Reliability levels of traumatic brain injury websites in Australia, New Zealand, the United Kingdom, and the United States

Heather M. Veith

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Research Advisor: Julie Jepsen Thomas, Ph.D., OTR/L

Occupational Therapy Doctorate Program

Department of Rehabilitation Sciences

University of Toledo

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Abstract

Purpose:

Traumatic brain injury (TBI) is one of the leading causes of disability. Occupational therapists provide services for this population that can include patient education materials. A large portion of the international population has low literacy skills. The purpose of this study was to determine the readability level of patient education materials from Australia, New Zealand, the United Kingdom, and the United States that relate to TBI.

Method:

The researchers included websites in this study if the information was from a national organization, addressed four chosen topic areas, and contained at least 30 sentences per topic area. The researchers used a predetermined protocol to collect and analyze the online version of the SMOG. A research assistant, who was blinded to the procedure, performed the manual analyses using a protocol prepared by the researchers. Descriptive statistics were used to present the findings.

Results:

Descriptive analysis revealed the overall readability for each country and content area ranged from grade levels 10 to 13.78. These numbers are equivalent to the grade level of two years of high school to half a year of college. The overall readability by country and content area was higher than the recommended 8th grade level.

Conclusion:

Occupational therapist should have an understanding of the readability levels of the resources they give to patients. Occupational therapists can be advocates for patients and create patient education materials at or below an 8th grade readability level. Recommendations are presented on how to lower readability levels for patient education materials.

Readability Levels of Traumatic Brain Injury Websites in Australia, New Zealand, the United Kingdom and the United States

Traumatic brain injury (TBI) is one of the leading causes of disability, particularly for children and adolescents (Center for Disease Control (CDC), 1999). The CDC estimates that 1.7 million people every year will sustain a new TBI event (2010). TBIs are occurring at an alarming rate and have been called an epidemic in countries around the world. TBI is estimated to be the largest cause of global disease burden by 2020 (Feigin et al., 2013).

Occupational therapists work on interprofessional teams to provide services for individuals with TBI in a variety of settings. Because the rate of TBI is growing, occupational therapists can expect to provide occupational therapy to people with TBI more often. Occupational therapists address many of the deficits that a person with a TBI may experience, such as cognitive, emotional, behavioral, and physical deficits (American Occupational Therapy Association (AOTA), 2002). One interventional method that occupational therapists can use to produce positive patient outcomes is patient education including Internet based patient educational materials.

Many occupational therapy models of practice can incorporate the use of patient education materials. For example, the Role Acquisition model (Mosey, 1986) emphasizes the importance of the individual regaining past roles independently. By empowering the patient to learn more about his or her condition, the patient becomes more able to resume old roles with the necessary adaptions and compensations. Patient education materials can provide additional resources to regain previous roles.

The Multicontextual Generalization-Dynamic Interaction model of practice (Toglia, 1991) also stresses the importance of patient cognition, an area of deficit for people who have

had a TBI. This model of practice emphasizes metacognition and generalization of knowledge learned. A patient can increase metacognition through learning about his or her condition. A patient also may be able to recognize his or her limitations from a condition and properly plan for safety precautions. Patient education materials are an important intervention tool for this model of practice.

Due to technology being easily accessible, occupational therapists often use the Internet as a source of patient education materials. The readability of the educational materials could have an impact on TBI treatment and affect the patient's outcomes. Readability of patient educational materials becomes an important factor in the effectiveness of therapy. However, many patients worldwide have low literacy levels. If a patient does not have the literacy skills to comprehend the material, the material will not produce the intended positive outcomes.

In addition to having low literacy skills, persons who have experienced a TBI may also have cognitive and processing deficits. These deficits will further affect their ability to comprehend resources. Previous studies have reported the readability of patient education materials, but this is the first study to specifically investigate and analyze the readability level of education materials in relationship to TBI.

The purpose of this study was to determine the readability level of patient education materials related to TBI from four English-speaking countries. The countries chosen for this study were Australia, New Zealand, the United Kingdom, and the United States. This research was founded on a review of previous literature regarding literacy levels, effects of TBI, impact of literacy levels on the practice of occupational therapy, and the connection between literacy and patient outcomes.

Review of the Literature

The review of the literature addresses components of literacy, literacy levels, identification of the components of well-written text, validity and reliability of the SMOG readability measure, Internet accessibility and usage, the definition of traumatic brain injury, and the impact of literacy levels on the practice of occupational therapy. The review has found internationally low literacy levels that affect the ability of the patient to understand health materials.

According to Auckland University of Technology in New Zealand, the incidence of TBI is rapidly increasing. However, almost 35% of the patients diagnosed with TBI do not seek medical intervention. These individuals could likely use the Internet to learn more about TBI symptoms and treatment options (2012). As healthcare accrediting agencies put more emphasis on the patient's ability to understand health information, occupational therapists are required to become more aware of the information they give to patients and the ability the patient has to comprehend the material.

Components of Literacy

Literacy has multiple components, but this research focuses on three distinct types of literacy. These types include prose, document, and health literacy. The National Institute for Literacy defines prose literacy as the ability to comprehend documents with text that is continuous (2008). For example, prose documents can include brochures, novels, or newspapers. Prose literacy can be found in patient education materials when there is continuous verbiage on a page. An example of prose literacy in online resources is when a paragraph describes what the effects of a TBI are and how it may impact the patient's occupations of daily living.

Document literacy is used to comprehend non-continuous text such as maps, online websites, schedules, or cookbooks (National Institute for Literacy, 2008). Patients use document literacy to comprehend educational materials that are commonly found on the Internet. For example, patient consent forms, online job applications, and cooking recipes can all be found on Internet sites and are examples of document literacy.

The third type of literacy discussed in the literature is health literacy. Health literacy is defined as the ability of an individual to access, read, and comprehend basic health information in order to make appropriate health decisions. The National Network of Libraries of Medicine (NNLM) (2012) states that health literacy is an indication of the patient's understanding of health education materials. An individual's health literacy can affect the decision making process and patient health outcomes (NNLM, 2012) This research will focus on prose, document, and health literacy due to the large impact these forms of literacy have on the formulation of patient education materials.

Frequently, an Internet webpage will use prose literacy for descriptions and document literacy for bullet points of information. Health literacy would include the health related terms inserted into the prose and document forms of text. Therefore, these forms of literacy are interrelated and linked. The three types of literacy are related to patient health outcomes because the resources provide the patient with therapy suggestions on how to enhance health outcomes. If the patient cannot understand the patient education material, the patient is missing out on important information for increasing health outcomes. An individual's literacy level is generally classified into one of the five levels discussed in the next section.

Literacy Levels

The United Nations Educational, Scientific, and Cultural Organization (UNESCO) classifies literacy skills in levels ranging from one to five based on prose or document literacy skills (2012). Literacy level one indicates that a person has very low or poor literacy skills. An example of literacy level one is an inability to read package labels. In terms of grade levels, literacy level one is correlated to less than a fifth grade reading level. A person functioning at literacy level two can comprehend simple reading such as clearly written paragraphs. A person at literacy level two can read but generally does poorly on tests. Literacy level two is considered reading at a fifth to seventh grade level (Schloman, 2004).

UNESCO stated that literacy level three is the literacy level needed for obtaining employment and executing general problem solving. Austermiller (2012) stated that literacy level three is the minimum literacy requirement for functioning in society. Furthermore, Scholman (2004) stated that people who have graduated from high school and have begun college are thought to have literacy level three skills. Although literacy level three is considered the literacy level needed to graduate from high school and comprehend 12th grade reading material, it is more strongly correlated with an eighth to ninth grade reading level (Schloman, 2004).

Literacy levels four and five are intermediate and advanced literacy levels. UNESCO (2012) stated that this level is where individuals can process information in a more skilled and complex way. Literacy levels four and five are often combined. Researchers have not assigned specific grade level to these literacy levels. Occupational therapists can assume that people performing with literacy levels four and five would have college and graduate level reading skills. To determine international levels of literacy, a large study was conducted in 1994. The

following section describes international literacy and the level at which percentages of populations can read.

Review of Readability Analyses

The readability of Internet based patient education materials for specific diagnoses has been analyzed in previous studies. The purpose of the studies was to analyze the grade level at which Internet based patient education materials were written. As stated in the section on literacy components, grade levels are often correlated with literacy levels.

One study investigated readability levels of patient education materials for people with Parkinson's disease. The results of the study showed the patient education materials were written between a 12.25 and 13.25 grade level (Austermiller, 2012). The grade levels of those patient educational documents were well above a fifth grade level that a person reading at literacy level one would be able to comprehend.

Another study focused on the readability of web based education materials for people with multiple sclerosis (MS). This study found that web based patient education material for people with MS in the United States and Australia were written at a grade level of 14 while websites from Canada and New Zealand were written at a grade level of 13 (Wolfe, 2011). Both of these studies support that patient education materials found on international websites may be well above the recommended fifth to eighth grade reading level (King, Winton, & Adkins, 2003).

Furthermore, a study by Schmitt and Prestigiacomo investigated the readability level of web based neurosurgery-related patient education materials that were provided by the American Association of Neurological Surgeons, the National Library of Medicine, and the National Institute of Health (2011). This study investigated websites from the United States alone. Researchers analyzed 75 articles using the Flesch-Kincaid grade level (FKGL) and the Flesch

Reading Ease Formula (FRE). Out of the 75 articles, only 8 were written at an eighth grade level or lower.

The other 67 articles, or 90% of the sample, were written at levels higher than the average American adult can comprehend. In terms of subject areas associated with TBI such as brain tumors, craniosynostosis, or cerebral aneurysms, the material was written at an average grade level of 11.8 (Schmitt & Prestigiacomo, 2011). However, other areas that pertain to TBI, such as traumatic brain injury and head injury prevention, were written at an average grade level of 8.2 (Schmitt & Prestigiacomo, 2011). Although grade level 8.2 is significantly better than a grade level of 11 in terms of comprehension, these literacy levels are still higher than what a person reading at a literacy level one can comprehend. The following section will discuss the percentage of populations are reading at literacy levels one through five in four English speaking countries.

International Literacy Rates

In 1994, the International Adult Literacy Survey (IALS) was administered in multiple countries to evaluate national literacy levels based on the above stated literacy levels. The study results revealed an international rate of low literacy. National literacy levels for prose literature in Australia, New Zealand, the United Kingdom, and the United States appeared to be similar.

In Australia, 44% of adults read at a literacy level one or two. Approximately 39% of Australians read at literacy level three and 17% read at literacy levels four and five (Australian Bureau of Statistics, 2013). In New Zealand, approximately 45% of the population reads at a literacy level one or two and 35% can read at literacy level three. This leaves 20% of New Zealand's population reading at literacy level four or five (Walker, Udy, & Pole, 1996).

In the United Kingdom, 48% of the population reads at literacy levels one and two, leaving 35% reading a literacy level three and 17% reading at literacy levels four and five

combined (Blum, Goldstein, & Guerin-Pace, 2001). In the United States, 48% of the population comprehends at literacy levels 1 and 2, leaving 32% of the population reading at literacy level three and 20% reading at literacy levels four and five (Kirsch, Jungeblut, Jenkins, & Kolstad, 2002). These statistics indicate that for Australia, New Zealand, the United Kingdom, and the United States, almost half of the populations are reading at or below an eighth grade reading level.

Health Literacy

Health literacy is a form of literacy that has taken a forefront in today's medical community. Readability of patient education materials is now a benchmark that the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) has required for accreditation. Additionally, improving health literacy is one of Healthy People 2010's goals (Safeer & Keenan, 2005). Healthy People 2020 continues to place importance on the readability of health related materials, specifically addressing web based material. Healthy People 2020 notes that health care agencies are increasingly using the Internet to deliver patient education materials. These web based materials can create a readability challenge for people with low literacy levels if the material is not written at an appropriate grade level (United States Department of Health Science and Human Services, Healthy People, 2012). Health literacy tends to be low for many individuals, making educational material more difficult to comprehend. A study examines the rate of individuals with low health literacy levels in urban areas of the United States.

According to a study of over 2,600 low income, English speaking patients in two public hospitals in the United States, 41.6% were unable to read and understand instructions for taking medication on an empty stomach, 26% were unable to comprehend information regarding when

a following appointment was, and 59.9% could not read and comprehend information on a consent document (Williams et al., 1995). This study indicated that almost 60% of patients are unable to understand documents regarding informed consent, including life threatening procedures.

Additionally, this study investigated literacy levels at different age groups. The outcomes indicated that the generations older than age 60 had statistically significant lower health literacy than the generation that was younger than 60 years old (Williams et al., 1995). Due to many of the patients that occupational therapist encounter currently being in the 60 years old and older cohort, occupational therapists can assume these patients have statistically significant lower health literacy. Lower health literacy could impact health outcomes for this cohort.

These international statistics also correlate with the average individual's ability to comprehend health information. In a study describing the grade levels of patient education materials, Scholman wrote that most health documents are written at a tenth grade level and most informed consent documents are written at a fifteenth grade level (2004). In the four countries included in this research, half of the population read below an eighth grade level. Therefore, with many adults reading below an eighth grade level, it seems less likely that these individuals would be able to comprehend patient education materials and use them effectively.

Health literacy has a direct effect on health outcomes. A review of the literature has shown that lower health literacy is correlated with poorer health outcomes in areas such as knowledge, general health status and use of health resources (Dewalt, Berkman, Sheridan, Lohr, & Pignone, 2004). Specifically, lower health outcomes could include low attendance and follow through at occupational therapy sessions or not taking medications appropriately. Furthermore, lower health literacy affects self-perceived health status. A study assessed health using global

health status measures that rated self-perceived health status as excellent, good, fair, or poor. Patients with lower literacy levels rated their health status as fair or poor compared to the group with higher literacy levels. The study stated that patients with lower literacy were two times more likely to report poor health in comparison to patients with higher literacy levels (Dewalt, Berkman, Sheridan, Lohr, & Pignone, 2004). Literacy has a strong relationship to health outcomes and thus is an important issue in the field of occupational therapy and reflected in the current standards used for reimbursement in health care.

There is some discrepancy in the health literacy field regarding the grade level at which patient education materials should be written. Experts in the field of health literacy suggest that text should be written at an eighth grade reading level or below (King, Winton, & Adkins, 2003). Other members of the field of health literacy believe text should be written at a third to fifth grade reading level (Mayer & Villaire, 2009). This differing opinion could be because many patient education materials include medical jargon, which can increase the grade level of the material even though the rest of the text is written at a lower grade level. Due to the large proportion of persons reading at low levels of literacy internationally, the conservative approach would be to write materials at the suggested fifth grade level. Individuals reading with literacy level one skills would be able to comprehend materials written at the fifth grade reading level.

When occupational therapists are working specifically with patients who have experienced a TBI, a lower grade level of materials is more appropriate due to the prevalence of cognitive and emotional deficits experienced by the patients. Complex text could lead to difficulty with comprehension and frustration for the individual with TBI, which would not be the goal of the patient education materials.

Occupational therapists should be aware of signs that a patient may display indicating the patient has low literacy skills. Safeer and Keenan (2005) report that low health literacy may be identifiable by the following behaviors exhibited by the patient: asking staff for help, bringing along someone who can read, missing multiple scheduled appointments, making excuses such as "my wife usually takes care of these things for me" or "I forgot my glasses". Other signs include not complying with medications, not following through with recommended interventions, and asking to read things at home and report back.

Occupational therapist should be aware of these signs and assist patients who may have lower health literacy levels. In addition, occupational therapists should write, distribute, or recommend patient education materials created at a lower literacy levels. This practice will automatically assist individuals who do not outwardly display the signs listed above but have difficulties with literacy.

It is possible that some occupational therapist believe that by writing patient education materials at a lower literacy level, the occupational therapist is not providing the higher literacy level reader the opportunity to use those skills. This could be perceived as insulting to the patient who can read at a higher grade level. Furthermore, documents written at a lower literacy level could possibly omit information and a greater level of detail that the patient may want to know. However, to be accessible to all patients, patient education materials still need to be written at the lower literacy level.

The occupational therapist can alleviate some of these possible concerns by knowing his or her patient and offering more advanced patient education materials as necessary. For example, the occupational therapist may have a patient who asks for more information. If the occupational therapist feels the patient can comprehend documents written at a higher literacy level, the

occupational therapist can suggest a more appropriate and detailed patient education materials that address areas of information for that specific patient. It is important to consider individuals reading at a lower literacy level to determine the literacy level at which a document should be written. The occupational therapist can easily add detailed information for those reading at higher literacy levels, when necessary.

Researchers found that patient education materials are often published by organizations and accessed by patients through the Internet at home. The PEW Research Center (2013) stated that 72% of Internet users looked on the Internet for health information in the past year. From the 72% who researched health information, 77% searched for resources using common Internet search engines such as Google, Bing, and Yahoo. According to PEW (2013), the most commonly-researched heath topics were specific diseases and conditions, treatments, and doctors or health care providers. These statistics support that the Internet is commonly used by patients to gain more information about conditions. Occupational therapists provide services for these conditions and the resources should be analyzed to make sure the information is accessible for patients. The next section will describe the international accessibility and international usage of the Internet.

Internet Accessibility and Usage

The Internet is widely available and accessible for individuals around the world. According to the Central Intelligence Agency (CIA), Australia has 15.8 million Internet users, New Zealand has 3.4 million users, the United Kingdom has 51.4 million users, and the United States has 245 million users (2012). In terms of percentages, these numbers indicate that 69% of Australians, 77% of New Zealanders, 82% of people in the United Kingdom, and 78% of the people in the United States actively use the Internet. Occupational therapists can assume that

persons with both good and poor literacy skills may be accessing the Internet for pertinent health information based on the large statistic of people who use the Internet.

Due to the lack of high literacy levels worldwide, it is critical to analyze patient education materials to assure the readability and applicability to individuals with health care needs. Patient education text should be well written and comprehensive. The next section will describe guidelines that authors can use to create well-written text for patient education materials in order to improve the readability of a document.

Identification of Components of Well-Written Text

Well-written text is often defined by its readability. Readability refers to how easy it is to read and comprehend text, generally prose text. Many readability instruments exist and generally measure the two most important factors of readability: word difficulty, which is determined by the number of syllables in a word, and sentence length (Nelson, Perfetti, Liben, & Liben, 2012). In addition to using easier words and shorter sentences, authors describe many guidelines to help increase text readability.

According to Doak, Doak, and Root, authors can assess text readability by identifying the quality of the text's organization, writing style, appearance, and appeal (1996). Text organization refers to how the author arranges text on a page. Specifically, text organization addresses if the front page of a brochure or website is attractive, while clearly identifying desired behaviors. Organization also refers to limiting main bullet points to three or four items. Authors can improve the readability of a work by improving writing style. Writing style can be improved if the message is delivered in a conversational, active, and friendly voice. Most importantly, writing style involves using minimal medical jargon that can greatly increase a text's readability. Authors can improve a document's appearance as well. Appearance can increase readability by

allowing ample white space, including simple illustrations, and using at least 12-point font. Lastly, appeal increases readability by ensuring the text is age and culturally appropriate. It is critical that the author uses language that will match the intended audience.

Once an occupational therapist gives a well-written document to a patient, the occupational therapist should offer additional forms of communication to help the patient understand the message. Communicating and demonstrating the material in a way other than text is important to allow the patient a different way to comprehend the material. Suggestions of forms of communication include verbal recommendations to the patient and demonstrating the material (Doak, Doak, & Root, 1996).

For example, an occupational therapist can give patient education material on energy conservation techniques. One technique recommended might be how to conserve energy while moving heavy pans to the stove for cooking. The occupational therapist can show the patient how to slide a pan full of water down the counter rather than pick it up and moving it. The occupational therapist can then have the patient try the task while being supervised. Having the handout and the demonstration can increase the patients understanding of the material if the resource alone is written at a level too difficult for the patient to comprehend.

This research focuses on the patient's ability to read and understand patient education materials found on the Internet. This is an area of increasing interest as the Internet is easily accessible to patients at home. The Internet helps to increase a patient's responsibility for his or her health care. The Internet is able to provide access to medical information, resources, and home monitoring systems that increase patient independence (Zeliff, 2005). This information may be accessible, but can only be used by the patient if the patient is able to comprehend the information via the text's readability. Internet readability guidelines include many of the same

principles of using short sentences with simple wording. Readability of a document or website is often determined using an instrument known as the SMOG. The validity and reliability of the SMOG is discussed in the following section.

The SMOG

The Simple Measure of Gobbledygook (SMOG) was created in 1969 by G. Harry McLaughlin. McLaughlin created the SMOG to estimate the grade level required to read text. McLaughlin stated that the SMOG uses a formula designed to "find the equation which best expresses the relationship between two variables, which in this case are a measure of the difficulty experienced by people reading a given text, and a measure of the linguistic characteristics of that text." (McLaughlin, 1969, p. 640). The SMOG is user friendly and can be used to analyze educational material on websites. Once the grade level of the websites is determined, this research will give recommendations for how to modify the education materials to lower the information to the SMOG reading level of eighth grade or lower.

Traumatic Brain Injury

Since the 1970's, the treatment of TBI has rapidly grown. TBI occurs because of an injury to the head. TBI is classified as an acquired or traumatic brain injury. Acquired brain injury occurs without the presence of external force acting on the skull. For example, a stroke occurs because of either a blood clot or a bleed in the vascular system of brain, not because of external trauma such as a fall. Traumatic brain injuries occur from outside pressures or forces on the skull and brain. Examples of traumatic brain injuries are those from falls or motor vehicle accidents.

Once identified as acquired or traumatic, the next step is to classify the injury as open or closed. An open TBI occurs when the skull is broken, such as a gunshot wound. A closed TBI

includes strong forces and pressures acting on the skull and brain without penetrating the skull. Examples of closed TBI are those from concussions or hematomas. Additionally, Conti describes coup and countercoup brain injuries. A coup injury involves the brain moving at a fast velocity as it strikes the skull. Countercoup injuries occur as the brain strikes one part of the skull and then the brain accelerates quickly to strike the opposite side of the skull (Conti, 2012).

According to a population study on the incidence of TBI in New Zealand, the most common causes of TBI are falls, mechanical forces, transport accidents, and assaults/violence (Feigin et al., 2013). War Veterans are also coming back from battlefield with TBIs. The Brain Trauma Foundation estimates that 10-20% of Iraq veterans have some level of TBI and approximately 30% of soldiers admitted to Walter Reed Army Medical center have been diagnosed with a TBI (2007). According to the same study, males have a 77% greater risk of sustaining a TBI than females (Feigin et al., 2013). Other forms of TBI include aneurysm, hemorrhage, tumors, encephalitis, stoke, hypoxic and anoxic brain injuries. Regardless of how a TBI occurs, patients generally experience similar types of deficits.

Conti states that TBI involves physical, cognitive, communicative, and behavioral deficits that could last a lifetime and will affect work, leisure, and social occupations (2012). The extent of these deficits varies from individual to individual. The amount of disability is generally identifiable within the first 48 hours after injury and is based on the length of amnesia or coma as assessed by the Glasgow Coma Scale (GCS) (Conti, 2012). A lower score on GCS tends to indicate more disability. TBI is further dissected into mild, moderate, and severe TBI. Conti discusses the definitions of each of these forms of TBI. Conti defines mild TBI as the loss of consciousness for less than 10 minutes, a score of 13-15 on the GCS, and no skull fracture on a physical examination. Moderate TBI occurs when the individual is hospitalized for a minimum

of 48 hours, GCS score of 9-12. A severe TBI is identified as the loss of consciousness for greater than 24 hours with a GCS rating of 1-8 (Conti, 2012). Fortunately, 85% of TBI are mild in nature and recovery happens quickly over a 3-month period. However, authors call TBI a "silent epidemic" because many individuals with a mild TBI never seek medical attention. Approximately 35% of people with an acute TBI will not seek medical attention (Auckland University of Technology, 2012). Many of these patients will instead use the Internet to find out more information on the symptoms they experience.

Symptoms of a mild TBI include headaches, dizziness, fatigue, nausea, sensitivity to light, difficulty sleeping, mood changes, visual disturbances, and difficulty with memory. Moderate and severe TBI injuries include symptoms such as profound confusion, slurred speech, difficulty with awakening from sleep, repeated vomiting, seizures, dilation of pupils, agitation, combative behavior, and clear fluids draining from the nose or ears (Mayo Clinic, 2012). Problems with memory, executive functioning, mood control, and motor deficits will affect performance skills and create difficulties with completing daily occupations. The cognitive deficits experienced by a person with TBI, make it difficult to read and understand patient education materials designed to convey information about treatment and recovery.

Implications of readability in the treatment of TBI in Occupational Therapy

Occupational therapists are often on the frontline of treating individuals who have experienced a TBI. This is because of occupational therapists' specific skill sets that can increase function in occupations of daily living. An important aspect that occupational therapists should consider when working with patients with a TBI is the cognitive deficits the individuals may be experiencing. These deficits may make it more difficult for the patient to read and comprehend patient educational material.

The incidence of TBI is rapidly increasing while the length of stay in a hospital is rapidly decreasing to help control medical expenses. Occupational therapists are faced with the challenge of providing interventions for persons with TBI during their short hospital stays and ensuring the patient has been properly educated for discharge. Occupational therapists have the responsibility of making sure the patient is educated so the patient is safe for discharge. Patient education materials can provide patients with reminders of principles learned in therapy sessions and tips for safety and improving occupational performance at home.

Smith and Gutman state that occupational therapists should be concerned with whether or not the patients with TBI understand how to use customized memory devices for cues in daily living (2011). If the patient does not understand how to use these devices through the patient education process and cannot understand the education resources that were sent home about the device, the device will become useless and the patient may have decreased function and independence.

One way occupational therapists accomplish the task of educating the patient is with patient education materials and resources. Accrediting agencies, such as JCAHO, created standards for hospitals to educate patients effectively. Occupational therapists are required to meet the patient education standards set by JCAHO. According to the Center for Health Care Strategies, health care professionals are subject to legal ramifications based on the readability and patient comprehension of health care materials. The accrediting bodies state that the health care provider must document evidence that the patient understands the medical information provided to them (2010). It is critical that occupational therapists understand the importance of educating the patient and the role that readability plays in patient education.

Occupational therapists can best serve their patients through providing comprehendible educational materials and resources such as Internet webpages that patients can access at home after discharge. It is for this reason that knowing the readability of current websites is of particular importance for the therapy community prior to recommending the pages to patients. Therefore, the research question for this study is: What is the readability of traumatic brain injury websites in Australia, New Zealand, the United Kingdom, and the United States as measured by the SMOG readability measure?

Methods

Websites

The researchers conducting this study analyzed the readability of TBI Internet-based patient education materials from four countries: Australia, New Zealand, the United Kingdom, and the United States. The researchers selected these four countries because these countries are English speaking, had relatively similar literacy levels, and the website content from each country was the most similar.

The researchers chose websites that were researched and selected using Google as a search engine for each selected country. Key terms were used in the search engine process such as “resources for traumatic brain injury” or “resources for head injury”. The websites were also reputable as they originated from national advocacy associations or sources. Once multiple sites were identified, the researchers chose four sites based on commonality of information in key areas.

The researchers included websites in this study if the information was from a national organization, included information pertaining specifically to TBI, encompassed one of four topic areas listed below, and contained at least 30 sentences per topic area. The researches excluded

websites based on the websites not having consistent topic areas with other countries' websites, not coming from a national source, and not containing enough sentences per section. The websites the researchers included for this study are the Brain Injury Centre from Australia http://www.braininjurycentre.com.au/aus/, Brain Injury Support from New Zealand http://www.brain-injury.org.nz/html/resources.html, The Brain Injury Association from the United Kingdom https://www.headway.org.uk/home.aspx, and The Brain Injury Center from the United States www.biausa.org. The researches selected four common areas for analysis from the websites. These areas include: *About the Brain, Types of TBI, Causes of TBI, and Effects of TBI*. Once the common areas were identified, the researchers placed sentences from each section into the instrument for this research, the SMOG Readability Measure. The next section will discuss the SMOG in more detail.

Instruments

The SMOG was chosen as the measure of readability for this research because it is considered the gold standard measure of readability (Fitzsimmons, Michael, Hulley, & Scott, 2010). The SMOG has also been used to determine the readability of health related education materials specific to patients with a diagnosis (Fitzsimmons, Michael, Hulley, & Scott, 2010).

Researchers have studied the SMOG and found it to be reliable and valid. The SMOG had a criterion validity of 0.985 when compared to the McCall-Crabbs reading formula. The SMOG was found to have strong internal consistency reliability. In a study analyzing the use of readability formulas in healthcare, the ICC value for the SMOG was 0.97 (Ley & Florio, 2007). McLaughlin (1969) reports that the SMOG is considered to be accurate at predicating grade level of reading material ranging from fourth to eighteenth grade with a standard error of 1.5159

grades. McLaughlin (1969) stated the standard error is similar to other readability measures (McLaughlin, 1969).

It is important to note that although the SMOG is considered the gold standard in calculating readability, one study found that other factors influence readability that are not accounted for in the SMOG, such as sentence cohesion (Kandula & Zeng-Treitler, 2008). According to this same study, a better standard of determining readability is to have a panel of experts rate the readability on a scale of difficulty (Kandula & Zeng-Treitler, 2008). Due to a panel of experts not being practical for this research, the SMOG was used as it is one of the most widely used instruments to determine readability.

The SMOG is available in two forms, a short and long version. It is also available in a manual and online version. Both the manual and online versions of the SMOG were used in this research to improve accuracy and inter-rater reliability of results.

The manual SMOG involves extracting 30 sentences out of text including 10 sentences from the beginning, 10 sentences from the middle, and 10 sentences from the end of the text. This is done to ensure the sample is representative of the entire text. Once the sentences have been extracted, the researcher counts and sums up every polysyllabic word, in each group of sentences. A polysyllabic word is comprised of three or more syllables. The researcher can then use the formula McLaughlin developed to determine the grade level equivalent or use the conversion table shown in Table 1 (University of Utah Spencer S. Eccles Health Science Library, n.d.).

Shorter documents can be measured with the SMOG by following the protocol of the SMOG for Shorter Passages. These passages include less than 30 sentences. The researcher counts the total number of sentences in the text, counts the number polysyllabic words, and uses

the conversion number shown in Table 2. The conversion number is then multiplied by the number of words with three or more syllables to calculate the correct grade level (University of Utah Spencer S. Eccles Health Science Library, n.d.).

The electronic version of the SMOG is a calculator and requires only that the researcher copy and paste the text into the calculator to be determined. The researcher must determine what material will be placed into the calculator by following a protocol, which is described in further detail in the procedures section.

Procedures

The procedures used to analyze text for this research have been adapted from previous studies that investigated the readability of patient education materials (Austermiller, 2012; Dessner, 2006; &Wolfe, 2011). The researchers selected content material based on its applicability to patient education. The researchers analyzed the four content areas (*About the Brain, Types of TBI, Causes of TBI, and Effects of TBI*) because the primary intent of these sections is to educate the patient or caregiver. The researchers focus was on including information that occupational therapist could potentially use to educate patients during treatment. To ensure consistency in the method of data collection, the researchers classified the data by using the 24 following steps:

1. Website text from the specific content areas was copied and pasted into individualized Microsoft Word documents.
2. Documents were saved and labeled according to the country and the date of access.
3. If the document needed to be reexamined or updated at any time during the process, the date of update was noted in the document.

4. Each document was trimmed to include only essential components of text.
5. Photos, boarders, decorations, website design, headers and subheadings were deleted.
6. If headers were the beginning of a list or section, the sentence was included (see related step eleven).
7. In a document that had 30 consecutive sentences, the entire 30-sentence passage was used.
8. In a document that had more than 30 consecutive sentences, the researcher attempted to use ten sentences closest to the beginning of the document, ten sentences closest to the end of the document, and the middle portion consisted of ten consecutive sentences that are representative of the remaining content.
9. For sites where content was taken from the same web page, but a different section of the webpage addressing the same topic area, ten sentences from one page came from the beginning of that page, ten sentences from another page in the topic area came from the middle of that page, and ten sentences from the last page relating to the topic area came from the last section. This allowed the researcher to have a broad sampling for the sections and while representative of the topic area.
10. All items in a list format were converted into a sentence form, including one word items.
11. For sentences or headers that end in a colon and begin a list, the first item was used to complete the original sentence and the subsequent items were put into sentence form (see procedure 9). For example,

    "For concentration and attention:

- Reduce distractions - find a quiet place, use earplugs, keep the radio / TV turned down or off.
- Watch out for signs of fatigue - one of the main causes of poor concentration is fatigue. Don't work on any one task too long. Take regular rest breaks."

  This will be changed to:

  "For concentration and attention, reduce distractions-find a quiet place, use earplugs, keep the radio/TV turned down or off.

  Watch out for signs of fatigue - one of the main causes of poor concentration is fatigue. Don't work on any one task too long. Take regular rest breaks."

12. Lists that are series of short items had punctuation added and were treated as a single sentence.
13. Lists composed of full sentences had bullets deleted and were treated as individual sentences.
14. Any string of letters or numerals with at least three syllables were included. Therefore, TBI, read as T-B-I is counted as a polysyllabic word (McLaughlin, 1969).
15. Large numbers that extended into the thousands were removed.
16. If there is a "%" symbol, it was changed to the word "percent". For example, "14%" was changed to "14 percent".
17. Symbols to phrase words such as " and ' were removed. For example 'minor head injury' was changed to minor head injury.

18. Words in all capital letters were placed into lower case letters. For example DON'T was changed to "don't" if in the middle of the sentence and "Don't" if it begins a sentence.
19. Any live hyperlink was deactivated and replaced with the words used to make the hyperlink.
20. Any citations in parenthesis were removed.
21. Any height that was written with feet being the symbol ' and inches being the symbol " was changed to the words. For example, if someone is 5'5", the height will be changed to 5 feet 5 inches.
22. In text references were removed such as APA or MLA sources and were added to the end of a paragraph.
23. Line spacing was adjusted to create single line spacing between sentences.
24. Original regional spelling was included for text analysis.

Once the documents were trimmed down to sentence form using the procedure identified, the researcher copied and pasted the text into the online version of the SMOG. The online version of the SMOG can be found at this website: http://www.wordscount.info./wc/jsp/clear/analze_smog.jsp/. Please see Appendix A for a picture of what the online calculator looked like.

The researchers followed this procedure to collect the data. Once the data were collected, the researchers recorded the results from the online version of the SMOG into Tables 5-8. To increase accuracy and insure inter-instrument reliability, a research assistant, who was blinded to the purpose of the study, completed the manual version of the SMOG on the same passages. Please see Appendix B for the manual SMOG instruction packet that was given to the blinded

research assistant. This instruction packet was used to guide the research assistant on how to assign grade levels to the passages manually. The manual results were recorded in Tables 9-12. The researchers then compared the manual results to the online calculation of readability. Finally, the researchers recorded final results and made suggestions to improve the readability of the text analyzed.

Analysis

The results from this research were analyzed with descriptive analysis to summarize findings from the data collected. The conversion table from Table 1 was used to convert results into grade level of readability. The researchers used results from this study to appropriately answer the research question and quantitatively summarize result findings. However, the results were not appropriate for further statistical analysis. The results of the study are discussed in the following section.

Results

Each document, analyzed by both the online and manual SMOG, consisted of exactly 30 sentences. The data were analyzed according to overall readability of the total website by country and are documented in Table 3. Data were then analyzed to assess grade level according to content areas in Table 4. The overall readability for each country and content area ranged from 10 to 13.78 as seen in Tables 3 and 4. These numbers are equivalent to the grade level of two years of high school to half a year of college.

The readability of each content area was analyzed by each country and is displayed in Tables 5-12. The percentage of polysyllabic words to the total number of words were calculated to assess if there was a relationship between percentage of polysyllabic words and SMOG grade level.

Tables 3 and 4 show the reliability of the online measure compared to the manual method of completing the SMOG. The average difference in grade level between the manual and online version of the SMOG was 0.61. This is equivalent to less than one grade level difference between the manual and online measure.

Discussion

The purpose of this study was to measure and compare the readability levels of Internet resources for patients with TBI in four English-speaking countries. The data show that overall readability expressed in grade levels for all four countries was from 10.51-13.78. These grade levels are all too high for the countries average literacy levels. The recommended readability level is 8th grade (King, Winton, & Adkins, 2003).

The researchers examined the similarity of the manual and online version of the SMOG. The results show there is minimal difference between the two versions. The average difference in grade level between the manual and online version of the SMOG was 0.61. This difference is less than one grade level. Because of the minimal difference in levels from the measures, occupational therapists can feel confident using either method to analyze the readability of a document and expect to find similar results.

Australia's online SMOG readability level was 13.78, which is equivalent to .5 years of college. However, in Australia, 44% of adults read at a literacy level one or two and approximately 39% of Australians are at literacy level three. Therefore, 83% of the population reads at a high school grade level or lower. This leaves only 17% of the population being able to fully comprehend the presented material.

Additionally, the United Kingdom had an overall readability level of 13.05. In the United Kingdom, 48% of the population reads at literacy levels one and two with an additional

35% able to read at a level three. These literacy rates show that 83% of the population in the United Kingdom would not be able to fully comprehend the presented material.

The overall readability for the United States was 12.83, which is equivalent to 12th grade reading comprehension. It is assumed that people who read at a level three literacy level can comprehend high school level material. In the United States, 48% of people comprehend at literacy levels one and two. This means 48% of the population of the country could not fully comprehend the information given and an additional 32% reading at level three may or may not completely comprehend the material.

New Zealand had the lowest overall readability level at 10.51. This level is equivalent to 10^{th} grade reading. In New Zealand, approximately 45% of the population comprehends at literacy levels one and two, meaning nearly half of the population cannot fully comprehend the material. Additionally, research from New Zealand has stated that TBI is occurring at epidemic levels (AUT, 2012). This leads to the assumption that comprehendible health materials are necessary for the growing number of individuals who are experiencing TBI.

Australia could have had higher overall online SMOG readability levels due to putting passages onto the website that were excerpts from major media sources and not original to the site. In the *About the Brain* section, the website posted a *New York Times* article to explain how the brain works. Even though the Australia website took media from a different source and posted the original work, the Australian site is still responsible for the readability of the content. This could be a contributor to why the readability rate is significantly higher than the recommended 8^{th} grade level.

Previous studies investigating the readability of patient education materials completed by researchers interested in applying the results to the field of occupational therapy have found

similar results. In a study investigating the readability of online patient education materials for people with multiple sclerosis, the researcher found online SMOG levels of 13.76-14.23 (Wolf, 2011). These levels all are higher than the recommended 8th grade reading level. Another study investigated the readability of patient education materials for people with Parkinson's disease and found the overall online readability to range between 11.85 and 13.02 (Austermiller, 2012). These levels also are higher than the recommended 8th grade reading level.

The current research, along with the two previous studies, shows that there is a trend in online patient education materials of being too difficult to comprehend by all readers. This is due to the information being presented in a grade level that is too high for readers with low literacy skills. These results are also similar to Williams et al., (1995) findings that report 41.6%-59.9% of individuals in the study could not comprehend patient education related materials.

The authors of websites can improve readability in several ways. Some of the New Zealand documents used principles to increase readability. As a result, some New Zealand sections had lower readability levels. For example, New Zealand: Types of TBI had a readability level of 8.94.

The current data showed that the number of polysyllabic words per sentence has a direct relationship to the overall readability level: the higher the number of polysyllabic words/total word ratio, the higher the total readability level of the document. The New Zealand website addressed that issue by emphasizing bulleted items and short sentences with words of 2 syllables or less.

Doak, Doak, and Root (1996) report readability can be improved through writing in an active voice, using minimal medical jargon, and improving overall appearance through simple illustrations and 12 pt. font. Readability can also be improved by using shorter sentences with

fewer syllables. Table 13 has examples of how to change text of a sample of online text used in this study to a lower readability level.

Implications for Occupational Therapy

This research has important implications for the field of occupational therapy. Occupational therapists serve a diverse patient population and with that comes diverse literacy abilities. Occupational therapists are often sending patients home with resources for themselves and their families to learn more about their specific conditions. These resources may be on the Internet and written by authors who are not informed about literacy rates. By recommending patients use these sites, we are giving them information to assist them that they may not be able to comprehend. The same idea is true if occupational therapists print off resources from the Internet and hand them to patients directly.

As stated in the introduction, it is increasingly important that occupational therapist educate their patients fully on patient education materials prior to patient discharge. JACHO has set standards to ensure patient education is a priority to health care providers. According to the Center for Health Care Strategies, health care professionals are subject to legal ramifications based on the readability and patient comprehension of health care materials. The accrediting bodies state that health care providers must document evidence that the patients understand the medical information provided to them (2010). This task becomes more challenging when the patient education material available to occupational therapists and patients over the Internet are not at the readability level for nearly half the population.

Occupational therapist can act as advocates on behalf of their patients to have online patient education materials more readable. This can be done by collaborating with website

authors to revise the current information or perhaps creating resources independently that are at the recommended readability level.

Additionally, occupational therapists can suggest additional media for presentation of content on the websites. Doak, Doak, and Root (1996) suggested that physical demonstration of information written on paper can help people with lower literacy levels comprehend the information. For example, occupational therapist could collaborate with website authors and developers to add videos to sites that provide audio and visual information to patients. Occupational therapists can suggest different sections on websites to help people with higher literacy levels obtain desired information. This would allow patients a choice in what they read while accommodating diverse literacy needs.

Limitations

One limitation to this study included analyzing data that can quickly change due to the nature of the Internet. Information is updated and changed quickly, which may change the readability grade levels on a given day. Another limitation included gathering information from more than one page in a website to have enough sentences for analysis. For example, Australia may have three different sections within the overall website that discuss concepts relating to the physical make-up of the brain. This information would be included in the *About the Brain* content. A problem may occur if one section of Australia's *About the Brain* has 20 sentences and the other two sections have 10 sentences each. In order to obtain the 30 sentences necessary to analyze the data in the SMOG calculator, sentences from multiple *About the Brain* sections needed to be complied together and submitted into the calculator. Please refer to Step 9 in the Procedures section for further clarification.

The information was always taken from the same website but may have been taken from complimentary portions of the same website. This method allowed analysis of content sections and the overall website. However, the information on some pages may not have been completely continuous, such as one might find in a text book or brochure example. This tends to be the nature of the Internet and may need to be taken into consideration for future follow-up studies. Additional future research suggestions are discussed in the following section.

Future Research

This study and previous studies show a trend in websites of providing patient education material written at a readability level that is too high for a large portion of the population. Future research could include taking the website information presented in this study and testing individuals with TBI to determine the extent of comprehension problems. This would give occupational therapists and website developers the opportunity to understand what information is being comprehended by patients with traumatic brain injury and if it affects patient outcomes. This population may have specific comprehension difficulties due to the nature of head injury.

Future research can also include further studies investigating the readability of online patient education materials in regards to other diagnoses. Further research on readability of patient education materials for specific diagnoses can strengthen the trend of information discovered in this and previous studies. Examples of diagnoses that can be used in the future are diabetes, breast cancer, or amyotrophic lateral sclerosis.

Conclusion

The purpose of this study was to determine the readability level of patient education materials related to TBI from four English-speaking countries. The results from the SMOG readability analysis showed all sites had readability levels higher than the recommended 8th

grade level. These results are consistent with previous studies investigating readability levels of online patient education materials.

These results are especially important to occupational therapists who distribute and recommend patient education materials often. Readable patient education materials are important as they may have a direct impact on clinical outcomes.

Occupational therapists can work as advocates for their patients to increase the readability of patient education materials and create readable materials to distribute. Occupational therapists can create readable material with the assistance of multiple resources. Occupational therapists can also advocate for the use of different kinds of media on websites to promote alternative avenues of education. This would be beneficial to patients with low literacy skills. Additionally, occupational therapists can independently check the readability of documents using the online or manual SMOG assessment tool to assure readability.

Future research in this area can include working with subjects who have a TBI and testing what they comprehend from the online sites listed in this study. Additional research can investigate the readability of patient education materials for other diagnoses commonly treated by occupational therapists.

Table 1

SMOG Conversion Table for Longer Materials

Word Count	Grade Level
0-2	4
3-6	5
7-12	6
13-20	7
21-30	8
31-42	9
43-56	10
57-72	11
73-90	12
91-110	13
111-132	14
133-156	15
157-182	16
183-210	17
211-240	18

Table 2

SMOG Conversion Table for Materials with Less Than 30 Sentences

Number of Sentences	Conversion Number
29	1.03
28	1.07
27	1.1
26	1.15
25	1.2
24	1.25
23	1.3
22	1.36
21	1.43
20	1.5
19	1.58
18	1.67
17	1.76
16	1.87
15	2.0
14	2.14
13	2.3
12	2.5

Table 3

Overall Average SMOG Readability Measures Completed Online and Manually for Australia, New Zealand, United Kingdom, and the United States

Country	Manual SMOG	Online SMOG	Difference
Australia	13.00	13.78	0.78
New Zealand	10.00	10.51	0.51
United Kingdom	12.50	13.05	0.55
United States	12.25	12.83	0.58

Table 4

Online and Manual Average SMOG Readability Level by Content Area

Content Area	Manual SMOG	Online SMOG	Difference
About the Brain	11.25	11.78	0.53
Causes of TBI	12.00	12.57	0.57
Types of TBI	12.00	12.94	0.94
Effects of TBI	12.50	12.88	0.38

Table 5

Online Analysis of SMOG Readability Levels, Total Word Count, Total Polysyllabic Words, and Percentage of Polysyllabic Words for Australia, New Zealand, United Kingdom and United States in Content Area: About the Brain

Country	Online SMOG	Total Word Count	Total Polysyllabic Words	% of Total
Australia	13.19	509	93	18.30%
New Zealand	10.28	305	47	15.40%
United Kingdom	12.91	572	88	15.40%
United States	10.72	332	53	16.00%

Note. Sentence count for each document is 30 sentences.

Table 6

Online Analysis of SMOG Readability Levels, Total Word Count, Total Polysyllabic Words, and Percentage of Polysyllabic Words for Australia, New Zealand, United Kingdom and United States in Content Area: Causes of TBI

Country	Online SMOG	Total Word Count	Total Polysyllabic Words	% of Total
Australia	13.3	571	95	16.60%
New Zealand	11.67	480	67	14.00%
United Kingdom	12.91	662	88	13.30%
United States	12.4	527	79	15.00%

Note. Sentence count for each document is 30 sentences.

Table 7

Online Analysis of SMOG Readability Levels, Total Word Count, Total Polysyllabic Words, and Percentage of Polysyllabic Words for Australia, New Zealand, United Kingdom and United States in Content Area: Types of TBI

Country	Online SMOG	Total Word Count	Total Polysyllabic Words	% of Total
Australia	14.74	588	124	21.10%
New Zealand	8.94	328	31	9.50%
United Kingdom	12.57	539	82	15.20%
United States	15.51	560	141	25.20%

Note. Sentence count for each document is 30 sentences.

Table 8

Online Analysis of SMOG Readability Levels, Total Word Count, Total Polysyllabic Words, and Percentage of Polysyllabic Words for Australia, New Zealand, United Kingdom and United States in Content Area: Effects of TBI

Country	Online SMOG	Total Word Count	Total Polysyllabic Words	% of Total
Australia	13.87	535	106	20.00%
New Zealand	11.14	358	59	16.50%
United Kingdom	13.82	558	105	18.80%
United States	12.69	466	84	18.00%

Note. Sentence count for each document is 30 sentences.

Table 9

Manual Analysis of SMOG Readability Levels, Total Word Count, Total Polysyllabic Words, and Percentage of Polysyllabic Words for Australia, New Zealand, United Kingdom and United States in Content Area: About the Brain

Country	Manual SMOG	Total Word Count	Total Polysyllabic Words	% of Total
Australia	12.00	509	88	17.30%
New Zealand	10.00	305	46	15.10%
United Kingdom	13.00	572	91	15.90%
United States	10.00	332	83	16.00%

Note. Sentence count for each document is 30 sentences.

Table 10

Manual Analysis of SMOG Readability Levels, Total Word Count, Total Polysyllabic Words, and Percentage of Polysyllabic Words for Australia, New Zealand, United Kingdom and United States in Content Area: Causes of TBI

Country	Manual SMOG	Total Word Count	Total Polysyllabic Words	% of Total
Australia	14.00	571	113	19.80%
New Zealand	11.00	480	71	14.80%
United Kingdom	12.00	662	87	13.10%
United States	12.00	527	77	14.60%

Note. Sentence count for each document is 30 sentences.

Table 11

Manual Analysis of SMOG Readability Levels, Total Word Count, Total Polysyllabic Words, and Percentage of Polysyllabic Words for Australia, New Zealand, United Kingdom and United States in Content Area: Types of TBI

Country	Manual SMOG	Total Word Count	Total Polysyllabic Words	% of Total
Australia	14.00	588	125	21.2%
New Zealand	8.00	328	28	8.5%
United Kingdom	12.00	539	84	15.6%
United States	15.00	560	147	26.3%

Note. Sentence count for each document is 30 sentences.

Table 12

Manual Analysis of SMOG Readability Levels, Total Word Count, Total Polysyllabic Words, and Percentage of Polysyllabic Words for Australia, New Zealand, United Kingdom and United States in Content Area: Effects of TBI

Country	Manual SMOG	Total Word Count	Total Polysyllabic Words	% of Total
Australia	13.00	535	105	19.6%
New Zealand	11.00	358	58	16.2%
United Kingdom	13.00	558	108	19.4%
United States	12.00	466	83	17.8%

Note. Sentence count for each document is 30 sentences.

Table 13

Examples of Revisions to Original Passages taken from Australia's "Types of TBI" with grade equivalence from the online version of the SMOG

Recommendations	Original: 14.74	Revision: 8.31
Shortening Sentences	There is very little understanding or knowledge in the community about brain injury and the impact it has on individuals and families.	We don't know how brain injury affects families.
Decreased number of polysyllabic words	While most people make a good recovery, many are left with lasting effects that, even if mild, may have significant consequences for everyday living.	Most people get better, but some problems can last a long time. These problems may make it hard to do tasks you used to do.
Use of familiar words	In a traumatic injury, damage to nerve tissue is usually focused in one or more areas of the brain, although tearing can result in diffuse injury.	With brain injury, damage is often in just one area, but it can spread.

Use active voice	An MRI scan will usually show diffuse injury, but is not often used due to the increased cost of the scan	Many doctors will use a MRI scan to help see where the damage is.

Appendix A

Online SMOG Measure

WordsCount

Language Is Our Passion

WordsCount: SMOG

This SMOG measure give you the reading grade determined by the formula described below.

Click
Click button to submit

Submit

100000 characters remaining.

WordsCount SMOG Results

To calculate SMOG

1. Count a number of sentences (at least: 10 from the start of a text, 10 from the middle, and 10 from the end).
2. In those sentences, count the polysyllables (words of 3 or more syllables).
3. Calculate using

$$\text{grade} = 1.0430\sqrt{30 \times \frac{\text{number of polysyllables}}{\text{number of sentences}}} + 3.1291$$

References

- **Dr. McLaughlin's Web site**: Professor G. Harry McLaughlin describes his formula with wit. [more]
- **Wikipedia**: SMOG (Simple Measure of Gobbledygook) is a readability formula that estimates... [more]

Appendix B

Manual SMOG Instruction Packet

Adapted from McLaughlin, G. (1969). SMOG grading: A new readability formula. *Journal of Reading 12*(8), 639-646.

This packet contains 16 documents. Please review the documents to determine each one's readability level using the SMOG formula. First, please date the document with date that you reviewed it. Then please assign a readability level to the document using the instructions below. Once you have assigned a readability level to the document, please clearly write the readability level you have assigned it in the top left hand corner of the page.

How to use the SMOG formula:

1. In the 30 selected sentences of the document, count (highlight) every word of three or more syllables. Any string of letters or numerals beginning and ending with a space or punctuation mark should be counted if you can distinguish at least three syllables when you read it aloud in context. Example: TBI is three syllables and is read as T-B-I.
2. Count hyphenated words as one word. For example: less-common would be three syllables.
3. Add up the total amount of polysyllabic words counted.
4. If a polysyllabic word is repeated, count each repetition.
5. Please do not include the titles of the document while scoring the page. Example: Title: A- About the Brain. This title would not be counted by the research assistant.
6. Once you have the total polysyllabic word count, use the SMOG conversion table to match up the number of words to the grade level of the document. Please see the next

page for the conversion chart. As an example, if there are 61 polysyllabic words, the SMOG readability level would be 11.

Appendix C

Completed Modifications to Text

Australia: Types of TBI. (Original: 14.74)

Acquired brain injury (ABI) is often called the hidden disability because it affects intangible processes like thinking and behavior. Since it's not physically visible or easily recognized, it's often its long term problems are usually in the areas of thinking and behaviour, and are not as easy to see and recognise as many other physical disabilities. As a consequence, the difficulties people with brain injuries face are easily ignored, overlooked or misunderstood. Very little knowledge about ABI exists within most communities, and even those closest to a person with ABI may simply think that person difficult or lazy. Family members and friends may regard a person with acquired brain injury who exhibits cognitive problems or changed behaviour, as lazy or hard to get along with. The term acquired brain injury is used to describe all types of brain injury that occur after birth. There is very little understanding or knowledge in the community about brain injury and the impact it has on individuals and families. Acquired brain injury is not the same as to be confused with intellectual disability. People with an ABI don't acquired brain injury always suffer a decrease indo not necessarily experience a decline in their overall intelligence. Instead, they tend to suffer specific deficits in levels of general intellectual functioning.

As a result of this blow or rapid movement, brain tissue may be torn, stretched, penetrated, bruised or become swollen. Oxygen may not be able to get through to the brain cells and there may be bleeding. Symptoms of TBIs range from temporary to permanent and from mild to severe. A sufferer may black out briefly after a punch to the head and then experience no more symptoms, or may remain unconscious for days or even years. The effects of traumatic brain injury can be temporary or permanent and range from mild injury, such as being

momentarily stunned while playing football, to a very severe injury that may cause prolonged loss of consciousness. Concussion for any period of time, however slight, may result in acquired brain injury. In fact, Concussion, for example, is classified as a mild TBI. The Centre for Disease Control in America defines concussion as mild traumatic brain injury. Most people recover fully, but some suffer lasting effects, mild to severe, that may present significant challenges. While most people make a good recovery, many are left with lasting effects that, even if mild, may have significant consequences for everyday living.

There are several mechanisms which may be at work with degenerative conditions. In multiple sclerosis, nerve cells die when the fatty lining which protects them is removed. In many diseases such as Alzheimer's and Parkinson's, there is a generalised or localised death of cells but the cause is not known, or very poorly understood. In a traumatic injury, damage to nerve tissue is usually focused in one or more areas of the brain, although tearing can result in diffuse injury. With a non-traumatic injury, damage is usually spread throughout the brain. Exceptions to this include tumours and an infection that remains localised or that spreads evenly from one starting point. This can make diagnosis difficult because small, scattered areas of damaged tissue may not show up on a CAT scan. An MRI scan will usually show diffuse injury, but is not often used to the increased cost of the scan. Some cognitive abilities, particularly short term memory, are commonly affected. Fatigue is also extremely common, due to the brain having to work harder to work around diffuse areas of injury.

Australia: Types of TBI. Modifications for lower readability: 8.31

An acquired brain injury happens after birth. Brain injury affects how you think and act. It may be hard to see these symptoms in people. You might think your loved one is being lazy or hard to be around. We do not know how brain injury affects families. We know that brain injury

does not mean a person is less smart. Only some parts of thinking will be injured. In an injury, the brain can be:

- Torn
- Pulled
- Swollen

Injury can be caused by:

- Bleeding
- No oxygen to the brain

Symptoms of brain injury can range from mild to severe. Concussions are a type of brain injury. The symptoms can last for a short time. Most people get better, but some problems can last a long time. These problems may make it hard to do tasks you used to do.

It may be harder to:

- Get dressed
- Remember to turn off the stove
- Drive

Damage to the brain can happen when tissues that carry signals get hurt. Other times areas of cells die in groups. With brain injury, damage is often in just one area, but it can spread too. A spreading injury is like when a tumor spreads through the brain.

It can be hard to say if someone has a brain injury. Many doctors will use a MRI scan to see where affected areas are. Areas that are hurt are:

- Cognitive skills
- Memory
- Fatigue

References

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