— METHODS & DESIGNS —

Visual-word recognition thresholds for screen-fragmented names of the Snodgrass and Vanderwart pictures

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The set of names corresponding to the pictures from Snodgrass and Vanderwart (1980) were screen fragmented by means of a series of procedures implemented in Microsoft QuickBasic on a Macintosh microcomputer. Words were screen fragmented by deleting blocks of pixels from their images rather than by deleting individual letters. The screen-fragmentation procedure is particularly useful for the present set of words, in which a large proportion of the names of the pictures are short (fewer than five letters). The screen-fragmentation procedure can produce any number of fragmentation levels. In the present implementation, eight levels of fragmented images were produced, to correspond to the eight levels available for the Snodgrass and Vanderwart pictures.

In recent years, interest in perceptual identification tasks such as word-fragment completion has increased dramatically, largely because such tasks are sensitive to influences of prior exposure even in cases in which conscious memory of this prior exposure is missing, as in amnesia. The type of memory assessed by a performance not requiring explicit interrogation of prior experience has been termed implicit memory by Graf and Schacter (1985), to distinguish it from the explicit memory required by recognition and recall.

A popular method of testing implicit memory is the use of the fragment-completion test. In the typical use of this test, subjects are presented with the complete stimulus during training and asked to process it in some way. Then, during test, the subject is presented with a fragmented version of the same stimulus and asked to complete or identify it. Implicit learning occurs when subjects show greater success in identifying the previously presented (old) stimulus as opposed to a new stimulus.

Many experimental questions in implicit memory concern the degree to which one form of a concept (e.g., a picture) primes the opposite form (e.g., a word). For example, Weldon and Roediger (1987) showed that expos-

ing subjects to pictures at study produced more priming in a picture-fragment completion test than in a word-fragment completion test. Furthermore, in apparent contradiction to the picture-superiority effect in memory, exposing subjects to words at study produced more priming in a word-fragment completion test than in a picture-fragment completion test. In contrast, Hirshman, Snodgrass, Mindes, and Feenan (1990) found that studying words (whether by reading them or by generating them to a sentence frame) produced equal priming of both words and pictures in a completion test. Although controversy about the relative contributions of data-driven as opposed to conceptually driven processing still rages in the literature (see Masson & Freedman, 1990; Toth & Hunt, 1990), the important point here is that there are good reasons for wanting comparable versions of completion tests for picture and word forms.

The manner in which stimuli are rendered incomplete varies widely. When words are used, they may be fragmented (Warrington & Weiskrantz, 1968), presented with only a stem (Graf & Mandler, 1984), presented tachistoscopically (Jacoby & Dallas, 1981), masked (Marcel, 1983), or presented with a few selected letters having a unique solution (Tulving, Schacter, & Stark, 1982).

In the present paper, we present a methodology for fragmenting words that is similar to that described by us previously for pictures (Snodgrass, Smith, Feenan, & Corwin, 1987). In this procedure, words or pictures are fragmented by deleting fairly large blocks of pixels from the image. This procedure produces pictures that are similar to Gollin's (1960) fragmented pictures and words that are similar to those used by Warrington and Weiskrantz (1968).

This research was supported by Research Grant AFOSR 89-0442 from the Air Force Office of Scientific Research to the first author. A number of people encouraged us to undertake this study. We thank June Corwin, Pamela Dalton, Kelly Feenan, Chun Luo, and Janet Mindes for their encouragement and advice throughout. Correspondence concerning this article should be addressed to Joan Gay Snodgrass, Department of Psychology, New York University, 6 Washington Place, Room 857, New York, NY 10003 (e-mail: gay@xp.psych.nyu.edu).

This procedure, which we call screen fragmentation, can be contrasted with the usual procedure of fragmenting words in which individual letters are deleted. The letter-deletion method will be called graphemic fragmentation to emphasize the fact that it uses a principled feature of words—graphemes—as the basis of fragmentation. The disadvantage of graphemic fragmentation is that if the investigator wishes to vary the difficulty of completion by varying the number of letters presented, only fairly long words can be used. For example, for eight levels of difficulty, words would need to be at least eight letters long. Of the 250 Snodgrass and Vanderwart (1980) pictures whose names were used in this study, 78% have names with fewer than eight letters and 33% have names with fewer than five letters. Accordingly, this study was undertaken to generate fragmented words by using the same general procedures that were used for the pictures, and to collect word-recognition thresholds for the resulting series of fragmented images.

Vokey, Baker, Hayman, and Jacoby (1986) described two procedures for degrading images on the Apple II microcomputer which are also applicable to both words and pictures. They called these mask clarification and dot clarification. In mask clarification, the image is overlaid with a random noise mask that slowly disappears, revealing the image below. The dot clarification procedure is similar to the present procedure. In dot clarification, a random proportion of black pixels is added to the image at each step of the clarification. The major difference between their dot clarification procedure and our procedure is in the unit size, or grain. In Vokey et al.'s dot clarification procedure, a single (black) pixel is the unit, whereas in our procedure a block of pixels (either 8×8 for words or 16×16 for pictures) is the unit of clarification. In our experience, using a single pixel as the unit of clarification produces images in which the transition from nonidentification to perfect identification is too abrupt.

Snodgrass and Corwin (1988) reported identification thresholds for individual pictures along with the actual fragmented pictures identified at the 35th percentile for pictures fragmented with this technique. The present paper is intended to provide comparable information for the names corresponding to the set of Snodgrass and Vanderwart pictures. In addition, we examined the effects of three variables that in the literature have accounted for some of the variance in word-recognition performance. These are word frequency as measured by Kučera-Francis (1967) word counts, word length, and neighborhood size as defined by Coltheart, Davelaar, Jonasson, and Besner (1977).

METHOD

Subjects

Forty-three subjects (19 males) enrolled in an introductory psychology course at New York University served as the subjects. They received course credit for their participation in the study. The data from 3 of the subjects

were discarded because they had performed significantly more poorly than the rest, leaving a total of 40 subjects, 20 per set.

Apparatus and Materials

All subjects were tested individually on a Macintosh Plus microcomputer. Of the 260 original pictures from the Snodgrass and Vanderwart set, 250 served as experimental stimuli to provide the names of the pictures. Of the 250 picture names, 16 were two-word phrases that were presented as single words (e.g., *ironingboard*, *fryingpan*, *baseballbat*). The set of 250 experimental stimuli were divided into two sets of 125 by assigning odd-numbered stimuli to one set and even-numbered stimuli to the second. Half of the subjects saw Set 1 and the other half saw Set 2. Three words selected from the alternative set served as practice stimuli and were presented in a constant order for all subjects seeing that set. For Set 1, the three practice stimuli from Set 2 were *babycarriage*, *dog*, and *ruler*. For Set 2, the three practice stimuli from Set 1 were *alligator*, *fryingpan*, and *sun*. The experimental stimuli were presented in a random order that was different for each subject. Words varied in length from 3 to 12 letters, and all two-word phrases were presented without spaces.

Prior to the experiment proper, the words were fragmented and stored as images in the PICT format. The procedure for fragmentation was as follows. First, the word was printed on the screen. Next, the area containing the word was divided into square blocks of pixels, and the blocks that contained information (i.e., black pixels) were identified. Finally, eight levels of fragmented image were created by randomly deleting an increasing number of pixel blocks from the complete image. These eight images were stored so that they could be used in the experiment proper in an ascending method of limits presentation.

The specific details of the fragmentation procedure were as follows. The word was printed in uppercase Basel typeface in 28-point size centered within a 246×246 pixel window. No word was longer than 12 letters, and all words fit within the window. Although the original intent was to fragment the words by using the same procedure as that for the pictures, we found that two modifications had to be made. First, whereas the pictures were fragmented by selecting a 16×16 pixel square as the unit of deletion, the words were fragmented by using an 8×8 pixel square as the unit of deletion because the words were more compact in size (they were 22 pixels high and ranged from 49 to 245 pixels long). Because of the compact nature of words, the maximum number of blocks that could contain information was 120. Across the set of 250 words, the actual number varied from 26 to 118 ($M = 60$).

The second modification concerned the rate at which blocks were added as the level of completion increased from Level 1 to Level 8. The function for pictures was exponential, such that the proportion of pixel blocks shown at each level followed the function $P = 0.7^{(8-\text{level})}$.

This function was selected in order to expand the rate of completion at the low end. For words, the same exponential function was used, but the value of 0.7 was replaced by 0.85. This meant that a larger percentage of pixel blocks was shown at Level 1 for words than for pictures (32% vs. 8%), and the rate at which pixel blocks were added was higher for words than for pictures. So, for example, 52% of pixel blocks were shown for words by Level 4 compared to only 24% for pictures. Figure 1 shows three examples of words fragmented at the eight levels. There are two software programs associated with this project. The first program fragments the stimuli and the second program runs the experiment.

Procedure

When subjects arrived, they were given a brief description of the experiment and then were asked to sign a con-

sent form. Instructions displayed on the screen of the computer informed them that they would be shown fragmented words and that their task was to identify them as soon in the sequence of presentations as possible. They were informed that the words were names of common objects and animals. They were instructed that the first presentation of the word would be most fragmented, and that they were to try to identify it. If they could not, they were to press the return key to go on to the more complete version. They were also instructed to type the word in lowercase even though the word was presented in uppercase.

The word was presented at Level 1 first, and was gradually completed until the subject correctly typed the word. The subject's threshold for each word was defined as the level of fragmentation at which correct identification occurred. Words had to be typed absolutely correctly for the program to accept the response as correct. If the word

Figure 1. Examples of three fragmented words. Level 1 (the most fragmented stimulus) is shown at the top, and Level 8 (the complete stimulus) is shown at the bottom.

Table 1
Distribution of Thresholds of Rescored Trials Compared to All Trials

	Threshold									
	L1	L2	L3	L4	L5	L6	L7	L8	L9	N
Rescored (%)	0.0	4.5	6.7	16.4	25.4	16.4	17.9	9.0	3.7	134
All (%)	12.4	11.3	16.4	18.8	18.1	14.6	7.2	0.9	0.3	5,000

Note—L = level. N = number of trials. Threshold can vary from L1 (identified at most fragmented level) to L9 (never identified even when shown at the most complete or L8 level).

had not been identified by Level 8, the response was scored as having a threshold of 9. Subjects' responses prior to the correct response were stored and examined after the experiment. A response scored as incorrect was rescored as correct if, in the judgment of both experimenters, the response indicated that the word had been correctly identified. Responses rescored as correct included some misspellings, capitalizations, punctuation errors, and extra spaces or nonletter characters. In particular, misspellings that when pronounced were judged identical to the pronunciation of the correct spelling were accepted as correct.

A total of 134 of the 5,000 trials (2.7%) were rescored in this fashion. If our rescoring procedure was correct in its assumption that the rescored responses really represented correct perceptions rather than misperceptions, the level at which the rescored response first occurred should be representative of overall thresholds. Table 1 shows the original thresholds of the rescored responses in comparison with the overall distribution of correct responses. As can be seen, rescored responses are representative in their distribution of the overall distribution of correct responses except at the extremes. No rescored response could have occurred at Level 1, and a number of responses originally scored as having thresholds of 9 (that is, the subject never typed the correct response) were rescored as lower. Even after rescoring, there were still a few (16 of 5,000) thresholds of 9. These were scored as thresholds of 8 when computing individual-item thresholds.

The task took most subjects 45–60 min to complete. When they had completed the experiment, they received a written debriefing statement and any questions about the experiment were answered.

RESULTS AND DISCUSSION

Mean thresholds for the two sets of words were not significantly different (3.95 and 4.00, respectively). The thresholds for individual words are shown in Appendix A. There was a large variation in thresholds for individual words, from a low of 1.20 for *apple* to a high of 7.05 for *harp*. This range was somewhat larger than for the 150 pictures studied by Snodgrass and Corwin (1988), which ranged from 2.80 to 7.20. One likely difference is that the pictures were fragmented repeatedly until they were judged to conform to a pattern of moderate difficulty. In contrast, in this experiment the first word fragmenta-

tion generated by the program was used as the fragmentation presented to the subjects, and so idiosyncrasies in the ease or difficulty of a particular series were retained.

Because many experiments employ only a single level of fragmented word to use as a test stimulus, we identified the level of fragmentation for each word by which 35% of the subjects had identified it. This is based on a total of 20 subjects, the same as the number of subjects who provided the comparable data for the pictures (see Snodgrass & Corwin, 1988). The level of fragmentation corresponding to the 35th percentile is also shown in Appendix A and the 35th percentile word fragments are shown in Appendix B. Not surprisingly, 35th percentiles correlated highly with thresholds, $r = .939$.

What Variables Affect Fragmented Word Identification?

Next we turn to the question: what variables affect fragmented word identification? As is apparent from Appendix A, there are large differences among items in difficulty of identification. Here we consider some variables that previous investigators have shown to affect word-recognition thresholds. We consider three variables here: frequency in print, word length, and neighborhood size. Before turning to these data, however, we want to emphasize that this study was not designed to investigate these variables per se; had we wished to do so, we would have selected words that varied orthogonally on each of these three dimensions. Our primary purpose was to obtain normative threshold data on this particular set of words, and so results from these additional analyses should be viewed with caution.

In order to simplify the interpretation of correlation coefficients, thresholds were reflected so that higher values would indicate better performance. Thus we expected positive correlations between reflected thresholds and both frequency and neighborhood size, and a negative correlation between reflected thresholds and length. Before computing these correlations, we first eliminated the 16 two-word phrases. Not surprisingly, the phrases had higher thresholds than regular words. The average threshold across the 16 phrases was 5.16. Phrases ranged from 8 to 12 letters in length. When mean thresholds were computed for the 39 single words of that length, the mean threshold was 4.09. The difference in thresholds between phrases and single words matched on length was highly significant by a t test [$t(53) = 4.45, p < .001$]. Because we expected that the inclusion of these two-word phrases

would distort any real effects of frequency, length, and neighborhood size on recognition thresholds, the phrases were excluded from the following analyses.

Frequency in Print

Word frequency has been shown to have powerful effects in a variety of word-recognition paradigms (see, e.g., Besner & McCann, 1987; Howes & Solomon, 1951). Frequency in print counts were obtained from Kučera and Francis (1967). Frequency ranged from 0 (i.e., the word did not appear in the counts at all) to 431 (for *hand*). Excluding the 16 phrases left a total of 234 words. The correlation (Pearson r) between $\log(\text{frequency} + 1)$ and reflected threshold was not significant ($r = .074$, $df = 232$).

Length

McGinnies, Comer, and Lacy (1952) found that word length had a retarding influence on word identification in an ascending methods of limits procedure, but only for low-frequency words. Eichelman (1970) found that word length increased same/different RTs when items were presented simultaneously, while Johnson (1977) found no effect of length in a memory-probe task. We found no relationship between word length and threshold for the 234 single words in this study ($r = -.064$). To determine whether length had a greater effect for low-frequency words, the correlations were repeated for words with Kučera-Francis counts below 13 and those 13 and above (which was approximately the median split for the 234 words). Neither correlation was significant; for low-frequency words, $r = -.122$, $df = 112$; for high-frequency words, $r = .050$, $df = 118$.

Neighborhood Size

Coltheart et al. (1977) proposed a simple measure of the size of a word's graphemic neighborhood. In their definition, the N of a letter string is the number of different English words that can be produced by changing just one of the letters in the string to another letter, preserving letter positions. So, for example, *football* has one neighbor, *footfall*. Coltheart et al. found that neighborhood size inhibited classification of nonwords in lexical decision, as measured by reaction times, but had no effect on words. Andrews (1989), however, found that neighborhood size facilitated both lexical decision and word-naming latencies, but only for low-frequency words and not for high-frequency words. In contrast, Grainger, O'Regan, Jacobs, and Segui (1989) found that words with large neighborhoods were responded to more slowly in a lexical decision task, as long as the neighbors were of higher frequency than the target word.

We measured neighborhood size with the Franklin Computer Spelling Ace, which contains in its lexicon more than 88,000 words (including proper names and abbreviations). Words can be entered with the wild card character "?" and all words in the lexicon with letters in that position will be recovered. Neighborhood size was

used as a predictor variable only for words between three and seven letters in length (195 of the 250 words). Very few eight-letter and longer words had any neighbors at all. For example, of the 17 eight-letter words in the sample, only 3 had neighbors, and these had only one neighbor.

Values of neighborhood size (N) for each word are also shown in Appendix A, and range from a high of 27 (for *cat*) to 0. The correlation (Pearson r) between neighborhood size and reflected threshold for the 195 words of seven letters or fewer was not significant ($r = .11$). To determine whether, in line with Andrews's results, there might be a larger correlation between neighborhood size and threshold for low-frequency than for high-frequency words, the set of 195 words was divided at the median by frequency and the correlation calculated between N and reflected threshold for low- and high-frequency words separately. Neither correlation was significant; for low-frequency words ($K-F \leq 15$), $r = .08$, $df = 97$, whereas for high-frequency words ($K-F > 15$), $r = .12$, $df = 96$. In summary, none of the three variables considered accounted for a significant amount of variance in the threshold values.

Availability

A program to fragment any word, and a program to present the fragmented words from this study in a variety of study/test formats, is available from the first author, along with a HyperCard stack containing the 35th percentiles of the words. These programs work only with the Apple Macintosh microcomputer, and the user must have a copy of Microsoft QuickBasic in order to run the fragmentation program. The programs and HyperCard stack may be obtained from the first author for \$5 to cover handling costs.

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APPENDIX A

ID Numbers, Names, Thresholds, 35th Percentiles, Kučera-Francis (1967) Frequencies (K-F), and Neighborhood Scores (N) for the 250 Names of Pictures from the Present Study

ID No.	Name	Threshold	35th p	K-F	N
1	accordion	3.90	3	1	-
2	airplane	3.90	3	11	-
3	alligator	3.40	2	4	-
5	ant	3.45	3	6	9
6	apple	1.20	1	9	2
7	arm	4.25	4	94	7
8	arrow	2.90	3	14	0
9	artichoke	3.20	2	0	-
10	ashtray	4.00	3	0	0
11	asparagus	2.90	3	1	-
12	axe	5.05	5	12	9
13	babycarriage	4.35	4	-	-
14	ball	5.25	5	110	18
15	balloon	3.90	4	10	0
16	banana	3.00	2	4	0
17	barn	3.05	3	29	12
18	barrel	3.50	3	24	3
19	baseballbat	4.55	4	-	-
20	basket	3.15	2	17	4
21	bear	3.60	3	57	19
22	bed	2.85	3	127	16
23	bee	6.20	7	11	13
24	beetle	5.40	5	0	0
25	bell	6.35	6	18	14
26	belt	5.30	5	29	11
27	bicycle	2.75	2	5	0
28	bird	4.70	5	31	3
29	blouse	4.85	5	1	0
30	book	2.90	3	193	12
31	boot	5.05	5	13	17
32	bottle	4.95	5	76	2
33	bow	4.90	5	15	19

APPENDIX A (Continued)

ID No.	Name	Threshold	35th p	K-F	N
34	bowl	2.05	2	23	9
35	box	2.85	2	70	11
36	bread	5.60	5	41	5
37	broom	4.00	4	2	4
38	brush	4.30	4	44	3
39	bus	4.85	5	34	9
40	butterfly	4.20	3	2	-
42	cake	2.25	1	13	18
43	camel	5.25	6	1	1
44	candle	3.05	3	18	3
46	cap	1.95	1	27	22
47	car	3.95	3	274	21
48	carrot	4.80	4	1	1
49	cat	1.75	1	23	27
50	caterpillar	2.95	2	1	-
51	celery	3.85	3	4	0
52	chain	5.15	5	50	1
53	chair	3.55	3	66	2
54	cherry	5.70	5	6	3
55	chicken	5.20	5	37	1
56	chisel	5.30	5	4	0
57	church	5.05	5	348	0
58	cigar	4.55	4	10	0
59	cigarette	3.85	4	25	-
60	clock	3.45	3	20	8
61	clothespin	4.00	3	0	-
62	cloud	5.05	4	28	2
63	clown	3.80	4	3	3
64	coat	1.95	1	43	9
65	comb	3.95	4	6	5
66	corn	2.80	2	34	12
67	couch	3.85	4	12	6
68	cow	3.75	3	29	22
69	crown	1.55	1	19	8
70	cup	2.10	1	45	10
71	deer	4.90	4	13	11
72	desk	4.30	4	65	3
73	dog	4.00	2	75	13
74	doll	4.60	5	10	11
75	donkey	4.05	4	1	1
76	door	5.15	4	312	6
77	doorknob	4.25	4	3	-
78	dress	5.15	5	67	5
79	dresser	5.00	4	1	3
80	drum	2.25	1	11	3
81	duck	1.80	1	9	12
82	eagle	6.25	6	5	0
83	ear	4.50	3	29	12
84	elephant	3.75	2	7	-
85	envelope	2.80	3	21	-
86	eye	6.45	6	122	10
87	fence	2.25	1	30	2
88	finger	2.95	2	40	5
89	fish	4.80	5	35	3
90	flag	2.75	3	16	9
91	flower	5.10	5	23	5
92	flute	4.10	4	1	2
93	fly	2.75	2	33	7
94	foot	4.50	4	70	12
95	football	3.15	3	36	-
97	fork	5.55	6	14	8

APPENDIX A (Continued)

ID No.	Name	Threshold	35th p	K-F	N
98	fox	2.85	2	13	10
99	frenchhorn	4.65	4	-	-
100	frog	2.20	2	1	3
101	fryingpan	6.35	6	-	-
102	garbagecan	5.40	4	-	-
103	giraffe	4.05	4	0	0
104	glass	5.65	5	99	5
105	glasses	4.40	4	29	4
106	glove	3.90	3	9	3
107	goat	3.70	4	6	7
108	gorilla	4.70	4	0	0
109	grapes	1.95	1	7	10
110	grasshopper	4.55	4	0	-
111	guitar	4.60	5	19	0
112	gun	3.45	4	118	15
113	hair	3.50	2	148	5
114	hammer	1.75	1	9	7
115	hand	2.70	3	431	9
116	hanger	4.45	4	0	8
117	harp	7.05	7	1	8
118	hat	4.95	5	56	22
119	heart	3.20	3	173	2
120	helicopter	4.90	5	1	-
121	horse	3.65	4	117	4
122	house	5.95	6	591	6
123	iron	3.60	2	43	2
124	ironingboard	4.50	4	-	-
125	jacket	2.30	1	33	3
126	kangaroo	3.40	3	0	-
127	kettle	3.85	4	3	4
128	key	2.75	1	88	6
129	kite	3.75	4	1	7
130	knife	3.80	4	76	0
131	ladder	4.50	4	19	4
132	lamp	4.35	4	18	12
133	leaf	2.55	2	12	7
134	leg	5.35	5	58	14
135	lemon	1.60	1	18	1
136	leopard	6.55	7	0	1
137	lettuce	3.40	3	0	0
138	lightbulb	4.85	4	-	-
139	lightswitch	6.60	7	-	-
140	lion	2.55	2	17	4
141	lips	4.50	4	69	13
142	lobster	5.00	5	1	1
143	lock	5.60	5	23	14
144	mitten	6.05	6	0	2
145	monkey	5.00	5	9	1
146	moon	2.35	1	60	11
147	motorcycle	3.25	3	0	-
148	mountain	3.50	3	33	-
149	mouse	4.45	4	10	7
150	mushroom	3.00	2	2	-
151	nail	4.10	4	6	10
152	nailfile	5.65	5	-	-
153	necklace	3.95	3	3	-
154	needle	3.55	3	15	0
155	nose	3.60	2	60	11
156	nut	3.30	3	15	13
157	onion	4.85	4	15	3
158	orange	5.00	5	23	2

APPENDIX A (Continued)

ID No.	Name	Threshold	35th p	K-F	N
159	ostrich	4.30	4	0	0
160	owl	4.25	5	2	4
161	paintbrush	4.90	4	1	-
162	pants	4.25	4	9	10
163	peach	2.05	1	3	7
164	peacock	3.60	3	2	0
165	peanut	3.90	3	6	0
166	pear	3.75	3	6	16
167	pen	3.05	2	18	20
168	pencil	1.95	1	34	0
169	penguin	2.60	3	0	0
170	pepper	3.10	2	13	3
171	piano	2.25	1	38	0
172	pig	1.85	2	8	15
173	pineapple	2.85	2	9	-
174	pipe	2.40	1	20	7
175	pitcher	3.85	3	21	2
176	pliers	6.25	6	1	2
177	plug	3.90	4	23	3
178	pocketbook	5.20	5	3	-
179	pot	2.80	2	28	21
180	potato	3.15	3	15	0
181	pumpkin	3.00	3	2	1
182	rabbit	3.90	4	11	2
183	raccoon	3.35	3	1	0
184	recordplayer	5.90	6	-	-
185	refrigerator	2.60	2	23	-
186	rhinoceros	5.50	5	3	-
187	ring	1.85	1	47	10
188	rockingchair	4.55	4	-	-
189	rollerskate	3.75	3	-	-
190	rollingpin	5.75	5	-	-
191	rooster	2.55	2	3	4
192	ruler	3.50	3	3	4
193	sailboat	5.70	6	1	-
194	saltshaker	5.80	6	0	-
195	sandwich	2.55	1	10	-
196	saw	3.55	3	352	19
197	scissors	4.25	4	1	-
198	screw	3.30	2	21	2
199	screwdriver	5.95	5	0	-
200	seahorse	5.15	5	-	-
201	seal	4.20	4	17	15
202	sheep	4.65	4	23	7
203	shirt	4.00	4	27	6
204	shoe	3.70	3	14	6
205	skirt	6.30	6	21	1
206	skunk	4.80	4	0	4
207	sled	5.70	6	0	9
208	snail	2.30	1	1	1
209	snake	3.30	3	44	5
210	snowman	3.60	3	0	0
211	sock	3.00	2	4	12
212	spider	6.15	6	2	2
214	thread	4.50	4	0	5
215	spoon	3.35	3	6	8
216	squirrel	3.70	3	1	-
217	star	3.70	3	25	3
218	stool	3.30	3	8	7
219	stove	5.20	5	15	16
220	strawberry	4.15	4	0	-

APPENDIX A (Continued)

ID No.	Name	Threshold	35th p	K-F	N
221	suitcase	3.05	3	20	-
222	sun	2.55	2	112	9
223	swan	5.15	5	3	4
224	sweater	3.20	2	14	7
225	swing	4.05	4	24	4
226	table	4.30	4	198	0
227	telephone	3.35	3	76	-
228	television	4.10	4	50	-
229	tennisracket	3.50	2	-	-
230	thimble	5.35	6	1	1
231	thumb	3.10	3	10	1
232	tie	6.60	7	23	15
233	tiger	1.95	1	7	3
234	toaster	4.00	4	0	3
235	toe	3.75	2	9	18
236	tomato	3.50	3	4	0
237	toothbrush	5.00	5	6	-
238	top	3.45	3	204	17
240	train	3.40	3	82	6
241	tree	3.45	3	59	5
242	truck	4.75	5	57	4
243	trumpet	2.40	1	7	2
245	umbrella	5.10	5	8	-
246	vase	2.15	2	4	9
247	vest	2.40	2	4	11
248	violin	3.75	3	11	0
249	wagon	3.85	4	55	0
250	watch	4.45	3	81	7
251	wateringcan	5.20	5	-	-
252	watermelon	2.85	2	1	-
254	wheel	5.80	6	56	1
255	whistle	4.15	4	4	2
257	window	4.55	4	119	1
258	wineglass	4.90	4	0	-
259	wrench	3.25	3	0	4
<i>M</i>		3.98	3.52	34.82	6.32
<i>Min</i>		1.20	1	0	0
<i>Max</i>		7.05	7	591	27
<i>SD</i>		1.19	1.46	69.26	5.90

Note—The ID No. is the identifying number of the picture named by the word from Snodgrass and Vanderwart (1980). The threshold is the average level of fragmentation required for correct identification. The 35th percentile (p) is the level of fragmentation by which 35% of the norming sample identified the word. The neighborhood score (N) is the number of different words that can be formed from the word by changing one letter. The name of one picture (ID 214) was changed from *spool of thread* to *thread*.

APPENDIX B

The 250 Picture Names, at the Level of Fragmentation Identified by 35% (7 of 20) of the Normative Sample.
(The Words are Arranged in Alphabetical Order by Rows)

ACCORDION	ALPHABET	ALLIGATOR	ANT	APPLE
ARM	ARROW	ARMCHOR	ASHTREE	ASTROLOGUS
AXE	BALLOON	BALL	BALLOON	BANANA
BARK	BARKER	BASKETBALL	BASKET	BEAR
BED	BEE	BELT	BELL	BENT
BICYCLE	BIRD	BLOUSE	BOOK	BOOK
BOTTLE	BOW	BOWL	BOX	BREAD
BUCKLE	BUSH	BUS	BUTTERFLY	CAGE
CAMEL	CANDLE	CAP	CAT	CATERPILLAR
CAR	CARTRIDGE	CELESTIAL	CHAIN	CHAIR

APPENDIX B (Continued)

CHEERY	CHEWEN	CHEEL	CHURCH	CHALK
CHICAPATE	CHUCK	CHOOTIES PL	CLOD	CLOWN
CLAY	COFF	COOKS	COUCH	COW
CROWN	COH	COHER	LESS	COG
GOLD	DONKEY	DOOR	DOCKNOB	DRESS
DRESSER	DUM	DUCK	EAGLE	EAR
ELEPHANT	ENVELOPE	ETE	FEED	FLICKER
FISH	FLAK	FLOWER	FLUTE	FLA
FLOYD	FOOTBALL	FORK	FOE	FRONCHHOPI
FRANK	FRIZINGPAN	GATEAGPCAN	GIRLFFS	GLASS

APPENDIX B (Continued)

GLASSES	GLOVE	GOAT	GORILLA	GRAPES
GRASSHOPPER	GUITAR	GUN	HAIR	HAMMER
HAND	HANDSAW	HARP	HAT	HEART
HELICOPTER	HORSE	HOUSE	IRON	IRONBOARDS
JACK	KANGAROO	KETTLE	KEY	KITE
KNIFE	LADDER	LAMP	LEAF	LENG
LEMUR	LEOPARD	LEUCIS	LIGHTBULB	LIGHTSWITCH
LION	LIPS	LIPSIER	LOCK	MILK
MONEY	MOON	MOTORBOAT	MOUNTAIN	MOUTH
MUSTARD	NAIL	NAUTICAL	NECKTIE	NEEDLE
NOSE	NUT	ONION	ORANGE	OSTRICH

APPENDIX B (Continued)

SQUIRREL	SLAP	STOOL	STOVE	STRAWBERRY
SUITCASE	SWIM	SWAN	SWITCH	SWING
TABLE	TELEPHONE	TELEVISION	TELETYPE	TEMBLE
TRUMP	TIE	TIGER	TOASTER	TOP
TOMATO	TOOTHBRUSH	TOY	TRAIN	TREE
TRUCK	TRUMPET	UMBRELLA	VAC	YES
VIOLIN	WAGON	WAGON	WATERINGCAN	WATERMELON
WHEEL	WHISKEY	WINDOW	WINDGLASS	WREATH

(Manuscript received April 15, 1991;
revision accepted for publication July 10, 1991.)