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Author(s): William C. Thompson

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***Developing Effective Methods for Addressing Contextual Bias in Forensic
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PI: William C. Thompson, Professor

william.thompson@uci.edu

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University of California,

Irvine, California 92697

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Final Summary Overview

William C. Thompson

William C. Thompson, PI

Introduction

In 2009, the National Research Council (NRC) identified a number of weaknesses in the scientific foundations of forensic science (NRC, 2009). One concern was that “forensic science experts are vulnerable to cognitive and contextual bias” that “renders experts vulnerable to making erroneous identifications.” (p. 4, note 8).

These concerns have considerable empirical support. There is a large psychological literature showing that human beings are susceptible to contextual bias, that people can be biased without being aware of it, and that even well-trained experts are susceptible to bias (for reviews of this literature, *see* Risinger et al., 2002; Thompson, 2009a; Kassin et al., 2013). Empirical studies have shown that forensic scientists in a number of disciplines are vulnerable to contextual bias (Kassin et al., 2013). Indeed, one commentator has suggested that forensic scientists might be *particularly* vulnerable to bias, given the nature of their expertise and how they perform examinations (Dror, 2011).

To address these concerns, academic commentators have encouraged forensic scientists to make greater use of “blinding” or “masking” procedures designed to shield analysts from exposure to task-irrelevant information that might inadvertently influence them (Risinger et al. 2002; Krane et al. 2008; Dror et al., 2015). But these proposals face a number of conceptual and practical difficulties (see e.g., Butt, 2013; Charlton, 2013; Budowle et.al., 2009; Ostrum, 2009; Wells, 2009). Forensic laboratories are complex organizations, in which the task of evaluating evidence is distributed across a number of individuals. Some of these individuals need to be informed about the context of a case in order to do their jobs properly (see e.g. Butt, 2013). For example, to decide what samples to collect at a crime scene and what examinations or analyses are needed, laboratory personnel must communicate with the police about the nature of the case and the information that the police need to solve it. To combine findings from multiple examinations (e.g., bloodstain patterns and DNA analysis of the blood) into an integrated interpretation of what happened at the crime scene, laboratory personnel may also need information about the context. Even those forensic scientists who confine themselves to addressing “source-level” hypotheses—i.e., whether two items have a common source—may need contextual information about the history of the samples (e.g., the environment in which they were collected, their likely age) in order to make an intelligent assessment.

This research project explored ways to address the problem of contextual bias in forensic science, taking account of the practical difficulties of implementing blinding or masking procedures, and considering ways to assure that forensic examiners have access to the information they need to perform a rigorous scientific examination while also (to the extent possible) shielding them from exposure to contextual information that is unnecessary and potentially biasing. This project focused on three general approaches to managing of contextual information: (1) the “case manager model” (Thompson, 2011; Stoel et al., 2015; Found and Ganas, 2013) which separates functions in the laboratory between case managers and examiners

in order to allow managers to be fully informed about context while examiners are provided only the information needed for the specific analytic tasks they are asked to perform; (2) “sequential unmasking” (Krane et al. 2008; Stoel et al., 2015), also called “linear sequential unmasking” (LSU) (Dror, et al., 2015), which sequences the order of various analytic tasks in order to assure that examiners make certain key analytic judgments before being exposed to potentially biasing information; and (3) blind re-examination, in which key judgments of an initial non-blind examiner are replicated by a second examiner who has not been exposed to potentially biasing information.

To explore the practical aspects of implementing these context management procedures, this project included three distinct lines of research. The first empirical component of the project consisted of interviews with laboratory directors and section heads about the way they view the issue of contextual bias and their opinions on the need for—and practicality of—various bias-reduction procedures. To take account of the possibility that attitudes on this issue vary across different types of legal systems (adversarial vs. inquisitorial) and different administrative environments (specifically, whether the laboratory was operated by a law enforcement agency or was independent of law enforcement), we made an effort to interview managers who operated in adversarial legal system as well as managers who operated in inquisitorial legal systems; within each system, we included participants from law enforcement labs and from labs independent of law enforcement.

The project also included studies that allowed a detailed examination of the decision-making process of forensic examiners in two disciplines: bloodstain pattern analysis and handwriting analysis. The focused research in these two disciplines explored, at a very high level of detail, the role that contextual information plays in the decision making process of professional examiners and how examiners’ access to such information might be managed. The research included both interviews and an experimental study in which examiners were asked to evaluate realistic case materials under controlled conditions. The interviews included “think aloud” studies in which forensic scientists were asked to explain their reasoning process as they thought through actual or hypothetical case evidence.

The ultimate goal of the research project was the development of practical protocols for managing contextual information which could be implemented by bloodstain pattern analysts and handwriting analysts. While the project focused primarily on those two disciplines, we believe the protocols we have developed will be useful to forensic scientists in other pattern matching disciplines as they consider ways to improve their laboratory SOP’s and protocols in an effort to address the problem of contextual bias.

Task-Relevance

Early in the project we identified a key conceptual issue that needed to be addressed: when is it appropriate for a forensic scientist to be influenced by contextual information, and when does

such influence constitute a bias? We found during interviews that forensic scientists often disagreed about whether a particular item of contextual information should or should not be considered when drawing conclusions. The question of what contextual factors should (and should not) be considered by a forensic examiner had not previously been addressed in the forensic science literature. Although academic commentators had discussed the need for forensic scientists to confine themselves to “domain-relevant information (Risinger et al., 2002), that term was never rigorously defined. Moreover, the key question that emerged from the interviews was not whether a particular item of contextual information might, at some point, be relevant to experts in a particular domain, but when and whether the contextual information is relevant to a particular scientific task.

To address this question on a conceptual level, the PI wrote and published a chapter in an edited volume:

Thompson, W.C. (2015). Determining the Proper Evidentiary Basis for an Expert Opinion: What Do Experts Need to Know and When Do They Know Too Much? In C. Robertson & A. Kesselheim (Eds.) *Blinding as a Solution to Bias: Strengthening Biomedical Science, Forensic Science, and Law*. Elsevier, Inc. pp. 133-150.

This chapter used a mathematical analysis involving conditional probabilities to explore the ways in which contextual information might be relevant to a forensic scientist’s interpretation of physical evidence, and proposed criteria for determining whether a forensic scientist should and should not consider a particular item of contextual information.

About the same time, the National Commission on Forensic Science took up the important issue of what information is task-relevant for a forensic science. The PI served as a member of the Human Factors Subcommittee of the National Commission. Relying on the analysis emerging from this project, the PI helped to draft a “views document” on the topic that was unanimously adopted by the National Commission in December 2015:

National Commission on Forensic Science. *Views Document: Ensuring That Forensic Analysis is Based on Task-Relevant Information*. December 2015. Available at: <https://www.justice.gov/ncfs/file/818196/download>

According to the Commission, information is “task-relevant” only if it helps the examiner draw conclusions “*from the physical evidence that has been designated for examination*” and “*through the correct application of an accepted analytic method...*”

This Commission document has been the basis for much discussion within the Organization of Scientific Area Committees for Forensic Science (OSAC) concerning the proper basis for scientific opinions in various forensic science disciplines. Understanding what is, and is not, task-relevant is a necessary first step when analyzing ways to address contextual bias. It is also, obviously, an issue of fundamental importance for forensic science generally.

Interviews and Survey of Laboratory Managers

We conducted detailed interviews with 56 laboratory directors and/or section heads from 11 agencies around the world (North America, New Zealand, Australia, Netherlands, Switzerland). Participants represented a variety of agency types (law enforcement: n = 30; and institutionally separated from law enforcement: n = 23) and forensic disciplines. Twenty-three participants were from countries that operate in a so-called inquisitorial legal system (in which a neutral magistrate conducts the investigation, experts are hired by a court and operate independently from the parties), and 29 were from countries that operate in an adversarial legal system (where experts are commissioned by the prosecution or defense and work under the party's guidance. Interviews were conducted either in person, or over the phone, and were audio recorded whenever the interviewee gave permission to do so. Interviews took between approximately 45 minutes and two hours. Interviewees were promised anonymity and confidentiality.

We found a broad diversity of opinions and approaches. Several laboratories had already adopted context management procedures and their experience was valuable in illustrating what approaches are practical. In some instances, approaches that had been dismissed as impractical in one laboratory were being implemented successfully in another. While there are a number of practical constraints to what can be accomplished, we generally found that those claiming context management is hopelessly impractical were refuted by others who had implemented such programs. When adopted, context management had some unexpected benefits, such as improving laboratory through-put in some disciplines by reducing the time examiners spent studying irrelevant details of cases. Our interviewees generally agreed that bench-level examiners should draw conclusions from the physical evidence they are assigned to examine, and not from contextual information such as police reports. There was some disagreement, however, about when and whether examiners need to communicate with investigators to obtain information needed for a scientific analysis of the physical evidence.

We are planning to publish this work in two separate articles. The first manuscript reporting the results of this research has been prepared:

NKP Osborne, J Vuille & WC Thompson, Interviews with forensic scientists around the world, Part I: Bias, law enforcement culture, and the need for contextual information.

A second manuscript is in preparation:

NKP Osborne, J Vuille & WC Thompson, Interviews with forensic scientists around the world, Part II: Barriers to and success factors for Contextual Information Management.

We intend to complete and publish these manuscripts in the next few months.

While conducting these interviews, an opportunity arose to conduct a survey on the same topic under the auspices of the National Commission on Forensic Science. The National Commission

was interested in obtaining information about how laboratory directors in the United States view the issue of contextual bias and how to deal with it. Drawing on materials developed through this project, the PI assisted in drafting a questionnaire which was emailed to the membership of the American Society of Crime Laboratory Directors. Responses were obtained from 174 of 488 ASCLD members. The PI analyzed the findings and presented a summary to the National Commission:

WC Thompson, Human Factors Subcommittee, Survey of ASCLD Members on Contextual Bias in Forensic Science. Presented to the National Commission on Forensic Science, March 21, 2016.

The findings indicated that most ASCLD members recognize contextual bias as a potential problem but are divided on the best way to address it. While some laboratories have begun to introduce context management procedures, such as sequential unmasking, the majority have not yet done so.

Focused Research On Bloodstain Pattern Analysis

We undertook a systematic program of research on the role of contextual information in bloodstain pattern analysis. Our goal was to understand the decision making process of bloodstain pattern analysts and the role that contextual information plays in decision making. We also hoped to gain insight into the types of contextual information that are task-relevant, and the types that are task-irrelevant and potentially biasing, in order to explore the viability of reducing contextual bias through context management procedures.

We have published two studies based on “think-aloud” protocols in which our researchers asked trained bloodstain pattern analysts to explain their thinking while they examined evidence from actual cases. Examiners were first shown bloodstain patterns. They were then offered various types of contextual information and asked whether (and how) it might be relevant and how it would affect their interpretation:

Osborne, N. K. P., Taylor, M. C., & Zajac, R. (2016). Exploring the role of contextual information in bloodstain pattern analysis: A qualitative approach. *Forensic Science International*, 260, 1-8.

Osborne, N.K.P., Taylor, M.C., Healey, M. & Zajac, R. (2016). Bloodstain pattern classification: Accuracy, effect of contextual information, and the role of analyst characteristics. *Science & Justice*, 56(2): 123-128.

These studies have provided important insights into the mental process of bloodstain pattern analysts while performing examinations. These studies have also revealed disagreement among analysts (and possibly some confusion) over the proper basis of an expert opinion. In particular, there is disagreement over whether the interpretation of a bloodstain pattern should follow strictly from the characteristics and features of the pattern itself, or whether the interpretation

should include a more holistic analysis of what happened at the crime scene, and thus should be influenced by witness statements, pathology reports, and other types of contextual information. The heart of the disagreement concerns the role bloodstain pattern analysts are expected to play in the legal system. Is their job simply to infer from bloodstain patterns the likely mechanism of blood deposition? Or is does their job also include crime scene analysis? And if so, should they allow the conclusions of their crime scene analysis to shape or modify their conclusions about mechanism that produced the bloodstain patterns, or should those conclusions rest solely on the features and characteristics of those patterns?

Regardless of how bloodstain pattern analysts ultimately answer such questions, it struck us as desirable and important to distinguish conclusions that flow directly from examination of bloodstain patterns themselves from conclusions that result from a more holistic contextual analysis of the crime scene. Consequently, we have recommended that laboratories take steps to separate those analyses. Based in part of the research funded by this grant, New Zealand's principle forensic science agency, ESR, developed a contextual information management protocol for bloodstain pattern evidence examined in the laboratory. Another publication funded under this grant describes a trial period during which the new protocol was adopted to test its viability. The test period was successful and the laboratory is now looking to extend the protocol to cover laboratory based examinations in other disciplines.

Osborne N. K. P., & Taylor, M. C. (2018). Contextual Information Management: An example of independent-checking in the review of laboratory-based Bloodstain Pattern Analysis. *Science & Justice*. 58(3): 226-231 <https://doi.org/10.1016/j.scijus.2018.01.001>

In addition to the peer-reviewed publications discussed so far, our research group published two letters in scientific journals concerning the research funded under this grant and its implications for forensic science practice:

Taylor, MC. & Osborne, NKP. (2018). Letter to the Editor: A contribution to Contextual Information Management in Bloodstain Pattern Analysis: Preliminary idea for a two-step method of analysis. *Journal of Forensic Sciences*, 63(1), 341.

Osborne, N. K. P. Commentary on: Lockhart, J. J., Satya-Murti, S. Diagnosing crime and diagnosing disease: bias reduction strategies in the forensic and clinical sciences. *Journal of Forensic Sciences*, <https://doi.org/10.1111/1556-4029.13453>. Epub 2017 Feb 23.

Finally, we conducted an elaborate experimental study designed to assess the ability of bloodstain pattern examiners to distinguish patterns created through four different mechanisms (impact, satellite spatter, expiration, cast-off) on the basis of the features of those patterns. The experiment also examined the way in which examiner's judgments were affected by three types of contextual information (other types of scientific evidence; investigative information; colleague's opinion). Bloodstain pattern examiners (N=46) from the United States, Canada,

Singapore, The Netherlands, and Australia each examined 12 bloodstain patterns that had been created under controlled conditions in the ESR laboratory in New Zealand and designed to simulate typical casework patterns. They were asked to evaluate two hypotheses about how each pattern was created. One hypothesis was correct—i.e., it stated the actual mechanism used to create the pattern. The other hypothesis was incorrect but was nevertheless plausible—i.e., it stated a mechanism that could not definitively be ruled out on the basis of the features observed in the pattern. The examiners made some evaluations based on the patterns themselves (without access to contextual information) and some evaluations after being exposed to contextual information that supported either the correct or incorrect hypothesis.

An article describing this experiment is currently being prepared.

Osborne, N.K.P., Taylor, M.C., Zajac, R., Thompson, W.C. (2017). Expertise, context, and de-biasing: Factors that affect bloodstain pattern interpretation.

We expect to submit it for publication early in 2019. The experiment found that examiners had a surprising degree of difficulty distinguishing the correct from second-best hypothesis regarding the mechanism that produced the 12 bloodstain patterns. Examiners' interpretations were influenced by other scientific and investigative information, but not by the reported opinion of a colleague. We expect this experiment will make an important contribution to bloodstain pattern analysis by improving understanding of the strengths and, importantly, the limitations of bloodstain pattern expertise, and by encouraging further discussion of the proper basis for examiners' conclusions.

Focused Research on Handwriting Analysis

We have also studied the decision making process of forensic handwriting examiners. The goal of this research was a detailed assessment of how handwriting examiners draw conclusions, focusing on how and when their conclusions might be influenced by contextual information and when contextual information is (and is not) relevant to their scientific task. As with bloodstain pattern analysis, our studies involved interview and “think aloud” protocols. Some preliminary results were presented at the International Association of Forensic Science:

Osborne, NKP., Kouwenhoven, M., Thompson, WC., & Zajac R. (2017) *Determining the relevance of contextual information in forensic handwriting examinations*. Paper presented at the International Association of Forensic Sciences (IAFS 2017), August 21 – 25, in Toronto, Canada.

Some of this work was also incorporated into a workshop presented at a meeting of the American Board of Forensic Document Examiners:

Osborne, NKP., Cunningham, L., & Lewis, J. (2017, August) *Write or Wrong? Bias, Decision-Making, and the role of Contextual Information in Forensic Handwriting*

Examinations. Workshop presented at the American Board of Forensic Document Examiners AGM, San Diego, August 28th-September 1st.

Marin Kouwenhoven, a doctoral candidate at the University of Otago in New Zealand, took the lead role in conducting interviews and think-aloud research with document examiners and is preparing a report of the findings as part of her dissertation in psychology. She will defend the dissertation later this year and the findings will be published thereafter.

Implications for Criminal Justice Policy and Practice

This research project has already produced some important benefits for forensic science. As noted earlier, the conceptual analysis of “task-relevance” developed with project support was incorporated into an important document issued by the National Commission on Forensic Science. That document has, in turn, proved influential with regard to standards development within OSAC.

Based on the research on bloodstain pattern analysis, co-PI Michael Taylor developed a new protocol for contextual information management that was adopted by ESR, the government forensic laboratory of New Zealand. The publication describing this new protocol, and its trial at ESR, has provided a roadmap for other laboratories that may wish to pursue more rigorous approaches to bloodstain pattern interpretation.

Based on research conducted under this project, PI William Thompson was able to contribute to academic discussion of contextual bias in other domains of forensic science. Two of his publications drew, in part, on research funded under this grant. One was a law review article that included a discussion of contextual bias and context management in the domain of forensic voice comparison:

Morrison, G.S. & Thompson, W.C. (2017). Assessing the admissibility of a new generation of forensic voice comparison testimony. *Columbia Science & Technology Law Review*, 18: 326-433.

<http://www.stlr.org/download/volumes/volume18/morrisonThompson.pdf>

The other was a general commentary on the nature of contextual bias, ways in which it might occur, and how to deal with it:

Dror, I.E., Thompson, W.C., Meissner, C.A., Kornfield, I., Krane, D., Saks, M. & Risinger, D.M. (2015). Context management toolbox: A linear sequential unmasking (LSU) approach for minimizing cognitive bias in forensic decision making. *Journal of Forensic Sciences*, 60(4): 1111-1112. DOI: 10.1111/1556-4029.12805

While these articles were not directly supported by NIJ funding, they drew on research and conceptual analysis that was supported as part of this NIJ project, and hence benefitted from that work.

The research conducted under this project has generally been well-received by forensic scientists. Post-doctoral scholar Nicola Osborne has been an invited guest of the OSAC subcommittee on bloodstain pattern analysis at several of their meetings, where she has discussed the BPA research conducted under this grant and participated in discussions of how to improve standards of practice. Dr. Osborne also presented an invited workshop on this research at a meeting of the Rocky Mountain Association of Bloodstain Pattern Analysts and was given an honorary membership in that Association.

Osborne, N. K. P., (2017, December). *The Human Factor in Bloodstain Pattern Analysis*. Workshop presented for the Rocky Mountain Association of Bloodstain Pattern Analysts meeting, Greeley, Colorado.

Additionally, Dr. Osborne presented an invited workshop at a meeting of the American Board of Forensic Document Examiners concerning the NIJ-supported work on forensic handwriting analysis:

Osborne, NKP., Cunningham, L., & Lewis, J. (2017, August) *Write or Wrong? Bias, Decision-Making, and the role of Contextual Information in Forensic Handwriting Examinations*. Workshop presented at the American Board of Forensic Document Examiners AGM, San Diego, August 28th-September 1st.

Dr. Osborne and PI William Thompson were invited to participate in discussions of the NIST Working Group on Human Factors in Forensic Document Examination. Dr. Osborne has been particularly active in that group and has participated in editing of the group's report. Dr. Osborne also received a travel award from the New Zealand Forensic Science Society to attend the Australia New Zealand Forensic Science Society conference in Perth, Australia and present results of the research funded under this grant.

These invitations and awards indicate that the forensic science community is receptive to this work and views it as a valuable contribution. We expect that the research findings discussed here will play a continuing role in future discussions of contextual bias in forensic science and will be an important factor in decisions about how best to deal with that problem.

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