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Cognitive Bias and Blindness: A Global Survey of Forensic Science Examiners

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Exposure to irrelevant contextual information prompts confirmation-biased judgments of forensic science evidence (Kassin, Dror, & Kukucka, 2013). Nevertheless, some forensic examiners appear to believe that blind testing is unnecessary. To assess forensic examiners' beliefs about the scope and nature of cognitive bias, we surveyed 403 experienced examiners from 21 countries. Overall, examiners regarded their judgments as nearly infallible and showed only a limited understanding and appreciation of cognitive bias. Most examiners believed they are immune to bias or can reduce bias through mere willpower, and fewer than half supported blind testing. Furthermore, many examiners showed a *bias blind spot* (Pronin, Lin, & Ross, 2002), acknowledging bias in other domains but not their own, and in other examiners but not themselves. These findings underscore the necessity of procedural reforms that blind forensic examiners to potentially biasing information, as is commonplace in other branches of science.

Keywords: Confirmation bias, Blind testing, Expert decision-making, Forensic science, Bias blind spot

General Audience Summary

Forensic science errors have been found in many cases where innocent people were wrongly convicted of crimes. Research suggests that some of these errors may be due to *confirmation bias*—the tendency to interpret new information in ways that confirm one's pre-existing beliefs. Some forensic labs have taken steps to protect against confirmation bias, while others have resisted doing so. To better understand forensic scientists' beliefs about bias, we surveyed over 400 professional forensic scientists from 21 countries. Although most agreed that bias is a problem in forensic science, few believed that bias affects them personally. Many also opposed procedures that are commonly used to prevent bias in other branches of science, and instead felt that willpower alone can prevent bias. We hope that our results can be used to encourage science-based reforms that will maximize the value of forensic science evidence.

Decades of psychological research have established that perception and decision-making are vulnerable to a host of confirmation biases—as seen in the tendency to seek out, select, and interpret information in ways that validate one's pre-existing beliefs or expectations (Nickerson, 1998). Recently, scholars have observed and documented these pernicious tendencies in the criminal justice system (Dror, 2016; Dror & Cole, 2010; Saks, Risinger, Rosenthal, & Thompson, 2003; Simon, 2012). In a target article published in the *Journal of Applied Research in Memory and Cognition*, Kassin, Dror, and Kukucka (2013) coined the term *forensic confirmation bias* to summarize the various ways in which one's beliefs, motives, and situational context have been shown to affect the collection and evaluation of evidence during the course of a criminal case.

The National Academy of Sciences (2009), the National Commission on Forensic Science (2015), and the President's

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Council of Advisors on Science and Technology (2016) have each identified confirmation bias as a potential cause of forensic science error, noting that such errors are prevalent in DNA exoneration cases (i.e., 46% of wrongful convictions identified by the Innocence Project; www.innocenceproject.org). Indeed, studies of professional forensic examiners have shown that irrelevant contextual information can distort their judgment. In one of the earliest such studies, latent fingerprint experts changed 17% of their own prior judgments of the same fingerprints when given different contextual information (Dror & Charlton, 2006; see also Stevenage & Bennett, 2017). In another study, blood pattern analysts' error rates nearly doubled when irrelevant contextual information suggested the presence of a particular pattern (Taylor, Laber, Kish, Owens, & Osborne, 2016). Similar effects have been found among experts in other forensic domains as well, such as arson investigation (Bieber, 2012), crime scene investigation (van den Eeden, de Poot, & van Koppen, 2016), forensic anthropology (Nakhaeizadeh, Dror, & Morgan, 2014; Nakhaeizadeh, Morgan, Rando, & Dror, 2017), forensic pathology (Oliver, 2017), and analysis of complex DNA mixtures (Dror & Hampikian, 2011; see Kukucka, 2018, for a review; see Dror, 2016, for a theoretical model of how bias impacts observations and judgments made by forensic experts).

To prevent bias-induced error, the President's Council of Advisors on Science and Technology (2016) noted "the importance of blinding [forensic science] practitioners to potentially biasing information" (p. 33). As standard practice, biomedical researchers demand the use of double-blind protocols in clinical drug trials (Kaptchuk, 1998) and psychological scientists strive to keep experimenters blind to conditions and/or hypotheses (Rosenthal, 1966). However, forensic examiners appear to disagree over the value of blind testing. While several laboratories have adopted procedures that shield examiners from irrelevant contextual information (e.g., Archer & Wallman, 2016; Found & Ganas, 2013), other examiners have argued that their training and expertise renders them immune to bias (e.g., Leadbetter, 2007) or that bias can be overcome by sheer willpower (Butt, 2013).

As it stands, it is not clear whether these latter opinions are normative or anomalous—nor whether opposition to blind testing is widespread among forensic experts. With this in mind, we aimed to measure the consensus and/or differences of opinion among forensic examiners on a range of bias-related issues. Specifically, we surveyed a global sample of forensic examiners as to their beliefs about the scope and nature of cognitive bias in the forensic sciences. As a secondary aim, we also sought to explore whether examiners differ in their beliefs about bias as a function of their experience or domain of specialization. We also compared the beliefs of bias-trained and -untrained examiners.

Method

Participants

Our sample included 403 professional forensic examiners (219 women, 183 men, and one who did not report gender) who were recruited via the electronic mailing lists of various professional forensic science organizations.[1] On average, examiners were 44.02 years old ($SD = 11.39$) and had 14.46 years of experience ($Mdn = 13$; $SD = 9.60$). Virtually all examiners held a college (42.43%), masters (38.71%), or doctoral (10.67%) degree.

Our sample included examiners from 21 different countries (*Mode* = United States; 82.38%) and a range of different forensic science domains, with the most common being biology and DNA (24.07%), latent fingerprint examination (14.64%), questioned document examination (e.g., handwriting identification; 8.68%), toxicology (6.20%), and firearm/toolmark examination (5.96%). Some examiners (17.62%) also reported having worked in multiple domains. Most (57.57%) currently worked in large laboratories (i.e., 21+ employees), while others worked alone (6.95%) or in very small laboratories (i.e., five or fewer employees; 8.44%). Most examiners reported having worked either exclusively (28.29%) or mostly (46.40%) for the prosecution; virtually none had worked either exclusively (0.25%) or mostly (0.74%) for the defense. The average (i.e., median) examiner estimated having worked on 1000 cases in their career (IQR = 487.75–4825) and having testified in court 25 times (IQR = 7–80.75).[2]

Procedure

Recruitment e-mails directed examiners to a password-protected survey website. After entering the password and giving electronic consent, they answered questions about their demographic (i.e., age, gender, location, education level) and professional background (i.e., current domain of specialization, years of experience, size of laboratory, number of cases worked, number of times testifying in court). They were also asked to estimate the accuracy rates of judgments in their domain and of their own judgments. On the next page, examiners read the following definition of cognitive bias:

> "In recent years, there has been some debate over whether forensic examiners are subconsciously influenced by prior beliefs and expectations formed on the basis of contextual information (e.g., a detective's opinion, evidence from other forensic domains, a suspect's criminal history, a confession, an eyewitness) that is irrelevant to the forensic samples they are evaluating. This phenomenon has been referred to as *cognitive bias*."

[1] Our goal was to obtain as many respondents as possible. Because we do not know how many examiners received our e-mails, the response rate is unknown. A total of 540 examiners began the survey (i.e., provided a password and consent). Of these, 137 were not included in our final sample—six (4.38%) who entered an incorrect password, 96 (70.07%) who exited the survey immediately after providing consent, and 35 (25.55%) who provided consent and demographic information but did not answer any of the 13 bias-related items.

[2] Examiners answered these items in an open-ended fashion. For those who gave a range (e.g., "50–100"), we recoded their response as the midpoint of that range. Inexact (e.g., "thousands") and/or non-numeric (e.g., "no idea") responses were excluded. Statistics for these two items are thus based on the responses of 370 and 396 examiners, respectively.

On a new page, examiners then responded to 13 items which assessed their opinions as to the scope (three items) and nature (ten items) of cognitive bias in forensic science. On the final page, examiners were asked whether they had ever received any training about cognitive bias, and if so, to explain when, where, and by whom the training was given. Overall, 58.06% of our sample ($n = 234$) reported having received training in cognitive bias; 40.69% ($n = 164$) reported that they had not received any such training.[3]

All procedures were approved by and performed in accordance with the Institutional Review Board at the City University of New York.

Measures

Estimated accuracy. Two open-ended items asked examiners to estimate the overall accuracy rate (0–100%) of judgments in their domain of specialization, and the accuracy rate of their own judgments. For examiners who gave a range (e.g., "95–100%"), we recoded their response to the midpoint of the range. Those who gave inexact (e.g., "more than 80%") or non-numeric (e.g., "I don't know") responses were excluded. As a result, analyses of these two items are based on the responses of $n = 335$ and 341 examiners, respectively.

Scope of bias. Three parallel items gauged examiners' opinions about the scope of cognitive bias in the forensic sciences (Table 1). First, we asked if they felt that cognitive bias was a cause for concern in the forensic sciences *as a whole*. Second, we asked if they felt that cognitive bias was a cause for concern *in their own domain* of forensic science. Third, we asked if they felt that *their own judgments* are influenced by cognitive bias. Each of these items included response options of "Yes," "No," and "I don't know." All examiners responded to the first two items; two examiners (0.50%) did not respond to the third item.

Nature of bias. Examiners read ten statements about the nature of cognitive bias in the forensic sciences (Table 2). For each, examiners were instructed to rate how strongly they agree or disagree with that statement as it pertains to the domain in which they currently work. Examiners rated their agreement with each statement on a scale from 1 (Strongly Disagree) to 7 (Strongly Agree), with a rating of 4 indicating neither agreement nor disagreement. Seven examiners (1.64%) did not rate one or more of these statements, but each statement was rated by at least 400 (99.26%) examiners in our sample.

Results

Estimated Accuracy

When asked to estimate the accuracy rates of judgments in their domain and of their own judgments, examiners responded with mean estimates of 94.41% ($Mdn = 98$, range = 40–100) and 96.25% ($Mdn = 99$, range = 50–100), respectively. Overall, examiners who responded to both items ($n = 328$) estimated their own accuracy rate ($M = 96.16$, $SD = 7.94$) to be higher than the overall accuracy rate for their domain ($M = 94.41$, $SD = 8.86$), $t(327) = 4.88$, $p < .001$, $d = 0.27$, 95% CI [0.15, 0.39]. Notably, 148 examiners (36.72% of the total sample) reported a belief that their own judgments are 100% accurate.

Table 1
Beliefs (%) about the Scope of Bias

	Yes	No	Don't know
In your opinion, is cognitive bias a cause for concern in the forensic sciences *as a whole*?	70.97	17.37	11.66
In your opinion, is cognitive bias a cause for concern in *your specific domain* of forensic science?	52.36	36.97	10.67
In your opinion, are *your own judgments* influenced by cognitive bias?	25.69	54.11	20.20

Scope of Cognitive Bias

As shown in Table 1, most examiners (71%) felt that cognitive bias was a cause for concern in the forensic sciences as a whole, but fewer (52%) saw bias as a cause for concern in their domain, and even fewer (26%) felt that their own judgments are influenced by bias. After excluding "I don't know" responses, a Cochran's Q test confirmed that examiners were decreasingly likely to answer "yes" to these three items, $Q(2) = 147.86$, $p < .001$, $\eta^2_Q = .27$ (Serlin, Carr, & Marascuilo, 1982).

Notably, 22.38% of examiners who believed that cognitive bias *is* a cause for concern in the forensic sciences as a whole also believed that bias *is not* a concern in their own domain. Similarly, 31.10% of those who believed that cognitive bias *is* a cause for concern in their own domain also believed that their own judgments *are not* influenced by bias.

Nature of Cognitive Bias

Table 2 shows the frequency of agreement ratings for each of our ten statements about the nature of cognitive bias. Table 3 shows the mean level of agreement with each statement, and the results of a one-sample t-test comparing this mean against the scale midpoint (i.e., four, which reflects neither agreement nor disagreement).

Are examiners vulnerable to bias? Overall, 68.8% of our sample agreed (either strongly, moderately, or slightly) that an examiner's expectations can influence his or her *analysis*, while only 25.9% disagreed (either strongly, moderately, or slightly) with this statement (Item #1; $d = 0.39$). However, they were divided as to whether an examiner's expectations can affect their *ultimate opinion* (Item #2; 55.9% agreed vs. 37.4% disagreed; $p = .079$). Similarly, while our sample recognized that examiners sometimes know what conclusion they are expected to find (Item #8; 63.6% agreed vs. 25.3% disagreed; $d = 0.32$), they

[3] Examiners' descriptions of the "training" they had received varied greatly. Of those who reported prior training, 64.53% ($n = 151$) cited a workshop or conference presentation given by one or more of the authors as all or part of their "training." Other commonly reported forms of training included undergraduate and graduate courses, in-house sessions at their own agency, and presentations at professional conferences.

Table 2
Frequencies (%) of Beliefs about the Nature of Bias

	Strongly disagree	Disagree	Slightly disagree	Neutral	Slightly agree	Agree	Strongly agree
1. An examiner's prior beliefs and expectations can affect how s/he goes about analyzing a forensic sample.	6.2	15.2	4.5	5.2	22.7	**37.4**	8.7
2. An examiner's prior beliefs and expectations can affect his or her ultimate opinion about a forensic sample.	9.2	19.5	8.7	6.7	25.2	**25.7**	5.0
3. An experienced examiner is less likely than a new examiner to be influenced by prior beliefs and expectations.	8.8	**24.0**	14.0	21.8	11.8	15.5	4.3
4. An examiner who makes a conscious effort to set aside his or her prior beliefs and expectations is less likely to be influenced by them.	2.0	6.8	6.0	14.0	18.5	**37.3**	15.5
5. Having access to irrelevant contextual information can help forensic examiners make more accurate judgments.	19.5	**27.9**	8.0	21.2	11.5	8.7	3.2
6. Having access to irrelevant contextual information makes a forensic examiner's job more interesting.	7.2	14.7	3.2	**30.1**	19.2	21.9	3.7
7. To the extent possible, examiners in my domain should be shielded from irrelevant contextual information.	5.8	16.3	9.3	20.0	14.0	**24.0**	10.8
8. Examiners sometimes know what conclusion they are expected to find.	8.2	11.9	5.2	10.9	24.6	**31.8**	7.2
9. When examiners know what they are expected to find, it affects the conclusions they reach.	17.5	**26.8**	11.3	13.5	17.3	10.8	3.0
10. Cognitive bias is generally less of a problem in my specialty domain than in other domains of forensic science.	7.7	15.2	9.2	**23.6**	12.7	21.6	10.0

Note. Modal responses are shown in bold.

Table 3
Means and One-Sample t-Tests for Beliefs about the Nature of Bias

	M (*SD*)	*t*	*p*	*d*	95% CI
1. An examiner's prior beliefs and expectations can affect how s/he goes about analyzing a forensic sample.	4.70 (1.80)	7.80	<.001	0.39	0.29, 0.49
2. An examiner's prior beliefs and expectations can affect his or her ultimate opinion about a forensic sample.	4.16 (1.85)	1.76	.079	0.09	−0.01, 0.19
3. An experienced examiner is less likely than a new examiner to be influenced by prior beliefs and expectations.	3.67 (1.71)	−3.84	<.001	−0.19	−0.29, −0.10
4. An examiner who makes a conscious effort to set aside his or her prior beliefs and expectations is less likely to be influenced by them.	5.14 (1.51)	15.08	<.001	0.75	0.64, 0.86
5. Having access to irrelevant contextual information can help forensic examiners make more accurate judgments.	3.16 (1.74)	−9.64	<.001	−0.48	−0.58, −0.38
6. Having access to irrelevant contextual information makes a forensic examiner's job more interesting.	4.20 (1.62)	2.46	.014	0.12	0.02, 0.22
7. To the extent possible, examiners in my domain should be shielded from irrelevant contextual information.	4.35 (1.79)	3.93	<.001	0.20	0.10, 0.30
8. Examiners sometimes know what conclusion they are expected to find.	4.56 (1.77)	6.37	<.001	0.32	0.22, 0.42
9. When examiners know what they are expected to find, it affects the conclusions they reach.	3.31 (1.78)	−7.83	<.001	−0.39	−0.49, −0.29
10. Cognitive bias is generally less of a problem in my specialty domain than in other domains of forensic science.	4.23 (1.80)	2.58	.010	0.13	0.03, 0.23

denied that this knowledge affects their conclusions (Item #9, 31.1% agreed vs. 55.6% disagreed; $d = -0.39$).

How should bias be addressed? Our sample most strongly believed that examiners who try to set aside their expectations are less likely to be influenced by them (Item #4; $d = 0.75$); 71.3% agreed with this statement whereas only 14.8% disagreed. A plurality of examiners (48.8%) agreed that examiners should be shielded from irrelevant contextual information, but another 31.4% felt that examiners should *not* be shielded from such information, and 20% neither agreed nor disagreed (Item #7; $d = 0.20$).

Comparison of Bias-Trained and -Untrained Examiners

Bias-untrained examiners were less likely than bias-trained examiners to view cognitive bias as a cause for concern in the forensic sciences as a whole (61.59% vs. 77.78%),

$\chi^2(2, N = 398) = 12.40$, $p = .002$, Cramér's $V = .18$, 95% CI [.08, .27], in their own forensic domain (39.63% vs. 61.11%), $\chi^2(2, N = 398) = 18.39$, $p < .001$, $V = .22$, [.12, .31], and in their own judgments (11.66% vs. 35.62%), $\chi^2(2, N = 396) = 28.91$, $p < .001$, $V = .27$, [.17, .37].

Table 4 compares bias-trained and -untrained examiners in terms of their agreement with our ten statements about the nature of bias. Compared to their trained counterparts, bias-untrained examiners less strongly believed that an examiner's expectations can influence their ultimate opinion (Item #2; $d = 0.40$), that examiners are affected by knowing what conclusion they are expected to find (Item #9; $d = 0.38$), and that examiners should be shielded from irrelevant contextual information (Item #7; $d = 0.47$).

Effects of Experience and Domain

Experience. A series of multinomial logistic regressions showed that years of experience as a forensic examiner did not predict responses to any of the three questions about the scope of bias, all Wald $\chi^2 < 0.67$, $p > .41$. Likewise, years of experience did not correlate with agreement ratings for any of the ten statements about the nature of bias, all $|r| < .10$, $p > .06$.

Domain. To compare beliefs across forensic areas of specialization, we focused on the five domains that were the most highly represented in our sample (i.e., biology and DNA analysis, latent fingerprint examination, questioned document examination, toxicology, and firearm/toolmark examination; all $ns \geq 24$). Domain was somewhat confounded with training, $\chi^2(4) = 16.00$, $p = .003$, $V = .26$, such that toxicologists were less likely to have had training relative to the other four groups, which did not differ from each other, $\chi^2(3) = 6.12$, $p = .106$, $V = .17$. Therefore, we excluded toxicologists and compared the remaining four groups.

As shown in Table 5, examiners from the four domains were equally likely to believe that cognitive bias is a cause for concern in the forensic sciences as a whole and in their own judgments. On the domain-specific question, however, questioned document examiners were more likely to see cognitive bias as a problem in their own domain (80.0%) than were firearm/toolmark examiners (54.2%) and biology/DNA examiners (46.4%), none of whom differed from latent fingerprint examiners (64.4%).

A one-way MANOVA revealed a multivariate effect of domain on beliefs about the nature of bias, Wilks' $\Lambda = .53$, $F(30, 581.85) = 4.75$, $p < .001$, with significant differences on seven of the ten items (see Table 5). Notably, compared to the other three groups, biology/DNA examiners more strongly believed that bias was less of a problem in their own domain (Item #10), that irrelevant contextual information could improve their accuracy (Item #5) and that they should not be shielded from irrelevant contextual information (Item #7).

Discussion

Despite ample research showing that forensic science experts are influenced by irrelevant contextual information (e.g., a detective's opinion, a suspect's confession, forensic evidence from other domains; see Kassin et al., 2013), our findings suggest that many examiners have only a limited appreciation of cognitive bias or see themselves as impervious to it. Overall, our respondents believed their own judgments to be nearly infallible, including 37% who self-reported a 100% accuracy rate. Although they recognized that examiners sometimes form expectations that can influence their analysis, they denied that these expectations affect their conclusions. Moreover, while most examiners acknowledged cognitive bias as a cause for concern in other forensic domains, fewer saw their own domain as vulnerable, and still fewer saw themselves as vulnerable. This pattern suggests that many examiners maintain a *bias blind spot*—they tend to recognize biases in others while denying the existence of those same biases in themselves (Pronin, Lin, & Ross, 2002). While this phenomenon has been amply documented in laypeople (e.g., Ehrlinger, Gilovich, & Ross, 2005; Pronin et al., 2002; West, Meserve, & Stanovich, 2012), very few studies have found evidence of a bias blind spot in judgments made by trained professionals (for an exception, see Steinman, Shlipak, & McPhee, 2001). Our study thus extends this phenomenon to a new population by showing that many forensic examiners tend to see their own judgments as unbiased while simultaneously recognizing that bias affects their peers. Examiners' lack of self-insight in this regard has profound implications for how they do their work (e.g., if they take steps to protect themselves against bias; see Dror et al., 2015) and how they present their findings in the courtroom (e.g., how they characterize their own accuracy and susceptibility to bias, which may well influence judicial decision-making).

Many respondents also showed a limited understanding of how to effectively mitigate bias. In our sample, forensic examiners were divided over whether they should be blinded to irrelevant contextual information (49% for, 31% against); indeed, 71% believed that examiners can reduce bias by simply trying to ignore their expectations. The latter finding suggests that many forensic examiners misconstrue cognitive bias as a motivational or ethical issue that can be overcome through sheer willpower, rather than an intrinsic feature of human nature that mediates judgments automatically (Klayman & Ha, 1987) and without awareness (Kunda, 1990). With this in mind, future efforts to educate examiners about cognitive bias should emphasize the fact that bias is innate and universal, and can therefore affect even well-intentioned and competent forensic examiners (Dror, Kassin, & Kukucka, 2013).

Notably, examiners with no prior training about cognitive bias more strongly believed that examiners are immune to bias and more strongly opposed blind testing. They also showed a more pronounced bias blind spot: compared to bias-trained examiners, untrained examiners were 26% less likely to see bias as a problem in the forensic sciences, 54% less likely to see bias as a problem in their own domain, and 305% less likely to see their own judgments as vulnerable to bias. These untrained examiners likely constitute a more representative sample of forensic examiners worldwide than our sample as a whole, which included a slight majority of bias-trained examiners. Hence, although our findings paint a rather bleak picture of the extent to which forensic science examiners understand bias and are willing to confront

Table 4
Bias-Trained and -Untrained Examiners' Beliefs about the Nature of Bias

	Trained*M* (*SD*)	Untrained*M* (*SD*)	*t*	*p*	*d*	95% CI
1. An examiner's prior beliefs and expectations can affect how s/he goes about analyzing a forensic sample.	4.91 (1.74)	4.41 (1.86)	2.73	.007	0.28	0.10, 0.46
2. An examiner's prior beliefs and expectations can affect his or her ultimate opinion about a forensic sample.	4.45 (1.81)	3.73 (1.83)	3.88	<.001	0.40	0.22, 0.58
3. An experienced examiner is less likely than a new examiner to be influenced by prior beliefs and expectations.	3.57 (1.66)	3.78 (1.76)	−1.22	.224	−0.12	−0.29, 0.04
4. An examiner who makes a conscious effort to set aside his or her prior beliefs and expectations is less likely to be influenced by them.	4.97 (1.64)	5.36 (1.29)	−2.58	.010	−0.26	−0.41, −0.11
5. Having access to irrelevant contextual information can help forensic examiners make more accurate judgments.	3.03 (1.77)	3.35 (1.65)	−1.85	.066	−0.19	−0.36, −0.02
6. Having access to irrelevant contextual information makes a forensic examiner's job more interesting.	4.22 (1.66)	4.20 (1.57)	0.11	.914	0.01	−0.15, 0.17
7. To the extent possible, examiners in my domain should be shielded from irrelevant contextual information.	4.70 (1.85)	3.88 (1.59)	4.60	<.001	0.47	0.30, 0.64
8. Examiners sometimes know what conclusion they are expected to find.	4.62 (1.85)	4.48 (1.64)	0.77	.440	0.08	−0.10, 0.25
9. When examiners know what they are expected to find, it affects the conclusions they reach.	3.57 (1.85)	2.91 (1.61)	3.62	<.001	0.38	0.20, 0.55
10. Cognitive bias is generally less of a problem in my specialty domain than in other domains of forensic science.	4.03 (1.83)	4.53 (1.71)	−2.76	.006	−0.28	−0.46, −0.11

Table 5
Beliefs about the Scope and Nature of Bias across Forensic Domains

	Biology and DNA ($n=96$)	Latent fingerprints ($n=58$)	Questioned documents ($n=33$)	Firearms and toolmarks ($n=24$)			
Scope of bias (%)					$\chi^2(6)$	*p*	*V*
General	76.29	71.19	85.71	70.83	4.09	.665	.10
Domain	46.39_a	64.41_{ab}	80.00_b	54.17_a	16.93	.010	.20
Self	19.59	25.42	26.47	33.33	6.44	.376	.12
Nature of bias (M [SD])					$F_{(3,207)}$	*p*	η_p^2
Item #1	4.49 (1.85)	5.07 (1.54)	5.27 (1.59)	4.71 (1.92)	2.31	.077	.03
Item #2	3.79_a (1.87)	4.41_{ab} (1.75)	4.91_b (1.77)	4.42_{ab} (1.79)	3.69	.013	.05
Item #3	3.49_a (1.60)	3.66_{ab} (1.90)	4.15_{ab} (1.54)	4.50_b (1.64)	3.04	.030	.04
Item #4	4.96 (1.65)	5.31 (1.49)	5.52 (1.23)	5.38 (1.47)	1.47	.223	.02
Item #5	3.57_a (1.75)	2.72_b (1.60)	2.52_b (1.54)	2.46_b (1.62)	6.05	.004	.08
Item #6	4.73_a (1.65)	4.02_{ab} (1.69)	3.97_{ab} (1.59)	3.63_b (1.69)	4.49	.004	.06
Item #7	3.83_a (1.77)	4.95_b (1.66)	5.64_b (1.14)	4.96_b (1.94)	12.01	<.001	.15
Item #8	4.43_a (1.79)	4.26_a (1.91)	5.52_b (1.37)	4.63_{ab} (1.66)	4.04	.008	.06
Item #9	3.18 (1.72)	3.16 (1.82)	3.79 (1.73)	3.33 (1.52)	1.17	.322	.02
Item #10	5.16_a (1.58)	3.45_b (1.51)	2.88_b (1.62)	3.54_b (1.50)	25.81	<.001	.27

Note. For the three Scope of Bias items, values reflect the percentage of examiners who believed that bias is a cause for concern. Means or percentages not sharing a common subscript differ at $p < .05$.

it, our results may very well underestimate the magnitude of the problem.

Although bias-trained examiners held somewhat more enlightened beliefs about the nature of bias, their greater appreciation of bias does not imply immunity. According to Wilson and Brekke's (1994) model of mental contamination and correction, being aware of one's biases and motivated to correct them are necessary—but not sufficient—conditions for overcoming their effects (see also Lilienfeld, Ammirati, & Landfield, 2009, for a review of debiasing techniques and their effectiveness). However, because we measured examiners' *beliefs* about bias and not its actual impact on their judgments, we cannot say whether examiners who are less knowledgeable about bias are also more susceptible to it, or vice versa. The absence of a performance measure raises two additional limitations with respect to the interpretation of our results. First, insofar as individual differences in biasability may exist among examiners (Dror, 2016), we cannot fully evaluate the accuracy of examiners' self-reported vulnerability to bias. That is to say, the examiners who reported that they are affected by bias may or may not be those who are actually most affected by it. Second, it is possible that our data do not demonstrate a bias blind spot; perhaps examiners accurately reported their own susceptibility to bias (or lack thereof) and overestimated the susceptibility of their peers. Although we believe this to be unlikely, we cannot definitively rule out this possibility. Future work should directly test the relationship between bias awareness and vulnerability by comparing examiners' beliefs about bias against those same examiners' tendency to be influenced by irrelevant contextual information.

Moreover, it is important to note that the observed differences between bias-trained and -untrained respondents cannot easily be interpreted. On the one hand, it is possible that such training heightened their sensitivity to cognitive bias; on the other hand, trained examiners may have actively sought out these opportunities, thereby representing a self-selected group of examiners who were already open-minded and concerned. Although our data cannot differentiate between these interpretations, future research should consider the possible benefits of bias training. To that end, a fully randomized study is needed to properly investigate any effects of such training on forensic examiners' beliefs or performance.

Alternatively, one can prevent bias by adopting an *exposure control* approach (Gilbert, 1993), which involves taking measures (either on one's own or via external intervention) to prevent exposure to potentially biasing information in the first place. In the forensic sciences, Dror et al. (2015) have advocated for the use of *Linear Sequential Unmasking* (LSU) protocols, which take an exposure control approach by regulating the flow of information to examiners and insulating them from task-irrelevant information. A key advantage of LSU is that it also allows for the possibility that some degree of contextual information may be beneficial—or even essential—to an examiner's analysis. With this in mind, LSU gives examiners the freedom to revise their initial (i.e., context-free) judgments in light of additional task-relevant information, provided that they document any such revisions. Several forensic laboratories that have adopted LSU have reported that its implementation was not onerous or expensive, and that it has noticeably increased confidence in the validity of the examiners' judgments (e.g., Archer & Wallman, 2016; Found & Ganas, 2013). As such, it is becoming increasingly clear that forensic sciences stand to benefit from embracing the same blind testing procedures that have long been commonplace in psychology and other sciences.

Conflict of Interest Statement

The authors declare no conflict of interest.

Author Contributions

All authors developed the study concept. J. Kukucka, S. Kassin, and I. Dror developed study materials and recruited participants. J. Kukucka performed the data analysis and interpretation. J. Kukucka and S. Kassin drafted the manuscript. I. Dror and P. Zapf provided critical revisions. All authors approved the final version of the manuscript for submission.

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