

RESEARCH ON SPOKEN LANGUAGE PROCESSING
Progress Report No. 24 (2000)
Indiana University

**Lexical Neighborhood Properties of the Original and Revised
Speech Perception In Noise (SPIN) Tests¹**

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¹ This work was supported by a National Science Foundation Graduate Research Fellowship to the author and was conducted at the Speech Research Laboratory, Indiana University. The author would like to thank Dr. David Pisoni for the opportunity to conduct this research in the SRL and Cynthia Clopper for the original idea for this analysis. This report was originally prepared for a course at Indiana University, P747: Spoken Word Recognition, with Dr. David Pisoni.

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Abstract. Recent research has shown that the frequency and density of a word's similarity neighborhood have an influence on its intelligibility over and above the influence of the word's frequency. A computational analysis was carried out to examine the lexical neighborhood properties of the original and revised versions of the Speech Perception In Noise (SPIN) Tests. While the SPIN Test was originally created to assess hearing-impairment for speech, it is also used in experimental psycholinguistic studies. Both versions of the SPIN Test contain eight sentence lists that are equivalent on the phonetic content and frequency of the final (target) word and have been found to be equivalent on intelligibility. Based on these equivalencies, any single list can be used for assessment. The purpose of the present study was to evaluate whether the eight lists of each test version are also equivalent on neighborhood characteristics of the words composing the lists. We calculated two measures of the relationship between the frequency of each target word and the frequency and density of the word's similarity neighborhood. For both test versions, the eight lists were found to be equivalent on both of these measures. The importance of these findings for both test usage and word recognition theory is discussed.

Introduction

The Speech Perception In Noise (SPIN) Test (Kalikow, Stevens, & Elliott, 1977) was originally developed as a test of hearing impairment for speech using sentence length materials. Because the test was intended to evaluate performance in relatively realistic listening conditions, the target words were placed within sentential context, and speech babble was used as noise. The sentences contained five to eight words, each ending in a common, monosyllabic word. The test contained two types of sentences: high probability (HP) and low probability (LP). In HP sentences, the final word was predictable from the semantic content of the sentence (e.g., Stir your coffee with a spoon.), whereas, in LP sentences, the final word was not predictable (e.g., We spoke about the knob.). Each final word appeared in one HP and one LP sentence context. Percent correct transcription of the final words was the measure of interest for the test. Ten lists of 50 sentences each were constructed to be statistically equivalent on mean frequency and phonetic content of the final word. Based on intelligibility tests with normal hearing listeners, two lists were eliminated. The remaining eight lists were not statistically different on intelligibility scores, and were therefore considered equivalent such that only one list need be used for testing purposes.

The SPIN Test was later evaluated by Bilger (1984; Bilger, Nuetzel, Rabinowitz, & Rzeczkowski, 1984) with hearing-impaired listeners over a range of ages, using the original ten lists created by Kalikow et al. (1977). Bilger et al. found that the lists were not equivalent on intelligibility for this population, and then revised the SPIN test based on item analyses (Elliott, 1995). The resulting test, the Revised SPIN Test (Bilger, 1984; 1994), consisted of eight equivalent lists made up of sentences from Kalikow et al.'s original ten lists. As with the original SPIN Test, the eight lists were equivalent on mean frequency and phonetic content of the final word.

Since its development, the SPIN Test has been used both for clinical evaluation of hearing impairment and for experimental psycholinguistic research (Elliott, 1995). Although the Revised SPIN Test improved the balance of lexical characteristics of the eight lists, the revised version has been more difficult to obtain than the original SPIN Test, the sentence materials for which were included in an

appendix of the original Kalikow et al. (1977) report (Elliott, 1995). As a result, both versions of the test continue to be utilized for studies of various kinds (e.g., Clarke, 2000; Clopper et al., 2000).

Recent findings in the spoken word recognition literature indicate that word frequency and phonetic content, the main lexical factors controlled across lists in both versions of the SPIN Test, may not be the only factors that affect the intelligibility of lexical items. Several studies have demonstrated that the characteristics of a word's lexical neighborhood (Landauer & Streeter, 1973), that is, the set of words that are phonetically similar to a target word, can affect performance on word perception tasks (Eukel, 1980; Luce, 1985; Luce & Pisoni, 1998; Meyer & Pisoni, 1999; Pisoni, Nusbaum, Luce, & Slowiaczek, 1985). For example, Luce (1985) found that words with higher intelligibility had a larger proportion of neighbors with a lower frequency than the word itself compared to the words with low intelligibility (cited in Pisoni, Nusbaum, Luce, & Slowiaczek, 1985). Put another way, the highly intelligible words that Luce examined had fewer neighbors of higher frequency, while the less intelligible words had many more neighbors of higher frequency.

The idea that perception of a word is affected by the relationship of the word to other words in the lexicon has been incorporated in a recent model of spoken word recognition. The Neighborhood Activation Model (NAM; Luce & Pisoni, 1998) proposes that the process of word recognition involves, first, activation of the lexical representations of the input word as well as its acoustic-phonetic neighbors, followed by competition among the neighbors. The outcome of the competition is based not only on each item's match with the acoustic-phonetic input, but also on its frequency, the number of lexical neighbors, and the frequency of the neighbors. Therefore, the likelihood of accessing the correct lexical representation depends on the input item's frequency in relation to the density and frequency of its neighborhood. In a series of behavioral experiments using several experimental techniques with normal-hearing listeners, Luce and Pisoni (1998) demonstrated NAM's ability to account for word perception data based on these relational factors.

The purpose of the present computational study is to examine the neighborhood properties of the final words of both the original and revised SPIN Tests. While the eight lists making up these tests were balanced on frequency and phonetic content, they were not balanced on neighborhood characteristics of the test words on each list. Given the evidence that neighborhood characteristics may affect word intelligibility, it is important to know whether any of the lists are substantially different from the others on these factors. As noted above, both versions have been tested for intelligibility, and the eight lists were found to be statistically equivalent (though some measures showed nonequivalence for the lists in the original version). However, given that the measures of equivalence were based on null results of analyses of variance (ANOVAs), and that it would be advantageous to account for any remaining variability in intelligibility among the lists, an analysis of the neighborhood properties of the words on these lists is worthwhile. Whether the SPIN Test is used in a clinical or experimental setting, any factor that may undermine the assumption of equivalence among the lists could disrupt test results and interpretations. It should be noted that neighborhood characteristics would be most relevant to the LP items on each list. It is assumed that neighborhood factors would have an attenuated relationship to the intelligibility of a word in a supportive semantic context.

Method

In both versions of the SPIN test there are 400 sentences based on 200 final (target) words, with each word in one HP sentence and one LP sentence. Each of the eight lists consists of 25 HP sentences and 25 LP sentences, and each list is paired with another such that the words in HP sentences in one list are in LP sentences in the other, and vice versa for the other list. Therefore, for this study, only words

taken from the 25 LP sentences in each list were considered. This resulted in 200 words from each test version.

Lexical statistics for the 200 target words from both tests (a total of 241 unique words since 159 words are common to both tests) were obtained from a 20,000 word computerized database based on Webster's Pocket Dictionary (Luce, 1986; Nusbaum, Pisoni, & Davis, 1984; Pisoni, Nusbaum, Luce, & Slowiaczek, 1985).³ The database contains several pieces of information about each word, including orthography, a phonemic transcription, written frequency, familiarity (Nusbaum, Pisoni, & Davis, 1984), neighborhood density, and neighborhood frequency. The data of central interest for this study were the frequencies and lexical densities of each word. In this database, the frequency of each word is given as the sum of the Kucera & Francis (1967) written frequencies of the word and all of its homophones. The lexical density of a word is the number of English words that can be obtained by substituting, adding, or deleting one phoneme in any position ("Density B"; Greenberg & Jenkins, 1964; Luce & Pisoni, 1998). An entry in the database was located for each target word based on phonological match. If a target word was plural, the entry for its singular form was used.

The words were grouped by list, and two "second-order" statistics (Meyer & Pisoni, 1999) were calculated for each word. The purpose of these statistics was to measure the frequency of each target word in relation to the density and frequency of its neighborhood. The first statistic (Neighborhood Ratio 1) is a ratio of a target word's log frequency and the mean log frequency of its neighbors (Meyer & Pisoni, 1999):

$$\frac{T}{(\sum N_i)/n}$$

where T is the log frequency of the target word, N_i is the log frequency of the i th neighbor of the target word, and n is the number of neighbors. This ratio represents the target word's frequency relative to the mean frequency of its neighbors. If the ratio is greater than 1, the target word's frequency is higher than the neighborhood mean; if it is less than 1, its frequency is lower than the neighborhood mean. The second statistic (Neighborhood Ratio 2) is the ratio of a target word's log frequency and the sum of the log frequencies of the target and its neighbors (Pisoni, Nusbaum, Luce, & Slowiaczek, 1985):

$$\frac{T}{T + \sum N_i}$$

This ratio represents the frequency of the target word in comparison with the total frequency of the neighborhood. This is slightly different from the first ratio in that it takes into account the number of neighbors in addition to the central tendency of their frequencies. These two ratios are meant to represent, in different ways, how much competition each target word has in the process of discriminating it from similar words during spoken word recognition (see Luce & Pisoni, 1998).

Results

Original SPIN Test

On average, the frequency of the target words in the original SPIN Test was moderate to low (mean frequency = 21.22; mean log frequency = 2.07), ranging from 1 to 269 words per million (Kucera & Francis, 1967). However, overall the words were highly familiar, with a mean familiarity score of 6.92,

³ One word, *dove* (/d^v/) from list 7 of the original SPIN Test, could not be found in the database.

ranging from 6.08 to 7.00, on a scale of 1 to 7 (1 = word is unknown, 4 = word is recognized but meaning is unknown, 7 = word is recognized and meaning is well known; Nusbaum, Pisoni, & Davis, 1984). The mean frequencies and mean log frequencies of the eight lists are shown in Table 1. A one-way ANOVA on log frequency showed no significant differences among the lists, $F(7, 191) < 1$. This was expected a priori because the lists were constructed to be equivalent on frequency (Kalikow et al., 1977).

Original SPIN Test									
<u>Mean</u>	<u>List 1</u>	<u>List 2</u>	<u>List 3</u>	<u>List 4</u>	<u>List 5</u>	<u>List 6</u>	<u>List 7</u>	<u>List 8</u>	<u>All</u>
Frequency	28.64	17.84	18.92	15.64	24.04	21.44	23.21	20.12	21.22
Log Frequency	2.14	2.01	2.08	2.03	2.04	2.08	2.08	2.14	2.07
Neighborhood Density	17.32	11.84	16.96	14.60	15.76	19.12	16.08	17.24	16.12
Neighborhood Ratio 1	1.10	1.11	1.08	1.07	1.04	1.10	1.09	1.10	1.09
Neighborhood Ratio 2	0.083	0.133	0.081	0.095	0.082	0.076	0.091	0.082	0.090

Table 1. Lexical statistics (means) for the eight lists and for all sentence final words of the original SPIN Test (Kalikow, Stevens, & Elliott, 1977). Neighborhood Ratio 1 = (log frequency word)/(mean log frequency neighborhood). Neighborhood Ratio 2 = (log frequency word)/(log frequency word + sum log frequency all neighbors).

The mean number of neighbors for the words in the original SPIN Test was 16.12. As can be seen in Table 1, the mean Neighborhood Ratio 1 for all eight lists is greater than 1, indicating that on average the log frequency of the target words is greater than the mean log frequency of their neighborhoods. A one-way ANOVA on Neighborhood Ratio 1 showed that there was no significant difference among the eight lists, $F(7, 191) < 1$. A final one-way ANOVA on Neighborhood Ratio 2 also showed no difference among the eight lists, $F(7, 191) = 1.36, p = 0.22$. A complete set of the target words of the original SPIN Test and their values on several lexical factors can be found in Appendix A.

Revised SPIN Test

The mean frequency of the target words of the revised SPIN Test was also moderate to low (mean frequency = 21.22; mean log frequency = 2.09), ranging from 1 to 269 words per million (Kucera & Francis, 1967). As in the original version, the revised test contained highly familiar words (mean = 6.93, ranging from 6.08 to 7.00, on a scale from 1 to 7). The mean frequencies and mean log frequencies of each list can be found in Table 2. Again as expected, a one-way ANOVA showed no significant differences among the eight lists on log frequency, $F(7, 192) < 1$.

The mean number of neighbors for the target words in the revised SPIN Test was 15.98. Table 2 shows that, as with the original test, the mean Neighborhood Ratio 1 for all eight lists of the revised test is greater than 1, indicating that on average the log frequency of the target words is greater than the mean log frequency of their neighborhoods. A one-way ANOVA showed that there was no significant difference among the eight lists on Neighborhood Ratio 1, $F(7, 192) < 1$. The third one-way ANOVA on Neighborhood Ratio 2 also showed no difference among the eight lists for the revised test, $F(7, 192) < 1$. A complete set of the target words of the revised SPIN Test and their values on several lexical factors can be found in Appendix B.

Revised SPIN Test									
<u>Mean</u>	<u>List 1</u>	<u>List 2</u>	<u>List 3</u>	<u>List 4</u>	<u>List 5</u>	<u>List 6</u>	<u>List 7</u>	<u>List 8</u>	<u>All</u>
Frequency	16.60	15.08	25.76	23.84	20.16	30.72	20.96	16.60	21.22
Log Frequency	2.09	2.00	2.17	2.13	2.05	2.19	2.07	2.02	2.09
Neighborhood Density	15.56	18.36	14.92	17.92	17.28	13.84	15.36	14.56	15.98
Neighborhood Ratio 1	1.15	1.07	1.08	1.09	1.01	1.14	1.09	1.11	1.09
Neighborhood Ratio 2	0.104	0.070	0.084	0.088	0.072	0.101	0.081	0.094	0.087

Table 2. Lexical statistics (means) for the eight lists and for all words of the revised SPIN Test (Bilger, 1984; 1994). Neighborhood Ratio 1 = (log frequency word)/(mean log frequency neighborhood). Neighborhood Ratio 2 = (log frequency word)/(log frequency word + sum log frequency all neighbors).

Discussion

The purpose of this computational analysis was to examine the lexical neighborhood characteristics of both the original and revised versions of the SPIN Test. The relationship of a test word to its phonological neighborhood is relevant for evaluation of test equivalence because it has been shown in recent research to influence word intelligibility, perhaps to a greater degree than word frequency (Luce & Pisoni, 1998). If one of the lists in the SPIN Test is composed of words that “stand out” among their respective similarity neighborhoods (that is, have a relatively high frequency compared to other words in the neighborhood), it will show systematic differences from the other lists in intelligibility scores, all other things being equal.

The aim of this analysis was to assess whether the eight lists in each test were equivalent on two measures that index the relationship between the sentence final words and their similarity neighborhoods. The lists in both the original and revised versions of the SPIN Test were found to be statistically equivalent on both measures (Neighborhood Ratio 1 and Neighborhood Ratio 2). In addition, we verified that the lists were equivalent on word frequency. These results might have been expected since the lists were equated on intelligibility for both versions (Bilger, 1984; 1994; Kalikow et al., 1977). However, it was possible that the lists still could have differed on neighborhood characteristics because these measure relational properties of words to other phonetically similar words in the lexicon. These potential differences could have been responsible for some of the remaining variability among the lists.

The findings of lexical equivalence are indeed reassuring for the claim that the relationship of a word to its lexical neighborhood is an important predictor of intelligibility (Luce & Pisoni, 1998; Pisoni, Nusbaum, Luce, & Slowiaczek, 1985). In particular, this claim implies that if the lexical neighborhood characteristics (e.g., Neighborhood Ratios 1 & 2) are not equivalent across word lists, then intelligibility will not be equivalent across word lists. If this statement is true, then a logical consequence is that if intelligibility *is* equivalent across lists, then lexical neighborhood characteristics must be equivalent across lists. Therefore, the findings here that the neighborhood ratios are equivalent, given that the intelligibilities are equivalent, are supportive of the claim.

For practical purposes, knowledge of the lexical neighborhood properties of these items is important for the use of the SPIN materials for both clinical testing and psycholinguistic research. These materials have the potential to be used with a variety of populations and under a variety of conditions. For example, while the authorized version of the SPIN Test (Bilger, 1994) comes with recorded materials and

a multi-talker babble track, researchers may choose to record their own versions of the test sentences and use other methods of stimulus degradation, such as random noise (Elliott, 1995). The findings by Kalikow et al. (1977; original) and Bilger (1984; 1994; revised) of list equivalence on intelligibility are only generalizable to testing situations with similar populations and comparable listening conditions. However, the lexical neighborhood properties measured here are based on properties of the lexical items themselves and their relationship to the rest of the lexicon. Hence, the assumption of the lists' equivalence on the neighborhood measures is valid for a wider variety of uses of the materials. A known exception is signal to noise ratio (SNR). Lexical neighborhood properties seem to lose their predictive power for word intelligibility at very low or very high SNRs (Meyer & Pisoni, 1999).

As noted above, the relevance of neighborhood property measures for the target words is greatest for the LP sentences. However, it is not clear whether the impact of neighborhood factors on intelligibility is eliminated or simply reduced in HP sentences. Investigation of this question would help to illuminate the relationship between lexical and contextual factors in spoken word recognition. As we gain more evidence for the importance of relational factors within the lexicon, future research should turn towards understanding how these relational factors act in concert with other known aspects of spoken word recognition.

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Appendix A: Original SPIN Test (LP items)

List	Final word	Transcription	Frequency	Log Freq ^a	N ^b Density ^c	Mean Freq N	Mean Log Freq N	N Ratio 1	N Ratio 2
1	lap	l@p	19	2.28	30	11.63	1.71	1.33	0.042
1	cake	kek	13	2.11	26	104.27	2.19	0.97	0.036
1	track	tr@k	38	2.58	10	14.90	1.90	1.36	0.120
1	pad	p@d	8	1.90	26	225.12	1.96	0.97	0.036
1	crates	kret	2	1.30	16	61.25	1.65	0.79	0.047
1	herd	hRd	269	3.43	20	461.95	2.32	1.48	0.069
1	mate	met	21	2.32	28	197.61	2.43	0.96	0.033
1	gin	JIn	23	2.36	20	1215.80	2.31	1.02	0.049
1	sand	s@nd	28	2.45	13	2310.46	2.63	0.93	0.067
1	dive	dYv	23	2.36	17	30.71	1.68	1.41	0.077
1	map	m@p	13	2.11	20	75.75	1.88	1.12	0.053
1	van	v@n	32	2.51	12	728.25	2.81	0.89	0.069
1	hive	hYv	2	1.30	15	322.47	2.01	0.65	0.041
1	bomb	bam	36	2.56	13	17.77	1.84	1.39	0.096
1	strips	strIp	30	2.48	6	18.00	1.68	1.47	0.197
1	yell	yEl	9	1.95	19	115.16	2.25	0.87	0.044
1	hug	h^g	3	1.48	21	8.38	1.60	0.92	0.042
1	knife	nYf	76	2.88	8	191.38	2.45	1.17	0.128
1	wax	w@ks	14	2.15	4	51.75	1.89	1.14	0.221
1	lock	lak	23	2.36	31	75.61	1.93	1.22	0.038
1	doll	dal	10	2.00	16	20.31	1.87	1.07	0.063
1	bruise	bruz	3	1.48	10	6.50	1.60	0.92	0.084
1	pine	pYn	14	2.15	30	35.03	1.91	1.13	0.036
1	dent	dEnt	2	1.30	19	56.37	1.95	0.67	0.034
1	crib	krlb	5	1.70	3	1.00	1.00	1.70	0.362
	Mean:		28.64	2.14	17.32	254.30	1.98	1.10	0.083
	<i>SD:</i>		<i>52.64</i>	<i>0.52</i>	<i>8.15</i>	<i>509.19</i>	<i>0.38</i>	<i>0.27</i>	<i>0.076</i>

List	Final word	Transcription	Frequency	Log Freq	N Density	Mean Freq N	Mean Log Freq N	N Ratio 1	N Ratio 2
2	growl	grWl	4	1.60	6	3.17	1.28	1.25	0.173
2	sheets	Sit	45	2.65	23	171.39	2.34	1.13	0.047
2	steam	stim	17	2.23	8	62.25	2.47	0.90	0.101
2	net	nEt	34	2.53	26	290.96	2.41	1.05	0.039
2	draft	dr@ft	24	2.38	7	7.14	1.50	1.58	0.185
2	screen	skrin	48	2.68	2	7.00	1.56	1.72	0.463
2	strap	str@p	2	1.30	6	10.67	1.71	0.76	0.112
2	coast	kost	61	2.79	12	158.00	2.67	1.04	0.080
2	swamps	swamp	5	1.70	1	2.00	1.30	1.31	0.566
2	crop	krap	20	2.30	9	10.67	1.53	1.50	0.143
2	bloom	blum	12	2.08	11	22.36	1.77	1.17	0.096
2	cap	k@p	27	2.43	30	81.13	1.91	1.28	0.041
2	fleet	flit	17	2.23	16	27.25	1.55	1.44	0.083
2	mugs	m^g	1	1.00	21	49.24	1.49	0.67	0.031
2	dart	dart	1	1.00	10	113.10	2.43	0.41	0.039
2	wheat	hwit	9	1.95	9	280.78	2.29	0.86	0.087
2	booth	buT	7	1.85	12	79.92	2.04	0.91	0.070
2	scab	sk@b	1	1.00	4	7.25	1.80	0.55	0.122
2	slave	slev	30	2.48	9	10.00	1.46	1.70	0.159
2	hay	he	19	2.28	26	920.85	2.86	0.80	0.030
2	ant	@nt	28	2.45	12	3204.83	2.59	0.94	0.073
2	stamp	st@mp	8	1.90	4	1.25	1.08	1.77	0.307
2	sport	sport	17	2.23	7	53.00	1.90	1.18	0.144
2	geese	gis	3	1.48	8	65.88	2.36	0.63	0.073
2	slot	slat	6	1.78	17	18.29	1.64	1.09	0.060
	Mean:		17.84	2.01	11.84	226.33	1.92	1.11	0.133
	<i>SD:</i>		<i>16.20</i>	<i>0.54</i>	<i>7.89</i>	<i>648.63</i>	<i>0.49</i>	<i>0.37</i>	<i>0.131</i>

^a Log Frequency = log₁₀(frequency) + 1

^b N = neighborhood

^c based on one-phoneme substitution/addition/deletion

Appendix A: Original (con't)

List	Final word	Transcription	Frequency	Log Freq	N Density	Mean Freq N	Mean Log Freq N	N Ratio 1	N Ratio 2
3	cot	kat	1	1.00	35	180.37	2.04	0.49	0.014
3	fee	fi	16	2.20	31	815.13	2.64	0.84	0.026
3	blame	blem	34	2.53	7	21.43	1.94	1.31	0.157
3	jar	Jar	16	2.20	16	345.13	2.04	1.08	0.063
3	gang	g@G	22	2.34	15	15.60	1.65	1.42	0.086
3	sleeves	sliv	11	2.04	7	43.57	1.84	1.11	0.137
3	foam	fom	37	2.57	16	689.38	2.24	1.15	0.067
3	breath	brET	53	2.72	3	17.33	1.98	1.37	0.314
3	barn	barn	29	2.46	11	24.00	1.87	1.31	0.107
3	scare	skEr	6	1.78	11	41.27	2.16	0.82	0.070
3	limb	llm	5	1.70	20	149.50	1.96	0.87	0.042
3	rope	rop	15	2.18	27	37.48	1.89	1.15	0.041
3	spoon	spun	6	1.78	11	22.82	1.57	1.13	0.093
3	hips	hlp	10	2.00	28	397.68	2.13	0.94	0.032
3	tack	t@k	4	1.60	37	78.49	1.96	0.82	0.022
3	mast	m@st	6	1.78	14	253.07	2.76	0.64	0.044
3	juice	Jus	11	2.04	13	17.31	1.68	1.22	0.086
3	fist	flst	26	2.42	11	160.27	2.24	1.08	0.089
3	coach	koC	24	2.38	14	26.14	2.00	1.19	0.078
3	crown	krWn	19	2.28	10	25.20	1.68	1.36	0.120
3	pile	pYl	25	2.40	28	21.54	1.90	1.26	0.043
3	swan	swan	3	1.48	11	1.45	1.13	1.31	0.107
3	coin	kOn	10	2.00	14	136.57	1.86	1.07	0.071
3	bar	bar	82	2.91	24	229.46	2.11	1.38	0.054
3	broom	brum	2	1.30	10	43.60	1.87	0.70	0.065
		Mean:	18.92	2.08	16.96	151.75	1.97	1.08	0.081
		<i>SD:</i>	<i>18.27</i>	<i>0.45</i>	<i>9.23</i>	<i>211.58</i>	<i>0.32</i>	<i>0.25</i>	<i>0.060</i>

List	Final word	Transcription	Frequency	Log Freq	N Density	Mean Freq N	Mean Log Freq N	N Ratio 1	N Ratio 2
4	thorns	Torn	3	1.48	9	27.89	1.96	0.75	0.077
4	raft	r@ft	4	1.60	14	5.57	1.38	1.16	0.077
4	drain	dren	18	2.26	13	24.77	1.85	1.22	0.086
4	kick	klk	16	2.20	28	21.11	1.80	1.23	0.042
4	vest	vEst	4	1.60	19	58.16	2.12	0.75	0.038
4	robe	rob	6	1.78	18	41.89	1.94	0.92	0.048
4	hint	hInt	9	1.95	10	15.70	1.66	1.18	0.105
4	bowl	bol	23	2.36	33	59.18	2.06	1.15	0.034
4	blast	bl@st	15	2.18	3	231.00	2.34	0.93	0.236
4	grease	gris	9	1.95	14	26.50	1.91	1.02	0.068
4	ditch	dIC	10	2.00	16	81.88	2.12	0.94	0.056
4	drum	dr^m	11	2.04	10	448.00	1.89	1.08	0.098
4	crash	kr@S	20	2.30	13	6.00	1.37	1.68	0.115
4	deck	dEk	23	2.36	20	40.20	2.00	1.18	0.056
4	mist	mIst	14	2.15	16	169.25	2.27	0.95	0.056
4	crew	kru	36	2.56	19	79.79	1.97	1.30	0.064
4	brook	brUk	3	1.48	6	62.83	2.30	0.64	0.097
4	goal	gol	60	2.78	28	57.64	1.84	1.51	0.051
4	mouse	mWs	10	2.00	14	79.43	1.93	1.04	0.069
4	cruise	kruz	2	1.30	8	9.63	1.66	0.78	0.089
4	grin	grIn	13	2.11	9	26.56	2.03	1.04	0.104
4	ape	ep	3	1.48	17	156.53	2.21	0.67	0.038
4	sponge	sp^nJ	7	1.85	1	16.00	2.20	0.84	0.456
4	truck	tr^k	57	2.76	9	14.11	1.67	1.65	0.155
4	fur	fR	15	2.18	18	203.28	1.78	1.22	0.064
		Mean:	15.64	2.03	14.60	78.52	1.93	1.07	0.095
		<i>SD:</i>	<i>15.16</i>	<i>0.39</i>	<i>7.58</i>	<i>99.04</i>	<i>0.26</i>	<i>0.28</i>	<i>0.087</i>

Appendix A: Original (con't)

List	Final word	Transcription	Frequency	Log Freq	N Density	Mean Freq N	Mean Log Freq N	N Ratio 1	N Ratio 2
5	junk	J^Gk	8	1.90	9	5.78	1.53	1.25	0.122
5	meal	mil	30	2.48	28	77.21	1.92	1.29	0.044
5	prize	prYz	28	2.45	10	41.00	2.36	1.04	0.094
5	mold	mold	45	2.65	18	88.94	2.10	1.27	0.066
5	scream	skrim	13	2.11	6	25.67	2.03	1.04	0.148
5	joints	JOnt	39	2.59	5	92.60	1.88	1.38	0.216
5	fudge	f^J	1	1.00	6	22.17	1.90	0.53	0.081
5	hedge	hEJ	2	1.30	11	71.36	2.09	0.62	0.054
5	plot	plat	37	2.57	12	17.00	1.65	1.56	0.115
5	rent	rEnt	21	2.32	17	69.00	1.91	1.22	0.067
5	bow	bo	17	2.23	32	615.56	2.54	0.88	0.027
5	firm	fRm	109	3.04	13	13.69	1.67	1.82	0.123
5	lid	lId	19	2.28	23	78.91	2.06	1.11	0.046
5	cramp	kr@mp	2	1.30	6	14.17	1.44	0.90	0.131
5	row	ro	36	2.56	38	196.08	2.25	1.14	0.029
5	spool	spul	1	1.00	9	71.33	1.91	0.52	0.055
5	den	dEn	2	1.30	33	130.64	2.18	0.60	0.018
5	bread	brEd	42	2.62	15	37.60	2.09	1.25	0.077
5	brat	br@t	1	1.00	11	35.91	1.79	0.56	0.048
5	slings	slIG	1	1.00	16	12.13	1.84	0.54	0.033
5	trap	tr@p	20	2.30	13	13.85	1.64	1.40	0.097
5	throat	Trot	51	2.71	6	52.00	2.19	1.23	0.171
5	tea	ti	65	2.81	33	1607.21	2.76	1.02	0.030
5	thief	Tif	8	1.90	8	29.25	1.99	0.96	0.107
5	mop	map	3	1.48	16	22.56	1.80	0.82	0.049
	Mean:		24.04	2.04	15.76	137.66	1.98	1.04	0.082
	<i>SD:</i>		<i>25.60</i>	<i>0.66</i>	<i>9.83</i>	<i>329.02</i>	<i>0.30</i>	<i>0.35</i>	<i>0.050</i>

List	Final word	Transcription	Frequency	Log Freq	N Density	Mean Freq N	Mean Log Freq N	N Ratio 1	N Ratio 2
6	shed	SEd	11	2.04	17	249.41	2.55	0.80	0.045
6	roar	ror	13	2.11	31	617.58	2.58	0.82	0.026
6	curb	kRb	13	2.11	12	10.00	1.64	1.29	0.097
6	peg	pEg	4	1.60	10	17.00	1.86	0.86	0.079
6	chat	C@t	5	1.70	22	743.36	1.98	0.86	0.037
6	bet	bEt	20	2.30	32	251.59	2.55	0.90	0.027
6	loot	lut	4	1.60	26	53.19	2.04	0.79	0.029
6	wits	wIt	20	2.30	31	618.23	2.18	1.05	0.033
6	rib	rIb	1	1.00	19	14.58	1.77	0.56	0.029
6	slice	slYs	13	2.11	8	11.13	1.62	1.31	0.140
6	clock	klak	20	2.30	15	11.13	1.59	1.45	0.088
6	cheers	Clr	8	1.90	27	87.22	2.13	0.89	0.032
6	film	fIlm	96	2.98	7	9.29	1.42	2.10	0.231
6	gum	g^m	14	2.15	16	161.31	1.93	1.11	0.065
6	trail	trEl	31	2.49	13	26.62	1.90	1.31	0.092
6	drug	dr^g	24	2.38	8	7.50	1.60	1.48	0.156
6	dust	d^st	70	2.85	8	239.88	2.22	1.28	0.138
6	fun	f^n	44	2.64	25	190.76	2.06	1.28	0.049
6	lanes	len	34	2.53	33	48.18	2.05	1.23	0.036
6	knob	nab	2	1.30	21	236.67	1.62	0.80	0.037
6	sap	s@p	1	1.00	27	14.96	1.76	0.57	0.021
6	cliff	klIf	11	2.04	5	46.80	1.84	1.11	0.182
6	rim	rIm	5	1.70	26	129.31	1.96	0.87	0.032
6	tin	tIn	12	2.08	30	830.50	2.15	0.96	0.031
6	task	t@sk	60	2.78	9	17.67	1.53	1.81	0.168
	Mean:		21.44	2.08	19.12	185.75	1.94	1.10	0.076
	<i>SD:</i>		<i>23.54</i>	<i>0.52</i>	<i>9.23</i>	<i>248.22</i>	<i>0.32</i>	<i>0.36</i>	<i>0.060</i>

Appendix A: Original (con't)

List	Final word	Transcription	Frequency	Log Freq	N Density	Mean Freq N	Mean Log Freq N	N Ratio 1	N Ratio 2
7	dove	-	-	-	-	-	-	-	-
7	lungs	l^G	16	2.20	18	88.00	2.04	1.08	0.057
7	chunks	C^Gk	2	1.30	10	7.20	1.65	0.79	0.073
7	seeds	sid	41	2.61	27	184.19	2.31	1.13	0.040
7	pole	pol	27	2.43	33	37.36	1.97	1.23	0.036
7	gown	gWn	16	2.20	8	187.25	2.48	0.89	0.100
7	tide	tYd	45	2.65	22	124.18	2.13	1.24	0.053
7	debt	dEt	13	2.11	28	109.29	2.36	0.90	0.031
7	vault	vclt	2	1.30	6	13.50	1.67	0.78	0.115
7	oath	oT	6	1.78	12	495.83	2.25	0.79	0.062
7	flock	flak	10	2.00	12	10.83	1.43	1.40	0.104
7	wheels	hwil	56	2.75	7	100.86	1.76	1.56	0.183
7	clerk	klRk	34	2.53	8	4.13	1.36	1.87	0.189
7	beads	bid	1	1.00	26	299.19	2.22	0.45	0.017
7	splash	spl@S	3	1.48	2	2.00	1.24	1.19	0.374
7	aid	ed	139	3.14	20	102.35	2.20	1.43	0.067
7	feast	fist	3	1.48	10	230.30	2.61	0.57	0.053
7	bark	bark	14	2.15	15	37.13	2.04	1.05	0.065
7	crumbs	kr^m	3	1.48	11	461.64	2.09	0.71	0.060
7	bay	be	63	2.80	35	570.31	2.36	1.19	0.033
7	calf	k@f	11	2.04	19	118.58	1.86	1.10	0.055
7	glue	glu	8	1.90	11	28.18	1.93	0.99	0.082
7	blade	bled	13	2.11	9	27.44	1.79	1.18	0.116
7	cops	kap	15	2.18	30	35.77	1.84	1.18	0.038
7	spray	spre	16	2.20	7	5.57	1.42	1.55	0.181
	Mean:		23.21	2.08	16.08	136.71	1.96	1.09	0.091
	<i>SD:</i>		<i>30.20</i>	<i>0.54</i>	<i>9.48</i>	<i>164.58</i>	<i>0.37</i>	<i>0.33</i>	<i>0.077</i>

List	Final word	Transcription	Frequency	Log Freq	N Density	Mean Freq N	Mean Log Freq N	N Ratio 1	N Ratio 2
8	beak	bik	1	1.00	28	298.21	2.06	0.49	0.017
8	bench	bEnC	35	2.54	7	11.43	1.63	1.56	0.182
8	flood	fl^d	19	2.28	5	35.00	2.14	1.06	0.175
8	pie	pY	17	2.23	32	423.63	2.32	0.96	0.029
8	clue	klu	15	2.18	12	29.08	1.82	1.20	0.091
8	hen	hEn	22	2.34	24	229.54	2.22	1.06	0.042
8	tent	tEnt	20	2.30	19	70.79	2.08	1.11	0.055
8	tub	t^b	13	2.11	17	14.00	1.67	1.26	0.069
8	flame	flem	17	2.23	11	21.27	1.68	1.33	0.108
8	pet	pEt	8	1.90	30	96.63	2.18	0.87	0.028
8	ox	aks	5	1.70	6	15.33	1.62	1.05	0.149
8	toll	tol	16	2.20	33	52.73	1.98	1.11	0.033
8	frogs	frcg	1	1.00	4	8.75	1.58	0.63	0.137
8	mat	m@t	8	1.90	30	636.03	2.37	0.80	0.026
8	skirt	skRt	21	2.32	10	5.00	1.30	1.78	0.151
8	logs	lcg	11	2.04	13	107.08	2.28	0.90	0.065
8	cards	kard	26	2.42	15	40.40	1.85	1.31	0.080
8	sheep	Sip	23	2.36	20	180.15	2.18	1.08	0.051
8	beam	bim	21	2.32	16	444.31	2.19	1.06	0.062
8	silk	sIlk	12	2.08	10	14.70	1.65	1.26	0.112
8	host	host	36	2.56	10	136.40	2.20	1.16	0.104
8	pill	pIl	15	2.18	36	88.97	2.12	1.03	0.028
8	notch	naC	6	1.78	7	664.43	1.96	0.91	0.115
8	pool	pul	111	3.05	18	25.28	1.99	1.53	0.078
8	bend	bEnd	24	2.38	18	52.06	2.16	1.10	0.058
	Mean:		20.12	2.14	17.24	148.05	1.97	1.10	0.082
	<i>SD:</i>		<i>20.95</i>	<i>0.44</i>	<i>9.63</i>	<i>194.99</i>	<i>0.28</i>	<i>0.28</i>	<i>0.049</i>

Appendix B: Revised SPIN Test (LP items)

List	Final word	Transcription	Frequency	Log Freq ^a	N ^b Density ^c	Mean Freq N	Mean Log Freq N	N Ratio 1	N Ratio 2
1	crib	krIb	5	1.70	3	1.00	1.00	1.70	0.362
1	growl	grWl	4	1.60	6	3.17	1.28	1.25	0.173
1	hut	h^t	13	2.11	27	196.37	2.16	0.98	0.035
1	knob	nab	2	1.30	21	236.67	1.62	0.80	0.037
1	rag	r@g	10	2.00	28	11.25	1.53	1.30	0.045
1	feast	fist	3	1.48	10	230.30	2.61	0.57	0.053
1	splash	spl@S	3	1.48	2	2.00	1.24	1.19	0.374
1	pond	pand	25	2.40	7	13.29	1.67	1.43	0.170
1	hips	hIp	10	2.00	28	397.68	2.13	0.94	0.032
1	lungs	l^G	16	2.20	18	88.00	2.04	1.08	0.057
1	foam	fom	37	2.57	16	689.38	2.24	1.15	0.067
1	drain	dren	18	2.26	13	24.77	1.85	1.22	0.086
1	mist	mIst	14	2.15	16	169.25	2.27	0.95	0.056
1	sleeves	sliv	11	2.04	7	43.57	1.84	1.11	0.137
1	skirt	skRt	21	2.32	10	5.00	1.30	1.78	0.151
1	host	host	36	2.56	10	136.40	2.20	1.16	0.104
1	crew	kru	36	2.56	19	79.79	1.97	1.30	0.064
1	toll	tol	16	2.20	33	52.73	1.98	1.11	0.033
1	cliff	klIf	11	2.04	5	46.80	1.84	1.11	0.182
1	crook	krUk	3	1.48	8	11.25	1.58	0.93	0.105
1	crack	kr@k	21	2.32	18	6.06	1.39	1.67	0.085
1	pile	pYl	25	2.40	28	21.54	1.90	1.26	0.043
1	van	v@n	32	2.51	12	728.25	2.81	0.89	0.069
1	bend	bEnd	24	2.38	18	52.06	2.16	1.10	0.058
1	hay	he	19	2.28	26	920.85	2.86	0.80	0.030
	Mean:		16.60	2.09	15.56	166.70	1.90	1.15	0.104
	<i>SD:</i>		<i>10.95</i>	<i>0.38</i>	<i>8.96</i>	<i>253.08</i>	<i>0.48</i>	<i>0.29</i>	<i>0.092</i>

List	Final word	Transcription	Frequency	Log Freq	N Density	Mean Freq N	Mean Log Freq N	N Ratio 1	N Ratio 2
2	risk	rIsk	54	2.73	9	7.67	1.60	1.71	0.159
2	spoon	spun	6	1.78	11	22.82	1.57	1.13	0.093
2	ox	aks	5	1.70	6	15.33	1.62	1.05	0.149
2	steam	stim	17	2.23	8	62.25	2.47	0.90	0.101
2	coin	kOn	10	2.00	14	136.57	1.86	1.07	0.071
2	drug	dr^g	24	2.38	8	7.50	1.60	1.48	0.156
2	lap	l@p	19	2.28	30	11.63	1.71	1.33	0.042
2	bone	bon	33	2.52	30	163.87	2.14	1.18	0.038
2	tanks	t@Gk	12	2.08	16	16.25	1.70	1.22	0.071
2	gin	JIn	23	2.36	20	1215.80	2.31	1.02	0.049
2	oath	oT	6	1.78	12	495.83	2.25	0.79	0.062
2	den	dEn	2	1.30	33	130.64	2.18	0.60	0.018
2	calf	k@f	11	2.04	19	118.58	1.86	1.10	0.055
2	silk	sIlk	12	2.08	10	14.70	1.65	1.26	0.112
2	lanes	len	34	2.53	33	48.18	2.05	1.23	0.036
2	pie	pY	17	2.23	32	423.63	2.32	0.96	0.029
2	mugs	m^g	1	1.00	21	49.24	1.49	0.67	0.031
2	blush	bl^S	2	1.30	7	27.57	1.98	0.66	0.086
2	clock	klak	20	2.30	15	11.13	1.59	1.45	0.088
2	sword	sord	7	1.85	13	55.00	2.21	0.84	0.060
2	braids	bred	1	1.00	18	31.33	2.07	0.48	0.026
2	map	m@p	13	2.11	20	75.75	1.88	1.12	0.053
2	crash	kr@S	20	2.30	13	6.00	1.37	1.68	0.115
2	pet	pEt	8	1.90	30	96.63	2.18	0.87	0.028
2	wits	wIt	20	2.30	31	618.23	2.18	1.05	0.033
	Mean:		15.08	2.00	18.36	154.49	1.91	1.07	0.070
	<i>SD:</i>		<i>12.28</i>	<i>0.46</i>	<i>9.21</i>	<i>273.54</i>	<i>0.31</i>	<i>0.31</i>	<i>0.042</i>

^a Log Frequency = log₁₀(frequency) + 1

^b N = neighborhood

^c based on one-phoneme substitution/addition/deletion

Appendix B: Revised (con't)

List	Final word	Transcription	Frequency	Log Freq	N Density	Mean Freq N	Mean Log Freq N	N Ratio 1	N Ratio 2
3	chest	Cest	53	2.72	13	74.08	2.21	1.23	0.087
3	ditch	dIC	10	2.00	16	81.88	2.12	0.94	0.056
3	swan	swan	3	1.48	11	1.45	1.13	1.31	0.107
3	joints	Jont	39	2.59	5	92.60	1.88	1.38	0.216
3	pole	pol	27	2.43	33	37.36	1.97	1.23	0.036
3	clue	klu	15	2.18	12	29.08	1.82	1.20	0.091
3	cruise	kruz	2	1.30	8	9.63	1.66	0.78	0.089
3	bark	bark	14	2.15	15	37.13	2.04	1.05	0.065
3	pork	pork	10	2.00	9	34.67	2.09	0.96	0.096
3	tea	ti	65	2.81	33	1607.21	2.76	1.02	0.030
3	geese	gis	3	1.48	8	65.88	2.36	0.63	0.073
3	dent	dEnt	2	1.30	19	56.37	1.95	0.67	0.034
3	sheets	Sit	45	2.65	23	171.39	2.34	1.13	0.047
3	coach	koC	24	2.38	14	26.14	2.00	1.19	0.078
3	throat	Trot	51	2.71	6	52.00	2.19	1.23	0.171
3	cap	k@p	27	2.43	30	81.13	1.91	1.28	0.041
3	wheat	hwit	9	1.95	9	280.78	2.29	0.86	0.087
3	bread	brEd	42	2.62	15	37.60	2.09	1.25	0.077
3	logs	leg	11	2.04	13	107.08	2.28	0.90	0.065
3	roar	ror	13	2.11	31	617.58	2.58	0.82	0.026
3	strap	str@p	2	1.30	6	10.67	1.71	0.76	0.112
3	firm	fRm	109	3.04	13	13.69	1.67	1.82	0.123
3	prize	prYz	28	2.45	10	41.00	2.36	1.04	0.094
3	bomb	bam	36	2.56	13	17.77	1.84	1.39	0.096
3	stripes	strYp	4	1.60	8	14.13	1.79	0.90	0.101
		Mean:	25.76	2.17	14.92	143.93	2.04	1.08	0.084
		<i>SD:</i>	<i>25.32</i>	<i>0.52</i>	<i>8.56</i>	<i>329.99</i>	<i>0.34</i>	<i>0.27</i>	<i>0.043</i>

List	Final word	Transcription	Frequency	Log Freq	N Density	Mean Freq N	Mean Log Freq N	N Ratio 1	N Ratio 2
4	spray	spre	16	2.20	7	5.57	1.42	1.55	0.181
4	dime	dYm	4	1.60	20	92.20	1.86	0.86	0.041
4	truck	tr^k	57	2.76	9	14.11	1.67	1.65	0.155
4	screen	skrin	48	2.68	2	7.00	1.56	1.72	0.463
4	scare	skEr	6	1.78	11	41.27	2.16	0.82	0.070
4	crown	krWn	19	2.28	10	25.20	1.68	1.36	0.120
4	broom	brum	2	1.30	10	43.60	1.87	0.70	0.065
4	aid	ed	139	3.14	20	102.35	2.20	1.43	0.067
4	grin	grIn	13	2.11	9	26.56	2.03	1.04	0.104
4	seeds	sid	41	2.61	27	184.19	2.31	1.13	0.040
4	bugs	b^g	4	1.60	26	190.58	1.80	0.89	0.033
4	tack	t@k	4	1.60	37	78.49	1.96	0.82	0.022
4	deck	dEk	23	2.36	20	40.20	2.00	1.18	0.056
4	rope	rop	15	2.18	27	37.48	1.89	1.15	0.041
4	kick	klk	16	2.20	28	21.11	1.80	1.23	0.042
4	mast	m@st	6	1.78	14	253.07	2.76	0.64	0.044
4	beef	bif	32	2.51	15	460.00	2.18	1.15	0.071
4	rim	rIm	5	1.70	26	129.31	1.96	0.87	0.032
4	ash	@S	11	2.04	17	986.53	2.18	0.94	0.052
4	bowl	bol	23	2.36	33	59.18	2.06	1.15	0.034
4	mate	met	21	2.32	28	197.61	2.43	0.96	0.033
4	mat	m@t	8	1.90	30	636.03	2.37	0.80	0.026
4	frogs	freg	1	1.00	4	8.75	1.58	0.63	0.137
4	fist	flst	26	2.42	11	160.27	2.24	1.08	0.089
4	wheels	hwil	56	2.75	7	100.86	1.76	1.56	0.183
		Mean:	23.84	2.13	17.92	156.06	1.99	1.09	0.088
		<i>SD:</i>	<i>29.07</i>	<i>0.50</i>	<i>9.87</i>	<i>227.65</i>	<i>0.31</i>	<i>0.31</i>	<i>0.092</i>

Appendix B: Revised (con't)

List	Final word	Transcription	Frequency	Log Freq	N Density	Mean Freq N	Mean Log Freq N	N Ratio 1	N Ratio 2
5	fun	f^n	44	2.64	25	190.76	2.06	1.28	0.049
5	fee	fi	16	2.20	31	815.13	2.64	0.84	0.026
5	bet	bEt	20	2.30	32	251.59	2.55	0.90	0.027
5	slice	sLYs	13	2.11	8	11.13	1.62	1.31	0.140
5	nap	n@p	4	1.60	20	6.75	1.50	1.07	0.051
5	hedge	hEJ	2	1.30	11	71.36	2.09	0.62	0.054
5	slot	slat	6	1.78	17	18.29	1.64	1.09	0.060
5	brook	brUk	3	1.48	6	62.83	2.30	0.64	0.097
5	grief	grif	10	2.00	11	27.55	1.99	1.01	0.084
5	wax	w@ks	14	2.15	4	51.75	1.89	1.14	0.221
5	dart	dart	1	1.00	10	113.10	2.43	0.41	0.039
5	beads	bid	1	1.00	26	299.19	2.22	0.45	0.017
5	fan	f@n	18	2.26	21	430.62	2.33	0.97	0.044
5	crates	kret	2	1.30	16	61.25	1.65	0.79	0.047
5	flame	flem	17	2.23	11	21.27	1.68	1.33	0.108
5	tide	tYd	45	2.65	22	124.18	2.13	1.24	0.053
5	bar	bar	82	2.91	24	229.46	2.11	1.38	0.054
5	ant	@nt	28	2.45	12	3204.83	2.59	0.94	0.073
5	pill	pIl	15	2.18	36	88.97	2.12	1.03	0.028
5	loot	lut	4	1.60	26	53.19	2.04	0.79	0.029
5	dust	d^st	70	2.85	8	239.88	2.22	1.28	0.138
5	trail	trel	31	2.49	13	26.62	1.90	1.31	0.092
5	sand	s@nd	28	2.45	13	2310.46	2.63	0.93	0.067
5	rug	r^g	13	2.11	22	16.64	1.65	1.28	0.055
5	sport	sport	17	2.23	7	53.00	1.90	1.18	0.144
		Mean:	20.16	2.05	17.28	351.19	2.07	1.01	0.072
		<i>SD:</i>	<i>20.87</i>	<i>0.54</i>	<i>8.89</i>	<i>756.50</i>	<i>0.34</i>	<i>0.28</i>	<i>0.048</i>

List	Final word	Transcription	Frequency	Log Freq	N Density	Mean Freq N	Mean Log Freq N	N Ratio 1	N Ratio 2
6	lamp	l@mp	18	2.26	11	13.27	1.72	1.31	0.107
6	shed	Sed	11	2.04	17	249.41	2.55	0.80	0.045
6	trap	tr@p	20	2.30	13	13.85	1.64	1.40	0.097
6	dive	dYv	23	2.36	17	30.71	1.68	1.41	0.077
6	scream	skrim	13	2.11	6	25.67	2.03	1.04	0.148
6	sponge	sp^nJ	7	1.85	1	16.00	2.20	0.84	0.456
6	clip	klIp	6	1.78	11	25.73	1.69	1.05	0.087
6	hen	hEn	22	2.34	24	229.54	2.22	1.06	0.042
6	mink	mlGk	5	1.70	13	47.23	1.98	0.86	0.062
6	cave	kev	9	1.95	22	69.00	1.93	1.01	0.044
6	rib	rIb	1	1.00	19	14.58	1.77	0.56	0.029
6	coast	kost	61	2.79	12	158.00	2.67	1.04	0.080
6	bench	bEnC	35	2.54	7	11.43	1.63	1.56	0.182
6	roast	rost	10	2.00	12	145.42	2.50	0.80	0.062
6	flood	fl^d	19	2.28	5	35.00	2.14	1.06	0.175
6	pool	pul	111	3.05	18	25.28	1.99	1.53	0.078
6	gang	g@G	22	2.34	15	15.60	1.65	1.42	0.086
6	thief	Tif	8	1.90	8	29.25	1.99	0.96	0.107
6	wrist	rlst	10	2.00	16	26.94	1.79	1.12	0.065
6	spy	spY	9	1.95	15	12.20	1.69	1.16	0.072
6	herd	hRd	269	3.43	20	461.95	2.32	1.48	0.069
6	clerk	klRk	34	2.53	8	4.13	1.36	1.87	0.189
6	ape	ep	3	1.48	17	156.53	2.21	0.67	0.038
6	jail	Jel	21	2.32	22	22.95	1.83	1.27	0.055
6	rent	rEnt	21	2.32	17	69.00	1.91	1.22	0.067
		Mean:	30.72	2.19	13.84	76.35	1.96	1.14	0.101
		<i>SD:</i>	<i>54.58</i>	<i>0.49</i>	<i>5.81</i>	<i>106.57</i>	<i>0.33</i>	<i>0.31</i>	<i>0.086</i>

Appendix B: Revised (con't)

List	Final word	Transcription	Frequency	Log Freq	N Density	Mean Freq N	Mean Log Freq N	N Ratio 1	N Ratio 2
7	shell	SEl	22	2.34	21	93.00	2.14	1.09	0.049
7	knife	nYf	76	2.88	8	191.38	2.45	1.17	0.128
7	cheers	Clr	8	1.90	27	87.22	2.13	0.89	0.032
7	skunk	sk^Gk	1	1.00	5	2.00	1.16	0.87	0.148
7	peg	pEg	4	1.60	10	17.00	1.86	0.86	0.079
7	fleet	flit	17	2.23	16	27.25	1.55	1.44	0.083
7	gown	gWn	16	2.20	8	187.25	2.48	0.89	0.100
7	hint	hInt	9	1.95	10	15.70	1.66	1.18	0.105
7	row	ro	36	2.56	38	196.08	2.25	1.14	0.029
7	bay	be	63	2.80	35	570.31	2.36	1.19	0.033
7	task	t@sk	60	2.78	9	17.67	1.53	1.81	0.168
7	sheep	Sip	23	2.36	20	180.15	2.18	1.08	0.051
7	brow	brW	6	1.78	7	26.57	1.45	1.23	0.149
7	shock	Sak	31	2.49	21	20.38	1.77	1.40	0.063
7	brat	br@t	1	1.00	11	35.91	1.79	0.56	0.048
7	yell	yEl	9	1.95	19	115.16	2.25	0.87	0.044
7	thorns	Torn	3	1.48	9	27.89	1.96	0.75	0.077
7	cards	kard	26	2.42	15	40.40	1.85	1.31	0.080
7	track	tr@k	38	2.58	10	14.90	1.90	1.36	0.120
7	gum	g^m	14	2.15	16	161.31	1.93	1.11	0.065
7	net	nEt	34	2.53	26	290.96	2.41	1.05	0.039
7	blade	bled	13	2.11	9	27.44	1.79	1.18	0.116
7	bruise	bruz	3	1.48	10	6.50	1.60	0.92	0.084
7	grease	gris	9	1.95	14	26.50	1.91	1.02	0.068
7	chunks	C^Gk	2	1.30	10	7.20	1.65	0.79	0.073
		Mean:	20.96	2.07	15.36	95.45	1.92	1.09	0.081
		<i>SD:</i>	<i>20.62</i>	<i>0.53</i>	<i>8.70</i>	<i>127.23</i>	<i>0.34</i>	<i>0.26</i>	<i>0.039</i>

List	Final word	Transcription	Frequency	Log Freq	N Density	Mean Freq N	Mean Log Freq N	N Ratio 1	N Ratio 2
8	grain	gren	27	2.43	20	67.25	2.24	1.08	0.051
8	vest	vEst	4	1.60	19	58.16	2.12	0.75	0.038
8	belt	bElT	29	2.46	17	56.59	2.02	1.22	0.067
8	tub	t^b	13	2.11	17	14.00	1.67	1.26	0.069
8	sap	s@p	1	1.00	27	14.96	1.76	0.57	0.021
8	mouse	mW's	10	2.00	14	79.43	1.93	1.04	0.069
8	spool	spul	1	1.00	9	71.33	1.91	0.52	0.055
8	plea	pli	11	2.04	17	46.00	1.81	1.13	0.062
8	fur	fR	15	2.18	18	203.28	1.78	1.22	0.064
8	lid	lld	19	2.28	23	78.91	2.06	1.11	0.046
8	notch	naC	6	1.78	7	664.43	1.96	0.91	0.115
8	jar	Jar	16	2.20	16	345.13	2.04	1.08	0.063
8	aim	em	37	2.57	21	127.38	2.41	1.07	0.048
8	fudge	f^J	1	1.00	6	22.17	1.90	0.53	0.081
8	chip	Clp	17	2.23	24	11.25	1.69	1.32	0.052
8	juice	Jus	11	2.04	13	17.31	1.68	1.22	0.086
8	mice	mY's	10	2.00	22	128.00	2.24	0.89	0.039
8	mold	mold	45	2.65	18	88.94	2.10	1.27	0.066
8	breath	brET	53	2.72	3	17.33	1.98	1.37	0.314
8	slave	slev	30	2.48	9	10.00	1.46	1.70	0.159
8	stamp	st@mp	8	1.90	4	1.25	1.08	1.77	0.307
8	cork	kork	9	1.95	11	84.91	2.24	0.87	0.074
8	strips	strIp	30	2.48	6	18.00	1.68	1.47	0.197
8	junk	J^Gk	8	1.90	9	5.78	1.53	1.25	0.122
8	raft	r@ft	4	1.60	14	5.57	1.38	1.16	0.077
		Mean:	16.60	2.02	14.56	89.49	1.87	1.11	0.094
		<i>SD:</i>	<i>14.00</i>	<i>0.49</i>	<i>6.65</i>	<i>141.77</i>	<i>0.31</i>	<i>0.32</i>	<i>0.076</i>