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Using the JACET 8000 Word List to Evaluate L2 Vocabulary and Reading Difficulty

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Introduction

The duties of the college English teacher in Japan include, besides teaching classes, writing the syllabuses for one's own courses and contributing questions to the annual college entrance examination. With the advent of online syllabus access and post-publication of entrance examination questions, administrators increasingly insist on making these documents readable at the upper-secondary level. In the past, readability has been gauged simply by using English-Japanese dictionaries, which mark words with asterisks or other symbols to indicate their inclusion in target vocabulary lists at the various levels of instruction. With the availability of computerized readability formulas, however, this labor-intensive process seems over-simplistic. Moreover, each dictionary professes a slightly different view of vocabulary difficulty.

There is a need, therefore, to establish a standardized vocabulary list and an efficient method for measuring the difficulty of texts reliably and quickly. Published in 2003 by the Japan Association of College English Teachers (JACET), the JACET 8000 word list offers the potential means of overcoming these obstacles. It not only transcends the idiosyncrasies of dictionaries; its eight different subdivisions (1000 words each) can be matched to different levels of English education: junior high school, high school, college, and beyond. It also comes with an online level marker which assesses the level of individual words.

The purpose of this paper is to evaluate the feasibility of using the JACET 8000 word list as a factor in measuring the reading difficulty of entrance examinations and course syllabuses. Going beyond the prescriptive simplicity of the asterisk system, the authors also evaluate the predictive difficulty of secondary and college-level English textbooks used in Japan and compare them with British and American literature ranging in difficulty from Grade 1 to Grade 12. Passages from all texts are compared with the Flesch Reading Ease scale for reference.

The findings have practical implications, inasmuch as college teachers must not only choose appropriate texts for their courses, but also write materials that fall within the realistic limits of their readers. Suggestions are made for improving the evaluation of reading difficulty in Japan, and also for using the JACET 8000 in international contexts such as the Common European Framework of Reference (CEFR).

Four computer software programs were used in this study. The online "Lexile Analyzer," by MetaMetrics, provided the word count and the Lexile scores. The Online-Utility "Text Analyzer" provided the number of sentences and characters. The "JACET 8000 Level Marker" was used to find the levels of each

word. For determining Flesch Reading Ease, the “Reading Set,” published by Micro Power and Light, proved very effective.

(Throughout this paper we will refer to a “minimum” paragraph, a 34-word segment of the U.S. Declaration of Independence, and a theoretical maximum paragraph, for reference purpose. See Appendix 1.)

Background, Methods & Materials

In Japan, college administrators usually rely on various dictionaries to ensure that passages on the syllabuses and entrance examinations fall within the vocabulary range of high school seniors. As an example, each word in this sentence, “We evaluate vocabulary difficulty,” is marked with an asterisk to indicate its inclusion in a target vocabulary list for Junior High School (***) , High School (**), University (*), and beyond (ø) in the *G4 Genius Dictionary*: We*** evaluateø vocabulary* difficulty**.

Readers may wonder why mainstream readability formulas, like the Flesch Reading Ease formula, are not used. The Flesch Reading Ease formula is based on the number of words per sentence, and the number of syllables per word.

In 2014 we did an ancillary study in which we asked 182 participants to tell how many syllables were in each of these words. The percentages of correct answers for each item are given below:

Table 1

1	Decide	45%	6	Possibility	22%
2	Development	49%	7	Pleasure	43%
3	Accident	46%	8	Seriously	38%
4	Experience	25%	9	Interpretation	39%
5	Fail	63%	10	Mode	49%

The results are rather poor, the total averaging only 41.6%, indicating that Japanese students do not understand the concept of syllables in English at all. This calls into question the validity of syllable-based formulas. How can syllables account for a major portion of any readability formula when students understand syllables so poorly?

Another mainstream readability formula was developed by Edgar Dale and Jeanne Chall in 1948. This, too, is based on the number of words per sentence. Instead of a syllable count, however, it relies on the inclusion (or exclusion) of words that should be familiar to 80% of ten-year-old American children. Raw scores are converted to grade levels by a table (see Table 2). However, as you can see (Table 3), among the 112 words that begin with the letter “A” in the Dale-Chall list, only 48% are studied in Japanese junior high schools, 29% are studied in high schools, 16% are studied in universities, and 6% are not studied in formal education at all. These data indicate that many Japanese learners may not know words that are familiar to American ten-year-old children.

Table 2

Raw Score	Grade Level
< 4.9	4 and below
5.0 – 5.9	5 – 6
6.0 – 6.9	7 – 8
7.0 – 7.9	9 – 10
8.0 – 8.9	11 – 12
9.0 – 9.9	13 – 15
> 10.0	16 +

Table 3

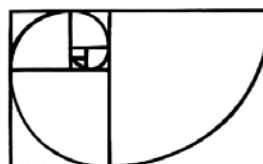
G4 Stars:	***	**	*	∅
Number:	54	33	18	7
%:	48.2%	29.4%	16.1%	6.3%

A more recent addition to mainstream readability formulas is the Lexile Scale. Just as a thermometer measures the freezing point and the boiling point of water, the Lexile theory uses data from seven basal primers at the low end, and the Grolier Encyclopedia at the high end, to derive a scale. The Celsius thermometer defines “one degree” as 1/100 the difference between the boiling point and the freezing point (100°C and 0 °C , respectively). One “lexile” is defined as 1/1000 the difference between the difficulty of the encyclopedia and that of the basal primers.

In addition to sentence length, the Lexile formula takes into account the frequency with which words occur in a corpus. This is based on the *American Heritage Word Frequency Book* (1971). Unlike other formulas, the Lexile Formula uses logarithms (对数) as factors of determination.

$$\text{Lexile} = 582 + 1768\log\text{SL} - 386\log\text{WF}$$

Logarithms are favored by engineers because they make calculations easier: you can add to multiply and subtract to divide. Logarithms also have various applications in nature e.g., a nautilus, which displays the Golden Section (the smaller part is to the greater part as the greater part is to the whole).



On the negative side, the Lexile Formula seems to be intended for native speakers, as was the Dale-Chall word list. It is difficult to replicate reported scores, even with the online Lexile analyzer (which, by the way, limits the length of passages it will analyze to 1000 words). Sentence Length is the main determiner: as you can see in this comparison of several works (Table 4), the same log WF (3.59) results in widely different Lexiles.

Table 4

Title	SL	logSL	WF	logWF	Lexile
Minimum (calc'd online) (calculated by hand)	2.00	0.30	8318 281,720	3.92 5.45	-660L -990L
Mr. Boar Builds a Castle	6.41	0.81	3890.45	3.59	350L
U.S. Decl. (2 sentences)	53.50	1.73	3890	3.59	1870L
U.S. Decl (34 sentences)	28.46	1.45	1259	3.10	1610L
G4 Fabricated (online) (calculated by hand)	30.00	1.45	832	2.92	2060L 1720L
JACET Theoretical	30.00	1.45	63	1.80	2500L

In Japan, it takes a long time for Western ideas to be assimilated into the culture. The time will probably come when the Lexile Formula *is* accepted in Japan, but until that time, we need a reliable method which is easily used by teachers, which approximates the logarithmic efficiency of the Lexile Formula, but which also has a home-grown air about it to appeal to Japanese administrators.

In 2013, the authors developed a formula for assessing reading difficulty using the “star” system of the English-Japanese *G-4 Dictionary* (Stewart and Stewart, 2013). In that study, twelve works of general literature ranging in difficulty on the Lexile scale from 260L to 1360L served as a control set. The formula worked very well for its purpose, but it centered on one particular dictionary; the “stars” for each particular word had to be verified manually without the use of a computer.

$$\text{G4 Readability (Stewart)} = \frac{\text{WL (Characters)} \times \text{SL} \times \text{Tokens/Type}}{\text{WL (Syllables)} \times \text{WF(G4)}}$$

In order to adapt the Stewart Formula for use with the JACET 8000 word list, it was first necessary to approximate the “star” system of the *G-4 Dictionary*. This was done using the JACET 8000 Level Marker, which renders a color-coded analysis of each word in a text. For example, here are the first two sentences from the U.S. Declaration of Independence:

When_1 in_1 the_1 Course_1 of_1 human_1 events_1, it_1 becomes_1 necessary_1 for_1 one_1 people_1 to_1 dissolve_5 the_1 political_1 bands_2 which_1 have_1 connected_2 them_1 with_1 another_1, and_1 to_1 assume_2 among_1 the_1 powers_1 of_1 the_1 earth_1, the_1 separate_1 and_1 equal_2 station_1 to_1 which_1 the_1 Laws_1 of_1 Nature_1 and_1 of_1 Nature_1, s_1 God_2 entitle_4 them_1, a_1 decent_3 respect_1 to_1 the_1 opinions_1 of_1 mankind_6 requires_1 that_1 they_1 should_1 declare_2 the_1 causes_1 which_1 impel_0 them_1 to_1 the_1 separation_4.

We_1 hold_1 these_1 truths_1 to_1 be_1 self_3-evident_4, that_1 all_1 men_1 are_1 created_1 equal_2, that_1 they_1 are_1 endowed_8 by_1 their_1 Creator_7 with_1 certain_1 unalienable_0 Rights_1, that_1 among_1 these_1 are_1 Life_1, Liberty_3 and_1 the_1 pursuit_4 of_1 Happiness_3.

Table 5

<i>U.S. Decl of Indep</i> (2 sentences)	***			**		*		0			Total
Level:	1k	2k	3k	4k	5k	6k	7k	8k	“0”		
Words:	87	7	4	4	1	1	1	1	2	108	
Words x Stars (*)	261	22		5		0				288	

In the following table you can see the similarity of the “JACET Stars” to the “G4 Stars” (in fact this may be even more similar due to the addition of 250 “basic” nouns and verbs to the JACET Level 1). These correspond to different grade levels in Japan.

Table 6

JACET 8000 Level	“Stars”	G4 Level	Grade Level (Japan)
1 ~ 1000 (1)	***	~ 1150 words	7 - 9
1001 ~ 3000 (2,3)	**	~ 3100 words	10 - 12
3001 ~ 5000 (4,5)	*	~ 5300 words	13 - 16
5001 ~ 8000 (6-8,0)	0	~ 70450 words	16 +

It then became necessary to decide which variables to use for calculations. To do this, the control set was evaluated using the Pearson Product-Moment formula. Letters per sentence yielded a higher correlation ($r = 0.93785$) with the Lexile scores (compared to $r = 0.79501$ for syllables per word and $r = 0.78355$ for letters per word). Moreover, a study of the JACET 8000 word list showed syllable length to be insignificant, the average number of characters per syllable being 3.23 for the first 1,000 words and 2.91 for the remaining 7,000 words. Accordingly, the revised formula was set as follows, without including word length in syllables as a variable.

$$\text{JACET 8000 (Stewart)} = 2.25 \times (\text{Letters per Sentence} / \text{“Stars” per Word})$$

Results and Discussion

The control set was evaluated according to the new formula. In Table 7, the results for each text are compared with the Lexile score and with the Flesch Reading Ease score. Correlations (indicated by “ $r = \underline{\quad}$ ”) were done for both the Lexile Score and the Flesch Reading Ease.

Table 7

No.	Title	Lexile Score	JACET 8000	Flesch
1	The Cat in the Hat	260L	16.98	110.68
2	Clifford the Small Red Puppy	330L	23.29	94.02
3	The Very Hungry Caterpillar	460L	24.68	89.20
4	The Giving Tree	530L	27.44	102.40
5	Charlotte’s Web	680L	40.70	79.36
6	A Farewell to Arms	730L	24.70	92.64
7	Harry Potter and the Sorcerer’s Stone	880L	43.33	83.64

8	The Lion, Witch, and Wardrobe	940L	46.81	84.57
9	The Hobbit	1000L	51.18	85.77
10	Gone with the Wind	1100L	71.40	73.00
11	A Brief History of Time	1290L	84.45	58.94
12	Metaphysics, by Aristotle	1360L	92.30	58.76
		r = 0.94411		
			r = -0.93374	

In the current study, a number of secondary textbooks, college textbooks, entrance examinations and syllabuses were evaluated. Comparisons with their respective Lexile scores showed strong correlations ranging from $r = 0.91963$ (College Textbooks) to $r = 0.97671$ (Entrance Examinations – see Appendices for details). The results are summarized in the following table.

Table 8

Category	Low	High	Correlation
General Literature	16.98	92.30	$r = 0.94411$
Secondary Textbooks	26.98	59.85	$r = 0.97075$
College Textbooks	27.42	85.36	$r = 0.91963$
Entrance Examinations	44.77	82.01	$r = 0.97671$
Syllabuses	37.89	102.12	$r = 0.96180$

These results demonstrate that the JACET 8000 word list with its online level marker does provide an accurate measure of vocabulary difficulty. The list can be used for predictive purposes, i.e., choosing appropriate texts for college courses, and also for productive purposes, i.e., writing syllabuses and entrance examination questions.

This method also works well in matching texts to the Common European Framework of Reference (CEFR). Table 9 shows the correspondences of the JACET scores to the CEFR, the Lexile formula, and Grade Levels in the U.S. and in Japan.

Table 9

JACET Formula	CEFR	Lexile (Rounded off)	Grade Level (US)*	Grade Level (Japan)
30 – 40	Pre-A1	~600L	4	7 – 9
40 – 50	A1	~800L	5 – 6	10 – 11
50 – 60	A2	~900L	7 – 8	11 – 12
60 – 70	B1	~1000L	9	13 – 14
70 – 80	B2	~1100L	10	15 – 16
80 – 90	C1	~1200L	11	16 +
90 – 100	C2	~1300L	12	16 ++

* Source: Lexile Org – Lexile-to-Grade Correspondence

Conclusion

The JACET 8000 formula is not a cure-all; it is a quick fix, offering a computerized alternative to the labor-intensive *G4* “Star” system. Unlike the syllable-based Flesch Reading Ease and the Dale-Chall

Grade Level, meant for native speakers, it has validity in a foreign-language setting like Japan. Like the Lexile formula, it establishes its scale on a high and a low standard, albeit these are theoretical, drawn from possibilities instead of real texts. It does not use logarithms to produce a graded scale, but the very derivation of the JACET 8000 Word List by the log-likelihood method creates a mini-corpus which itself serves as an effective proxy for logarithmic relationships. The JACET 8000 formula was applied to a control set of twelve works of general literature, secondary textbooks, tertiary textbooks, entrance examinations and syllabuses. These produced high correlations with the corresponding Lexile scores. Based on these findings, the authors were able to construct a reference list for comparing JACET 8000 scores, grade levels in Japan and in the U.S., as well as the Common European Framework of Reference.

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Appendix 1
Sample Passages

Text	FRE	D-C	Lexile	G4	JACET
Minimum 1.00 syllable per word 3.00 letters per word 2.00 words per sentence 0% rare words Type/Token = 20% log WF = 5.45 (***)	121.21	< 1	-990L	10	4.50
U.S. Decl. of Independence 1.65 syllables per word 4.99 letters per word 28.46 words per sentence 24% rare words Type/Token = 44.1% log WF = 3.10	38.65	11-12	1610L	77.2 ¹	126.79
Maximum (G4 Fabricated) 1.67 syllable per word 5.0 letters per word 30 words per sentence 43% rare words Type/Token = 45% log WF = 2.92 (***)	33.28	16++	2060L	100	173.79
Maximum (Theoretical) 1.67 syllables per word 4.5 letters per word 30 words per sentence 31% rare words Type/Token = 45% log WF = 1.79 (***) ²	33.95	16+	2500L	89.83	135.00

1) G4 = 77.2 for 34 sentences. For entire 45 sentences, G4 = 81.99.

2) Fewer than 2 stars average is highly unlikely.

Appendix 2
Secondary Textbooks

No.	Title	Lexile Score	JACET 8000 Formula	Flesch Reading Ease
1	New Crown	440L	26.975	87.09
2	New Horizon	500L	28.649	83.76
3	Exceed	520L	34.025	68.12
4	Power On Communication	700L	42.824	71.07
5	Unicorn 1	790L	45.853	73.78
6	Voyager 1	790L	46.584	70.45
7	Plus One	810L	49.376	72.81
8	Polestar	830L	45.842	76.27
9	Crown	880L	45.587	86.59
10	Cosmos	890L	49.417	75.24
11	Sunshine Readings	990L	56.342	69.44
12	Power On Reading	990L	59.848	69.10
		$r = 0.97075$		
			$r = -0.57672$	

Appendix 3
College Textbooks

No.	Title	Lexile Score	JACET 8000 Formula	Flesch Reading Ease
1	Reading Keys Bronze	500L	27.416	84.99
2	Global Beginner	720L	40.959	69.71
3	Touchstone 2	730L	41.053	79.50
4	American Vision	790L	42.999	58.08
5	Faces of the USA	890L	43.732	67.28
6	Refreshing Grammar	930L	43.096	83.41
7	Global Upper Intermediate	950L	45.607	63.22
8	Flying Across Borders	990L	51.422	66.34
9	English in Common 2b	1050L	62.671	62.58
10	Global Intermediate	1080L	61.932	62.93
11	Success with College Writing	1110L	68.163	58.13
12	Global Advanced	1230L	85.364	52.25
		$r = 0.91963$		
			$r = -0.76890$	

Appendix 4
Entrance Examinations
(Alphabetized for Discretion)

No.	Title	Lexile Score	JACET 8000 Formula	Flesch Reading Ease
1	E	750L	44.770	64.52
2	F	800L	44.189	80.27
3	A	820L	44.176	65.71
4	B	900L	51.852	71.88
5	K	900L	51.319	60.10
6	G	910L	50.940	67.12
7	D	930L	54.948	69.95
8	C	1070L	66.621	54.11
9	I	1090L	67.081	56.63
10	H	1150L	75.976	52.67
11	L	1150L	81.746	41.99
12	J	1180L	82.007	47.62
		r = 0.97671		
			r = -0.88194	

(Alphabetical Order = Chronological Order)

Appendix 5
Syllabuses

No.	Title	Lexile Score	JACET 8000 Formula	Flesch Reading Ease
1	Interactive English 1	580L	37.88	68.58
2	Eikaiwa 1	870L	43.75	64.99
3	Creative Writing	900L	51.83	69.94
4	Conversation B2	930L	58.76	40.11
5	ESP	1050L	70.45	63.34
6	Listening Skills	1060L	72.74	47.10
7	Reading & Listening 1	1090L	71.30	63.50
8	Business English	1100L	73.74	33.73
9	Conversation A	1150L	80.32	39.71
10	Advanced Oral Presentation	1180L	82.04	45.93
11	Reading & Writing B2	1250L	96.83	39.67
12	Reading & Writing C1	1390L	102.24	58.43
		r = 0.96180		
			r = -0.51404	

(ジャン スチュワート：英語メディア学科 教授)
(ウィリアム スチュワート：沖学園高等学校 講師)