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The readability of expert reports for non-scientist report-users: Reports of forensic comparison of glass

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ABSTRACT

Scientific language contains features that may impede understanding for non-scientists. Forensic scientists' written reports are read by police, lawyers, and judges, and thus assessment of readability is warranted. Past studies of readability differed in background theory and approach, but analysed one or more of: content and sequence; language; and format. Using a holistic approach, we assessed the readability of expert reports ($n = 78$) of forensic glass comparison from 7 Australian jurisdictions. Two main audiences for reports were relevant: police and the courts. Reports for police were presented either as a completed form or as a brief legal-style report. Reports for court were less brief and used either legal or scientific styles, with content and formatting features supporting these distinctions. Some jurisdictions prepared a single report to satisfy both the courts and police. In general, item list, analytical techniques, results, notes on interpretation, and conclusions were included in reports of all types. However, some reports omitted analytical techniques, and results and conclusions were sometimes combined. According to Flesch Reading Ease, language was *difficult*, with a Flesch–Kincaid grade level of *university undergraduate*. Sentences were long and contained undefined specialist terms. Information content per clause (lexical density), was typically high, as for other scientific texts. Uncertainty was expressed differently by jurisdiction. Reports from most jurisdictions were cluttered in appearance, with single-line spacing, narrow margins, and gridlines in tables. Simple suggestions, based on theory and past research, are provided to assist scientists to enhance the readability of expert reports for non-scientists.

Scientists have long provided expert opinion, or interpretations of findings, for use in police investigations and courts [1]. The difficulties for scientists in explaining their findings and expert opinions to non-scientists have been recognised as a challenge [2]. Traditionally, when using forensic science to inform operational decisions in investigations, police investigators have deferred to the expert knowledge and opinion of forensic scientists. In contrast, judges and jurors have relied upon forensic scientists facilitate their comprehension of, or educate them about, the science relevant to a case, to inform their finding of fact and decision on a verdict [3]. Similarly, lawyers require sufficient understanding of the science to examine and cross-examine effectively the expert witnesses at trial [4]. But because of the implausibility of jurors (and others) obtaining an adequate understanding of the complexity of forensic science within the context of a specific trial [2], Mnookin [1] described the educational approach to communication of expert opinion as a variant of the deferential approach.

In most court cases, forensic scientists are not summonsed to appear, and therefore, are not present to explain their reports [5]. Furthermore, investigative and pre-trial meetings between scientists and report-users do not always occur [6]. Therefore, enhancing the readability of expert reports is important as part of an approach that aims to address the issue of communicating expert opinion to non-scientists. Readability has been defined as the ease with which a text can be read because of the style of writing [7] or the functionality of a document for its audience in the context of its use [8].

This paper is the second in a programme of ongoing research that aims to address the issue of the readability of expert reports. Whilst reporting and interpretation are related, our focus is on reporting. The purpose of these papers is to contribute to the

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international discussion of how best to facilitate comprehension for the non-scientists who use expert reports. The first paper analysed conclusions written as part of an international proficiency test of forensic glass analysis [9]. In the present paper, we explore aspects of the readability of expert reports of forensic comparison of glass written by scientists in Australian jurisdictions,[1] and thus in an adversarial legal system. We describe current reporting practices, analyse holistically their readability, and suggest modifications to enhance readability. The next paper in the series is concerned with the readability of reports of DNA analysis.

1. Scientific language

A helpful perspective from which to consider scientific language is offered by the theoretical framework of systemic functional linguistics. In this framework, language is seen as a resource for making meaning in texts and contexts [11]. The use of scientific language, a specialised language, can be particularly effective when scientists communicate with others from the same field of specialised knowledge [12]. This is because in the process of becoming a scientist, scientists enter a scientific discourse community [12,13] and come to share an understanding of the nature of scientific inquiry and of scientific knowledge.[2] It cannot be said that a shared understanding of science exists between forensic scientists and non-scientist report-users in the criminal justice system. Instead, scientific language can be unfamiliar and alienating to non-scientists and can pose an obstacle in communication from scientists to non-scientists [11,15].

According to Halliday [16], understanding science is synonymous with understanding the language of science. Four key features of scientific language make it difficult for non-scientists to understand [15]:

(1) *Informational density* (also called lexical density) refers to a high proportion words carrying content (as opposed to fulfilling a grammatical function) in the text [16].
(2) *Abstraction* refers to the use of long strings of nouns as the grammatical subjects and objects of sentences [15], and the use of nouns to describe actions that would usually be described in ordinary English by verbs. Moreover, the passive voice is often used, which can result in ambiguity about agency (who or what is responsible for the actions described) [17].
(3) *Technicality* refers to the use of both specialised vocabulary and ordinary words with specialist meanings as well as the complex inter-relationships of the specialist terms to each other [16].
(4) *Authoritativeness* is communicated through the use of specialist and technical terms, and by the sense of objectivity associated with text written in the third person and the passive voice [15].

In addition to these four features, it has been argued (e.g., [17,18] that scientific writing is characterised by hedging, or using words and expressions (such as "may", "should", and "probably") that fall along a continuum of uncertainty or caution regarding a conclusion.

Recently, international debate about expert evidence has focused on this issue of communicating uncertainty. The debate recognises the difficulty of communicating the appropriate degree of uncertainty about expert opinions (with or without the use of statistics), without causing confusion for non-scientists [19–21]. Providing only a statement that two fragments of glass *could have* come from the same source is seen as a simplistic approach [19] that does not communicate the significance of the evidence. Yet communicating uncertainty, with what is known as the "logically correct" approach [22], using likelihood ratios, can pose difficulties for scientists and non-scientists (including judges and lawyers) alike [23]. Ligertwood and Edmond [24] suggested reporting simple frequencies rather than likelihood ratios to avoid confusion for judges and jurors. They argued that scientists' preference for using likelihood ratios, particularly when presented in numerical form, but also as verbal scales, could lead to misunderstandings for non-scientists, such as the prosecutor's fallacy (that the number or term expressing the likelihood ratio equated to the probability that the suspect left the trace).[3] While this debate ensues, some of the less contentious aspects of readability could be addressed.

2. Approaches to assessing readability

As outlined below, a great deal of past research on readability assessment has been within the field of patient education and health literacy, in which practitioners communicate with a lay audience. In addition, studies on readability of written communication from professionals in one discipline to another, as is the case in the criminal justice system, have included psychologists' reports on students for use by teachers. Although the communication in these contexts is less likely to be contested than is the communication of forensic science in the criminal justice system, the methods used to assess the readability of texts can be applied to expert reports.

Approaches to assessing the readability of texts include the use of formulas to quantify textual features [25], and more descriptive approaches to content analysis to illustrate these features (e.g., [26]). Formulas can be used to calculate: the lexical density of a text [16,27,28]; the reading ease of a text [29,30]; the number of years of schooling based on the US education system required to read a text [31]; and the difficulty of documents that present information in matrix form, such as lists, tables, and graphs [32].

In addition to quantitative approaches, content analysis offers a systematic, exploratory method [33,34] to identify trends in written communication of groups or institutions [35,36]. The categories for coding can be derived from the text itself or directed by existing style guides,[4] theory, or past research [41,42]. Coding generally covers all relevant aspects of data, minimises overlap and ambiguities, and produces a coherent breakdown of content [36]. The process of coding usually involves quantifying features of text

[1] Australian police (and forensic laboratory) services are organised by state ($n = 6$), territory ($n = 1$), and federal ($n = 1$) jurisdictions [10]. Each laboratory is accredited to the same standard by a single accrediting body, the National Association of Testing Authorities (NATA).

[2] Although language conventions also exist in policing and law [14], and some overlap could be expected in the forensic science community, the focus of this article is on scientific language conventions, because the scientific language is most likely to pose difficulties for police, lawyers, and judges who use the expert reports.

For jurors, language conventions specific to all professions working within the criminal justice system may be unfamiliar to readers; however, jurors are less likely to receive copies of the reports.

[3] In contrast, the scientist expresses an opinion on the probability of the findings given the propositions. Critically, the scientist comments on whether the suspect left the trace versus had nothing to do with the incident, not on the probability of the propositions given the finding.

[4] Although no definitive style guide exists for writing expert reports, it is reasonable to expect that forensic scientists would be influenced by the writing conventions of the broad scientific discourse community. This includes the styles used in scientific journals (such as the use of the IMRAD – introduction, method, results, and discussion format) [37]; the wording and expressions alluded to in the forensic science discourse community, including disciplinary and sub-disciplinary handbooks (e.g., [38]), and seminal articles (e.g., [39]); and the specific in-house laboratory styles [5]. Furthermore, for forensic scientists, there exists overlap between scientific, policing, and legal discourses. Scientists would necessarily be influenced by legal requirements, such as practice directions on the form and content of expert reports (e.g., [40]).