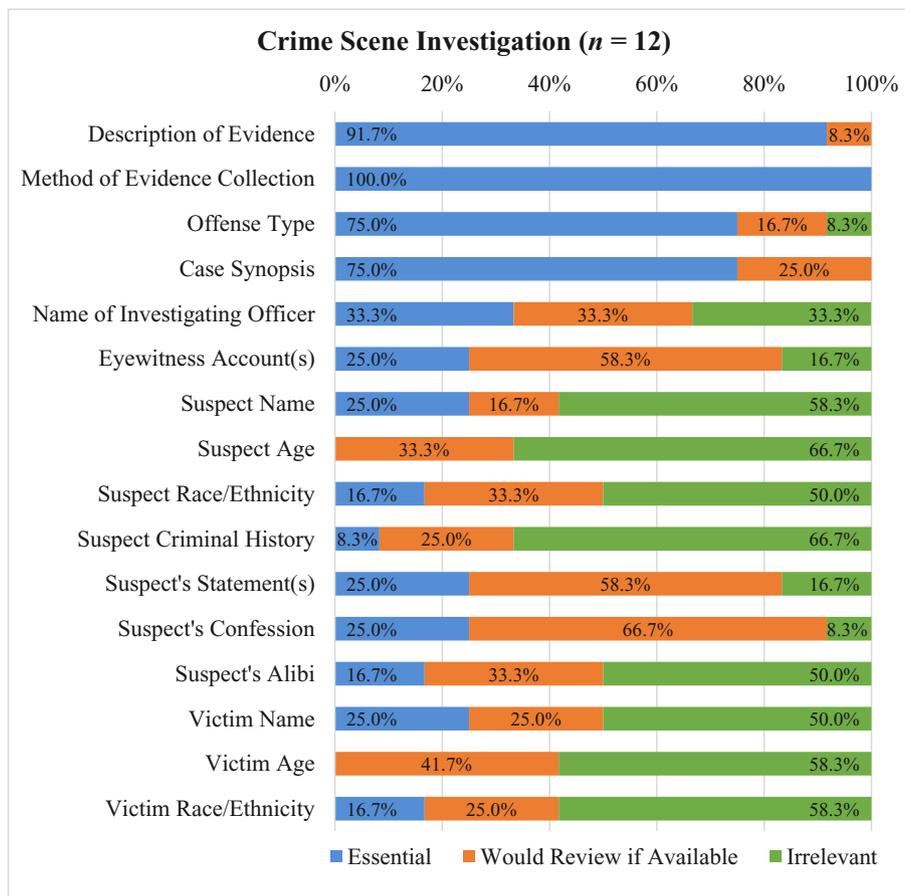


Fig. 4. Perceptions of Task-Relevance by Crime Scene Investigators. n = 12.

willingness among many analysts to review information that the NCFs has specifically identified as task-irrelevant. The present results therefore suggest that before many context management procedures can be consistently implemented, forensic science disciplines need to reach a consensus regarding the task-relevance of information commonly documented during the criminal investigation process.

Declarations of interest

None.

References

[1] I.E. Dror, C. Champod, G. Langenburg, D. Charlton, H. Hunt, R. Rosenthal, Cognitive issues in fingerprint analysis: inter- and intra-expert consistency and the effect of a 'target' comparison, *Forensic Sci. Int.* 208 (2011) 10–17.

[2] I.E. Dror, D. Charlton, Why experts make errors, *J. Forensic Identif.* 56 (4) (2006) 600–616.

[3] I.E. Dror, S.A. Cole, The vision in “blind” justice: expert perception, judgment, and visual cognition in forensic pattern recognition, *Psychon. Bull. Rev.* 17 (2) (2010) 161–167.

[4] I.E. Dror, G. Hampikian, Subjectivity and bias in forensic DNA mixture interpretation, *Sci. Justice* 51 (4) (2011) 204–208.

[5] I.E. Dror, A.E. Péron, S. Hind, D. Charlton, When emotions get the better of us: the effect of contextual top-down processing on matching fingerprints, *Appl. Cogn. Psychol.* 19 (2005) 799–809.

[6] I.E. Dror, W.C. Thompson, C.A. Meissner, I. Kornfield, D. Krane, M. Saks, M. Risinger, Letter to the editor – context management toolbox: a linear sequential unmasking (LSU) approach for minimizing cognitive bias in forensic decision making, *J. Forensic Sci.* 60 (2015) 1111–1112.

[7] I.E. Dror, K. Wertheim, P. Fraser-Mackenzie, J. Walajtys, The impact of human-technology cooperation and distributed cognition in forensic science: biasing effects of AFIS contextual information on human experts*, *J. Forensic Sci.* 57 (2012) 343–352.

[8] M.R. Durose, A.M. Burch, K. Walsh, E. Tiry, Publically funded forensic crime laboratories: resources and services, 2014, *Bur. Justice Stat.* (2016) 1–11.

[9] E. Elaad, A. Ginton, G. Ben-Shakhar, The effects of prior expectations and outcome knowledge on polygraph examiners' decisions, *J. Behav. Decis. Mak.* 7 (1994) 279–292, <https://doi.org/10.1002/bdm.3960070405>.

[10] B.O. Gardner, S. Kelley, D.C. Murrie, K.N. Blaisdell, Do evidence submission forms expose latent print examiners to task-irrelevant information? *Forensic Sci. Int.* 297 (2019) 236–242, <https://doi.org/10.1016/j.forsciint.2019.01.048>.

[11] S.M. Kassir, I.E. Dror, J. Kukucka, The forensic confirmation bias: problems, perspectives, and proposed solutions, *J. Appl. Res. Mem. Cogn.* 2 (2013) 42–52, <https://doi.org/10.1016/j.jarmac.2013.01.001>.

[12] S.M. Kassir, K. Neumann, On the power of confession evidence: an experimental test of the “fundamental difference” hypothesis, *Law Hum. Behav.* 21 (1997) 469–484, <https://doi.org/10.1023/A:1024871622490>.

[13] S.M. Kassir, H. Sukel, Coerced confessions and the jury: an experimental test of the “harmless error” rule, *Law Hum. Behav.* 21 (1997) 27–46, <https://doi.org/10.1023/A:1024814009769>.

[14] J. Kukucka, S.M. Kassir, Do confessions taint perceptions of handwriting evidence? An empirical test of the forensic confirmation bias, *Law Hum. Behav.* 38 (3) (2014) 256–270.

[15] T. Laber, P. Kish, M. Taylor, G. Owens, N. Osborne, J. Curran, Reliability assessment of current methods in bloodstain pattern analysis, (2014) (Final Report for NIJ).

[16] G. Langenburg, C. Champod, P. Wertheim, Testing for potential contextual bias effects during the verification stage of the ACE-V methodology when conducting fingerprint comparisons, *J. Forensic Sci.* 54 (2009) 571–582.

[17] S. Nakhaeizadeh, I.E. Dror, R.M. Morgan, Cognitive bias in forensic anthropology: visual assessment of skeletal remains is susceptible to confirmation bias, *Sci. Justice* 54 (2013) 208–214.

[18] National Academy of Sciences, Strengthening Forensic Science in the United States: a Path Forward, National Academies Press, Washington, DC, 2009.

[19] National Commission on Forensic Science, Ensuring that Forensic Analysis Is Based upon Task-Relevant Information, Retrieved from, 2015. <https://www.justice.gov/necfs/file/818196/download>.

[20] R.E. Nisbett, T.D. Wilson, Telling more than we can know: verbal reports on mental process, *Psychol. Rev.* 84 (1977) 231–259.

[21] N.K. Osborne, S. Woods, J. Kieser, R. Zajac, Does contextual information bias bi-temark comparisons? *Sci. Justice* 54 (2014) 267–273.

[22] President's Council of Advisors on Science and Technology, Report to the President: Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature-Comparison Methods, Executive Office of the President of the United States, Washington, DC, 2016.

[23] M.D. Risinger, The NAS report on forensic science: a glass nine-tenths full (this is

- about the other tenth), *Jurimetrics* 50 (2009) 21–34.
- [24] R.D. Stoel, C.E. Berger, W. Kerkhoff, E. Mattijssen, I. Dror, Minimizing contextual bias in forensic casework, in: K. Strom, M.J. Hickman (Eds.), *Forensic Science and the Administration of Justice*, Sage, New York, 2015.
- [25] W.C. Thompson, Beyond bad apples: Analyzing the role of forensic science in wrongful convictions, *Southwest. Univ. Law Rev.* 37 (2009) 971–994.
- [26] UK Forensic Science Regulator, *Cognitive Bias Effects Relevant to Forensic Science Examinations*, Retrieved from, 2015. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/510147/217_FSR-G-217_Cognitive_bias_appendix.pdf.
- [27] D.B. Wallace, S.M. Kassin, Harmless error analysis: how do judges respond to confession errors? *Law Hum. Behav.* 36 (2012) 151–157, <https://doi.org/10.1037/h0093975>.
- [28] D.C. Murrie, B.O. Gardner, S. Kelley, K.N. Blaisdell, I.E. Dror, What do forensic science analysts know and believe about error rates in their disciplines? Symposium presented at the annual meeting of the American Psychology-Law Society, Symposium presented at the annual meeting of the American Psychology-Law Society, Portland, Oregon, March, 2019.