THE ASSESSMENT OF WRITTEN INFORMATION FOR CLIENTS AND PATIENTS

1   Introduction

1.1   The reasons for this module?

There are two main reasons for the inclusion of this module on the assessment of the readability of written information.

Firstly, as users of tests and questionnaires in paper and pencil form (or even on the computer screen), psychologists need to be able to estimate, in some objective manner, the likelihood of somebody not understanding the items to which they are being asked to give an answer.

Secondly, as producers of written materials and instruction for clients and patients, psychologists have a duty to see that these are written in a form likely to be understood by those for whom they are intended,

Obviously explanatory leaflets, homework assignments, and instructional leaflets about the behavioural or cognitive changes that are needed, have to be understood.

These problems can sometimes be especially acute with those from non-English speaking backgrounds.

It is true that a psychologist can always ask if the material is understood, and this should always be done. But people sometimes do not realise that they have not understood something properly, Sometimes, too, for fear of offending, or losing face, or other such reasons, people do not like to admit that they have had difficulty with written materials.

So, it is necessary to use some objective measure of difficulty level.

Also, some typographical factors can lead to text being harder to read or process (especially for elderly patients). A piece of writing which is hard to read will probably be less likely to be read.

Later sections of this module give examples of potentially problematic physical features of written materials

1.2   Readability and Readability Formulas

Readability in this context means comprehensibility. It is concerned with the understandability of written information.

Readability Formulas are essentially multiple regression equations that predict the School Grade (Year Level) of reading proficiency, which is needed for somebody to understand a given piece of text.

Predictor variables have included word difficulty, word length, sentence length, and a host of other variables. Even psycholinguistic variables such as Yngve depth counts have been tried.

The criterion has usually been a set of reading passages. These passages have been scaled on a dimension of reading grade level. The levels have been assigned by some rule such as:

 'The Reading Grade Level of a passage is the average Grade Level, on a reading achievement test, of those students who can answer N percent of the multiple choice questions'

The 'N percent' referred to has varied from formula to formula in the range 50 to 100 percent.

With adult readers, a standardised reading test has been administered to them to see what grade level of reading ability they have – i.e. a standardised reading achievement test. So this time the rule will be:

 'A passage is at the Reading Grade Level equal to the average grade level on the standardised reading achievement test of those who can answer N percent of the questions'

Sometimes (especially with adults) the criterion has not been a multiple-choice test but a cloze test. You will remember that the cloze procedure involves taking a passage of text, deleting every Nth word (usually every fifth word) and asking people to fill in the missing words. For example:

> **Readability _____ are essentially multiple regression _____ which predict the School _____ (Year Level) of reading _____ which is need for _____ to understand a given _____ of text.**

The cloze score is the percent of missing words correctly filled in. The higher the score the easier is the text.

The rule in this case will be something like the following:

 'A passage is at the Reading Grade Level equal to the average grade level on the achievement test of those who obtain a cloze score of (say) 35% or more.'

The table below allows you to translate a cloze score into a corresponding percent correct on a multiple-choice test.

Cloze score	Multiple choice test
50 - 60%	70 – 80%
35 – 50%	50 – 60%
Below 35%	Below 50%

This has been a very brief account. More detail will be given when various individual Readability Formulas are described.

But you can download, free, an excellent, interesting and thorough review of readability formulas.

This is the review written by William H DuBay[1], and it can be found at:

http://www.impact-information.com/impactinfo/readability02.pdf

You are strongly urged to read this review, if you are likely to use readability formulas.

Other relevant reviews of the use of readability formulas in health care generally are listed at the end of this module[2] [3] [4]

1.3   Literacy levels in Australia

The information summarised in the Table below might soon need updating. It is based on the 1996 ABS Survey, The Australian Bureau of Statistics has carried out a similar survey in 2006, but the results are not yet available.

The scales used in the international literacy surveys and in the Australian surveys do not report their results in terms of grades, so the table below give a translation of the survey results into approximate US grade levels. These are of course the Grade Levels given by most readability formulas.

Literacy Level	Grade level	Percent of Australians aged 16 - 65 years at each level	
		All	Non – English-speaking background
1 Rudimentary	1 - 2	17%	48%
2 Basic	3 - 6	27%	24%
3 Intermediate	7 - 11	37%	21%
4 Adept	12 - 15	(4 + 5 combined)	(4 + 5 combined)
5 Advanced	16+	19%	7%

It can be seen that (at the time of the last survey) about 44 percent of Australians had prose literacy at or below the 6th grade level.

1.4 Literacy levels required for understanding current leaflets and other literature issued to clients and patients.

The chart below summarises data on the Reading Grade Level required for understanding written information issued to psychiatric patients[5].

Difficulty levels of information leaflets for psychiatric patients
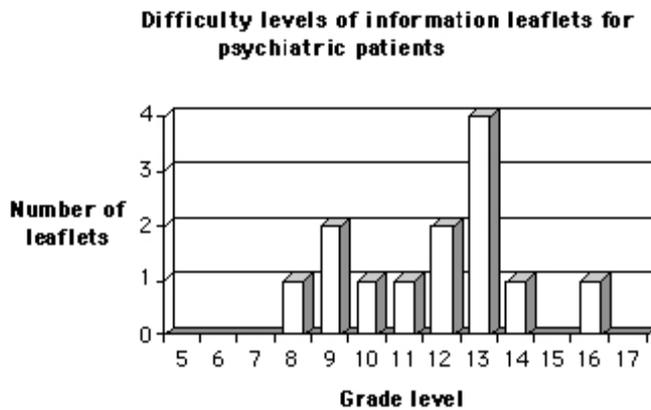
And the next chart shows the reading Grade levels of various behavioural therapy self help manuals intended for clients and patients.

Difficulty levels of behaviour therapy self help manuals
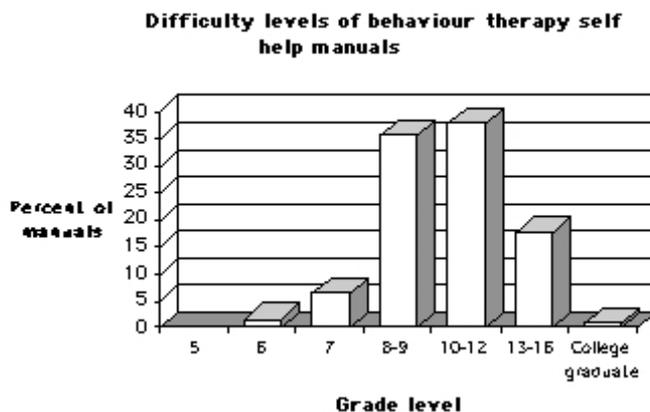
The final example is the readability of questionnaires, rating scales and pamphlets produced for parents of children with behavioural problems[6].

Readability of Parental Rating Scales
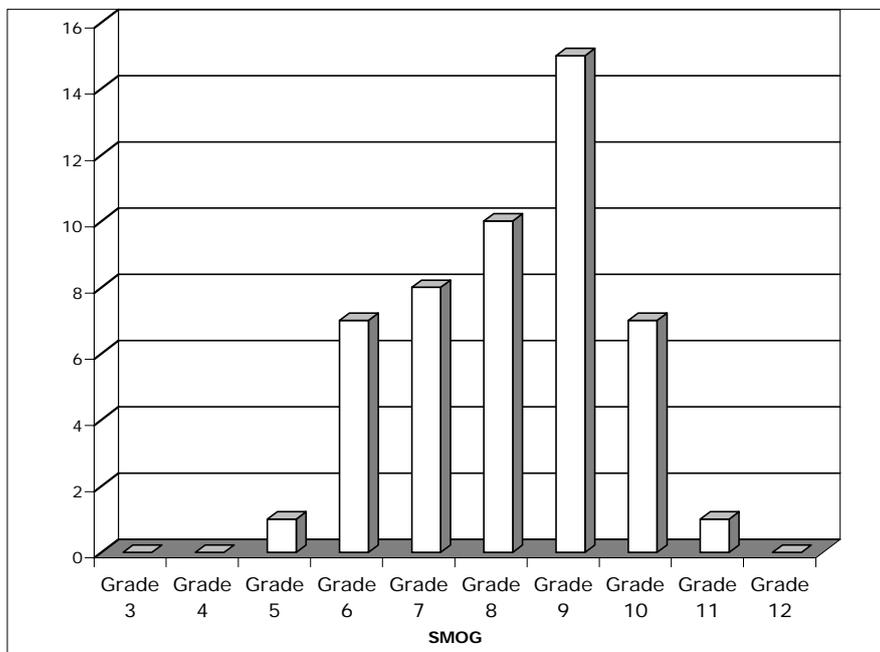
Thus there is an obvious mis-match between the likely skills of the intended reader and the difficulty of the documents,

We therefore need to asses the readability of the documents, and the written tests that we use in order to reduce the this mismatch. That is where Readability Formulas can help.

2   Readability Formulas

2.1   Reading Grade Levels

The easiest way to estimate the likely comprehensibility of text is to use a Readability Formula to estimate the Grade Level of reading ability required to understand a particular piece of writing.

The grades referred to in readability formulas are generally United States school grades. The relationship of these grades to age is shown below.

Grade													
K	1	2	3	4	5	6	7	8	9	10	11	12	13
5	6	7	8	9	10	11	12	13	14	15	16	17	18
Age													

As a rule of thumb it is wise to assume that an individual's Reading Ability Level is <u>at least</u> two years less than number of years of schooling[7].

Years of schooling completed by Australians are shown here.

Australian Educational Levels
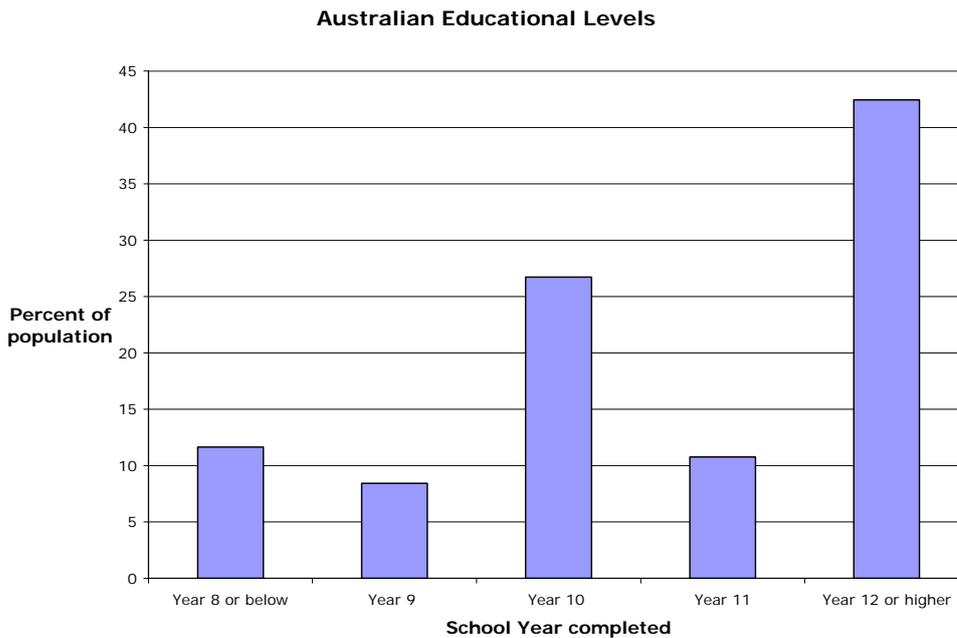
There are many readability formulas. Most of the ones we discuss involve relatively simple calculations.

However if you do not want to do the calculations and preliminary labour yourself, see if your word processing program has readability formulas built in. Some have.

And many also tell you the number of words and the number of sentences in a piece of writing. Some even tell you the number of characters. These values can make the use of readability formulas much easier.

Also, as we describe the formulas we will list sites with on-line calculators, which will do the job for you. This is in addition to the calculators written specially for this site.

The formulas have been somewhat arbitrarily classed as those for use with adults and those for use with children.

In fact most formulas can be used throughout the age range.

Finally, note that most formulas were devised for hand scoring and hand counting of syllables, words and sentences. Because of this, samples of the text were taken (e.g. 100 words or 150 words or 30 sentences). With the use of computers the whole text can be easily analysed. But this sometimes means that the formulas have to be slightly modified from their original form, to take account of the fact that we are no longer dealing with, say, a sample of 150 words. The formulas given below should work for the analysis of whole texts, or samples of text,

2.2 **Assessment of text for adults**

Three of the easiest to use, and most commonly used, formulas are:

the Flesch Formula

the Flesch Kincaid Formula

McLaughlin's SMOG Formula

As there is an excellent calculator for the last of these, we will start with it.

The calculator print-out provides data on:

number of syllables

number of words

number of sentences

These data can be used to compute the other two formulas

2.3 **McLaughlin's SMOG Formula**

(McLaughlin, G. H. SMOG Grading - a new readability formula. *Journal of Reading*, 1969, 12, 639 – 646)

The initial SMOG formula was a simplified approximation of a more complicated regression equation. It was calculated as follows:

Reading Grade Level = $3 + \sqrt{lw30}$

where:

lw30 = number of words of 3 or more syllables per 30 sentences

More generally (for text containing fewer or more than 30 sentences) this becomes.

$$RGL = 3 + \sqrt{\left(lw \times \frac{30}{NS} \right)}$$

where:

lw = number of words of 3 or more syllables

NS = number of sentences

It might be instructive to see how to use such a formula using hand counting and calculation. Let's take the SMOG formula as an example.

McLaughlin's own instructions for the simplified version of his formula cannot be bettered so here they are.

"SMOG Grading

1. Count 10 consecutive sentences near the beginning of the text to be assessed, 10 in the middle and 10 near the end. Count as a sentence any string of words ending with a period, question mark or exclamation point.

2. In the 30 selected sentences count 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.

If a polysyllabic word is repeated, count each repetition.

3. Estimate the square root of the number of polysyllabic words counted.

This is done by taking the square root of the nearest perfect square.

For example, if the count is 95, the nearest perfect square is 100, which yields a square root of 10. If the count lies roughly between two perfect squares, choose the lower number. For instance, if the count is 110, take the square root of 100 rather than that of 121.

4. Add 3 to the approximate square root. This gives the SMOG Grade, which is the reading grade that a person must have reached if he is to understand fully the text assessed."

The exact SMOG formula is:

$$\text{Reading Grade} = 1.043 \times \sqrt{number\ of\ polysllables \times \left(\frac{30}{Number\ of\ sentences}\right)} + 3.1291$$

where a polysyllable is a word of three or more syllables.

More information about the formula, including a downloadable copy of McLaughlin's original paper can be found at:

http://webpages.charter.net/ghal/SMOG.html

And the calculator is at:

http://www.wordscount.info/hw/smog.jsp

McLaughlin's suggested interpretation of SMOG Grades is:

SMOG Grade	Educational Level	Example
0 - 6	low-literate	Soap Opera Weekly
7	junior high school	True Confessions
8	junior high school	Ladies Home Journal
9	some high school	Reader's Digest
10	some high school	Newsweek
11	some high school	Sports Illustrated
12	high school graduate	Time Magazine
13 - 15	some college	New York Times
16	university degree	Atlantic Monthly
17 - 18	post-graduate studies	Harvard Business Review
19+	post-graduate degree	IRS Code

2.4   The Flesch Reading Ease Formula.

(Flesch, R. (1948) A new readability yardstick. *Journal of applied Psychology*, **23**, 221 – 233)

This formula (probably the most famous of all) was validated against the McCall-Crabbs Passages. For any passage it predicted the average Reading Grade Level of students who correctly answered 75% of the comprehension questions about that passage. The formula is:

$$\text{Reading Ease:} \quad RE = 206.835 - (1.015 \times sl) - (84.6 \times wl)$$

where:

sl = average number of words in a sentence.

wl = average number of syllables per word

If you use the SMOG calculator first you will have the number of syllables, the number of words, and the number of sentences provided in the results.

You can then use that information to calculate Flesch's Reading Ease Score. The higher the score the easier the text is. Flesch's recommendation is that in materials for general consumption you should aim for a Reading Ease Score of 70 or higher.

Otherwise you will have to count the words, syllables and sentences yourself. But there is a good dictionary based syllable counter at:

http://www.wordscount.info/hw/syllable.jsp

Once you have the number of syllables, words and sentences the calculator below will do the sums for you. All you have to do is enter the number of words, the number of syllables and the number of sentences. It will calculate Flesch's Reading Ease Score and also give you the Flesch-Kincaid Grade estimate as well.

Not only that, if you also count and enter the number of words of three syllables, the calculator will return the SMOG grade.as well.

RE, FK and SMOG.xlt

You can then use that information to calculate Flesch's Reading Ease Score. The higher the score the easier the text is. Flesch's recommendation is that in materials for general consumption you should aim for a Reading Ease Score of 70 or higher.

RE scores can be converted to Grade equivalents by use of this table:

The interpretation of Flesch Reading Ease Scores

Reading Ease score	Grade Level	Difficulty Level
90 -100	5	very easy
80 - 90	6	easy
70 - 80	7	fairly easy
60 - 70	8 - 9	standard
50 - 60	10 - 12	fairly difficult
30 - 50	13 - 16	difficult
0 - 30	college graduate	very difficult

Recall that we earlier estimated that about 44 percent of Australians have reading ability at or below the Grade 6 level.

A score of 70 or higher was chosen as the target to aim for, because this is generally accepted as what has been called the 'tabloid line'. Mass circulation newspapers usually score at or above this level

In surveys about two thirds of newspaper readers choose newspapers scoring above the tabloid line (i.e., Reading Ease of 70 or higher). This suggests that material at this level of difficulty is preferred by most people.

2.5   The Flesch-Kincaid Formula

(Kincaid, J. P., Fishburne, R. P., Rogers, R. L. and Chissom, B. S. (1975) *Derivation of new readability formula for navy enlisted personnel.* Millington, Tennessee: Navy Research Branch)

The Flesch-Kincaid formula was developed for use with military personnel. It was for a time (and possibly still is) the US Department of Defence standard. It is a version of the Flesch Formula developed for, and been used extensively with adult groups.

The Flesch-Kincaid Formula is:

$$RGL = (.39 \times sl) + (11.8 \times wl) - 15.59$$

where:

       sl = average number of words per sentence

       wl = average number of syllables per word

The calculator we have provided will work out the Flesch-Kincaid Grade Level after you have entered number of words, number of syllables, and number of sentences.

2.6   Other formulas

2.6.1. The Automated Readability Index[8]

This formula uses length of words in characters, and words per sentence as predictors. Some word processing programs will tell you the number of characters in a passage.

The formula is;

$$RGL = \left(4.71 \times \frac{c}{w} \right) + \left(0.5 \times \frac{w}{s} \right) - 21.43$$

where:

c = number of characters

w = number of words

s = number of sentences

An on-line calculator is available at:

http://www.online-utility.org/english/readability_test_and_improve.jsp

2.6.2   Coleman Liau[9]

This formula also uses word length in characters and sentence length in words.

The full original form predicted cloze scores;

$$Cloze\% = 114.84 - .215L + 1.08S$$

where:

L = number of letters per 100 words

S – number of sentences per 100 words

The Cloze percent score can the be converted into a reading Grade Level by the formula;

$$RGL = -\left(27.4 \times estimated\, cloze\%\right) + 23.064$$

However there is a simpler approximate formula which does the whole thing in one swoop.

$$RGL = \left(5.9 \times \frac{c}{w}\right) - \left(30 \times \frac{s}{w}\right) - 15.8$$

where:

c = number of characters

w = number of words

s = number of sentences

An on-line calculator is available at:

http://www.online-utility.org/english/readability_test_and_improve.jsp

2.6.3 FORCAST[10]

This formula uses the rate of one syllable words per 150 word passage.

$$RGL = 20.43 - \left(.11 \times n_{mono} \times \frac{150}{nw}\right)$$

where:

nw = number of words in the text being assessed

n_{mono} – number of words of one syllable in the text

An online calculator is available at:

http://www.online-utility.org/english/readability_test_and_improve.jsp

2.6.4 Gunning's Fog Index[11]

Gunning's formula like the SMOG formula uses words of three or more syllables a one of its predictors. McLaughlin, in fact, states that he got the idea of using polysyllabic word count from gunning, and indeed named his formula SMOG to suggest its relationship to FOG.

The Fog Index is:

$$Fog\,Index = \left(.4 \times \frac{w}{s}\right) + \left(100 \times \frac{w_{pol}}{w}\right)$$

where:

w = number of words

s = number of sentences

w_{pol} = number of words of three or more syllables **<u>EXCLUDING</u>**

1. proper names (people or places)

2. combinations of short easy words eg bookkeeper, manpower

3. verb forms that make the third syllable by the addition of 'ing' or 'es' or 'ed' - for example 'pursuing', 'trespasses', 'created',

An online calculator for the Fog Index can be found at:

http://www.online-utility.org/english/readability_test_and_improve.jsp

2.6.5   The Fry Readability Graph[12]

To use the graph you need to calculate two values.

A. Calculate average number of syllables per 100 words

The formula is :
$$100 \times \frac{syl}{w}$$

where:

$\quad$ syl = total number of syllables

$\quad$ w = total number of words

B. Calculate average number of sentences per 100 words

The formula is:
$$100 \times \frac{NS}{w}$$

Use Graph to estimate Reading RGL see below.

The horizontal axis variable is average number of syllables per 100 words.

The vertical axis variable is average number of sentences per 100 words

Fry graph for readability; grade levels
y: average number of sentences per hundred words; x: average number of syllables per hundred words
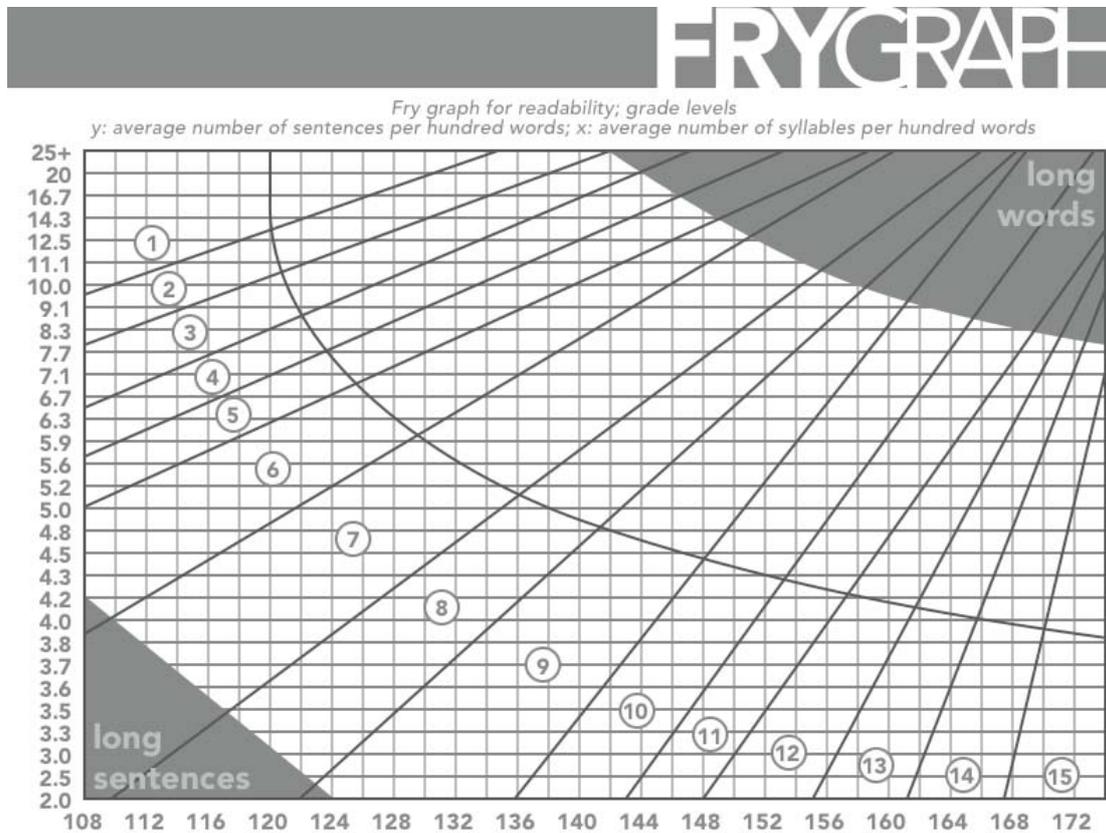
Reproducible copies of the Fry Readability Graph can be found at

http://justen.blogspot.com/2006/01/reproducible-fry-graphs.html

and from

http://school.discovery.com/schrockguide/fry/fry2.html

2.7   Some Examples

The examples below were analysed using four tools;

the in-built readability tools in MS Word

our own calculator

the SMOG site calculator

the multi-measure calculator provided at

http://www.online-utility.org/english/index.jsp

except where stated otherwise, the values in the following tables are the results of using the above site.

For Flesch Reading Ease, Flesch Kincaid Grade, and SMOG, three estimates are provided. You can use these to compare the different calculators. Some variation in values is inevitable given that the different calculators use different algorithms for counting syllables.

Example 1

"Stress is extremely prevalent in our society and stress related difficulties are one of the most common problems seen by General Practitioners. It can affect anyone and everyone, young or old, male or female.

Stresspac is one of the most effective ways of treating it.

Stresspac is a self-help treatment, which has been shown to be an effective therapy for anxiety/stress. It will teach the individual about stress and give you the skills to manage it effectively. Stresspac has been found to be particularly effective when delivered in a group format.

People with the following difficulties can benefit from Stresspac: anxiety, stress, panic attacks, agoraphobia, social phobia, specific phobia, obsessive compulsive disorder, post traumatic stress disorder.

Stresspac is provided through a 2-hour lesson every week over 6 weeks. The lessons will be held in colleges or community centres at times convenient for most people to attend. General Practitioners, Nurse, Psychologist, Occupational Therapist, Social Worker are able to provide details of the next course and access to the course is obtained through a "Stresspac prescription" which is provided by these professionals .

On completion of the course the individual will need to go back to his / her General Practitioner or whoever suggested attending, and discuss how useful they found the course. The individual will be asked to complete a small, anonymous questionnaire by the course facilitators, which will help them understand how useful the course has been."

Readability Measure	Grade
Flesch Reading Ease	39.19
MS Word Flesch Reading Ease	41.1
Our calculator Flesch Reading Ease	40.25
Flesch Kincaid	12.72
MS Word Flesch Kincaid	12.00
Our calculator Flesch Kincaid	12.57
SMOG Site SMOG	14.83
SMOG	14.94
Our calculator SMOG	14.55
Fog Index	16.17
Coleman Liau	13.8
ARI	13.36

All formulas agree that this is a very difficult piece of text. The implication would be that it should be re-written, if it is intended for patients in general.

Example 2

"One-to-one counselling and psychology sessions are available at all GP practices.

The form of therapy on offer will focus on helping you move forward and will concentrate on steps that you can take yourself to tackle your difficulties.

Although generally short-term, the number and frequency of sessions offered are flexible and will be negotiated between you and the counsellor or psychologist.

The therapists who provide the service are qualified members of a counselling or psychology profession; in some surgeries they are assisted by counsellors or psychologists in training."

The results of a readability analysis of this piece were:

Readability Measure	Grade
Flesch Reading Ease	32.21
MS Word Flesch Reading Ease	36.1
Our calculator Flesch Reading Ease	35.9
Flesch Kincaid	14.42
MS Word Flesch Kincaid	12.0
Our calculator Flesch Kincaid	13.9
SMOG site SMOG	15.85
Our calculator SMOG	16.53
SMOG	16.13
Fog Index	16.13
Coleman Liau	14.21
ARI	15.00

Again, the piece is too difficult for general use.

Example 3.

"Now to get your breathing back into an even rhythm we will explain carefully how this is done and when this has been practised regularly for a time, you will be able to use it at any time you need.

Sit in a comfortable chair and notice when you breathe normally that the chest and shoulders move, this is the usual way to breath. This method is to keep your chest and shoulders still and allow your stomach to extend out slightly when you take a breath. There is not a big difference between the two ways but this new way will stop over-breathing or the breaths being too small. The correct balance in the blood stream and lungs of oxygen and carbon dioxide is important to sufferers to stop a panic.

Another position to practise this is to lie on the floor on your back. Put a light book on your stomach and watch the book go up and down. This will make sure the stomach is moving.

Start breathing slowly through your nose and at the same time push your stomach out, then let it go back. Keep doing this and just to make sure it is even and slow, start to count as you breathe in, one, two, three, (then exhale out), four, five six, seven. Repeat this for five minutes. This is quite a simple method and after a while you will become good at it. Instead of hurrying away from situations that may cause a panic, this method of breathing can defuse a panic attack. This is an important tool to use to combat this debilitating condition.

At present you are probably feeling rather confused but gradually when you grasp these proven techniques you will find great benefit by using them."

Results this time are:

Readability Measure	Grade
Flesch Reading Ease	75.8
MS Word Flesch Reading Ease	74.1
Our calculator Flesch Reading Ease	72.51
Flesch Kincaid	8.62
MS Word Flesch Kincaid	7.8
Our calculator Flesch Kincaid	8.06
SMOG site SMOG	9.32
Our calculator SMOG	9.56
SMOG	9.63
Fog Index	10.34
Coleman Liau	7.63
ARI	8.42

This is a bit too difficult. It should be made a little easier. About half the Australian population would have difficulty with it.

Example 4.

This example consists of the instructions to those who complete the Lovibond DASS questionnaire.

" Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you over the past week. There are no right or wrong answers. Do not spend too much time on any statement."

Readability Measure	Grade
Flesch Reading Ease	68.53
MS Word Flesch Reading Ease	79.8
Our calculator Flesch reading Ease	85.87
Flesch Kincaid	6.17
MS Word Flesch Kincaid	5.6
Our calculator Flesch Kincaid	4.76
SMOG	9.32
SMOG site SMOG	6.16
Our calculator SMOG	6.43
Fog Index	9.41
Coleman Liau	5.76
ARI	4.52

This time we seem to have a piece at an acceptable level of difficulty.

Example 5

"This is intended as an excruciatingly difficult paragraph for analysis by readability formulas the expectation being that comprehension will present considerable difficulties to the average reader, who is unaccustomed to perusing lengthy sentences consisting disproportionately of polysyllabic structural ingredients. "

Readability Measure	Grade
Flesch Reading Ease	- 47.5
MS Word Flesch Reading Ease	0
Our calculator Flesch Reading Ease	- 49.67
Flesch Kincaid	29.57
MS Word Flesch Kincaid	12
Our calculator Flesch Kincaid	29.88
SMOG site SMOG	27.49
Our calculator SMOG	28.03
SMOG	27.49
Fog Index	32.01
Coleman Liau	24.81
ARI	31.16

As was probably obvious from reading it, the last example was rather difficult. BUT look at the MS Word Flesch Kincaid Grade. It is only 12 – a paltry value compared with the others.

It does look as though the Flesch Kincaid Grade has a maximum of 12.00 in at least some MS Word readability analysis programs. So, if you are going to analyse readability using the built in analysers of your word processing program, use the hard sentence in this example to see what limits your program has built in to it.

Note also that the Reading Ease score has a floor of zero in MS Word, but this is trivial in that it would be very unwise to issue any written materials with a score of zero or lower.

Do formulas sometimes give the wrong result?

It is certainly possible to write a meaningful, but hard to understand sentence which would receive a very high readability score. In fact one with;

Flesch Reading Ease = 100

Flesch-Kincaid Grade = 1

SMOG Grade = 3

Try it:

"The rat that the cat that the dog chased killed ate the malt."

It is not without its difficulties, is it?

The general rule is this. If the readability formula says the text is too hard make it easier, but if the formula says the text is easy, read it carefully to see if it makes sense.

There is a very big difference between;

"Mary had a little lamb. Its fleece was white as snow,"

and

"Lamb had little a Mary. Was fleece snow white its as."

Both get the same readability score!

2.8 Assessment of text intended for children

While the Flesch and SMOG readability formulas can be used with materials for children, two other formulas are probably more commonly used for this purpose. These are the Dale-Chall Formula and the Spache Formula.

(Incidentally the Dale-Chall Formula can be used with adults as well,)

2.9 The Dale Chall Formula

(Dale, E. and Chall, J. S. 1948 A formula for predicting readability. *Educational Research Bulletin* 27, 11 – 20 and 27 – 54)

The use of this formula requires the use of the Dale list of easy words. This can be accessed by selecting this link :

Dale Word List.doc

Note also that place and person names are treated as easy words

The Dale-Chall Formula is:

$$\text{Score} = 0.1579\text{D} + 0.496\ \text{sl} + 3.6365$$

Where:

D = Percent of Words <u>not</u> in the Dale list of easy words

Sl = average number of words in a sentence

This table then has to be used to convert the score to a grade Level

Score	Reading Grade Level
4.9 or less	Grade 4 or below
5.0 – 5.9	Grade 5 - Grade 6
6.0 – 6.9	Grade 7 – Grade 8
7.0 – 7.9	Grade 9 – Grade 10
8.0 – 8.9	Grade 11 – Grade 12
9.0 – 9.9	Grade 13 – Grade 15 (college)
10 and above	Grade 16 or higher (Graduate)

An on-line calculator is available at:

http://www.interventioncentral.org/htmdocs/tools/okapi/okapi_28Aug06.php

Let's see what happens when we apply the formula to the nursery rhyme we have already met.

Mary had a little lamb. Its fleece was white as snow. And everywhere that Mary went, the lamb was sure to go

Total Words in Sample: *22*

Total Sentences in Sample: *3*

Average Number of Words Per Sentence: *7.33*

Words Not Matched to Dale Familiar 3000-Word List: *1*

Percentage of Words Not Matched to Dale Familiar 3000-Word List: *4.54*

Dale-Chall Readability Index: *4.71 Raw Score; 4th Grade or Below*

2.10   The Spache Formula

(Spache, G. D,, 1974 *Good reading for poor readers*. **Champaign, Ill.,** Garrard)

This formula is especially suited to children in Grade 3 or lower.

$$Grade\ Level = .121sl + .082dw\ + .659$$

Where:

sl = average sentence length in words

dw = (difficult words) the percentage of words that are not in the Spache Word List

The Spache word list can be called up by using this link.

Spache word list.doc

Again an online calculator is available at

http://www.interventioncentral.org/htmdocs/tools/okapi/okapi_28Aug06.php

The pull down menu in the webpage gives you a choice of Dale-Chall or Spache. (You might as well get both.)

Let's try the formula on the nursery rhyme:

Mary had a little lamb. Its fleece was white as snow. And everywhere that Mary went, the lamb was sure to go.

Total Words in Sample: *22*

Total Sentences in Sample: *3*

Average Number of Words Per Sentence: *7.33*

Number of Words Not Matched to Revised Spache Word List: *3*

Percentage of Words Not Matched to Revised Spache Word List: *13.63*

Spache Readability Index: *3.04*

3 Physical aspects of written material which affect the ease with which it can be read

3.1 Introduction

(This account relies heavily on previous reviews [13] [14] [15] [16] [17] [18] [19] [20]

If you are likely to have to produce material for people with visual disabilities then see the Tiresias. Org site[21] and the very useful bibliography of most factors affecting legibility[22] , and see also [23]. This last site contains a link to a downloadable review paper by Elizabeth Russell-Minda *et al*, (2006) *An evidence-based review of the research on typeface legibility for readers with low vision*.)

Amongst the physical factors are:

- print size
- line length
- spacing between lines
- the reflectiveness of the surface – matt is best
- the contrast between the print and the background
- the use of all capital letters as opposed to lower case
- the use of italic script
- justification
- use of serifs
- segmenting the text
- interactions amongst the above factors

3.2   Size of print

There appears to be consensus that with most type faces 8-point type is the <u>minimum</u> for easy reading for the population in general [24] [25]. For people in general, and older readers in particular, a larger type is preferable.

As type gets smaller, there is a decline in reading speed and comprehension. For example, a drop in size from 10 point to 6 point leads to a drop in reading speed of about 10 percent; 9 point to 8 point a drop of about 7 percent; 6 point to 4 point a drop of about 45 percent. Reading becomes more effortful and slower, and as might be expected people are less inclined to read the material. For example, one study found that people rated their likelihood of reading 10 point as opposed to 8 point as being about 40 percent higher [26].
There is also evidence that condensing text by narrowing letters to 60 or 35 percent of their normal width reduces reading speeds in university student samples by 10 percent or so, and that full width letters are much preferred [27].

3.3   Line length

Line length can be too long or too short for the size of print used [28]. This is illustrated below. In general, for optimal reading, line length should be about 1.5 alphabets long.

But remember that font size interacts with line length. Essentially, lines can be too long or too short for the size of the letters.

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But remember that font size interacts with line length. Essentially, lines can be too long or too short for the size of the letters.

3.4   Leading

Leading (space between lines) also makes a difference to reading speed. A typical figure is that 2 point leading is read about 7 percent faster. However, print size and line length interact with leading to produce the optimal result.

Leading too small	Leading is the white space between lines. If there is not enough leading the reader will have more difficulty reading the text. Leading should probably be at least 25 to 30 percent of the font size	Leading is the white space between lines. If there is not enough leading the reader will have more difficulty reading the text. Leading should probably be at least 25 to 30 percent of the font size
Leading (continued)	On the other hand it is quite possible for leading to be too large and this will also make for difficulties in reading – as you would expect.	On the other hand it is quite possible for leading to be too large and this will also make for difficulties in reading – as you would expect.

3.5   Reflectiveness of surface

Print on highly reflective surfaces is harder to read [29]. This is especially true with longer text.

3.6 Contrast between print and background.

High contrast is best. Best of all is black on white. This is read about 10 to 15 percent faster than white on black [30], but white on black might sometimes be useful in conditions of low illumination. However this is probably not clearly established. Coloured print on white background is <u>sometimes</u> acceptable, as is black print on coloured background [31]. Colour on colour is always risky and should be carefully tested before use.

|		
Insufficient contrast	If there is not sufficient contrast between letters and the background on which they are written, then obviously reading will be made more difficult.	If there is not sufficient contrast between letters and the background on which they are written, then obviously reading will be made more difficult.
Insufficient contrast 2	**Using coloured background and coloured letters to make your document look more attractive is not without its dangers.**	**Using coloured background and coloured letters to make your document look more attractive is not without its dangers.**
Black letters white background	**Probably the best results – in terms of contrast are obtained by using black letters on a white background**	**Probably the best results – in terms of contrast are obtained by using black letters on a white background**

3.7 Use of all capitals text

A large number of studies have found that text written all in capital letters takes about 10 to 12 percent longer to read. This is true even of relatively short 'headline' text [32] [33]. It is also harder to understand and recall [34].

All capital letters	PUTTING EVERYTHING IN CAPITAL LETTERS USUALLY MAKES THE TEXT MORE DIFFICULT TO READ - ESPECIALLY IF IT IS A LONG TEXT CONTAINING, MANY POLYSYLLABIC AND RARE WORDS	Putting everything in capital letters usually makes the text more difficult to read - especially if it is a long text, containing many polysyllabic and rare words

The deleterious effect of all capitals text was formerly supposed to be largely due to the disappearance of word shape cues when capitals are used. For example look at the shapes of the two words below in lower case and in capitals. The (exaggerated) shapes of the lower case words are very different. In capitals the overall word shape is an identical oblong

cat   dog

CAT   DOG
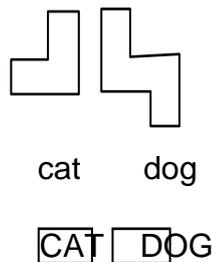
3.8   Use of italic script

Use of italic script seems to slow down reading by about 13 percent [35].

| Italics | *Text all in italics is usually a bit harder to read than text not in italics. Use italics sparingly. Otherwise you will make life harder for your reader.* | Text all in italics is usually much harder to read than text not in italics. Use italics sparingly. Otherwise you will make life harder for your reader. |

10.3.9 Justification

There is some evidence that in some circumstances leaving the right hand ends of lines ragged rather than trying to make them look even speeds up reading. This is especially true of shorter lines read by poorer readers [36] [37] . This is probably due to the fact that justified right margins require either space adjustments and/or the use of hyphenation. With shorter lines the use of these breaks up the text more than with longer lines. Here are some examples. The shorter lines show considerable break-up, while it is hardly noticeable in the longer lined examples.

Lines justified	Justified	Not justified
	Justification refers to the process of making beginnings and ends of lines stretch enough to reach right and left margins of a document's printing area as has happened in this rather contrived example, thus leading to unnecessary white spaces within the text, making reading slower than usual.	Justification refers to the process of making beginnings and ends of lines stretch enough to reach right and left margins of a document's printing area as has happened in this rather contrived example, thus leading to unnecessary white spaces within the text, making reading slower than usual.

Justified

Justification refers to the process of making beginnings and ends of lines stretch enough to reach right and left margins of a document's printing area as has happened in this rather contrived example, thus leading to unnecessary white spaces within the text, making reading slower than usual.

Justified

Justification refers to the process of making beginnings and ends of lines stretch enough to reach right and left margins of a document's printing area as has happened in this rather contrived example, thus leading to unnecessary white spaces within the text, making reading slower than usual.

3.10   Use of serifs

There is a useful on-line recent review of some aspects of the complicated nature of this problem [38]. The evidence favouring serif fonts is at best disputable, though the evidence that people prefer serif fonts is possibly stronger.

<div align="center">

This text has letters with serifs

(the extensions and curls at the ends of the letters)

But this text does not have serifs.

</div>

There is a mixed literature on this topic. Probably most of the published investigations have reported that text with serifs is easier to read [39] [40] [41]. But not all investigations found this to be true. Some studies have indeed found the opposite with warning labels [42]. The reasons for the different findings are not known. Many of the investigations were conducted in days when serif type was the commonest form in use. Any slowing down in reading speed might thus have been an effect of the unfamiliarity of the typeface. In addition, even if the finding of superiority for serif type was true at a given point in time, new typefaces appear quite frequently. Unless we had a convincing theory about why serif type is superior (if it is) we

could not be sure that the next type face that came along would give a different result.

However, it is likely that serifs are better for older readers, and better with longer text [43] [44].

Sans serif font	**Sans serif** Sans serif fonts - those with no curly and sticking out bits attached to the letters are supposed to be harder to read than fonts with serifs	Serif Sans serif fonts - those with no curly and sticking out bits attached to the letters are supposed to be harder to read than fonts with serifs

3.11   Frames and legibility

It has been suggested that in some circumstances surrounding text with a border can make it harder to read. An important factor in this is said to be how close the border is to the text and how heavy the border is. Heavy borders and borders close to the text should be worse. Thus the left hand one of these two should be harder to read than the right.

Heavy border	Enclosing text within a heavy border is supposed to make text a bit more difficult to read easily especially if the text runs right up to the edges of the bordered area	Enclosing text within a heavy border is supposed to make text a bit more difficult to read easily especially if the text runs right up to the edges of the bordered area

Further, the two below should be easier to read than the two above, because the text does not run up to the borders.

Enclosing text within a heavy border is supposed to make text more difficult to read especially if the text runs right up to the edges of the bordered area	Enclosing text within a heavy border is supposed to make text more difficult to read especially if the text runs right up to the edges of the bordered area

3.12   Interaction between these factors

The effect of all of the factors examined is that, if they are not optimally set, text will be very effortful to read. In turn this will reduce the likelihood that people will read it. It is likely that justified text all in italicised sans serif capitals using a 8 point condensed type face with excessive leading, and a dark background will be considerably harder to read than if it were 10 point black lower case on a white background. Try it.

COMBINATIONS OF THESE VARIOUS 'BAD' FEATURES CAN MAKE READING THE TEXT EXTREMELY DIFFICULT AS YOU WOULD EXPECT. COMBINATIONS OF THESE VARIOUS 'BAD' FEATURES CAN MAKE READING THE TEXT EXTREMELY DIFFICULT AS YOU WOULD EXPECT. COMBINATIONS OF THESE VARIOUS 'BAD' FEATURES CAN MAKE READING THE TEXT EXTREMELY DIFFICULT AS YOU WOULD EXPECT. COMBINATIONS OF THESE VARIOUS 'BAD' FEATURES CAN MAKE READING THE TEXT EXTREMELY DIFFICULT AS YOU WOULD EXPECT. COMBINATIONS OF THESE VARIOUS 'BAD' FEATURES CAN MAKE READING THE TEXT EXTREMELY DIFFICULT AS YOU WOULD EXPECT. COMBINATIONS OF THESE VARIOUS 'BAD' FEATURES CAN MAKE READING THE TEXT EXTREMELY DIFFICULT AS YOU WOULD EXPECT

Combinations of these various 'bad' features can make reading the text extremely difficult as you would expect. Combinations of these various 'bad' features can make reading the text extremely difficult as you would expect. Combinations of these various 'bad' features can make reading the text extremely difficult as you would expect. Combinations of these various 'bad' features can make reading the text extremely difficult as you would expect. Combinations of these various 'bad' features can make reading the text extremely difficult as you would expect

And finally try this one

COMBINATIONS OF THESE VARIOUS 'BAD' FEATURES CAN MAKE READING THE TEXT EXTREMELY DIFFICULT AS YOU WOULD EXPECT. COMBINATIONS OF THESE VARIOUS 'BAD' FEATURES CAN MAKE READING THE TEXT EXTREMELY DIFFICULT AS YOU WOULD EXPECT. COMBINATIONS OF THESE VARIOUS 'BAD' FEATURES CAN MAKE READING THE TEXT EXTREMELY DIFFICULT AS YOU WOULD EXPECT. COMBINATIONS OF THESE VARIOUS 'BAD' FEATURES CAN MAKE READING THE TEXT EXTREMELY DIFFICULT AS YOU WOULD EXPECT. COMBINATIONS OF THESE VARIOUS 'BAD' FEATURES CAN MAKE READING THE TEXT EXTREMELY DIFFICULT AS YOU WOULD EXPECT. COMBINATIONS OF THESE VARIOUS 'BAD' FEATURES CAN MAKE READING THE TEXT EXTREMELY DIFFICULT AS YOU WOULD EXPECT

It is not likely that many people would fail to recognise the errors outlined examples provided above. But using a checklist can alert you to any features of a booklet which might cause problems.

The combined cumulative effect of milder forms of the faults outlined can be such that the intended reader will find the material harder to read than necessary.

If it is harder to read, then the likelihood is that it will not be read.

4.   References

[1] DuBay, W. H. *The Principles of Readability*
 http://www.impact-information.com/impactinfo/readability02.pdf

[2] Ley, P. and Florio, T (1996) The use of readability formulas in health care. *Psychology, Health and Medicine*, **1**, 7 – 28

[3] Ley, P (1997) *Communicating with patients*. Cheltenham, Stanley Thorne's.

[4] Ley, P (1997) The use and improvement of written communication in mental health care and promotion. *Psychology, Health and medicine*, 3, 19 - 53

[5] Ley,P (1997) The use and improvement of written communication in mental health care and promotion. *Psychology, Health and medicine*, 3, 19 - 53

[6] Jensen, S.A., Fabiano, G. A., Lopez-Williams, A, and Chacko, A (2006) The reading grade level of common measures in child and adolescent clinical psychology. *Psychological Assessment*, **18**, 346-352

[7] Ley, P. and Florio, T (1996) The use of readability formulas in health care. *Psychology, Health and Medicine*, **1**, 7 – 28

[8] Smith, E. A. and R. J. Senter (1967). 'Automated readability index', *AMRL-TR*, 66-22. Wright-Patterson AFB, OH: Aerospace Medical Division.

[9] Coleman, M.; and Liau, T. L. (1975); *A computer readability formula designed for machine scoring*, Journal of Applied Psychology, Vol. 60, pp. 283-284

[10] Caylor, J. S., Sticht, T. G., Fox, L. C;. and Ford, J. P. (1973) Methodologies for determining reading requirements of military occupational specialities. HumPRO Technical report 73.5, Division No 3, Presidio of Monterey, California

[11] Gunning, R. (1973) *The technique of clear writing*. Mew York, McGraw Hill.

[12] **Fry**, E. (1977) *Elementary Reading Instruction*. New York, McGraw-Hill.

[13] Tinker, M. A. (1963). *Legibility of print*. Ames, Iowa: State University of Iowa Press.

[14] Tinker, M. A. (1966) Experimental studies in the legibility of print: An annotated bibliography. *Reading Research Quarterly*, 1, 57-118

[15] Poulton, E. C. (1969) How efficient is print? *New Society*, No. 349, 869-71

[16] Felker, D. B. (ed) (1980) *Document design: A review of relevant research*. Washington, D. C.: American Institutes for Research

[17] Hartley, J. (1982) Psychology and written instruction. In S. Canter and D. Canter (eds) *Psychology in practice.* Chichester: John Wiley and Sons

[18] Ley, P. and Morris, L. A. (1985) Psychological aspects of written information for patients. In S. J. Rachman (ed) *Contributions to medical psychology, 3*. Oxford, Pergamon Press

[19] Sanders, M. S. and McCormick, E. J. (1987) *Human factors in engineering and design. (6th Edition*.) New York: McGraw Hill

[20]Connolly, K.
http://www.psych.ucalgary.ca/PACE/VA-Lab/gkconnol/Introduction.html

[21] http://www.tiresias.org/fonts/lpfont/report/lpfont91.htm

[22] http://www.tiresias.org/fonts/lpfont/report/lpfont91.htm

[23] http://www.cnib.ca/accessibility/clearprint/

[24] Tinker, M. A. (1966) Experimental studies in the legibility of print: An annotated bibliography. *Reading Research Quarterly*, 1, 57-118

[25] Poulton, E. C. (1969) How efficient is print? *New Society*, No. 349, 869-71

[26] Braun, C. C. and Silver, N. C. (1882) Likelihood of reading warnings: effects of fonts and font size. *Proceedings of the Human Factors Society 36th Annual Meeting* (pp 926 - 930), Santa Monica, CA, Human Factors Society

[27] Young, S. L., Laughery, K. R. and Bell, M. (1992) Effects of two type density characteristics on the legibility of print. *Proceedings of the Human Factors Society 36th Annual Meeting* (pp 504 - 508), Santa Monica, CA, Human Factors Society

[28] Tinker, M. A. (1963). *Legibility of print*. Ames, Iowa: State University of Iowa Press

[29] Tinker, M. A. (1966) Experimental studies in the legibility of print: An annotated bibliography. *Reading Research Quarterly*, 1, 57-118

[30] Tinker, M. A. (1966) Experimental studies in the legibility of print: An annotated bibliography. *Reading Research Quarterly*, 1, 57-118

[31] Tinker, M. A. (1966) Experimental studies in the legibility of print: An annotated bibliography. *Reading Research Quarterly*, 1, 57-118

[32] Poulton, E. C. (1969) How efficient is print? *New Society*, No. 349, 869-71

[33] Tinker, M. A. (1966) Experimental studies in the legibility of print: An annotated bibliography. *Reading Research Quarterly*, 1, 57-118

[34] Rickards, J. and August, G. (1975) Generative underlining strategies in prose recall. *Journal of Educational Psychology*, 67, 860 - 865

[35] Tinker, M. A. (1966) Experimental studies in the legibility of print: An annotated bibliography. *Reading Research Quarterly*, 1, 57-118

[36] Gregory, M. and Poulton, E. C. (1970) Even versus uneven right hand margins and the rate of comprehension in reading. *Ergonomics*, 13, 427-434.

[37] Poulton, E. C. (1969) How efficient is print? *New Society*, No. 349, 869-71

[38] http://www.alexpoole.info/academic/literaturereview.html

[39] Tinker, M. A. (1966) Experimental studies in the legibility of print: An annotated bibliography. *Reading Research Quarterly*, 1, 57-118

[40] Poulton, E. C. (1969) How efficient is print? *New Society*, No. 349, 869-71

[41] American Institutes for Research (1982) Six graphics guidelines. Simply *Stated*, No. 30, October

[42] eg Silver, N. C. and Braun, C. C. (1993) Perceived readability of warning labels with varied font sizes and styles. *Safety Science*, 16, 615 - 625

[43] Vanderplas, J. M. and Vanderplas, J. H. (1980) Some factors affecting legibility of printed materials. *Perceptual and Motor Skills*, 50, 923 - 932

[44] McClean, R. (1980) *The Thames and Hudson manual of typography*. London, Thames and Hudson.