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Readability of Australian Road Safety Information for the General Public

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Abstract

This research was conducted as a result of the authors becoming aware of the Australasian College of Road Safety (ACRS) submission to the National Road Safety Strategy 2021-2030. The ACRS submission outlined six key elements, one of which suggested that the National Road Safety Strategy should include 'Publication in easily consumable form, for the public, of infrastructure safety star ratings for all road users' (ACRS, 2021, p.61). This prompted the researchers to consider the road safety information provided to the general public about driving behaviour. Forty excerpts from online data from one Australian State's road safety website were assessed for readability using an online tool. Fifteen additional excerpts from another three States were assessed to ensure consistency across Australia. Results indicated that the excerpts assessed were written at a readability level that is too high for almost half of the Australian public. Recommendations include that those producing road safety information consider the level of literacy across the general public and ensure that their work becomes increasingly accessible to more Australians. The limitations of readability are acknowledged in relation to the overall communications which often include pictures and/or diagrams.

Key findings

- Documents written for the Australian general public should be written at a year 8 level
- The mode readability level for road safety information is at year 10 level
- Readability ranged from year 6 to year 20 (university graduate)
- Much of road safety information is too difficult to read

Introduction

One of the six proposed key elements of the Australasian College of Road Safety (ACRS) submission to the National Road Safety Strategy 2021 – 2030 was 'Publication in easily consumable form, for the public, of infrastructure safety star ratings for all road users' (ACRS, 2021, p. 61). This prompted the authors to consider the readability of road safety information provided to the general public about driving behaviour. The authors had previously assessed health information provided in relation to the COVID-19 pandemic (Ferguson et al., 2021). This paper reviews the current readability of a range of Australian online road safety documents that are aimed at the general public. These documents addressed a range of different driving behaviours. Readability is part of document accessibility for general public consumption. This paper firstly explains readability. Then data on the general public's literacy skills are presented, with a focus on Australian data, although other first world country data reveal similar information. This is followed by the procedure for the current readability research, results, and discussion with recommendations on how the producers of road safety online information can increase the accessibility of the information for the general public.

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Readability

Readability is one part of the communication process when writing documents for public consumption and is 'what makes some texts easier to read than others' (DuBay, 2004, p. 3). As early as 1963, Klare defined readability as the ease of understanding or comprehension due to the style of writing. Readability is based on mathematical formulae that take into consideration sentence length, word length, and number of syllables in words. Academic papers have noted challenges in readability of texts including in scientific papers, (Plavén-Sigray et al., 2017) and online patient education (Kher et al., 2017). Readability formulae are described by McLaughlin (1969, p. 640) as mathematical equations that provide 'a measure of the difficulty experienced by people reading a given text, and a measure of the linguistic characteristics of that text'. There are numerous readability instruments each of which has a slightly different formula. Considerable research has been conducted in the provision of health information and much of this research has reported that the information has been produced at levels that are beyond the reading ability of a large number of the population (Ferguson et al., 2021; Fitzsimmons et al., 2010).

There are instructions for authors writing for the Internet (Australian Government, n.d.). A perusal of these does not specifically include readability, although they do indicate that writers should consider their audience (Australian Government, n.d.). In the area of health information, there is evidence that people often use the internet to search for health information (Vida Estacio et al., 2019) however some personal variables such as age (older), education level (lower) and income level (lower) can affect internet access (ABS, 2018). Additionally, material published on the Internet can vary in readability. Typically United States of America (USA) government funded websites were significantly less difficult to read than commercially funded websites (Cochrane et al., 2012). Lupton (2020) reported high usage of a range of digital tools by youth for health and fitness information. The prevalence of the Internet as a source of information for other knowledge would suggest that road safety information is likely also sourced in this way. There does not appear to have been any recent research internationally on the readability of road safety information. A 1980 report by Sheppard and Harrison from the United Kingdom (UK) reported that road safety information readability varied considerably and could be difficult to read. Unfortunately, this report could not be accessed. Research from the USA on the readability of learner driver manuals reported grade levels of 10 to 12 that are classified as difficult to read (Stahl et al., 1984). More recent research on designing, implementing and evaluating road safety communication campaigns (Delhomme et al., 2009) did not include the readability of communications as part of the process.

In the context of road safety, relevant communication with the public is important, and written communications can provide a more accurate transmission of information than verbal communications, in particular those from friends and family (Edworthy et al., 2015). As reported in their abstract, Sheppard and Harrison (1980) indicated that rewriting a difficult text to make it more readable increased knowledge in the readers. The implications are that information which is not understood may lead to limited or inaccurate information being transmitted amongst vulnerable groups. Inaccurate information may not prevent poor driving behaviour that can lead to unfavourable outcomes, which in the context of road safety may result in serious injury or death. Online communications whether in writing or in audio or video or both form part of a linear and unidirectional communication process which is vulnerable to misunderstanding as no feedback is provided to the author by the viewer.

Literacy skills in the Australian community

Internationally many individuals have literacy levels below *The Programme for the International Assessment of Adult Competencies* (*PIAAC*) Level Three, the standard required for broad participation in work, education and training, and society (OECD, 2013). Although PIAAC data are now almost ten years old, it is the latest information available. The data indicate that approximately 40 percent of the population of Australia, the UK, and the USA aged 16 to 65 years have difficulty with literacy, scoring below level three (Goodman et al., 2013). Within Australia the health industry considers readability is appropriate based on year eight level of education (Cheng & Dunn, 2015). In the UK, the government has determined that writing for a person reading as a nine year old is appropriate (Government Digital Services, 2021); and in the USA, the standard is for grade six (Fitzsimmons et al., 2010).

Accordingly, if the intention of an organisation is to provide publicly available information, attention must be given to the reading abilities across the population. When readability is not considered, the distribution of knowledge is not equitable. Lower levels of literacy are more evident in vulnerable groups of low socio-economic status (Pluck et al., 2020) with a relationship to cognitive abilities (Noble et al., 2007) that can persist throughout the lifespan (Foverskov et al., 2019). Associations also exist between poor literacy and poor health (Kakarmath et al., 2018) including poor mental health, and poor mental health can impede reading ability and understanding of text (Hendren et al., 2018).

Recent Australian research investigating reading for pleasure in an adolescent population reported that the percentage of daily readers reduced with age, with 50 percent of 15 to 16 year old not reading daily (Rutherford et al., 2018). Motivation to read is partly based on topic interest and comprehension of the material (Harrison & Alvermann, 2017). These data support the contention that to be read and understood, public health documents need to be relevant and accessible to readers. In the context of road safety, young drivers have been identified as a vulnerable group (Palamara, 2018). The *Longitudinal Surveys of Australian Youth, 2009* data indicated that current 23 year olds have reduced their reading of books, and magazines, but have significantly increased their use of the internet (NCVER, 2018). This longitudinal survey compared within

Table 1. Flesch Reading Ease Scores with US Education Level and USDHHS* Readability

Flesch Reading Ease Score	US education level	USDHHS* Readability rating
0-29	college/university graduate	Difficult
30-49	college/university	
50-59	10th-12th grade	
60-69	8th-9th grade	Average
70-79	7th grade	
80-89	6th grade	Easy
90-100	5th grade	

*United States Department of Health and Human Services – these categories are consistently referred to in a number of research papers including Edmunds et al., 2014; Kher et al., 2017.

and across cohorts and the current comparison is made with the cohort that were 23 year olds in 2007.

The research question for this study is: 'How well do written communications available online for road safety information meet the readability criteria to support understanding of the general public?'

Methods

This research has adopted a case study approach to the written online communications that are available on Australian road safety websites. The research focused on the readability of communications that are aimed at the general public, rather than at academics/researchers. The case study boundaries included Australia and a timeframe during which this research was conducted, May to August 2021. Documents did not need to be published during a particular period of time to warrant inclusion, and therefore some documents that were published earlier and were still accessible at the time of data collection were included in the research. The researchers acknowledge that there are other road safety websites where public information is provided, both within Australia and internationally. However, for the purposes of this research a local sample from one State, supported by smaller samples from three other States was considered sufficient to demonstrate the level of readability in the discipline.

Instruments used for analysis

Analysis was conducted through a website that provides scores from seven different readability indices and an average readability score (Readability Formulas, 2021). This website includes scores from Flesch Reading Ease Score, Gunning Fog, Flesch-Kincaid Grade Level, The Coleman-Liau Index, The SMOG Index, Automated Readability Index, Linsear Write Formula, and Readability Consensus Grade Level (RCGL). Each of these instruments uses different formulae to calculate readability scores. The RCGL measures an average of the first seven scores and provides an easy to understand score. It should be noted that the website is based in the USA and therefore the RCGL cites grade levels for the USA. However, these grade levels are the equivalent of Australian School year levels (Educationista, n.d.).

Although the website provides scores for the seven different instruments, this research focused on the three most commonly used scores: Flesch Reading Ease Score, the SMOG Index, and RCGL. The first two are commonly employed in readability research in health issues, and the RCGL provides an easily deciphered result for readers who are not fully familiar with readability scores. A brief description of these instruments and the rationale for their inclusion are provided below. While these instruments were originally developed to analyse printed documents, they have been used in analysis of internet-based sources (Cheng & Dunn, 2015; Fitzsimmons et al., 2010). The reliability of online tools for assessing readability has been tested (Cheng & Dunn, 2015) and the website employed in this research has been cited in previous peer-reviewed publications (Ferguson et al., 2021; Gyasi, 2013; Sheats et al., 2019).

Flesch Reading Ease Score

Developed in the 1940s by Rudolph Flesch, this readability calculator is based on average sentence length (ASL) (number of words) and average word length (AWL) (number of syllables). The resultant score ranges from 0 to 100 with a low score indicating greater reading difficulty. The formula is cited as (0.39 x ASL) + (11.8 x ASW) – 15.59 (Fitzsimmons et al., 2010). A document considered accessible to the general public would score 60 or more. As shown in Table 1, the Flesch Reading Ease Scores are related to grade levels within the US education system (Kher et al., 2017). The Flesch Reading Ease Score has been commonly used in health literature readability research.

The SMOG Index

The Simple Measure of Gobbledygook (SMOG) was developed by McLaughlin in 1969. This formula may offer advantages over the Flesch Reading Ease Score as it more accurately assesses likely comprehension of the material being tested (Fitzsimmons et al., 2010). The SMOG was designed to measure complete comprehension whereas other readability formulae only measure partial comprehension (McLaughlin, 1969). To manually calculate a reading grade in SMOG, one counts the number of words with three or

Table 2. Readability Consensus Grade Level Explanations*

Grade Level	Readability	Age of Grade Level
6	Fairly easy to read	10-11 years (5th & 6th grade)
7		11-13 years (7th & 8th grade)
8	Standard/average	12-14 years (7th & 8th grade)
9		13-15 years (8th & 9th grade)
10/11	Difficult to read	14-15 years (9th & 10th grade)
12	Fairly difficult to read	17-18 years (12th grade)
13		18-19 years (college/university level entry)
14	Difficult to read	21-22 years (college/university level)
15		college/university graduate
16/20	Very difficult to read	

*This table only includes the explanation for the grade levels that were located in the documents assessed in this research.

more syllables across three ten-sentence samples; then calculates the square root of that total and adds three. Like the Flesch Reading Ease Score, the SMOG has been used in readability research in the health industry (Kher et al., 2017; Walsh & Volsko, 2008). The SMOG Index has been employed in this research as it is recommended by the Cochrane Collaboration (2013) which has an excellent international reputation for independent research.

The Readability Consensus Grade Level

This measure is based on the average results from the seven readability instruments above. The RCGL provides an easy to understand measure and has been employed in previous research (Ferguson et al., 2021; Gyasi, 2013; Sheats et al., 2019). The use of multiple measures for assessing readability and averaging them is supported in the literature, with each instrument having strengths and weaknesses (Burke & Greenberg, 2010). The Flesch Reading Ease Score is considered to be the least and SMOG the most conservative at scoring (Burke & Greenberg, 2010; Grabeel et al., 2018). This is due to the SMOG being based on 100 percent comprehension (Fitzsimmons et al., 2010). Table 2 shows an explanation of the Grade Levels in the Readability Consensus Grade Level Explanations.

Limitations in relation to readability instruments

The Flesch Reading Ease Score has been criticised for its simplicity which does not take comprehension into account (Fitzsimmons et al., 2010) and other instruments could be similarly criticised. A further limitation of this research is that some communications may include diagrams and pictures that support the written word. Readability instruments are not designed to assess full communication and only form part of the issue of good communication.

Procedure

Since the focus of this research is road safety communications created for general public consumption in Australia, the researchers directly targeted State Government websites that focus on road safety. This purposive sample was employed on the basis that the information within these websites would be accurate. Documents and information targeted towards the general public were examined. The chosen documents were about safe driving across a number of behaviours. These behaviours include the fatal five of speeding, drink driving, fatigue, distraction and seat belt use as well as information provided about tyre maintenance and buying your first car. Documents were identified, downloaded and copied to a Word document, analysed, and the scores entered into a Statistical Package for the Social Sciences (SPSS) file. Documents were taken from the State Government websites of Queensland, New South Wales, Victoria and Western Australia.

Documents were 'cleaned' to address the requirements of the readability website. Cleaning included the exclusion of headers and footers, tables and pictures. Additionally, the website employed to calculate the readability requires a minimum of 100 words and a maximum of 3,000 words, however, in most cases the full document was employed as they were fewer than the maximum words. Documents varied in size. Links on front page documents to other documents were followed; however, if these second level documents included further links, documents at this 'third level' were not accessed. The rationale for this was based on the work of Eysenbach and Kohler (2002). These researchers reported that members of the public who participated in research to locate health information spent on average only one minute and nine seconds on each website and viewed only a small number of links when searching.

Data Collection

To focus on Australian data, the road safety website of one State government was targeted for content. Some documents downloaded were not assessed, in particular where the majority of the document content included tables which, for example, tabulated particular offences and the penalties that applied. Therefore, the sample was purposive as it needed to fit within the parameters of the Automatic Readability Checker.

Table 3. Range, means, modes for the measures (main sample)

Measure	Range	Mean (SD)	Mode
Flesch Reading Ease Score	25.70-74.90	56.82 (12.76)	51.90
SMOG	6.20-16.10	9.59 (2.40)	6.40
RCGL	6.00-20.00	10.58 (3.02)	10.00

Table 4. Number of documents in each category by USDHHS Readability ratings/year level

Measure	Easy	Average	Difficult
Flesch Reading Ease Score	Nil	20	20
SMOG	5	21	14
RCGL	1	13	26

Three other State government websites were examined and 15 documents (five from each website) downloaded for examination. This process was employed to triangulate the data from the first website, rather than to make direct comparisons. The documents from these websites were treated in the same manner and the data from them are recorded separately.

Data Analysis

Descriptive statistics and frequency distributions of the scores for the Flesch Reading Ease Score, the SMOG and the RCGL were extracted.

Sample and Sample Size

Forty documents were accessed and reviewed from the main target website. An additional five were accessed from three other websites. Sample size in readability studies varies considerably and is often smaller than samples where data are collected from individuals. A sample of 40 documents provided a range of scores with acceptable skewness and kurtosis across the three measures employed in this research. These skewness and kurtosis data indicated an acceptable distribution. Skewness data ranged from -0.667 to 1.183 and kurtosis from -0.257 to 1.434.

Results/findings

The range of scores, means, and modes for the data from the main State are shown in Table 3 and the distribution of scores in relation to meeting the needs of the population for readability are shown in Table 4. These data are based on the USDHHS Readability ratings shown in Table 1.

The data in Table 3 look different as the scores are presented differently by the instruments, with a score being provided for the Flesch Reading Ease Score and a school grade/year (or years of education completed) provided for the SMOG and the RCGL. Interpretation of the Flesch Reading Ease Score range indicates that the items chosen for analysis ranged widely from very difficult to read to being able to be read by an average reader (with the abilities of a year seven student). No item was scored as being easy to read. The mean score of 56.82 falls into the difficult to read category. Table 1 provides the different levels. The SMOG calculation is based on school year and again ranged considerably from year six to college/university level education. The mean score on this measure (9.59) is just above the preferred limit of year eight. The RCGL which combines the seven measures on the website provides a higher mean for the data of 10.58 years of school/education. Table 4 indicates the number of documents that fell into the USDHHS categories of easy, average, and difficult to read (see Table 1).

As shown in Table 4, no documents were classified as easy to read when the Flesch Reading Ease Score was applied, although five (12.5%) were in that category when SMOG was used in relation to year level. Most of the documents (about 50% for Flesch Reading Ease Score and SMOG) scored in the average range which indicates readability for school years seven through to nine. The RCGL which combines the results of the seven measures provided a different perspective which may be the result of the combination of scores. Data from comparison States are shown in Table 5 and show data that are similar to those from the main State.

The comparative State data were generated to provide a sense of reliability of the main State data, without undertaking unnecessary extra data extraction and analysis. The distribution of scores in Table 4 and Table 6 and the the descriptive data in Table 3 and Table 5 suggest similarities in both samples.

Discussion

This study was a review of the current readability of a range of Australian online road safety documents that are aimed at the general public. These documents addressed a range of driving behaviours. The focus of this paper was on the readability of road safety information presented on the website of one Australian State Government website, with supporting information from another three similar websites. The impetus for the paper was the reminder that the Australasian College of Road Safety submitted to the

Table 5. Descriptive data from comparison States - Range and mean (sample of 15)

State	Flesch (mean)	SMOG (mean)	RCGL (mean)
Comparison State 1	46.8-70.7 (59.70)	7.1-10.4 (8.92)	6.0-13.0 (10.00)
Comparison State 2	42.3-77.6 (54.16)	4.6-12.3 (9.34)	8.0-14.0 (11.00)
Comparison State 3	22.8-72.0 (56.02)	6.2-13.9 (9.12)	6.0-15.0 (9.80)

Table 6. Comparison States number of documents in each category by USDHHS Readability ratings/year level (sample of 15)

Measure	Easy	Average	Difficult
Flesch Reading Ease Score	Nil	7	8
SMOG	2	6	7
RCGL	2	2	11

National Strategy for Road Safety, one of the six recommendations was 'Publication in easily consumable form, for the public, of infrastructure safety star ratings for all road users' (ACRS, 2021, p. 61).

If the data are considered in relation to the Australian health industry standard of year eight, the data indicate that 19/40 (47.5%) of documents from the main data collection meet that criterion according to SMOG, and 10/40 (25.0%) for the RCGL. As the data for years eight and nine are combined for the Flesch Reading Ease Score (score of 60-69), particular data for year eight cannot be calculated, however 20/40 (50%) of the assessed documents were considered to be of average ease for readability. This narrowness in the Flesch Reading Ease Scores for years eight/nine is most likely the result of the known narrowing of literacy progression at that time in schooling (Main et al., 2020). As shown in Table 1 there is an even greater narrowing of the scores from 50-59 being related to grades/years 10, 11, and 12. An explanation for this is that literacy skills are generally acquired more quickly early in schooling and slow down in the later years. This is represented in the differences between the different categories in the Flesch Reading Ease Scores (Table 1), where the score of 50-59 represents three years of schooling (years 10, 11, and 12) whereas the score of 70-79 represents one year (year 7).

Despite none of the assessed documents in this research being easy to read according to the Flesch Reading Ease Score, the readability of the Australian road safety information is more accessible to the public when compared to health information. An Australian study of the readability of COVID-19 information from government websites in Australia, UK, and USA reported mean scores across 52 international documents of Flesch Reading Ease Score 44.3; SMOG, 11.2; and RCGL, 13, indicating greater difficulty in reading (Ferguson et al., 2021). The percentage of accessible documents was also greater in the road safety domain.

Limitations of the Research

Readability is only one aspect of communications and readability instruments have been criticised for their mathematical perspective that does not always address understanding (Jindal & MacDermid, 2017). Some websites viewed for this research included a range of other resources such as videos, posters, diagrams, and tables that support the public in the effort to understand road safety issues. It was noted that one of the websites reviewed in this research provided information in a number of different languages commonly spoken in Australia. Some information was also supported by audio where the individual could listen to the information rather than read it.

Recommendations

1. Authors of road safety information should consider the general public's ability to read and understand the written word.
2. A reading age of between grade/year six and eight should be the target readability level.
3. Authors of road safety information should employ one of the free readability checkers to determine the level of readability of their written work. The readability checker employed in this research is free and has been used in other academic research.
4. Semiotics should continue to be a key component of any online material. This should include culturally appropriate material that highlights diversity in the community.

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Author contributions

Catherine Ferguson was responsible for the conception, design, execution, analyses, or interpretation of research and drafted the article. Stephen Winn revised the article crit-

ically for intellectual contents and added to the literature cited. All authors have read and agreed to the published version of the manuscript.

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Conflicts of interest

The authors declare that there are no conflicts of interest.

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