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PAPER

GENERAL

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Forensic Confirmation Bias: Do Jurors Discount Examiners Who Were Exposed to Task-Irrelevant Information?*,†

ABSTRACT: Knowledge of task-irrelevant information influences judgments of forensic science evidence and thereby undermines their probative value (i.e., *forensic confirmation bias*). The current studies tested whether laypeople discount the opinion of a forensic examiner who had *a priori* knowledge of biasing information (i.e., a defendant's confession) that could have influenced his opinion. In three experiments, laypeople (N = 765) read and evaluated a trial summary which, for some, included testimony from a forensic examiner who was either unaware or aware of the defendant's confession, and either denied or admitted that it could have impacted his opinion. When the examiner admitted that the confession could have influenced his opinion, laypeople generally discounted his testimony, as evidenced by their verdicts and other ratings. However, when the examiner denied being vulnerable to bias, laypeople tended to believe him—and they weighted his testimony as strongly as that of the confession-unaware examiner. In short, laypeople generally failed to recognize the superiority of forensic science judgments made by context-blind examiners, and they instead trusted examiners who claimed to be impervious to bias. As such, our findings highlight the value of implementing context management procedures in forensic laboratories so as not to mislead fact-finders.

KEYWORDS: confirmation bias, context management, contextual bias, cross-examination, expert testimony, forensic science, juror decision-making, task-relevant

Misleading forensic science has contributed to over 600 known wrongful convictions (1). In recent years, *forensic confirmation bias*—that is, the phenomenon whereby task-irrelevant information influences judgments of forensic science evidence—has been identified as one source of these costly errors (2). In an early demonstration of this phenomenon, Dror and Charlton (3) found that fingerprint examiners unknowingly changed 17% of their own prior judgments of the same pair of fingerprints after being told that the suspect had either confessed (implying that the prints should match) or provided a verified alibi (implying that the prints should not match). This effect has since been replicated (4,5), and other studies have found similar effects in myriad forensic science disciplines (for reviews, see (6,7))—such as handwriting identification (8,9), arson investigation (10), forensic anthropology (11), bloodstain pattern analysis (12), bitemark analysis (13), crime scene investigation (14), and complex DNA analysis (15).

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In 2015, the National Commission on Forensic Science explained that *task-irrelevant* information includes any "contextual information [that] supports inferences about a proposition only through a chain of logic that does not involve assessment of the physical evidence"—such as a suspect's criminal history, confession, or alibi (16). Stated otherwise, forensic examiners "should draw conclusions solely from the physical evidence that they are asked to evaluate... and not from any other evidence in the case" (16). Reliance on task-irrelevant information undermines the probative value of a forensic examiner's opinion because it creates a problematic double-counting of evidence (e.g., [17–20]). For example, if an examiner judges physical evidence as inculpatory only because they had *a priori* knowledge of a suspect's confession, their opinion appears to independently corroborate the confession, but is actually a product of it (20). (For a discussion of this problem from a Bayesian perspective, see (21).)

As such, forensic laboratories have been urged to adopt procedures that blind examiners to task-irrelevant information and thereby minimize the risk of cognitive bias (e.g., [18,22–23]). However, many forensic examiners remain uninformed or unconcerned about how bias can affect their work. In a recent survey of 403 forensic examiners from 21 countries, Kukucka et al (24) found that only 49% felt that they should be shielded from task-irrelevant information, and 71% believed that they can mitigate bias simply by ignoring their expectations. Moreover, the examiners exhibited a "bias blind spot" (25): Most (71%) saw bias as a problem in the forensic sciences as a whole, but fewer (52%) saw bias as a problem in their own domain, and still fewer (26%) believed that bias affects them personally. In other words, many examiners felt that cognitive bias can affect their peers but not themselves.

If examiners do not take steps to combat bias in the laboratory, the onus of identifying and discounting biased forensic opinions will fall on judges and jurors. Two independent lines of research suggest pessimism over their ability to do this. First, basic social-cognitive psychology indicates that lay observers tend to accept other people's self-reports at face value, resulting in a truth bias that contributes to poor performance at detecting deception (26). In the related domain of attribution, it is well-established that observers routinely commit the *fundamental attribution error* (or *correspondence bias*), making dispositional attributions for other people's words and deeds, while underestimating the impact of situational factors (27–30). This literature would thus suggest that even observers who are aware of an examiner's prior exposure to potentially biasing information will underappreciate the impact of that situational information on their conclusions.

Second, research has indicated that judges (31,32) and jurors (33,34) are generally not adept at identifying flaws in scientific evidence. Of particular relevance to forensic confirmation bias are two studies in which jurors failed to recognize *experimenter bias* (i.e., a form of self-fulfilling prophecy in which a researcher's expectations unconsciously impact the outcome of their study; (35)) as a threat to the validity of research findings (36,37). Compounding this problem, laypeople tend to believe that forensic science errors are exceptionally rare (38). Hence, jurors tend to trust forensic evidence (39,40), even if it was analyzed using an unvalidated technique (41) and even after being explicitly informed of its limitations (42).

Although jurors left to their own devices may fail to recognize unreliable scientific evidence, some studies suggest that cross-examination that attacks scientific validity rather than credibility can sensitize jurors to the quality of scientific evidence presented by an expert (43,44). Others, however, have found little or no effect of cross-examination (33,45). With respect to the forensic sciences, findings have also been mixed: Lieberman et al (39) found that an "evidence-focused" cross-examination (i.e., noting the potential for contamination and subjectivity involved in the analysis) weakened the credibility of a DNA expert more so than an "expert-focused" cross-examination (i.e., attacking the expert's experience and academic record), whereas Koehler (46) found that a cross-examination highlighting the potential for error had little effect on jurors' appraisals of testimony from a shoeprint expert.

To date, two studies have specifically examined whether cross-examination can sensitize jurors to cognitive bias as a factor that undermines evidence quality. Chorn and Kovera (47) had mock jurors read expert testimony from a clinical psychologist who administered an intelligence test to the plaintiff in a civil case. In some conditions, the clinician was blind to the plaintiff's supposed IQ score when administering the test; in others, the clinician knew *a priori* that the plaintiff was thought to have a low IQ. This variation had no significant effect. Jurors rated the clinician as similarly competent and the test result as similarly compelling regardless of whether its administration was blind or nonblind. This held true even among jurors who heard a cross-examination that explained the importance of blind testing for scientific validity.

Of particular relevance to the current studies, Thompson and Scurich (48) had venirepersons read a summary of an assault case that included testimony from a forensic odontologist who compared a bitemark on the victim against a model of the suspect's teeth. In some conditions, the odontologist admitted that he was exposed to task-irrelevant information (i.e., the suspect's criminal history and gang affiliation) before performing this comparison and either admitted or denied that this information influenced his judgment. In another condition, the odontologist explained that his laboratory's standard protocol kept him blind to this information until after he completed his analysis. Venirepersons rated his testimony as more credible when he was purposefully blinded to task-irrelevant information than when he was exposed to it, regardless of whether he claimed to have ignored or used that information. However, they did not rate the nonblind examiner as less credible than a control examiner who was not exposed to task-irrelevant information. This pattern suggests that laypeople understand that blinding procedures increase the probative value of forensic science evidence, but they fail to understand that nonblind procedures correspondingly decrease its value.

Participants in Thompson and Scurich (48) evaluated testimony on bitemark comparison, which is among the most criticized of forensic science disciplines. In its 2016 report, the President's Council of Advisors on Science and Technology (23) concluded that "bitemark analysis does not meet the scientific standards for foundational validity [and] the prospects of developing bitemark analysis into a scientifically valid method [are] low" (p. 87). Indeed, such comparisons may be highly subjective, as research has shown that the same teeth can leave bitemarks that appear quite different (e.g., [49,50]), while different people can leave bitemarks that are indistinguishable from each other (e.g., [51,52]). As such, it is perhaps unsurprising that laypeople considered a blinded bitemark examiner to be more credible than a nonblind bitemark examiner.

But do jurors understand that bias can affect other forensic disciplines—even those with relatively strong scientific foundations? For example, fingerprint examiners typically follow a standardized procedure (i.e., the ACE-V method; [23]), use sophisticated technologies to identify potential matches to a latent print (53), and exhibit low error rates (e.g., [54,55]). Yet, they are likewise vulnerable to cognitive bias (e.g., [3,56,57]). Moreover, laypeople seem to view bitemark and fingerprint evidence as equally compelling: Koehler (38) found that laypeople believed both fingerprint and bitemark identification errors to be exceptionally rare (1 in 5.5 million and 1 in 1 million, respectively), and Ribeiro et al (58) found that laypeople perceived fingerprint and bitemark identification as equally accurate (88% vs. 89%, respectively) and as entailing a comparable degree of subjective judgment.

The Present Studies

The present studies investigated whether mock jurors would devalue the testimony of a forensic examiner who had *a priori* knowledge of task-irrelevant information that could have influenced his opinion. To be exact, we tested whether jurors would discount the opinion of an examiner who had *a priori* knowledge of the defendant's confession—a form of evidence that creates a uniquely strong expectation of guilt (20) and has repeatedly been shown to impact people's perceptions, memories, and judgments (e.g., [59–61]), including judgments of forensic science evidence (e.g., [8]). Outside of the laboratory, forensic science errors have been found in 67% of DNA exonerations that involved false confessions—and in these cases, the false confession almost always preceded the forensic science error, such that the former may have spawned the latter in some cases (62).

In three studies, we varied whether the examiner was exposed to the defendant's confession prior to his analysis, and if so, whether he admitted or denied that it could have influenced his opinion. Study 1 also tested whether the effect of exposure depended on the scientific validity of the examiner's discipline (i.e., bitemarks vs. fingerprints). Study 2 then aimed to partially replicate the findings of Study 1. Finally, Study 3 tested whether the effect of exposure depended on the credentials of the individual examiner, as opposed to the general validity of their discipline.

Study 1

Study 1 aimed to partially replicate and extend the findings of Thompson and Scurich (48) by comparing across forensic science disciplines with a more powerful form of task-irrelevant information (i.e., confession evidence) and novel stimulus materials (e.g., a different crime). Participants read a trial summary in which either a bitemark or fingerprint examiner testified that the defendant's bitemark or fingerprint matched evidence from the crime scene. For some participants, the examiner testified that he was aware of the defendant's confession before he analyzed the forensic evidence, and under cross-examination, he either admitted or denied that it could have influenced his analysis; for other participants, the examiner testified that he was unaware of the defendant's confession. We also included a control condition with no forensic evidence, allowing us to test whether the confession-unaware examiner strengthened the prosecution's case and/or the confession-aware examiner weakened their case.

Method

Participants and Design

Participants ($N = 377$) were recruited online via Amazon Mechanical Turk (mTurk) and completed the study on an external survey website. Overall, 52.3% of participants were female, 74.5% were White, and 53.0% were college-educated. The sample included at least one individual from 43 of the 50 U.S. states.

Each participant was randomly assigned to one of seven cells in a 2 (Discipline: Bitemark vs. Fingerprint) × 3 (Exposure to Confession: Unexposed, Deny, or Admit) + 1 (Control: No Examiner) between-subjects design, with cell sizes ranging from $n = 49$ to 59. See Table 1 for an explanation of the components of each Exposure condition.

Procedure

After providing consent, participants read a summary of a murder trial. The summary first recounted opening statements by the prosecution and defense, which provided background information on the case, including the fact that the defendant had confessed but recanted his confession prior to trial. Then, the summary recounted the testimony and cross-examination of the defendant's coworker, the defendant's neighbor, and by random assignment, either a bitemark examiner (*Bitemark* condition), a fingerprint examiner (*Fingerprint* condition), or neither (*No Examiner* condition). In the Bitemark and Fingerprint conditions, the defense attorney asked the examiner under cross-examination if he had been aware of the defendant's confession prior to analyzing the forensic evidence and, if so, whether it could have influenced his judgment. By random assignment, the examiner replied that he was either unaware of the confession (*Unexposed* condition), aware of it but denied that it influenced his judgment (*Deny* condition), or aware of it and admitted that it could have influenced his judgment (*Admit* condition). Finally, the summary recounted closing statements by the prosecution and defense. After reading the summary, participants rendered a verdict, rated their confidence in that verdict, and provided judgments of the prosecutor, the defense attorney, and each witness.

Trial Summary

Each participant read one of seven versions of a trial summary (943–1286 words) that were newly created for the current studies. The summary recounted the first-degree murder trial of Michael Thompson. In all seven versions, the prosecutor's opening statement argued that Thompson sexually assaulted and murdered his former boss, Jane Anderson, out of anger over having recently been fired. The prosecutor noted that Thompson had previously been accused of sexual assault while in college and that he could not provide an alibi for his whereabouts on the night of the murder. Finally, the prosecutor argued that Thompson had confessed and that his confession contained details that would only be known to the true perpetrator. The defense attorney's opening statement argued that Thompson's confession was the only evidence against him, that it was false, and that it was coerced by detectives who threatened him and fed him details of the crime during a lengthy interrogation.

All participants then read a summary of testimony given by Thompson's coworker, who testified for the prosecution. The coworker testified that he heard Thompson throw a lamp and threaten Mrs. Anderson upon learning that he had been fired. On cross-examination, the coworker testified that Thompson had a bad temper but never acted on it, explaining that Thompson always calmed down quickly, seemed embarrassed by his behavior, and apologized for it.

Next, participants read the testimony of either a bitemark examiner, a fingerprint examiner, or neither (*Discipline* manipulation). Participants in the *Bitemark* condition read the testimony

TABLE 1—*Components of exposure conditions in studies 1–3.*

Condition	Studies	Defendant confessed	Examiner testified	Examiner exposed to confession	Examiner denied influence of confession	Examiner admitted influence of confession
No confession or examiner	2, 3	–	–	–	–	–
No examiner	1, 2, 3	X	–	–	–	–
Unexposed	1, 2, 3	X	X	–	–	–
Exposed	2, 3	X	X	X	–	–
Deny	1, 2, 3	X	X	X	X	–
Admit	1, 2, 3	X	X	X	–	X

An X indicates that this component was present in the corresponding condition.

of a bitemark examiner who testified for the prosecution. The bitemark examiner held a doctoral degree in dental surgery and was a member of the American Society of Forensic Odontology. He explained the methodology he had used to compare photographs of a bitemark on the victim's neck against a model of Thompson's teeth, and he concluded that the bitemark matched the model. Participants in the *Fingerprint* condition read the analogous testimony of a fingerprint examiner who testified for the prosecution. The fingerprint examiner held a Bachelor's degree in forensic science, was trained at an FBI laboratory, and was certified by the International Association for Identification. He too explained the methodology he had used to compare photographs of fingerprints found in the blood surrounding the victim's body against Thompson's fingerprints, and he concluded that the two sets of prints matched. Participants in the *No Examiner* condition did not read either examiner's testimony.

Participants in the Bitemark and Fingerprint conditions also read a summary of the examiner's cross-examination, in which the defense attorney asked the examiner if he was aware of Thompson's confession prior to his analysis (*Exposure* manipulation). In the *Unexposed* condition, the examiner testified that he had not been aware of the confession. In the Deny and Admit conditions, the examiner testified that he was aware of the confession, and the defense attorney asked the examiner if that knowledge could have influenced his conclusion. In the *Deny* condition, the examiner stated that the confession had no bearing on his conclusion and then reiterated this point. In the *Admit* condition, the examiner conceded that the confession could have influenced his conclusion, and the defense attorney then prompted him to reiterate this point.

In all conditions, the final witness was Thompson's neighbor, who testified for the defense. The neighbor testified that she saw Thompson in their apartment building on the night of the murder and that he said he was going to watch a movie at home that night. On cross-examination, the neighbor clarified that she had seen Thompson around 6 p.m. and could not confirm that he was in his apartment for the entire evening. Finally, the prosecution and defense made their closing arguments, which reiterated the main points of their opening statements.

Dependent Measures

See Table 2 for a summary of our dependent measures. After reading the trial summary, participants first rendered a verdict (guilty or not guilty) and rated their confidence in this verdict on a scale from 1 (very unsure) to 10 (very confident). Then, on a new screen, participants separately rated the convincingness of the prosecutor and defense attorney's arguments, each on a scale from 1 (very unconvincing) to 9 (very convincing).

Next, for each witness whose testimony they read (coworker, neighbor, and/or examiner), participants rated the convincingness of their testimony, the importance of their testimony in rendering a verdict, and the degree to which they were biased toward the side for which they testified—each on a 9-point scale. We did not analyze ratings of the two nonexaminer witnesses; these items were included only to conceal the purpose of the study, and we had no reason to believe that our manipulations would affect ratings of these witnesses.

Manipulation Check

Lastly, participants in the six experimental conditions answered two questions to verify that they had noticed and remembered the details of our manipulations (i.e., which type of evidence the examiner had analyzed, and whether the examiner had known about Thompson's confession prior to his analysis). Unfortunately, these data were lost due to a malfunction of the survey website; hence, we did not exclude data from any participants prior to analysis. We return to this point later.

TABLE 2—*Dependent measures in studies 1–3.*

Measure	Study 1	Study 2	Study 3
Verdict (guilty/not guilty)	X	X	X
Likelihood of commission (0–100)		X	X
Prosecutor convincingness (1–9)	X		X
Defense convincingness (1–9)	X		X
Examiner convincingness (1–9)	X		X
Examiner importance (1–9)	X		X
Examiner pro-prosecution bias (1–9)	X		X
Examiner influence on verdict (1–10)		X	
Examiner influenced by confession (1–10)		X	X

An X indicates that this measure was collected in the corresponding study. The five Examiner ratings were not collected in the two control conditions. Ratings of 'Examiner Influenced by Confession' were not collected in the Unexposed condition.

Results

Verdicts

Across all conditions, 68.7% of participants returned a guilty verdict. A full factorial logistic regression revealed that neither Discipline, Wald $\chi^2(1) = 0.17$, $p = 0.679$, $OR = 1.19$ [95% CI: 0.53, 2.67], nor Exposure, Wald $\chi^2(2) = 1.67$, $p = 0.435$, nor their interaction, Wald $\chi^2(2) = 2.01$, $p = 0.366$, predicted verdict. As shown in Table 3, pairwise comparisons indicated that participants in the Fingerprint/Unexposed (80.4%), $\chi^2(1) = 6.87$, $p = 0.009$, $OR = 3.11$ [95% CI: 1.31, 7.38], and Fingerprint/Deny (76.3%), $\chi^2(1) = 4.94$, $p = 0.026$, $OR = 2.44$ [95% CI: 1.10, 5.39], conditions voted guilty more often than those in the No Examiner control condition (56.9%)—but none of the other experimental conditions differed from the No Examiner condition, *p*s > 0.07.

Prosecutor and Defense Convincingness

Ratings of the prosecutor and defense attorney were negatively correlated, $r = -0.62$, $p < 0.001$; overall, participants rated the prosecutor's argument as more convincing ($M = 6.80$, $SD = 2.03$) than the defense attorney's argument ($M = 4.11$, $SD = 2.29$), $t(376) = 13.41$, $p < 0.001$, $d = 0.69$ [95% CI: 0.58, 0.81].

A 2 (Discipline) X 3 (Exposure) MANOVA on ratings of the prosecution and defense revealed a multivariate effect of Exposure, $F(4,624) = 2.68$, $p = 0.031$, $\eta^2_p = 0.02$, with univariate effects on both prosecutor convincingness, $F(2,313) = 3.38$, $p = 0.035$, $f = 0.15$, and defense convincingness, $F(2,313) = 5.03$, $p = 0.007$, $f = 0.18$. As shown in Table 4, Tukey HSD comparisons showed that participants in the Admit condition rated the prosecutor's argument as less convincing than those in the Deny condition—neither of which differed from the Unexposed condition. Conversely, participants in the Admit condition rated the defense's argument as more convincing than those in the Deny or Unexposed conditions, which did not differ from each other.

TABLE 3—*Effects of exposure, discipline (bitemark vs. fingerprint), and credentials (weak vs. strong) on guilty verdicts (%) in studies 1–3.*

	No confession or examiner	No examiner	Unexposed	Exposed	Deny	Admit
Study 1		56.9	70.8		75.0	66.7
Bitemark			61.8		73.5	64.7
Fingerprint			*80.4*		*76.3*	68.5
Study 2	28.1_{a}	44.8_{b}	77.8_{c}	52.2_{abc}	62.5_{bc}	55.6_{bc}
Study 3	10.3	53.1	74.5_{a}	62.8_{a}	65.7_{a}	40.8_{b}
Weak			62.5	60.0	61.1	34.8
Strong			*87.0*	65.2	70.6	46.2

The suspect had confessed in all conditions unless otherwise noted (see Table 1). Marginal values in the same row that do not share a common subscript differ at $p < 0.05$. Cell values that are shown in italics differ from the corresponding No Examiner control group at $p < 0.05$.

Neither the multivariate effect of Discipline, $F(2,312) = 1.57$, $p = 0.210$, $\eta^2_p = 0.01$, nor the multivariate interaction, $F(4,624) = 0.83$, $p = 0.508$, $\eta^2_p = 0.01$, was significant.

As shown in Table 4, a one-way ANOVA with planned contrasts indicated that participants in the Fingerprint/Unexposed, $p = 0.015$, and Fingerprint/Deny, $p = 0.015$, conditions rated the prosecutor's argument as more convincing than those in the No Examiner control condition—but no other conditions differed from the No Examiner condition, *p*s > 0.35. Ratings of the defense attorney's argument did not differ between the No Examiner control condition and any of the six experimental conditions, *p*s > 0.12.

Judgments of the Examiner

A 2 X 3 MANOVA on three judgments of the forensic examiner's testimony (i.e., convincingness, importance, and pro-prosecution bias) revealed a multivariate effect of Exposure, $F(6,624) = 5.39$, $p < 0.001$, $\eta^2_p = 0.05$, with univariate effects on convincingness, $F(2,313) = 13.68$, $p < 0.001$, $f = 0.30$, and pro-prosecution bias, $F(2,313) = 3.22$, $p = 0.041$, $f = 0.14$, but not importance, $F(2,313) = 1.42$, $p = 0.245$, $f = 0.10$. As shown in Table 5, Tukey HSD comparisons indicated that participants in the Unexposed condition rated the examiner's testimony as more convincing than those in the Deny condition, who in turn rated it as more convincing than those in the Admit condition. Participants in the Admit condition rated the examiner's testimony as less biased toward the prosecution than those in the Unexposed condition—neither of which differed from the Deny condition.

Neither the multivariate effect of Discipline, $F(3,311) = 1.03$, $p = 0.378$, $\eta^2_p = .01$, nor the multivariate interaction, $F(6,624) = 0.80$, $p = 0.571$, $\eta^2_p = 0.01$, was significant.

Discussion

Study 1 participants rated a forensic examiner's testimony as less convincing if he had *a priori* knowledge of the defendant's confession than if he did not. This finding implies that laypeople possess at least some understanding that cognitive bias can undermine the value of forensic science evidence, which is consistent with Thompson and Scurich's (48) finding that venirepersons rated a blinded forensic expert as more credible than one who was exposed to potentially biasing information. However, in contrast to Thompson and Scurich, Study 1 participants were no less likely to convict the defendant—the only legally relevant outcome measure—if the examiner had been aware of the defendant's confession.

A closer look at our data reveals an even more concerning departure from Thompson and Scurich's findings. In their study, participants rated the nonblind examiner as less credible regardless of whether he claimed to have used or ignored task-irrelevant information. In Study 1, however, several findings suggest

TABLE 4—*Effects of exposure, discipline (bitemark vs. fingerprint), and credentials (weak vs. strong) on verdict-confidence ratings (study 1), likelihood of commission estimates (studies 2 and 3), and convincingness of the prosecution and defense (studies 1 and 3).*

	No confession or examiner	No examiner	Unexposed	Exposed	Deny	Admit
Likelihood of commission (0-100)						
Study 2	$51.56\ (3.97)_{a}$	$61.03\ (4.28)_{ab}$	$78.33\ (4.30)_{b}$	$67.39\ (4.92)_{ab}$	$62.92\ (6.00)_{ab}$	$68.89\ (5.02)_{ab}$
Study 3	46.21 (4.95)	60.63 (4.21)	$75.32\ (2.96)_{a}$	$71.63\ (3.79)_{ab}$	$75.14\ (3.49)_{a}$	$61.02\ (3.77)_{b}$
Weak			69.58 (4.72)	69.00 (5.47)	72.78 (4.03)	53.04 (5.95)
Strong			*81.30 (3.16)*	*73.91 (5.33)*	*77.65 (5.85)*	68.08 (4.44)
Prosecutor convincingness (1–9)						
Study 1		6.41 (0.25)	$7.05\ (0.17)_{ab}$		$7.10\ (0.20)_{a}$	$6.44\ (0.22)_{b}$
Bitemark			6.76 (0.26)		6.84 (0.31)	6.57 (0.32)
Fingerprint			*7.35 (0.21)*		*7.32 (0.25)*	6.31 (0.30)
Study 3	4.17 (0.41)	5.48 (0.42)	$7.19\ (0.23)_{a}$	$6.81\ (0.29)_{ab}$	$7.20\ (0.24)_{a}$	$5.90\ (0.31)_{b}$
Weak			*6.96 (0.37)*	*6.75 (0.41)*	*6.89 (0.38)*	5.70 (0.46)
Strong			*7.43 (0.25)*	*6.87 (0.42)*	*7.53 (0.27)*	6.08 (0.43)
Defense convincingness (1–9)						
Study 1		4.26 (0.31)	$3.85\ (0.20)_{a}$		$3.76\ (0.23)_{a}$	$4.66\ (0.23)_{b}$
Bitemark			4.02 (0.31)		3.73 (0.32)	4.37 (0.36)
Fingerprint			3.67 (0.25)		3.78 (0.32)	4.93 (0.28)
Study 3	6.62 (0.43)	5.23 (0.36)	$3.96\ (0.29)_{a}$	$4.19\ (0.40)_{a}$	$4.60\ (0.41)_{ab}$	$5.84\ (0.33)_{b}$
Weak			4.04 (0.43)	4.70 (0.56)	4.78 (0.56)	5.87 (0.48)
Strong			*3.87 (0.39)*	*3.74 (0.56)*	4.41 (0.61)	5.81 (0.46)

All values are presented as *M* (*SE*). Marginal means in the same row that do not share a common subscript differ at $p < 0.05$. Cell means that are shown in italics differ from the corresponding No Examiner control group at $p < 0.05$.

TABLE 5—*Effects of exposure, discipline (bitemark vs. fingerprint), and credentials (weak vs. strong) on judgments of the examiner (M [SE]) in studies 1–3.*

	Unexposed	Exposed	Deny	Admit
Convincingness				
Study 1	7.42 (0.14)$_a$		6.75 (0.21)$_b$	6.02 (0.22)$_c$
Bitemark	7.27 (0.20)		6.55 (0.30)	6.20 (0.31)
Fingerprint	7.59 (0.18)		6.92 (0.28)	5.85 (0.30)
Study 3	7.20 (0.31)$_a$	6.70 (0.33)$_a$	6.69 (0.44)$_a$	4.88 (0.37)$_b$
Weak	6.54 (0.50)	6.20 (0.48)	6.72 (0.53)	4.26 (0.51)
Strong	7.91 (0.31)	7.13 (0.44)	6.65 (0.74)	5.42 (0.52)
Importance				
Study 1	7.33 (0.16)		7.07 (0.19)	6.91 (0.19)
Bitemark	7.15 (0.25)		6.86 (0.30)	6.78 (0.31)
Fingerprint	7.53 (0.21)		7.25 (0.25)	7.04 (0.22)
Study 3	7.59 (0.27)	7.26 (0.27)	7.40 (0.39)	7.57 (0.22)
Weak	7.29 (0.45)	7.00 (0.38)	7.67 (0.44)	7.65 (0.35)
Strong	7.91 (0.29)	7.48 (0.38)	7.12 (0.65)	7.50 (0.29)
Pro-prosecution bias				
Study 1	4.67 (0.10)$_a$		4.32 (0.15)$_{ab}$	4.14 (0.18)$_b$
Bitemark	4.76 (0.16)		4.33 (0.23)	4.00 (0.26)
Fingerprint	4.57 (0.13)		4.32 (0.20)	4.28 (0.25)
Study 3	4.48 (0.23)	4.07 (0.23)	4.03 (0.29)	3.61 (0.30)
Weak	4.29 (0.30)	3.70 (0.36)	4.39 (0.40)	3.48 (0.43)
Strong	4.68 (0.34)	4.39 (0.29)	3.65 (0.41)	3.73 (0.42)
Influence on verdict				
Study 2	8.17 (0.69)	7.70 (0.48)	7.83 (0.49)	6.78 (0.52)
Influenced by confession				
Study 2		5.26 (0.70)	4.33 (0.59)	5.44 (0.46)
Study 3		4.58 (0.40)$_a$	4.46 (0.50)$_a$	5.98 (0.35)$_b$
Weak		5.70 (0.51)	4.11 (0.68)	6.61 (0.49)
Strong		3.61 (0.53)	4.82 (0.75)	5.42 (0.47)

Marginal means in the same row that do not share a common subscript differ at $p < 0.05$.

that our participants believed the examiner when he claimed that the confession did not influence him. Overall, participants rated the examiner's testimony as more convincing when he denied influence than when he admitted to the possibility. Moreover, when the fingerprint examiner denied influence, participants voted to convict more often and rated the prosecutor's argument as more convincing compared to the no examiner control condition. For both measures, an examiner who knew of the confession but denied its influence was perceived no differently than an examiner who was unaware of the confession.

This pattern is problematic insofar as many forensic examiners resist claims of cognitive bias. As noted above, survey data from Kukucka et al. (24) revealed a "bias blind spot" among forensic examiners, such that examiners generally recognized that bias can impact their peers but simultaneously denied that bias can impact their own judgments (see also [63]). Hence, even if an examiner were to be cross-examined on this issue, they will presumably deny that task-irrelevant information could have impacted their judgment—and the results of Study 1 suggest that jurors will tend to believe them.

Though latent fingerprint examination is widely considered to have a stronger scientific foundation than bitemark identification (23), participants' ratings generally did not reflect this, as bitemark and fingerprint examiners were rated as equally convincing and equally influential, and their testimony was equally likely to elicit a guilty verdict. However, the unexposed fingerprint examiner—but not the unexposed bitemark examiner—increased the conviction rate and perceived strength of the prosecutor's argument relative to the no examiner condition, thus providing some indication that participants considered fingerprint evidence more probative than bitemark evidence.

A glaring limitation of Study 1 was the unfortunate loss of manipulation check data, which prevented us from verifying that all participants had noticed critical aspects of the examiner's testimony. In theory, including inattentive participants in our final sample would increase statistical noise and make it more difficult to detect significant effects. Still, this problem may have caused us to underestimate the magnitude of the observed effects and/or fail to detect other important effects. For that reason, we sought to replicate the findings of Study 1.

Study 2

The primary aim of Study 2 was to replicate the effects observed in the Fingerprint condition of Study 1. Each participant read one of six versions of a trial summary, four of which were the Unexposed, Deny, Admit, and No Examiner summaries used in Study 1. A fifth version included a fingerprint examiner who admitted to knowing about the defendant's confession but neither admitted nor denied that it could have influenced his judgment (i.e., Exposed condition). A sixth version provided a second control group in which the defendant did not confess and no forensic examiner testified.

Method

Participants and Design

Participants (N = 186) were recruited via mTurk and completed the study on an external survey website. We later excluded data from 33 participants (17.7%) who failed a manipulation check, leaving a final sample of N = 153. No demographic information was collected.

Each participant was randomly assigned to one of six groups in a one-way design (i.e., Unexposed, Exposed, Deny, Admit, No Examiner, or No Confession or Examiner; see Table 1 for an explanation of the components of each condition).

Procedure

Each participant read one of six versions of a trial summary, which were adapted from the summaries used in Study 1. After reading the summary, participants rendered a verdict, rated their confidence in that verdict, estimated the likelihood that the defendant had committed the murder, and rated the degree to which each witness' testimony (i.e., the coworker, neighbor, and/or fingerprint examiner) had influenced their verdict. Finally, participants completed a manipulation check.

Trial Summary

Each participant read one of six versions of a trial summary (550–1044 words) in which the defendant was charged with first-degree murder. The summaries were identical to those used in Study 1, apart from the exceptions described below. As in Study 1, each summary included opening statements by the prosecution and defense, testimony and cross-examination of the defendant's coworker and neighbor, and closing statements.

Four of the six summaries also included the testimony and cross-examination of a fingerprint examiner who testified that the defendant's fingerprints matched fingerprints found in the blood around the victim's body (i.e., experimental conditions; see Table 1). In each, the defense attorney asked the examiner if he had been aware of the defendant's confession prior to analyzing the fingerprints; the four summaries differed in how the examiner responded to this question. In the *Unexposed* condition, the examiner testified that he was unaware of the confession when he analyzed the fingerprints. In the *Exposed* condition, the examiner testified that he was aware of the confession; however, the examiner was not asked if it could have influenced his judgment. In the *Deny* condition, the examiner testified that he was aware of the confession but insisted that it did not influence his judgment, which he described as "purely objective." In the *Admit* condition, the examiner testified that he was aware of the confession and admitted that it could have influenced his judgment, which he described as "partly subjective."

Two of the six summaries did not include testimony from a fingerprint examiner (i.e., control conditions; see Table 1). In the *No Examiner* condition, participants read only opening statements (which mentioned the defendant's recanted confession), testimony from the defendant's coworker and neighbor, and closing statements. In the *No Confession or Examiner* condition, they read this same summary, but with all references to the defendant's confession and fingerprint examiner removed.

Dependent Measures

See Table 2 for a summary of our dependent measures. As in Study 1, participants first rendered a verdict (guilty or not guilty) and rated their confidence in that verdict on a 10-point scale. To obtain a more sensitive measure of belief in the defendant's guilt, we also asked Study 2 participants to estimate the likelihood that the defendant had committed the murder, using an 11-point scale with options ranging from 0% to 100%.

Whereas Study 1 participants rated the convincingness, importance, and biasedness of each witness' testimony, Study 2 participants provided only one rating for each witness—namely, the extent to which that witness' testimony influenced their verdict, on a scale from 1 (not at all) to 10 (very). As in Study 1, we did not analyze participants' ratings of the nonexaminer witnesses.

Lastly, we asked participants in the Exposed, Deny, and Admit conditions to rate the extent to which they believed that the fingerprint examiner's analysis was influenced by his knowledge of the defendant's confession, on a scale from 1 (not at all) to 10 (very). This item was presented after the manipulation check so as not to prime participants' responses to those items.

Manipulation Check

Participants in the four experimental conditions answered one or two items to verify that they noticed and remembered key aspects of the fingerprint examiner's testimony. The first item (included in all four experimental conditions) asked if the examiner knew about the defendant's confession prior to analyzing the fingerprints. The second item (Deny and Admit conditions only) asked if the examiner said it was or was not possible that the confession influenced his analysis. We later excluded data from participants who responded incorrectly to either or both of these items (n = 33; 17.7%), leaving a final sample of N = 153.

Results

Verdicts

Overall, 52.2% of participants returned a guilty verdict—including 28.1% in the No Confession or Examiner control condition and a combined 57.0% in the five conditions where the defendant confessed, $\chi^2(1) = 8.46$, $p = 0.004$, $OR = 3.39$ [95% CI: 1.45, 7.94]. A chi-square test revealed an overall effect of our manipulation on verdicts, $\chi^2(5) = 13.81$, $p = 0.017$, $V = 0.30$ (see Table 3). Compared to the No Confession or Examiner control condition, the conviction rate significantly increased in the Unexposed (77.8%), Deny (62.5%), and Admit (55.6%) conditions. In contrast, only the Unexposed condition increased the conviction rate above the No Examiner control condition (44.8%). However, the conviction rate also did not significantly differ between the four experimental conditions (i.e., Unexposed, Exposed, Deny, and Admit).

Likelihood of Commission

On average, participants estimated a 63.73% likelihood that the defendant had committed the murder (SD = 25.10%). A one-way ANOVA revealed a significant effect of our manipulation on these estimates, $F(5,147) = 3.36$, $p = 0.007$, $f = 0.34$. As shown in Table 4, Tukey HSD comparisons revealed that participants in the Unexposed condition thought it more likely that the defendant had committed the crime compared to those in the No Confession or Examiner condition, and no other conditions differed from each other.

Judgments of the Examiner

Participants in the four experimental conditions reported that the examiner's testimony strongly influenced their verdict (overall $M = 7.55$, $SD = 2.59$). A one-way ANOVA indicated that these ratings did not differ between conditions, $F(3,88) = 1.27$, $p = 0.289$, $f = 0.21$ (see Table 5).

Participants in the Exposed, Deny, and Admit conditions believed that the examiner's analysis was somewhat influenced by his knowledge of the defendant's confession (overall $M = 5.03$, $SD = 2.89$). A one-way ANOVA indicated that these ratings did not differ between conditions, $F(2,71) = 1.05$, $p = 0.356$, $f = 0.17$ (see Table 5).

Discussion

Study 2 participants recognized that a fingerprint examiner's knowledge of a defendant's confession can influence his judgment, and they believed that the confession would have the same impact regardless of whether the examiner admitted or denied that such influence was possible. This recognition, however, was not reflected in their judgments and verdicts: Participants who read testimony from an unexposed or exposed fingerprint examiner felt equally influenced by his testimony, believed it equally likely that the defendant had committed the crime, and were equally likely to return a guilty verdict. As such, we replicated the finding from Study 1 that the fingerprint examiner's testimony vis-à-vis bias did not affect judgments of guilt.

As in Study 1, the unexposed examiner increased the conviction rate above the no examiner control condition—but unlike in Study 1, the examiner who denied being influenced by the confession did not increase the conviction rate in Study 2. That is to say, the examiner's testimony increased guilty verdicts relative to the control condition in Study 2 only when the examiner was unexposed. This pattern may suggest optimism regarding jurors' ability to detect and discount forensic opinions that have been compromised by cognitive bias. However, the rate of guilty verdicts also increased—albeit nonsignificantly—in each of the three exposed examiner conditions relative to the control condition, and participants in those conditions still reported that the exposed examiner's testimony strongly influenced their verdicts. Thus, this pattern may instead indicate that Study 2 was underpowered to detect differences in conviction rate that are relatively small in magnitude but perhaps still practically important.

In contrast, likelihood of commission ratings was equivalent across the four experimental conditions and the no examiner control condition, which may suggest that participants universally gave little weight to the fingerprint examiner's testimony. As discussed earlier, prior work suggests that laypeople's trust in fingerprint evidence is highly variable (e.g., [38,58]). Accordingly, the weak differences between conditions could be partly attributable to a subset of participants who are generally skeptical of fingerprint evidence and felt that it should carry little weight regardless of the conditions under which it was analyzed.

Perhaps jurors' judgments are influenced more by characteristics of the individual examiner than by that examiner's discipline as a whole. Consistent with dual-process models of persuasion (64), jurors who are unable or unmotivated to fully process a message may be more heavily influenced by peripheral cues—such as the examiner's credentials or confidence—and less influenced by the degree to which the examiner's conclusions are scientifically valid. Supporting this idea, Koehler et al. (41) found that an examiner's level of experience—but not the degree to which their method had been scientifically validated—reliably affected laypeople's judgments of the strength of the evidence. Relatedly, although many forensic examiners agree that experience does not immunize examiners from cognitive bias (24), jurors might believe that a forensic examiner who has more training and experience is necessarily less susceptible to bias. Study 3 tested this possibility.

Study 3

Study 3 tested whether the effect of an examiner admitting exposure to incriminating but task-irrelevant information depends on the examiner's credentials. Similar to Study 2, most participants read a trial summary in which a fingerprint examiner—with either strong or weak credentials—testified that he either was or was not aware of the defendant's confession prior to his analysis, and if he was aware, either admitted or denied that the confession could have influenced his judgment (or neither). As in Study 2, we also included two control conditions that did not include testimony from a fingerprint examiner and/or a confession.

Method

Participants and Design

Participants (N = 315) were recruited via mTurk and completed the study on an external survey website. We later excluded data from 80 participants (25.4%) who failed a manipulation check, leaving a final sample of N = 235. Our final sample included at least one participant from 35 of the 50 U.S. states, and a slight minority of participants (48.1%) held a Bachelor's degree or higher. No other demographic information was collected.

Each participant was randomly assigned to one of ten cells in a 2 (Credentials: Weak vs. Strong) × 4 (Exposure: Unexposed, Exposed, Deny, or Admit) + 2 (Controls: No Examiner; No Confession or Examiner) between-subjects design.

Procedure

As in Studies 1 and 2, participants read one of ten versions of a trial summary (550–1065 words), which recounted opening and closing statements from the prosecution and defense and testimony from the defendant's coworker and neighbor. Eight of the ten summaries also recounted the testimony of a fingerprint examiner, which varied in terms of the examiner's credentials and his explanation of whether he was aware of and/or influenced by the defendant's confession. Participants then completed an amalgamation of the dependent measures from Studies 1 and 2 (see Table 2) as well as a manipulation check.

Trial Summary

Each participant read one of ten trial summaries, which were identical to those used in Study 2, apart from the *Credentials* manipulation. In the *Strong Credentials* condition, the examiner held a Bachelor's degree in biophysical chemistry from a prestigious college, held a Master's degree in forensic science, and had been working at the crime laboratory for 10 years. In the *Weak Credentials* condition, the examiner held a Bachelor's degree in communications from a relatively unknown college, had completed an online certificate in fingerprint analysis, and had been working at the crime laboratory for 18 months.

Dependent Measures

See Table 2 for a summary of our dependent measures. Study 3 included all of the dependent measures from Study 1, plus two items that were added in Study 2 (i.e., likelihood of commission and—for the Exposed, Deny, and Admit conditions only—a rating of the degree to which the examiner's knowledge of the confession influences his analysis).

Manipulation Check

Participants in the eight experimental conditions answered three or four items to verify that they noticed and remembered key aspects of the fingerprint examiner's testimony. The first two items asked participants to recall how long the fingerprint examiner had been working at the crime lab (i.e., 6 months, 18 months, 4 years, 10 years, or 15 years) and rate the strength of the examiner's credentials on a scale from 1 (not strong) to 10 (very strong). The third and fourth items were identical to the manipulation check items from Study 2.

We later excluded data from participants who responded incorrectly to any of the three nonscalar items (n = 80; 25.4%), leaving a final sample of N = 235. Confirming the effectiveness of our manipulation, participants in the Strong Credentials condition rated the examiner's credentials (M = 7.55, SD = 1.43) as much stronger than those in the Weak Credentials condition (M = 4.49, SD = 2.10), $t(170) = 11.21$, $p < 0.001$, d = 1.76 [95% CI: 1.41, 2.11].

Results

Verdicts

Overall, 53.2% of participants returned a guilty verdict—including 10.3% in the No Confession or Examiner control group and a combined 59.2% in the other conditions, $\chi^2(1) = 24.39$,

$p < 0.001$, $OR = 12.59$ [95% CI: 3.69, 42.93]. Compared to the No Confession or Examiner condition, the conviction rate significantly increased in the No Examiner condition (53.1%), $p < 0.001$, and in all eight experimental conditions, ps < 0.04. Additional pairwise comparisons indicated that only the Strong/Unexposed condition (87.0%) produced a higher conviction rate than the No Examiner control condition, $p = 0.008$; none of the other experimental conditions differed from the No Examiner condition, ps > 0.23 (see Table 3).

A full factorial logistic regression revealed that Exposure significantly predicted verdicts, Wald $\chi^2(3) = 8.33$, $p = 0.040$, such that the conviction rate was lower in the Admit condition (40.8%) compared to the Unexposed (74.5%), Deny (65.7%), or Exposed (62.8%) conditions, which did not differ (see Table 3). Neither Credentials, Wald $\chi^2(1) = 0.35$, $p = 0.556$, $OR = 0.66$ [95% CI: 0.16, 2.68], nor the interaction, Wald $\chi^2(3) = 1.56$, $p = 0.669$, predicted verdicts.

Likelihood of Commission

A 2 X 4 ANOVA on likelihood of commission estimates revealed a main effect of Exposure, $F(3,166) = 4.26$, $p = 0.006$, $f = 0.28$. As shown in Table 4, Tukey HSD comparisons indicated that participants in the Unexposed and Deny conditions thought it more likely that the defendant had committed the crime compared to the Admit condition—none of which differed from the Exposed condition.

A main effect of Credentials also emerged, $F(1,166) = 6.71$, $p = 0.010$, $d = 0.39$ [95% CI: 0.09, 0.69], such that participants who read testimony from a Strong examiner thought it more likely that the defendant committed the crime ($M = 74.83$, $SD = 22.32$) compared to those who read the same testimony from a Weak examiner ($M = 65.65$, $SD = 24.81$). No Credentials X Exposure interaction was found, $F(3,166) = 0.53$, $p = 0.662$, $f = 0.10$.

A one-way ANOVA with planned contrasts indicated that the Strong/Unexposed, $p = 0.001$, Strong/Deny, $p = 0.015$, and Strong/Exposed, $p = 0.037$, conditions produced higher likelihood of commission estimates than the No Examiner control condition (see Table 4). None of the other experimental conditions differed from the No Examiner condition, all ps > 0.075.

Prosecution and Defense Arguments

As in Study 1, ratings of the prosecution and defense were negatively correlated, $r = -0.57$, $p < 0.001$, and participants rated the prosecutor's argument as more convincing ($M = 6.25$, $SD = 2.17$) than the defense attorney's argument ($M = 4.99$, $SD = 2.45$), $t(233) = 4.72$, $p < 0.001$, $d = 0.31$ [95% CI: 0.16, 0.45].

A 2 X 4 MANOVA on ratings of the prosecution and defense revealed a multivariate effect of Exposure, $F(6,330) = 3.94$, $p = 0.001$, $\eta^2_p = 0.07$, with univariate effects on both prosecutor convincingness, $F(3,166) = 5.31$, $p = 0.002$, $f = 0.31$, and defense convincingness, $F(3,166) = 6.04$, $p = 0.001$, $f = 0.33$. As shown in Table 4, Tukey HSD comparisons indicated that participants in the Unexposed and Deny conditions rated the prosecutor's argument as more convincing than those in the Admit condition—none of which differed from the Exposed condition. Conversely, participants in the Admit condition rated the defense attorney's argument as more convincing than those in the Unexposed or Exposed conditions—none of which differed from the Deny condition.

Neither the multivariate effect of Credentials, $F(2,165) = 1.12$, $p = 0.327$, $\eta^2_p = .01$, nor the multivariate interaction, $F(6,330) = 0.41$, $p = 0.875$, $\eta^2_p = 0.01$, was significant.

A one-way ANOVA with planned contrasts indicated that six of the eight experimental conditions—that is, Strong/Unexposed, $p < 0.001$, Strong/Deny, $p < 0.001$, Strong/Exposed, $p = 0.009$, Weak/Unexposed, $p = 0.005$, Weak/Deny, $p = 0.014$, and Weak/Exposed, $p = 0.022$—rated the prosecutor's argument as more convincing than the No Examiner control condition, all other ps > 0.24 (see Table 4). Conversely, only two conditions—Strong/Unexposed, $p = 0.033$, and Strong/Exposed, $p = 0.020$—rated the defense attorney's argument as less convincing than the No Examiner condition, all other ps > 0.059.

Judgments of the Examiner

A 2 X 4 MANOVA on three judgments of the examiner's testimony (i.e., convincingness, importance, and pro-prosecution bias) revealed a multivariate effect of Exposure, $F(9,495) = 3.94$, $p < 0.001$, $\eta^2_p = 0.07$, with a univariate effect on convincingness, $F(3,165) = 9.35$, $p < 0.001$, $f = 0.41$, but no effect on importance, $F(3,165) = 0.37$, $p = 0.777$, $f = 0.08$, or bias, $F(3,165) = 2.02$, $p = 0.113$, $f = 0.19$. As shown in Table 5, Tukey HSD comparisons indicated that participants in the Admit condition rated the examiner's testimony as less convincing than those in the Unexposed, Exposed, and Deny conditions, which did not differ from each other. Neither the multivariate effect of Credentials, $F(3,163) = 2.08$, $p = 0.105$, $\eta^2_p = 0.04$, nor the multivariate interaction, $F(9,495) = 0.72$, $p = 0.692$, $\eta^2_p = 0.01$, was significant.

Overall, participants in the Exposed, Deny, and Admit conditions believed that the examiner's analysis was somewhat influenced by his knowledge of the defendant's confession ($M = 5.09$, $SD = 2.72$). A 2 X 3 ANOVA on these ratings revealed a main effect of Exposure, $F(2,121) = 4.78$, $p = .010$, $f = 0.28$ (see Table 5), such that participants in the Admit condition felt that the examiner was more influenced by the confession than those in the Deny or Exposed conditions, which did not differ from each other. Neither a main effect of Credentials, $F(1,121) = 3.43$, $p = .067$, $f = 0.17$, nor an interaction, $F(2,121) = 2.93$, $p = .057$, $f = 0.22$, was found.

Discussion

As in Studies 1 and 2, participants in Study 3 showed only a limited understanding that exposure to a confession could impact a fingerprint examiner's judgment. As such, exposed and unexposed examiners generally had the same impact on their decision-making. Moreover, Study 3 yielded additional evidence that people tend to believe fingerprint examiners who claim to be impervious to bias. We return to these points in the General Discussion.

The examiner's credentials had little effect on perceptions or judgments. Testimony from the stronger-credentialed examiner increased likelihood of commission ratings relative to the weaker-credentialed examiner, but it did not affect verdicts or the examiner's perceived credibility, nor did it moderate the effect of exposure to the defendant's confession. This pattern was surprising given that jurors consider experience and education to be the most important qualifications of a forensic science expert (65) and that prior studies found that jurors were more heavily influenced by forensic examiners with greater experience (41). Additionally, though many examiners believe that their vulnerability to bias declines with experience (24), this pattern suggests that jurors view examiners as equally affected (or unaffected, as the case may be) by cognitive bias regardless of their credentials. To date, only one study has compared the biasability of forensic experts and novices: van den Eeden, de Poot, and van Koppen (66) found that biasing information had the same impact on forensic science students' and experienced crime scene investigators' judgments of a mock crime scene. Future work should continue to explore how experience impacts professional forensic examiners' credibility and biasability.

General Discussion

Forensic science evidence can be an extremely powerful tool in solving crimes. However, misleading forensic science has also contributed to an alarming number of wrongful convictions (1). In recent years, research has overwhelmingly indicated that when forensic examiners are exposed to information that is not germane to their analysis, that knowledge can color their opinions of forensic evidence, thereby undermining the independent probative value of those opinions (2,17,21). The current studies tested whether laypeople discount the testimony of a forensic examiner who was exposed to incriminating but task-irrelevant information (i.e., a confession) that could have influenced his opinion.

Across three studies, we found little evidence that laypeople gave more weight to the forensic examiner who was not exposed to task-irrelevant information. Although they rated the unexposed examiner's testimony as most convincing (Study 1) and as least influenced by the defendant's confession (Study 2), they also reported that the examiner's testimony had the same impact on their verdict whether he was exposed to the confession or not (Studies 1, 2, and 3). Accordingly, exposed and unexposed examiners elicited equivalent conviction rates (Studies 1, 2, and 3) and likelihood of commission estimates (Studies 2 and 3). These findings suggest that jurors should not be trusted to recognize and discount forensic science opinions that have been impacted by cognitive bias. This conclusion echoes previous research showing that jurors are poor at recognizing flaws in scientific evidence—including experimenter expectancy effects (36,37) and confirmation bias (47).

Although participants were largely unable to recognize bias on their own, they generally recognized bias when it was made explicit. When the forensic examiner openly admitted that his knowledge of the defendant's confession could have influenced his opinion, participants rated the prosecution's argument as weakest, the defense's argument as strongest, and the examiner's testimony as least convincing (Studies 1 and 3), and produced the fewest guilty verdicts and lowest likelihood of commission estimates (Study 3). It is unlikely, however, that real world jurors would hear an examiner make such a concession. A recent study found that defense attorneys failed to recognize when confirmation bias had tainted evidence against their client, such that only 46% of attorneys who read a patently biased autopsy report asked the medical examiner about potential bias during cross-examination (67). Moreover, while many examiners recognize that cognitive bias can affect their peers, few believe that they are personally vulnerable to bias (i.e., a "bias blind spot;" [24–25]). To the contrary, many examiners continue to insist that task-irrelevant information does not affect, and may even benefit, the accuracy of their judgments (e.g., [68–72]).

Thus, even if asked, many forensic examiners would deny being susceptible to bias—and our results suggest that jurors believe these denials. When our examiner denied that the defendant's confession impacted his judgment, participants believed that he was in fact less influenced by it (Study 3) and rated his testimony as more convincing (Study 1) compared to when the examiner admitted to possible influence. Moreover, participants weighted the testimony of the exposed examiner who denied influence just as heavily as that of the unexposed examiner, as evidenced by equivalent conviction rates (Studies 1, 2, and 3), likelihood of commission estimates (Studies 2 and 3), and ratings of the convincingness of the prosecutor's argument (Studies 1 and 3) and the examiner's testimony (Study 3). Jurors can be discerning in their reliance on expert testimony (e.g., (73,74]), but our participants clearly trusted the examiner who claimed to be impervious to bias—even though the extant literature indicates that this trust is misplaced (2,6).

It is important to note that while further studies should seek to replicate our findings, the basic pattern of results is highly consistent with research in nonforensic domains. Specifically, research has shown that observers tend to focus on persons and underestimate the role of situational factors. This pattern was first reported by Jones and Harris (75) who presented participants with an essay purportedly written by a fellow student. As one would expect, participants inferred the student's true opinion from his essay when he freely chose the position he espoused. But they also inferred that student's opinion in a no-choice condition in which he was assigned to the position he took. Across topics and modalities, this finding that observers lack sensitivity to the situational determinants of behavior is robust (28). In one experiment, participants were themselves assigned to take a position, whereupon they swapped essays and rated each other. Remarkably, they still jumped to conclusions about each other's attitudes (76). In another experiment, participants inferred attitudes from a speech even when they were the ones who had assigned the writer to the position to be taken (77).

The tendency of social perceivers to focus on persons and overlook the impact of situations is so pervasive that it has been called the *fundamental attribution error* ([29]; for a retrospective overview, see [30]). In *The Psychology of Interpersonal Relations,* Fritz Heider (78), the architect of attribution theory, noted that behavior "has such salient properties that it tends to engulf the field rather than be confined to its proper position as a local stimulus whose interpretation requires the additional data of a surrounding field—the situation in social perception" (p. 54). Gilbert and Malone (27) offered additional explanations, the most compelling being that people draw quick, reflex-like dispositional inferences from behavior and then fail to adjust or correct for the presence of situational constraints, an effortful process.

The fundamental attribution error can also be seen in studies of how mock juries evaluate confession evidence. Kassin and Sukel (79) presented mock jurors with one of three versions of a murder trial transcript—a low-pressure version in which the defendant had confessed to police immediately upon questioning; a high-pressure version in which the defendant was interrogated aggressively and at length; and a control version that contained no confession. In the high-pressure condition, participants perceived the statement to be coerced. Yet this confession significantly increased their conviction rate—regardless of coercion. This same pattern was also obtained in a study of judges (80). Similarly, jurors tend to trust secondary confession evidence, even when provided by an informant with an obvious incentive to lie (81). In short, just as factfinders do not sufficiently account for the pressures that elicit a confession, our participants evaluated forensic science examiners in a manner that was largely oblivious to their exposure to biasing information.

In Thompson and Scurich (48), venirepersons likewise rated the testimony of a nonblind examiner who denied bias as no less credible than that of an examiner who was not exposed to task-irrelevant information. The current studies therefore replicated this finding with novel stimulus materials that described a different discipline (fingerprints vs. bitemarks), crime (murder vs. assault), and form of task-irrelevant information (confession vs. criminal history). Notably, however, Thompson and Scurich's participants did devalue the nonblind examiner relative to an examiner who was deliberately kept unaware of task-irrelevant information as per his laboratory's standard procedures, whereas the current studies did not include an analogous condition. Perhaps jurors are not affected by the examiner's unawareness *per se*, but rather by his description of his laboratory's purposeful blinding procedures. Future research should explore this possibility.

Along these same lines, the fingerprint examiner in Studies 2 and 3 described his analysis as "partly subjective" when he admitted that bias was possible but described it as "purely objective" when he denied bias, such that his self-described biasability was confounded with his characterization of the analysis. It is therefore possible that our participants did not actually believe that the examiner was impervious to bias but rather that bias was a nonissue because the analysis was objective. In Thompson and Scurich, venirepersons devalued the bias-denying examiner's testimony only if he was also cross-examined about the subjectivity of his analysis, which suggests that the perceived risk of bias may depend on the perceived objectivity of the analysis. Future research should more carefully examine how jurors' general understanding of the analytic procedure interacts with case-specific details to shape decision-making.

Future research should also directly investigate *why* jurors fail to detect and/or discount biased forensic expert testimony. One possibility is that jurors are *unable* to identify biased testimony as such because they are uninformed about the phenomenon of cognitive bias and/or unaware of the subjectivity inherent to many forensic science judgments. If that is the case, perhaps opposing expert testimony on cognitive bias would better equip jurors to detect bias testimony. Alternatively, and consistent with a cognitive coherence framework (82), jurors may be *unwilling* to discount biased testimony if that testimony accords with their belief in the defendant's guilt. In our study, for example, if participants did not believe the defendant's recantation of his confession, they may have been less motivated to scrutinize the forensic examiner's testimony due to a prevailing belief in the defendant's guilt. Future studies on this topic should incorporate additional measures (e.g., open-ended items) with an eye toward clarifying why exactly jurors find exposed and unexposed examiners equally persuasive.

In any case, our findings provide further indication that jurors cannot be trusted to differentiate between valid and biased forensic science testimony. In turn, jurors may weight forensic and other evidence inappropriately. As Thompson (18) explained, task-irrelevant information that shapes a forensic examiner's opinion is "double-counted" in a way that undermines the independent probative value of the examiner's opinion. Similarly, Kassin (20) explained that, once obtained, confession evidence can corrupt the interpretation of other evidence, thereby creating an illusion of independent corroboration. For example, if a forensic examiner's knowledge of a confession leads that examiner to judge the forensic evidence as also incriminating, then the confession is effectively being counted twice. At trial, however, jurors will view the confession and fingerprints as two independent but congruent pieces of evidence and give them more weight than they deserve. Notably, Gardner et al. (70) recently found that 34% of forensic examiners said they would review a suspect's confession if it was available, so this example is hardly farfetched.

Policy Implications

Rather than relying on jurors to serve as the safety net in cases involving dubious forensic science evidence, this problem would be better addressed further upstream—by reforming laboratory procedures and keeping dubious forensic opinions out of the courtroom in the first place. For example, Thompson (18) proposed a case manager model to protect examiners against the biasing effects of task-irrelevant information. Under this model, a qualified case manager acts as an intermediary between police investigators and the forensic examiner working on the case; the case manager would receive both task-relevant and task-irrelevant information from investigators, however, convey only the task-relevant information to the examiner. Examiners thus base their analysis solely on task-relevant information and provide the results of their analysis to the case manager, who relays this information back to investigators.

A second approach, called *linear sequential unmasking* (LSU; 22), may be less onerous than the case manager model insofar as it does not require a second examiner to act as case manager. Under the LSU approach, the examiner first analyzes the crime scene evidence in isolation and carefully documents their analysis, including their confidence in their initial judgment. Only after this is done may the examiner compare the crime scene evidence against the suspect's sample and consider other task-relevant information. The examiner is then permitted to revisit and revise their initial judgment, but all revisions must be documented. LSU therefore does not eliminate the possibility of bias, but it does make it more transparent. Moreover, by requiring examiners to first analyze trace evidence in isolation of any reference material, LSU also mitigates attentional biases associated with comparing two forensic samples (22,83).

Several forensic laboratories have described positive experiences of implementing either or both of these context management procedures. Found and Ganas (84) reported on a forensic handwriting laboratory whose examiners implemented a case manager approach and revised their evidence submission forms to eliminate information that was unnecessary and potentially biasing (see also [85]). Several months later, these examiners reported "no negative outcomes," adding that these procedures have boosted confidence in their opinions and were not "complex, overly time-consuming or expensive" to implement (p. 158; see also [86]). Mattijssen, Kerkhoff, Berger, Dror, and Stoel (87) recounted the implementation of a similar context management procedure in a firearms examination laboratory and noted that its examiners have been "very supportive and receptive" of the changes (p. 121). Finally, Archer and Wallman (88) described the adoption of case manager and sequential unmasking procedures in a forensic entomology laboratory; they concluded that these changes have served to "increase the value of the [examiners'] opinion to the court by endeavoring to remove contextual influences" (p. 1276). In short, examiners who use context management procedures have almost unanimously reported that their implementation was not difficult or disruptive, and furthermore, that these procedures have increased the value of their opinions (for an alternate perspective, see [89]).

Like all humans, forensic science examiners are vulnerable to unconscious cognitive biases, and research has overwhelmingly indicated that these biases can influence the opinions they present in court. The current findings suggest that jurors cannot be relied on to distinguish between the reliable testimony of a context-blind forensic examiner and the dubious testimony of one who was exposed to task-irrelevant information. Rather than seeking to instruct or educate jurors about these effects, perhaps a more expedient solution would be to minimize the bias before it gets to court—by encouraging forensic laboratories to adopt context management procedures that will ensure the independent probative value of that evidence.

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