

University of Alberta norms of relative meaning frequency for 566 homographs

LESLIE C. TWILLEY, PETER DIXON, DEAN TAYLOR, and KAREN CLARK
University of Alberta, Edmonton, Alberta, Canada

For many models of lexical ambiguity resolution, relative frequency of the different meanings of homographs (words with more than one meaning) is crucial. Although several homograph association norms have been published in the past, none has involved a large number of subjects responding to a large number of homographs, and most homograph norming studies are now at least a decade old. In Experiment 1, associations to 566 homographs were collected from an average of 192 subjects per homograph. Frequency of occurrence for the three most common meanings is reported, along with the corresponding associates, and a measure of the overall ambiguity of each homograph. Homographs whose meanings differed in part of speech were more ambiguous overall than homographs whose different meanings belonged to a single grammatical class. Homographs whose pronunciation depended on meaning (heterophones) were no more ambiguous than nonheterophones, and word frequency was unrelated to overall ambiguity. Estimates of homograph balance across different norming studies were compared, and homographs with two meanings of approximately equal relative meaning frequency (*balanced* homographs) and homographs with one clearly dominant meaning (*polarized* homographs) were identified. In Experiment 2, reliability of meaning categorizations was measured for a subset of the homographs in the first experiment. Meaning categorizations were shown to be highly reliable across raters.

Homographs are words that have more than one meaning but share the same orthography. They most often also share phonology (e.g., a dog's bark vs. a tree's bark; a fireplace poker vs. a poker game), but a few English homographs have distinct phonologies for their different meanings. For these *heterophonic* homographs, pronunciation depends on meaning; examples are "bass" (fish vs. guitar) and "wind" (gale vs. to coil). Contrary to intuition, homographs are not an obscure class of linguistic items. Rather, homographs could be considered important topics of study solely because of their *abundance* in English. Britton (1978) found that 44% of a random sample of English words had more than one meaning, and that 85% of a sample of high-frequency English words had more than one meaning. Several authors have argued that meaning indeterminacy in language and the environment in general is widespread and is one of the pervasive problems of human information processing (e.g., Simpson, 1989; Simpson & Burgess, 1988; Swinney, 1991; Yates, 1985).

There are other, more empirically driven reasons why cognitive scientists might wish to understand homograph

processing. The resolution of lexical ambiguity, including its time course and interaction with context, has been a critical issue in the modularity debate in discussions of lexical access (Neill & Klein, 1989; Prather & Swinney, 1988; Simpson, 1984; Simpson & Burgess, 1988; Swinney, 1991). A central question is whether the processes that access a word's meaning can be penetrated by the context in which the word appears. Homographs are a particularly attractive stimulus type to use because orthography and even phonology can be controlled, leaving only meaning to vary. This eradicates the influence of uncontrolled lexical variables that is possible with nonidentical target stimuli that are simply matched on characteristics such as word frequency, length, and number of syllables. Many researchers in this area have argued that the relative frequency of multiple meanings determines the course of lexical access (e.g., Carpenter & Daneman, 1981; Hogaboam & Perfetti, 1975; Neill, Hilliard, & Cooper, 1988; Rayner & Morris, 1991; Simpson, 1984; Simpson & Burgess, 1985).

Unfortunately, existing frequency norms for homograph meanings are unsatisfactory for many purposes. That is, many of the published norms of homograph meaning frequency have included data for only a small number of homographs, and others used too few subjects to ensure adequate reliability. As Table 1 shows, three of the studies used 50 or fewer homographs (Geis & Winograd, 1974; Kausler & Kollasch, 1970; Warren, Bresnick, & Green, 1972) and three used fewer than 100 subjects (Geis & Winograd, 1974; Gilhooly & Logie, 1980; Nelson, McEvoy, Walling, & Wheeler, 1980). In fact, none of the pub-

This research was funded by a Natural Sciences and Engineering Council of Canada (NSERC) operating grant to P. Dixon. L. C. Twilley was supported by an NSERC postgraduate scholarship. The authors would like to thank D. Nelson, T. Neill, and an anonymous reviewer for many helpful comments and suggestions. Requests for reprints should be sent to L. Twilley or P. Dixon, Department of Psychology, University of Alberta, Edmonton, Alberta, T6G 2E9 (e-mail: twilley@psych.ualberta.ca).

—Accepted by previous editor, Margaret Jean Intons-Peterson

Table 1
 Number of Homographs, Number of Responses per
 Homograph, and Percent Overlap and R^2 -squared
 With Our Data Set, for Nine Other Studies

Study	Homographs	Responses per Homograph	% Overlap	R^2
Cramer (1970)	100	109	99	.66
Kausler & Kollasch (1970)	40	200	100	.74
Perfetti et al. (1971)	109	108	92	.77
Warren et al. (1972)	20	100	75	.52
Geis & Winograd (1974)	50	68	100	.79
Gilhooly & Logie (1980)	387	40	34	.53
Nelson et al. (1980)	317	46	100	.85
Wollen et al. (1980)	120	108	99	.61
Gorfein et al. (1982)	96	100	86	.88

lished norms used both a large number of homographs and a large number of subjects. Cramer (1970), Gorfein, Viviani, and Leddo (1982), Perfetti, Lindsey, and Garson (1971), and Wollen, Cox, Coahran, Shea, and Kirby (1980) each used moderate numbers of both homographs and subjects. We think that our data will be invaluable to researchers who require quantification of homograph meaning frequencies that is both reliable and comprehensive; we report data for 566 homographs, each homograph having been responded to by an average of 192 subjects. It is also important to ensure the recency of any linguistic norms because linguistic usage may change in a relatively short period of time. This is the first published large-scale homograph meaning frequency norming study in the last decade. Furthermore, the size of our corpus of homographs permits investigation of an issue which has received little attention to date: reliability of estimates of homograph balance (*balanced* homographs have two relatively equally frequent meanings; *polarized* homographs have a primary meaning which is much more frequent than the next most common meaning). The continuum of homograph balance is theoretically meaningful, and is a design issue in some lexical ambiguity experiments (e.g., Duffy, Morris, & Rayner, 1988; Rayner & Frazier, 1989). Observed differences in processing between items varying in degree of balance are used to support arguments about how the language-processing system handles meaning indeterminacy. Several important studies have made critical theoretical arguments based on homograph balance effects. Until now, however, there have been little data addressing the issue of how variable such estimates are from one norming situation to another.

Two studies provide evidence that homograph-meaning frequencies are generally quite stable, and that homographs whose primary meaning has a high relative frequency are more stable than homographs with less frequent primary meanings. Gorfein et al. (1982) had subjects produce four associations for each of a list of homographs. Eighty-two percent of the subjects produced associations to the same meaning on the first and second associations; 66% produced associations to the same meaning all four times. The correlation between proba-

bility of producing the same meaning across four associations and primary meaning strength was .84. Geis and Winograd (1974) calculated test-retest reliabilities for single word associations to homographs. Associations to the same meaning on both trials occurred 83% of the time. The correlation between probability of responding with the same meaning on both trials and strength of primary meaning was .70 to .76 (after delays of 5 min and 48 h, respectively). The results of these two studies are less than conclusive, however, given the methodology used. Requiring multiple associations seems especially prone to strategic factors, lessening the value of such results as indicators of lexical variables. We address the issue of reliability by comparing relative meaning frequencies and balance estimates across 10 sets of independently collected norms from various regions.

We used single word associations to obtain meaning information for our set of homographs. Word association has been the method of choice for obtaining estimates of relative meaning frequencies in the lexicon (e.g., Cramer, 1970; Geis & Winograd, 1974; Gilhooly & Logie, 1980; Gorfein et al., 1982; Kausler & Kollasch, 1970; Nelson et al., 1980; Perfetti et al., 1971). It is assumed that associates to lexical items are produced in proportion to the strength of the related semantic features of the items—in the case of homographs, in proportion to the strength of the different meanings. This assumption is supported by findings showing that words related to semantic features of other words can be used as primes for those words, and that the amount of priming is related to the centrality of the feature, for both homographs (e.g., Kellas, Paul, Martin, & Simpson, 1991; Tabossi, Colombo, & Job, 1987) and nonhomographs (e.g., Barclay, Bransford, Franks, McCarrell, & Nitsch, 1974; Barsalou, 1982). Kausler and Kollasch (1970) found that the semantic word counts of Lorge and Thorndike (1938, cited in Kausler & Kollasch, 1970) predicted the dominant meanings of homographs in their word-association norming study approximately 75% of the time. Single word associations thus appear to be a valid method of obtaining estimates of actual meaning frequencies occurring in the linguistic environments of readers or speakers.

EXPERIMENT 1

Method

Subjects. The subjects were 458 undergraduates participating for course credit in a single large introductory psychology class at the University of Alberta in September 1991; the experiment was run during a regular class period. Seventy-four subjects reported a first language other than English; their data were not included in the analyses, leaving a total of 384 subjects.

Materials. Stimuli were culled from a number of sources. Most stimuli in the norms of Cramer (1970), Geis and Winograd (1974), Kausler and Kollasch (1970), Nelson et al. (1980), and Wollen et al. (1980) were included (excluded stimuli were different forms of homographs already in the sample; a few stimuli were also inadvertently omitted). Also included were homographs we generated for experiments on activation and suppression of homograph meanings (Twilley & Dixon, 1992). Substantial overlap resulted with other norming sets that came to our attention after creation of the homograph list. Overlap between our list of homographs and those in the other norming studies is expressed in Table 1 as the percentage of homographs from the other norms that were included in our sample. In our sample of homographs, 75.6% had at least one meaning for which the subjects' responses could be classified into more than one grammatical class (e.g., a sand desert vs. to desert someone, to bowl vs. to fill a bowl); such homographs fall under the heading of "syntactic category ambiguity" (Rayner & Morris, 1991). Heterophonic homographs comprised 5.7% of the sample. For our purposes, homographs were considered heterophonic if pronunciation depended on meaning, including a change in the pronunciation of one or more phonemes (e.g., /bæs/ vs. /bes/) and/or a change in stress pattern (e.g., /in' sens/ vs. /in sens'/) with meaning. Mean Kučera and Francis (1967) word frequency for the stimuli was 83.6 per million (median = 26.5, $SE = 7.5$).

There was insufficient time in the experimental session for subjects to respond to all 566 homographs. Instead, each subject responded to half of the items. Half of the items were randomly chosen and ordered for one subject, and the other 283 items were randomly ordered for the next subject. This procedure was repeated until stimuli were generated for 500 subjects. This resulted in the randomization across subjects of both choice and order of items. On average, 192 responses to each item were included in the analyses (384 subjects with English as a first language completed 283 responses each). Stimuli were presented on two sheets of paper of three columns each. Each homograph was followed by a blank line for the subject's response.

Procedure. The subjects were provided with written instructions, which were explained by one of the experimenters. They were asked to write down the first word they thought of as they read each homograph. They were told that any response was appropriate, as long as it was the first word that came to mind when they saw the stimulus word. Stimuli were to be completed in order (down the columns), and the subjects were asked not to go back and change any responses. The written instructions sheet covered the two stimulus sheets, so that the subjects had no advance viewing of the stimuli. No mention was made of the homographic nature of the items. Several experimenters walked around the room during instructions and completion of the task to ensure that the task was being carried out as directed. The task took 20–30 min to complete.

Scoring. Two raters scored the responses collaboratively. One category was created for each distinct meaning of the homograph that was used by the subjects; there was also an "Unclear" category. Unclear responses were of three types. Any response that was itself ambiguous, in that it could fit with more than one of the meanings for the homograph, was put into the Unclear category (i.e., "hand" in response to "second" could mean the second hand of a watch or it could mean a second-hand item). Responses that had no apparent association with the homograph were also categorized as Unclear. Finally, some Unclear responses involved an in-

correct association (such as responding "strawberries" to "desert," or "chicken" to "foul"). After the two raters had scored the responses, a third rater reviewed all of their decisions; any errors or nonobvious decisions were discussed with one of the two original raters, and changes were made if necessary.

Number of distinct meanings produced varied from 1 (for 28 of the stimuli) to 7 (for "set"), with a mean of 2.53 ($SE = .037$). Meanings were judged to be separate if they could be reliably distinguished from each other on the basis of one or more semantic features. Distinctiveness of meanings was easier to judge for some homographs than for others. Such words as "quack" or "cricket," for example, have meanings with virtually no semantic overlap; they were relatively easy to categorize. Such words as "advance" and "order," which have several meanings that are somewhat similar, were more difficult to categorize reliably. For some words (e.g., "light" or "dress"), closely related meanings were collapsed into a single category because subjects' responses were not separable with one consistent feature; rather, responses were compatible with different shades of a single meaning. Raters had the overall goal of distinguishing categories as consistently as possible while avoiding excessive assignment of responses to the Unclear category.

Following Britton (1978) and Perfetti et al. (1971), an information-theory measure of uncertainty (Atneave, 1959) was calculated for each homograph. This was calculated using the formula $U = -\sum_{i=1}^n p_i \log_2(1/p_i)$, where n is the number of distinct meanings for that homograph and p_i is the proportion of responses associated with meaning i . The Unclear category was excluded in calculating these proportions. U can be thought of as a measure of the overall ambiguity of a homograph: the larger the value of U , the more ambiguous the homograph. A two-meaning homograph whose responses all fell into one meaning would have a U value of 0; a two-meaning homograph with equiprobable meanings would have a U value of 1. The maximum value of U , and thus the possible range for U , increases with number of meanings.

To enable comparisons of balance estimates for homographs across different norming studies, we calculated a balance estimate, B , for each homograph. B was calculated with the same formula as U , but only the two most frequent meanings were included (their relative frequencies were normalized to sum to 1). The resulting metric had a range from 0 to 1 and represented the degree to which the most common meaning was dominant over the secondary meaning. A homograph with a B value of 1 had a secondary meaning with a relative frequency equal to that of the primary meaning; a B value of 0 indicated that the secondary meaning had a relative frequency of 0. This measure quantified the often discussed relationship between the primary and secondary meanings of a homograph (see, e.g., Duffy et al., 1988; Rayner & Frazier, 1989). B values were also calculated for the homographs in our corpus from the relative frequencies provided in the other nine norming studies; the two meanings used were the primary and secondary meanings in our norms. Table 2 contains the R^2 values between our norms and the other norms for the balance measure.

Results

Appendix A contains the condensed data for the norms.¹ For the three most common meanings (or fewer, if there were fewer than three meanings given as responses), the primary associate for that meaning is reported, followed by the relative frequency of that associate, followed by the relative frequency of that meaning category. The last three columns of Appendix A represent the relative frequency of other meanings, the relative frequency of Unclear categorizations, and U . Relative frequencies are expressed as the proportion of all responses to that homograph. Table 3 shows means and standard errors of the

Table 2
R's for Balance Estimates

Study	Entire Data Set		Balanced/Polarized Homographs Only	
	R ²	Count	R ²	Count
Cramer (1970)	.04	98	0	28
Kausler & Kollasch (1970)	.26*	37	.16	11
Perfetti et al. (1971)	.27*	98	.29*	27
Warren et al. (1972)	.18	15	.84	3
Geis & Winograd (1974)	.38*	50	.67*	13
Gilhooly & Logie (1980)	.09*	133	.24*	40
Nelson et al. (1980)	.48*	316	.56*	100
Wollen et al. (1980)	.34*	119	.46*	35
Gorfein et al. (1982)	.63*	83	.75*	22

* $p < .05$.

various relative frequencies and U , as well as number of homographs associated with each relative frequency (means for second, third, and other meanings were based on less than 566 homographs, because not all homographs had frequencies greater than zero for second and higher meanings).

To determine whether grammatical class variation, heterophony, and word frequency were related to U , t tests were carried out. U values were higher for homographs with at least one meaning for which subjects' responses could be classified into more than one grammatical class ($M = .76$, $SE = .02$) than they were for homographs for which meanings were all within a single grammatical class ($M = .60$, $SE = .04$) [$t(564) = 3.35$, $p < .001$]. Heterophones ($M = .83$, $SE = .09$) did not differ from non-heterophones ($M = .71$, $SE = .02$) [$t(564) = 1.35$, $p > .10$]. The correlation between U and word frequency was minimal ($R = .05$, $p > .10$).

Correlations between meaning frequencies in our norms and those of other norms are shown in the last column of Table 1 (note that in 7 of the 956 cases in which a homograph in our stimulus set appeared in another study, the meaning categorizations used by the other study were incompatible with ours. These 7 cases were not included in the across-study correlations). The R^2 values are all quite high, ranging from .52 to .88 (all $ps < .05$). The correlations with the Wollen et al. (1980) and Warren

et al. (1972) norms are among the lowest (.61 and .52, respectively). These are the only two studies that did not use the word-association measure. This provides support for the claim that word association and sentence generation or definition writing are tapping somewhat different processes, perhaps due to the increased opportunity for strategic responding in tasks like sentence generation and definition writing. Gilhooly and Logie (1980) did not include meanings given by 10% or less of their subjects; such a procedure applied to our data would exclude a substantial number of meanings. This restriction of their sample may explain the low correlation (.53) with our data. Similarly, Cramer (1970) arbitrarily restricted her meaning categories to two for all homographs; third or higher meanings were disregarded. This discrepancy in number of meaning categories between her study and ours would decrease the correlation (which was .66). The R^2 values for the remaining five sets of norms range from .74 to .88, leaving 12% to 26% of the variance unexplained. Some of this variability may be due to regional differences, differences in year (or decade) of testing, and discrepancies in meaning definition (i.e., some studies combined meanings that were considered distinct in others). However, the R^2 values are sufficiently high to allow use of our norms in situations other than the one in which they were collected.

Many informative experimental designs involve comparing polarized and balanced homographs; it is thus of interest to look at the reliability of balance estimates for the two extremes of the balance distribution. Two groups of homographs were identified, including 86 balanced homographs with B values of .95 and higher and 96 polarized homographs with B values of .1 to .3 (homographs with B values between 0 and .1 were rejected in order to exclude homographs with a very rare secondary meaning which might not be known to all readers). R^2 values for these stimuli are given in Table 3. Appendix B lists the homographs in the polarized and balanced sets.

Discussion

It is noteworthy that many of the homographs in our list have more than two meanings; nearly half (230) have three or more meanings, and 75 have four or more meanings. In some previous studies, possible responses and/or

Table 3

Means, Standard Errors, and N for the Various Frequencies and U

Variable	M	SE	N
P1	.25	.006	566
M1	.71	.007	566
P2	.07	.003	538
M2	.16	.005	538
P3	.03	.002	230
M3	.07	.004	230
Remaining Meanings	.05	.006	75
Unclear category	.10	.003	566
U	.72	.020	566

Note—P1, P2, P3 = proportion of primary associate responses to the homograph for the first, second, and third most frequent meanings, respectively. M1, M2, M3 = proportion of responses to the homograph for the first, second, and third most frequent meanings, respectively. U = overall ambiguity of the homograph in terms of uncertainty of information.

categorizations of responses were limited to just two meanings. Our results show that such a strategy will underestimate the ambiguity of many homographs. Number of meanings has theoretical importance to models such as the ordered-access model (Hogaboam & Perfetti, 1975) or the activation-suppression model of Neill and colleagues (e.g., Neill, 1989; Neill et al., 1988). In these models, the time taken to search for all meanings of a homograph is limited by search time for the least frequent meaning (although this can be overridden by context in Neill's model). Accurate modeling of search time by these models would require knowledge of frequencies of all meanings of homographic stimuli. Using frequency estimates from norms in which number of meanings is limited to two would underestimate search times for those cases in which third most frequent (or rarer) homograph meanings are used.

U has not been widely used as an index of overall ambiguity for homographs, so we do not have an established base of data with which to compare our findings. Neither Perfetti et al. (1971) nor Britton (1978) reported correlations between U and any other lexical characteristics, and theirs are the only studies we are aware of in which the uncertainty-of-information measure is applied to homographs. The finding of significantly higher U values for homographs with grammatical class variability indicates that semantic flexibility covaries with syntactic flexibility. Some researchers have studied noun-verb homographs separately from noun-noun homographs (e.g., Frazier & Rayner, 1987; Seidenberg, Tanenhaus, Leiman, & Bienkowski, 1982). Seidenberg et al. found that processing of syntactic-category ambiguity differs from that of within-syntactic-category ambiguity. They found that semantic priming of noun-noun homographs (e.g., organ) led to selective access of the appropriate meaning of the homographs, but that semantic priming of noun-verb homographs (e.g., tire) failed to produce selective access. Our findings point to a potential confound in this work: The difference in processing found may be related to the fact that syntactic-category ambiguity covaries with overall semantic uncertainty (U). This allows the possibility that it was not syntactic-category ambiguity but simply high overall ambiguity that led to exhaustive access for the noun-verb homographs.

There was no difference in U between heterophones and nonheterophones in our sample. The data show a trend toward greater overall ambiguity for heterophones, but this trend is unreliable, perhaps partially due to the small number (32) of heterophones in our sample (indeed, in the English language). Gorfein et al. (1982) report that heterophones show greater meaning stability (across repeated associations) than do nonheterophones, but they do not report U for their homographs. Warren et al. (1972), whose stimuli were all heterophones, found a mean of 2.4 meanings per heterophone, which is very similar to the mean of 2.53 meanings for our sample and is not different from the mean of 2.56 for nonheterophones in our sample. Thus, the data are mixed with regard to

whether heterophones might be expected to behave differently from nonheterophones in experimental tasks.

We found no relationship between word frequency and U . The data on similar relationships in other stimulus sets are limited. Britton (1978) reports high semantic uncertainty for high-frequency words, although his data are based on dictionary entries rather than actual usage. Cramer (1970) found no relationship between word frequency and frequency of the most common meaning (nor do we; $F = 1.88, p > .05$). She does report that the difference between first and second meaning frequencies increases with decreasing frequency, although this observation is not supported by statistical analysis. Similar analyses on our data indicate no such relationship ($F = 1.25, p > .05$). Ferraro and Kellas (1990) had subjects rate homographs as having 0, 1, or 2 meanings. The correlation between these ratings and word frequency was significant, but small [$r(388) = .18$]. Paivio, Yuille, and Madigan (1968) report that high-frequency words are more *meaningful*, in that more associative responses are generated for them within a limited time period; this measure is clearly not the same as U or number of meanings, however. Thus, the relationship between various measures of ambiguity and word frequency is inconsistent across other data sets, and is not evident in our data either. It is likely that a relationship, if it exists, is small.

We provided data on the stability of balance estimates across norms. The R^2 values indicate that balance estimates are generally stable across norming studies, and that extreme-groups designs like those used in many studies produce a stable balance contrast.

EXPERIMENT 2

It is important to have an index of the reliability of the meaning classifications used in these norms. One such index is the interrater reliability for assignment to meaning categories. These data are not available for the entire data set for two reasons. First, we felt that collaboration rather than some sort of statistical resolution of disagreements between raters produced a more valid and more stable set of classifications. In many cases in Experiment 1, one rater was able to provide information unknown or unconsidered by the other rater which caused that rater to change his or her categorization. Second, separate categorizations and subsequent combination of these categorizations was simply not feasible for the 33,078 distinct responses. In Experiment 2, interrater reliabilities were calculated for a subset of the homographs in order to provide an estimate of the reliability of the original classifications.

Method

Materials. Fifty-eight homographs (10.2% of the original corpus) were chosen, half of which were moderately polarized (mean B value = .852, $SE = .009$) and half of which were balanced according to the original raters' categorizations (mean B value = .997, $SE = .001$). Because of the constraints of the optical scanning sheets used for computer scoring of categorizations, homographs with more than nine dictionary meanings were excluded.

Raters. Four raters were employed to independently score the responses to these homographs. None had been involved in scoring the original responses, and all reported English as a first language.

Scoring. Meaning categories were the dictionary definitions of the homographs in a pocket dictionary (Drysdale, 1991). Dictionary definitions were provided to ensure that all judges used the same categories, thus enabling interrater comparisons. These comparisons served as an estimate of the reliability of classifications of word associations into meaning categories. Furthermore, the use of dictionary definitions gave us a method of gauging the appropriateness of our original judges' decisions about collapsing across related meanings due to featural overlap. Any increase in interrater reliability observed after dictionary definitions were collapsed to match the categories generated by our original judges is due to the suitability of the decisions to combine related meanings. A decrease in reliability would indicate that the meaning categories were not collapsed in a manner consistent with the four new raters' judgments. The correlations between the original raters and the new raters also provide an estimate of the lower bound on the reliability of the original raters' categorizations.

When a response was deemed appropriate for more than one definition, raters were told to choose the most appropriate definition. This ensured that responses were deemed "Unclear" only when they were simply unrelated to the homograph or were erroneous responses. Because closely related meanings were to be collapsed after calculating original interrater reliabilities, this procedure maximized the data available with which to estimate interrater reliability.

Results and Discussion

Interrater reliabilities were calculated for all six possible pairings of the 4 raters. The dependent measure was percent overlap in assignment to dictionary definition categories, corrected for chance. The formula used was $(\% \text{ overlap} - \text{chance level}) / (1 - \text{chance level})$, with chance level equal to $(1/\text{number of dictionary definitions})$. The resulting means are given in Table 4. Means for percent overlap after collapsing meaning categories, corrected for chance, can be found in Table 5.

Mean overlap between raters was 64% before collapsing across dictionary definitions and 76% after collapsing (70% and 83%, respectively, before chance correction); this 12% difference was significant [$F(1,56) = 51.6, p < .05$]. There was no main effect of balance [$F(1,56) = 1.4, p > .05$]; nor did meaning source and balance interact [$F(1,56) < 1, p > .05$]. Thus, after correcting for chance, overlap was substantial and improved significantly when the original raters' categorizations were used to collapse dictionary definitions into categories consistent with those used in the norming study proper.

Mean overlap between the 4 raters and the original raters was 76% (82% before chance correction); this was

Table 4
Percent Overlap in Meaning Categorizations
for Four Raters (Corrected for Chance)

	Rater			
	1	2	3	4
1	—	66	65	62
2		—	62	60
3			—	61

Table 5
Percent Overlap in Meaning Categorizations for
4 Raters and Original Raters (Corrected for Chance),
After Collapsing Meaning Categories

	Rate				
	Orig.	1	2	3	4
Orig.	—	75	74	77	76
1		—	75	77	75
2			—	76	75
3				—	78

Note—Orig. = Original raters.

identical to the mean interrater overlap for the 4 subset raters. There was a marginal main effect of balance [$F(1,56) = 3.7, p < .10$]. Examination of the overlap distribution revealed three clear outliers. For one of the homographs ("chuck"), overlap between the 4 raters was high, but overlap with the original raters was low. This occurred because many of the responses to "chuck" referred to its use as a proper name; proper names did not appear in the dictionary definitions used by the four subset raters. For the other two homographs ("copy" and "hatch"), overlap was low between the 4 raters as well as between the 4 raters and the original raters. These homographs thus had meanings that were simply difficult to discriminate along a single semantic feature. When these three items were removed from the analysis, there was no effect of balance on reliability of meaning categorization [$F(1,53) < 1, p > .05$].

CONCLUSIONS

Homographs appear in the stimulus lists of countless experiments dealing with central issues in the study of semantic processing. Some of the key issues revolve around comparisons of meanings differing in relative frequency, and normative estimates of relative meaning frequencies are essential. We have provided data on a large number of homographs, and we have demonstrated that our meaning categorizations are reliable. Comparisons of meaning categorizations and balance estimates across norming studies indicate that these measures are generally stable, although variations due to region and time of data collection may occur. We demonstrated that variables such as grammatical class are related to the overall ambiguity of homographs; an interesting future direction for research is to determine the role such relationships play in the resolution of meaning indeterminacies.

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NOTE

1. A document containing all individual responses and their categorizations can be obtained from the authors. A disk copy will be sent in lieu of a paper copy if a 3.5-in. disk is enclosed with the request (please indicate whether Macintosh or DOS format is required). FTP requests can also be accommodated.

APPENDIX A
Homograph Association Norms

Homograph	Primary 1	P1	M1	Primary 2	P2	M2	Primary 3	P3	M3	R	X	U
ACE	cards	.27	.66	pilot	.04	.08	tennis	.03	.05	.01	.20	.92
ACT	play	.23	.74	now	.03	.11	amendment	.01	.02		.14	.68
ADMIT	confess	.08	.58	one	.07	.27					.15	.90
ADVANCE	forward	.12	.49	money	.09	.26					.24	.93
AFFAIR	sex	.16	.71	current	.03	.10					.19	.53
AIR	plane	.12	.92	grievances	.01	.01					.07	.05
ANGLE	math	.19	.81	fish	.03	.04	approach	.01	.01		.14	.37
ANNUAL	yearly	.22	.88	book	.02	.05					.08	.29
ARM	leg	.46	.91	gun	.03	.05					.04	.31
ARTICLE	paper	.18	.58	clothing	.19	.24	lawyer	.03	.06		.11	1.19
BALL	bat	.13	.92	dance	.02	.02					.07	.13

Homograph Association Norms (Continued)

Homograph	Primary 1	P1	M1	Primary 2	P2	M2	Primary 3	P3	M3	R	X	U
BAND	music	.31	.63	aid	.14	.23	121.5-mz	.01	.01		.13	.92
BANK	money	.54	.98								.02	.00
BAR	drink	.29	.79	soap	.03	.07					.14	.39
BARK	dog	.61	.68	tree	.26	.26					.05	.85
BASE	ball	.32	.53	bottom	.07	.13	army	.06	.13	.07	.14	1.58
BASS	guitar	.13	.56	outlet	.09	.19	fish	.16	.19		.06	1.37
BAT	ball	.39	.53	man	.07	.34	hit	.04	.04		.09	1.19
BATTERY	car	.18	.84	assault	.04	.06	cannons	.01	.01		.08	.45
BAY	water	.16	.45	store	.13	.21	window	.07	.08	.05	.21	1.61
BEAD	necklace	.47	.85	aim	.01	.01					.14	.09
BEAM	light	.35	.61	wood	.04	.23	face	.01	.02		.14	.97
BEAR	grizzly	.08	.82	down	.01	.01					.17	.05
BEEF	cow	.20	.91								.09	.00
BEING	human	.25	.47	here	.05	.36					.17	.99
BELT	pants	.23	.85	hit	.07	.07	down	.01	.01		.07	.45
BEND	over	.18	.57	road	.05	.16					.26	.76
BILL	money	.22	.50	ted	.07	.25	of-rights	.01	.04	.03	.18	1.35
BIT	bite	.17	.37	little	.06	.19	horse	.11	.13	.17	.13	2.07
BITTER	sweet	.34	.65	mad	.02	.19					.16	.76
BLOCK	wood	.07	.45	stop	.03	.22	parent	.06	.15		.18	1.43
BLOW	wind	.16	.49	job	.11	.11	hit	.04	.08	.07	.25	1.45
BLUE	red	.18	.85	sad	.02	.03	movie	.01	.01		.10	.32
BLUFF	lie	.16	.72	cliff	.03	.06	grass	.02	.04		.18	.67
BLUNT	sharp	.21	.76	forward	.01	.09					.14	.50
BOARD	game	.15	.70	meeting	.03	.07	ship	.03	.06	.01	.17	.85
BOIL	water	.45	.89	sore	.01	.05					.06	.29
BOLT	nut	.18	.46	lightning	.22	.24	run	.10	.19	.01	.09	1.55
BOND	glue	.10	.30	james	.27	.28	money	.14	.23		.19	1.58
BOOM	bang	.16	.74	bust	.05	.10	camera	.01	.01		.14	.63
BOOT	shoe	.24	.59	kick	.09	.11	camp	.05	.06	.01	.23	1.04
BOUND	tied	.15	.61	jump	.05	.12	homeward	.01	.06		.22	.96
BOW	arrow	.30	.35	tie	.19	.26	curtsey	.03	.09	.13	.18	1.97
BOWL	cereal	.11	.64	ball	.05	.24	over	.02	.02		.10	.96
BOX	square	.12	.75	tyson	.01	.03	pussy	.01	.02		.20	.38
BREAK	glass	.14	.70	time	.02	.08	through	.02	.06		.17	.79
BRIDGE	water	.21	.60	cards	.09	.20	deck	.01	.01	.01	.18	.98
BROKE	fix	.14	.69	money	.10	.19					.12	.75
BRUSH	hair	.42	.92	fire	.02	.03					.06	.18
BUG	insect	.10	.74	off	.04	.07	computer	.00	.00		.19	.48
BULB	light	.76	.86	flower	.05	.11					.03	.52
CABINET	wood	.13	.79	minister	.05	.12					.08	.57
CABLE	tv	.68	.93	knit	.01	.01					.07	.05
CALF	cow	.65	.81	leg	.08	.11					.08	.53
CALL	phone	.38	.75	yell	.05	.12					.13	.59
CAN	soup	.11	.67	can't	.04	.16	washroom	.01	.03	.01	.12	1.00
CANE	candy	.19	.69	sugar	.10	.10					.21	.54
CAP	hat	.45	.79	pen	.02	.06	gun	.01	.01		.14	.43
CAPE	superman	.16	.52	cod	.23	.41					.07	.99
CAPITAL	city	.35	.60	money	.06	.16	letter	.07	.09	.09	.06	1.49
CARD	birthday	.20	.47	game	.10	.42	comedian	.01	.01		.10	1.08
CARP	fish	.70	.73								.27	.00
CASE	lawyer	.07	.47	brief	.10	.38					.15	.99
CAST	broken	.12	.34	play	.11	.27	away	.05	.24	.11	.04	1.90
CELL	jail	.19	.48	biology	.14	.40					.12	.99
CHAIN	link	.15	.78	letter	.03	.10					.12	.52
CHANCE	luck	.22	.54	opportunity	.04	.24					.21	.89
CHANGE	clothes	.14	.49	money	.25	.41					.10	.99
CHARGE	card	.27	.66	bull	.05	.12	arrest	.02	.07	.06	.09	1.27
CHARM	bracelet	.23	.46	wit	.03	.39					.15	1.00
CHECK	mark	.11	.52	money	.14	.31	mate	.07	.07	.02	.08	1.38
CHEST	hair	.12	.51	treasure	.05	.27					.22	.93
CHEW	gum	.35	.91	out	.01	.01					.08	.09
CHINA	dishes	.09	.51	japan	.08	.36					.13	.98
CHIP	potato	.13	.68	break	.03	.11	dale	.09	.10		.11	1.02
CHOP	cut	.09	.52	suey	.21	.35	hit	.01	.03		.10	1.15
CHUCK	throw	.17	.26	wagon	.14	.25	berry	.03	.18	.13	.18	2.08
CLIP	board	.30	.70	cut	.07	.15	hit	.02	.02	.04	.10	1.07
CLOG	drain	.35	.74	shoe	.11	.18					.08	.72
CLUB	group	.07	.45	bat	.05	.23	night	.04	.17	.05	.11	1.68

Homograph Association Norms (Continued)

Homograph	Primary 1	P1	M1	Primary 2	P2	M2	Primary 3	P3	M3	R	X	U
COAST	ocean	.13	.77	soap	.10	.10	glide	.02	.07		.07	.84
COAT	jacket	.23	.89	paint	.03	.05					.06	.31
COLD	hot	.32	.77	sick	.03	.10	war	.02	.03		.10	.70
COMB	hair	.68	.98	rooster	.01	.01					.01	.09
COMPACT	disc	.36	.36	small	.16	.19	makeup	.10	.18	.22	.04	2.11
COMPANY	business	.08	.53	friends	.07	.31					.16	.95
COMPOUND	fracture	.13	.40	w	.09	.26	interest	.10	.13	.10	.12	1.80
CONSOLE	help	.12	.60	car	.07	.27					.13	.90
CONTACT	lens	.32	.55	touch	.07	.15	call	.02	.10	.01	.19	1.25
CONTRACT	agreement	.07	.74	disease	.05	.08	dilate	.01	.03		.16	.64
COPY	cheat	.22	.48	machine	.09	.42					.10	1.00
CORD	rope	.17	.82	pants	.04	.05	wood	.01	.01		.13	.35
CORN	cob	.35	.94	feet	.01	.01					.05	.09
COUNT	numbers	.26	.71	dracula	.16	.21	on	.02	.02		.07	.88
COUNTER	top	.24	.53	balance	.04	.23	numbers	.03	.10		.14	1.30
COURSE	school	.13	.70	golf	.09	.09	path	.01	.07	.00	.13	.92
COURT	judge	.11	.50	tennis	.20	.34	date	.04	.12		.05	1.39
COVERED	blanket	.08	.73	safe	.02	.03					.24	.21
CRAB	lobster	.15	.80	animal	.03	.09	apple	.05	.05	.01	.04	.81
CRAFT	art	.13	.69	boat	.04	.12	crafty	.00	.01		.17	.73
CRANE	lift	.10	.44	bird	.27	.33	neck	.05	.05		.19	1.25
CRANK	shaft	.22	.75	call	.05	.15					.11	.65
CREST	toothpaste	.45	.52	badge	.04	.23	hill	.06	.13	.01	.10	1.44
CRICKET	bug	.12	.54	game	.15	.37					.09	.98
CROOK	thief	.24	.77	arm	.02	.14					.09	.61
CRUST	bread	.38	.90	earth	.02	.05					.05	.31
CUE	pool	.42	.67	card	.03	.26					.06	.86
CUFF	shirt	.24	.78	hit	.10	.18					.05	.69
CURB	car	.14	.83	appetite	.02	.07					.09	.41
CYCLE	bike	.52	.86	circle	.03	.08					.06	.42
DART	board	.36	.77	run	.02	.06	car	.03	.03		.13	.62
DASH	run	.38	.61	board	.10	.14	salt	.04	.09	.05	.10	1.41
DATE	girl	.08	.43	time	.10	.40	fruit	.02	.04		.13	1.23
DECK	boat	.08	.63	cards	.17	.19	hit	.05	.08	.03	.07	1.30
DEED	good	.17	.61	will	.08	.28					.10	.90
DEEP	water	.19	.89	heavy	.01	.03					.08	.19
DEPOSIT	money	.48	.94	clean	.01	.03					.03	.18
DESERT	storm	.17	.68	leave	.02	.02					.30	.19
DIAMOND	ring	.47	.89	baseball	.03	.04	ace	.01	.01		.06	.32
DIE	live	.24	.87	dice	.01	.02					.12	.13
DIGEST	food	.25	.61	reader's	.26	.37					.02	.96
DIGIT	number	.45	.70	finger	.22	.25					.05	.83
DIP	chip	.17	.72	stick	.09	.13	down	.02	.05		.10	.89
DIRT	mud	.19	.89	smut	.02	.03					.08	.18
DIVE	water	.23	.94	my-house	.01	.01					.05	.05
DOUGH	bread	.49	.88	money	.07	.09					.03	.43
DOVE	bird	.31	.77	soap	.09	.09	in	.02	.08		.06	.86
DOWN	up	.53	.88	feather	.01	.04	syndrome	.02	.02	.02	.04	.53
DRAFT	beer	.30	.30	army	.12	.28	draw	.03	.17	.17	.07	2.01
DRAG	race	.27	.36	pull	.13	.34	smoke	.04	.07	.10	.13	1.82
DRAW	picture	.21	.79	gun	.03	.10	near	.01	.01	.01	.10	.63
DRESS	clothes	.11	.88								.12	.00
DRILL	bit	.13	.59	sergeant	.08	.26					.15	.89
DRIP	water	.22	.90	loser	.02	.04					.06	.26
DRIVE	car	.53	.89	golf	.01	.02					.09	.13
DROP	fall	.11	.78	water	.03	.14					.09	.61
DROVE	car	.41	.80	care	.01	.05	golf	.02	.02		.14	.44
DRUM	beat	.20	.92	up	.01	.01					.07	.05
DRY	wet	.44	.78	beer	.07	.18					.04	.70
DUCK	quack	.15	.81	under	.01	.06					.13	.35
DUMP	garbage	.36	.85	break-up	.01	.04					.11	.27
EAR	hear	.16	.95								.05	.00
ENTRANCE	exit	.62	.96	awed	.01	.01					.03	.09
EXCISE	tax	.12	.13	remove	.02	.09					.78	.98
EXPRESS	train	.17	.58	yourself	.08	.30					.12	.92
FAIR	game	.06	.44	rides	.03	.17	dark	.03	.15	.11	.14	1.89
FALL	down	.19	.55	autumn	.08	.36					.09	.97
FAN	cool	.21	.75	club	.05	.19					.07	.72
FANCY	dress	.16	.77	free	.04	.09					.15	.48

Homograph Association Norms (Continued)

Homograph	Primary 1	P1	M1	Primary 2	P2	M2	Primary 3	P3	M3	R	X	U
FARE	bus	.30	.75	well	.02	.02					.22	.18
FAST	slow	.47	.89	eat	.02	.03					.09	.19
FAULT	blame	.09	.39	earthquake	.06	.19	tennis	.04	.08		.34	1.33
FAWN	deer	.59	.78								.22	.00
FELT	pen	.19	.56	touch	.06	.30					.14	.93
FENCE	post	.13	.83	sword	.05	.10	crime	.01	.01		.06	.58
FIELD	dreams	.10	.98								.02	.00
FIGURE	skate	.14	.70	eight	.09	.16	out	.05	.05		.09	.95
FILE	cabinet	.20	.72	nail	.08	.19	rank	.01	.01		.07	.82
FILM	movie	.30	.90	black	.01	.02					.08	.12
FINE	money	.07	.23	line	.05	.22	tune	.04	.21	.08	.26	1.91
FINISH	start	.27	.91	coat	.01	.03					.06	.18
FIRE	hot	.16	.87	gun	.02	.03	hire	.01	.01		.10	.23
FIRM	hard	.13	.82	company	.04	.14					.04	.61
FIT	shape	.06	.40	clothes	.08	.36	anger	.02	.06		.18	1.29
FIX	break	.16	.76	dog	.01	.02	drink	.01	.01	.01	.21	.33
FLAT	round	.11	.83	apartment	.02	.04	beer	.02	.04	.02	.08	.62
FLEET	ships	.30	.78	run	.02	.07					.15	.41
FLIGHT	plane	.36	.85	fancy	.01	.03	stairs	.02	.02		.10	.39
FLING	throw	.28	.52	affair	.13	.26					.22	.92
FLOAT	boat	.18	.79	ice-cream	.04	.12	parade	.02	.02	.01	.06	.74
FLUSH	toilet	.77	.81	red	.06	.09	cards	.02	.05	.01	.04	.82
FLY	bird	.11	.48	bug	.11	.34	rod	.01	.02	.01	.15	1.20
FOIL	tin	.28	.76	fool	.02	.10	fencing	.02	.05	.01	.08	.87
FOLD	paper	.23	.88	sheep	.01	.01					.11	.09
FOOT	ball	.20	.93	long	.02	.02					.05	.15
FORCE	push	.10	.59	air	.12	.27					.14	.89
FORM	paper	.08	.39	shape	.08	.29	make	.06	.14		.19	1.48
FOUL	smell	.17	.46	ball	.09	.31					.23	.97
FRAME	picture	.63	.93	clue	.01	.02					.05	.12
FRAY	jeans	.10	.75	fight	.04	.07					.18	.44
FREE	jail	.04	.50	money	.06	.34					.16	.97
FRESH	fruit	.15	.90	prince	.05	.06	people	.01	.01		.04	.37
FRISK	police	.23	.66	cat	.08	.17					.17	.74
FRONT	back	.70	.90	line	.05	.06					.04	.32
FUSE	box	.22	.48	light	.11	.22	together	.06	.13		.17	1.38
GAG	choke	.20	.49	joke	.16	.27	mouth	.03	.15		.09	1.43
GAME	play	.22	.89	animal	.01	.03					.08	.19
GAS	car	.35	.80	fart	.03	.03	fun	.01	.01		.16	.28
GEAR	shift	.18	.55	camping	.05	.31					.13	.94
GERM	disease	.17	.87	layer	.01	.02					.11	.13
GIN	tonic	.37	.87	rummy	.07	.08					.05	.42
GLARE	sun	.13	.48	stare	.25	.47					.05	1.00
GLASS	window	.10	.63	cup	.07	.29					.07	.90
GRACE	prayer	.09	.47	ballet	.02	.22	kelly	.10	.21		.10	1.48
GRADE	mark	.12	.88	steep	.02	.04					.08	.26
GRAFT	skin	.46	.52	tree	.03	.05	con	.01	.03		.40	.68
GRAIN	wheat	.32	.77	sand	.11	.17					.06	.68
GRASS	green	.51	.82	smoke	.05	.07					.11	.41
GRATE	cheese	.62	.74	sewer	.03	.15	annoy	.01	.02		.10	.76
GRAVE	dead	.27	.88	mistake	.01	.04					.08	.27
GREEN	grass	.18	.94	golf	.02	.02					.05	.12
GRILL	barbecue	.21	.94	hound	.01	.02					.04	.12
GRIND	coffee	.17	.80	work	.02	.04					.16	.26
GROSS	disgusting	.10	.49	anatomy	.11	.25	big	.04	.14	.01	.11	1.48
GROUND	dirt	.12	.76	beef	.12	.17					.07	.69
GUY	girl	.41	.64	lafleur	.05	.12	wire	.01	.01		.24	.67
HABIT	bad	.19	.79	nun	.04	.06					.15	.38
HAIL	rain	.25	.68	mary	.10	.24					.08	.83
HAM	pig	.11	.88	funny	.01	.03					.09	.21
HAMPER	clothes	.56	.84	stop	.03	.10					.06	.49
HAND	foot	.19	.93	friendship	.01	.01					.06	.09
HANG	man	.08	.63	loose	.05	.09					.28	.54
HARD	soft	.38	.75	easy	.05	.14					.10	.63
HARP	music	.31	.80	nag	.03	.08					.12	.44
HATCH	egg	.27	.44	back	.15	.43					.13	1.00
HAUNT	ghost	.35	.94								.06	.00
HEAD	hair	.12	.79	start	.01	.03					.18	.23
HEAT	cold	.27	.95	dog	.02	.02					.03	.15

Homograph Association Norms (Continued)

Homograph	Primary 1	P1	M1	Primary 2	P2	M2	Primary 3	P3	M3	R	X	U
HEEL	shoe	.25	.86	dog	.04	.06					.08	.35
HEM	dress	.23	.94								.06	.00
HIDE	seek	.51	.84	animal	.01	.07					.09	.39
HOLD	on	.15	.91								.09	.00
HOOD	car	.25	.36	robin	.28	.31	jacket	.10	.23		.10	1.56
HOP	jump	.26	.84	hip	.05	.09	beer	.01	.01		.07	.50
HORN	car	.19	.77	cow	.04	.17					.06	.67
HOST	hostess	.21	.77	parasite	.04	.06	bread	.02	.04		.13	.63
HOUND	dog	.87	.91	bother	.02	.05					.03	.31
HULL	boat	.22	.42	brett	.13	.36	corn	.02	.05		.17	1.27
HUSKY	dog	.46	.48	big	.08	.35	gas	.07	.15		.02	1.46
INCENSE	smell	.32	.79	anger	.02	.06					.15	.36
INCLINE	decline	.19	.92	do	.01	.05					.03	.30
INTEREST	hobby	.05	.48	money	.18	.38					.14	.99
INTIMATE	close	.21	.92	suggest	.01	.01					.08	.05
INVALID	wrong	.10	.54	sick	.07	.27					.20	.92
IRON	fist	.05	.49	clothes	.17	.47					.04	1.00
ISSUE	magazine	.22	.38	debate	.06	.30	give	.05	.16		.15	1.51
JACK	jill	.32	.67	hammer	.08	.19	queen	.04	.08		.07	1.11
JAM	toast	.20	.87	stuck	.01	.04	session	.01	.02		.07	.40
JAR	jam	.40	.93	hit	.01	.02					.05	.12
JERK	asshole	.09	.59	off	.11	.32					.09	.93
JET	plane	.45	.87	ski	.04	.08					.05	.42
JOINT	knee	.14	.58	smoke	.07	.20	together	.04	.13	.02	.07	1.43
JUICE	orange	.55	.95								.05	.00
JUNK	garbage	.19	.94	boat	.01	.01					.05	.09
KERNEL	corn	.46	.89								.11	.00
KEY	lock	.30	.90	word	.01	.04	board	.01	.01		.05	.35
KICK	ball	.19	.96								.04	.00
KID	child	.23	.72	goat	.10	.10	joke	.01	.01		.16	.64
KIND	nice	.25	.91	type	.02	.04					.04	.26
LACE	dress	.08	.67	shoe	.12	.26	arsenic	.01	.03		.04	1.03
LAND	water	.14	.89	plane	.02	.07					.04	.37
LAP	sit	.17	.54	run	.03	.13	tongue	.03	.08		.25	1.13
LASH	out	.21	.69	eye	.15	.21	tie	.01	.01		.08	.87
LEAD	pencil	.36	.65	follow	.18	.33					.03	.92
LEAF	tree	.37	.89	page	.02	.03	through	.01	.01		.08	.24
LEAN	meat	.14	.64	over	.04	.27					.08	.88
LEFT	right	.77	.94	behind	.02	.04					.03	.23
LETTER	mail	.10	.68	alphabet	.03	.07					.25	.46
LIE	truth	.21	.65	down	.15	.25					.10	.85
LIGHT	dark	.30	.78	heavy	.06	.10	beer	.03	.04	.02	.06	.88
LIKE	hate	.22	.74	as	.03	.10					.16	.52
LIME	lemon	.41	.88	light	.03	.06					.06	.33
LIMP	leg	.15	.54	wrist	.04	.38					.07	.98
LINE	straight	.18	.94								.06	.00
LIP	kiss	.20	.90	sink	.02	.03	insolence	.01	.01		.06	.30
LIST	words	.09	.83	over	.01	.03					.14	.22
LITTER	garbage	.23	.56	box	.15	.15	kittens	.04	.11		.18	1.20
LOAF	bread	.82	.91	lazy	.03	.06					.04	.32
LOBBY	hotel	.51	.81	government	.03	.13					.06	.58
LOCK	key	.33	.96	barrel	.00	.01	hair	.00	.00		.02	.13
LOG	tree	.16	.80	book	.04	.09	logarithm	.01	.04		.08	.69
LOT	house	.14	.66	little	.06	.17					.16	.74
LOUNGE	bar	.16	.60	chair	.11	.37					.03	.96
LOW	high	.61	.96								.04	.00
MAD	angry	.26	.52	dog	.08	.24	magazine	.08	.12		.12	1.36
MAJOR	minor	.42	.64	dad	.14	.31					.05	.91
MARBLE	floor	.18	.51	game	.09	.36					.14	.98
MARCH	april	.21	.51	walk	.09	.47					.02	1.00
MARK	grade	.07	.42	guy	.03	.16	pen	.02	.14	.03	.25	1.58
MAROON	red	.17	.56	island	.12	.28	gullible	.01	.01		.14	1.00
MASS	weight	.23	.36	media	.08	.34	church	.16	.24		.06	1.56
MATCH	fire	.22	.58	maker	.03	.17	game	.06	.16		.10	1.29
MEAL	food	.26	.97	corn	.01	.01					.02	.09
MEAN	nice	.21	.88	average	.03	.08	it	.01	.01		.03	.49
MESS	room	.20	.83	hall	.06	.09	around	.02	.02		.07	.58
MIGHT	strong	.10	.47	maybe	.16	.39					.13	.99
MIND	brain	.23	.82	manners	.01	.04					.14	.25

Homograph Association Norms (Continued)

Homograph	Primary 1	P1	M1	Primary 2	P2	M2	Primary 3	P3	M3	R	X	U
MINE	yours	.49	.58	gold	.11	.30	field	.03	.07		.04	1.25
MINT	candy	.25	.85	condition	.05	.12					.03	.54
MINUTE	second	.28	.87	small	.04	.06					.07	.34
MISS	america	.06	.43	hit	.09	.42					.15	1.00
MODEL	pretty	.10	.56	car	.10	.39					.05	.98
MOLD	bread	.17	.67	clay	.05	.27					.06	.86
MOLE	animal	.10	.49	face	.07	.27	chemistry	.04	.08	.01	.15	1.42
MOTION	move	.13	.84	hand	.02	.06	lawyer	.01	.01		.10	.39
MUG	coffee	.37	.84	shot	.07	.07	anger	.01	.05		.04	.69
NAG	mom	.16	.93	horse	.04	.04					.03	.26
NAIL	hammer	.41	.58	polish	.08	.35					.08	.95
NAP	sleep	.67	.95	cloth	.01	.01					.04	.05
NET	fish	.33	.83	gain	.04	.14					.03	.60
NOTE	book	.17	.84	music	.07	.10					.06	.48
NOVEL	book	.66	.87	idea	.06	.09					.04	.45
NUT	cracker	.09	.48	case	.15	.30	bolt	.12	.14		.08	1.43
OBJECT	thing	.19	.65	subject	.13	.15	agree	.02	.10	.04	.07	1.32
ODD	weird	.14	.51	even	.39	.46					.03	1.00
OPERATION	doctor	.14	.80	desert-storm	.02	.14					.06	.62
ORDER	food	.16	.54	chaos	.03	.18	command	.03	.11		.17	1.27
ORGAN	heart	.16	.50	music	.15	.47					.03	1.00
PACK	back	.10	.71	wolves	.06	.12	cigarettes	.02	.09		.07	1.01
PAD	paper	.34	.54	maxi	.04	.21	house	.04	.12		.12	1.33
PAGE	book	.17	.77	boy	.03	.13					.10	.60
PALM	hand	.42	.59	tree	.16	.27					.14	.89
PANEL	wood	.13	.51	judges	.13	.36					.13	.98
PARK	car	.25	.45	bench	.06	.42					.13	1.00
PART	time	.09	.59	hair	.15	.30					.11	.92
PARTY	fun	.19	.97	line	.01	.01					.02	.09
PASS	go	.06	.43	fail	.20	.28	bus	.04	.16	.01	.12	1.52
PASSAGE	way	.13	.89	book	.02	.08					.03	.42
PAT	dog	.09	.65	friend	.02	.18	butter	.01	.02		.15	.86
PATIENT	doctor	.36	.79	impatient	.03	.13					.08	.59
PAWN	sell	.15	.53	chess	.29	.39					.07	.98
PEER	friend	.31	.69	look	.12	.21					.10	.78
PELT	beaver	.21	.60	rain	.08	.33					.07	.94
PEN	pencil	.43	.91	pig	.02	.04					.05	.24
PERCH	bird	.33	.66	fish	.30	.32					.02	.91
PERFECT	excellent	.06	.85								.15	.00
PERIOD	time	.11	.40	sentence	.09	.22	blood	.05	.20		.18	1.51
PERMIT	licence	.14	.62	allow	.23	.34					.04	.93
PET	dog	.53	.91	fur	.01	.02					.07	.12
PICK	up	.22	.75	axe	.04	.14					.11	.62
PICKET	strike	.22	.50	fence	.44	.45					.05	1.00
PILE	shit	.13	.90	drive	.02	.04	carpet	.01	.01		.05	.34
PINCH	hurt	.20	.80	salt	.07	.09	hit	.02	.03		.08	.64
PIPE	smoke	.32	.51	line	.06	.33	organ	.03	.08		.08	1.31
PIT	hole	.15	.74	cherry	.06	.19					.06	.73
PITCH	baseball	.23	.80	sound	.02	.06	tent	.02	.03	.05	.05	.92
PITCHER	water	.16	.49	baseball	.24	.48					.04	1.00
PLAIN	simple	.11	.81	field	.02	.10					.09	.50
PLANE	fly	.27	.87	flat	.02	.07					.06	.39
PLANT	green	.27	.93	power	.02	.02					.05	.15
PLAY	ball	.13	.83	shakespeare	.02	.06	music	.02	.05		.05	.66
PLOT	story	.21	.48	plan	.06	.18	graph	.10	.17	.12	.04	1.78
POACH	egg	.37	.59	kill	.08	.39					.02	.97
POINT	sharp	.11	.40	finger	.14	.33	break	.09	.12	.09	.06	1.84
POKER	game	.23	.87	fire	.04	.09					.04	.44
POLE	vault	.16	.66	north	.17	.19	polish	.01	.01		.14	.86
POOL	swim	.32	.73	table	.08	.20	car	.01	.02		.05	.89
PORT	boat	.15	.66	wine	.04	.12	bow	.02	.09		.14	1.03
POST	office	.34	.69	fence	.04	.14	game	.01	.07	.03	.07	1.17
POT	pan	.17	.70	drugs	.06	.20					.10	.76
POUND	weight	.11	.46	hit	.06	.25	dog	.13	.15	.06	.07	1.70
PRESENT	gift	.30	.53	past	.10	.24	show	.04	.07	.07	.09	1.54
PRESS	down	.10	.50	news	.06	.28	iron	.12	.20		.02	1.48
PRIME	time	.29	.90	number	.03	.04	paint	.03	.04		.03	.48
PRODUCE	vegetables	.14	.70	make	.10	.26					.04	.85
PROJECT	work	.11	.77	voice	.02	.11					.12	.55

Homograph Association Norms (Continued)

Homograph	Primary 1	P1	M1	Primary 2	P2	M2	Primary 3	P3	M3	R	X	U
PROOF	evidence	.17	.70	read	.10	.14	alcohol	.02	.04	.02	.10	1.04
PRUNE	juice	.20	.92	cut	.02	.03					.05	.21
PUMP	gas	.25	.88								.12	.00
PUNCH	hit	.17	.70	bowl	.07	.23	line	.03	.03		.05	.98
PUPIL	student	.49	.67	eye	.29	.33					.01	.91
QUACK	duck	.69	.71	doctor	.14	.23					.06	.80
QUEEN	king	.51	.90	fag	.01	.01					.09	.09
QUIVER	shake	.45	.76	arrow	.07	.18					.06	.71
RACE	run	.24	.92	color	.02	.04					.04	.26
RACKET	ball	.47	.80	noise	.11	.13	mob	.02	.03		.04	.77
RAKE	leaves	.50	.97								.03	.00
RAM	goat	.12	.59	hit	.05	.23	computer	.02	.03		.16	1.02
RANGE	domain	.10	.36	gun	.06	.27	stove	.11	.17	.06	.14	1.77
RANK	army	.13	.79	smell	.05	.12					.09	.57
RAP	music	.49	.76	knock	.03	.09					.15	.47
RARE	unique	.04	.46	steak	.16	.36					.18	.99
RASH	red	.26	.85	harsh	.02	.06					.09	.35
REAR	end	.32	.93	horse	.02	.03	child	.01	.01		.04	.26
RECORD	music	.18	.84	break	.01	.05	write	.01	.03		.08	.51
REEL	fish	.30	.78	film	.05	.11	rock	.01	.04	.01	.07	.82
REFLECT	mirror	.28	.59	think	.15	.34					.08	.95
REFRAIN	stop	.37	.72	song	.07	.19					.09	.75
REFUSE	no	.24	.72	garbage	.14	.19					.09	.75
REGISTER	school	.18	.61	cash	.20	.33	furnace	.01	.02		.04	1.04
RELISH	mustard	.32	.91	love	.02	.07					.02	.38
RENT	apartment	.15	.97								.03	.00
RESERVATION	hotel	.24	.70	indian	.12	.19	unsure	.01	.02		.09	.88
RESERVE	save	.07	.45	indian	.11	.21	army	.09	.19	.03	.12	1.62
RESORT	holiday	.12	.92	last	.02	.04					.05	.24
REST	sleep	.43	.93	all	.01	.01					.06	.09
RIB	cage	.13	.93	bug	.01	.02	condoms	.01	.01		.04	.23
RICH	poor	.54	.88	little	.02	.04	chocolate	.01	.02		.05	.42
RIDDLE	joke	.38	.92	bullets	.01	.01					.08	.05
RIGHT	left	.43	.53	wrong	.36	.40	now	.02	.05	.01	.02	1.27
RING	finger	.14	.63	bell	.11	.30					.07	.91
ROAD	car	.08	.94								.06	.00
ROCK	roll	.28	.46	stone	.08	.26	baby	.01	.02		.26	1.10
ROLL	over	.09	.60	bread	.05	.19	rock	.13	.13	.02	.06	1.38
ROOM	bed	.18	.79	space	.05	.06					.15	.38
ROOT	tree	.31	.75	evil	.02	.08	dig	.02	.02	.01	.14	.65
ROSE	flower	.30	.86	axel	.01	.03	up	.01	.02		.09	.31
ROUND	square	.24	.83	robin	.02	.06	off	.02	.03		.07	.57
ROW	boat	.55	.66	column	.09	.27	fight	.02	.02		.06	.98
RUBBER	band	.24	.83	condom	.12	.15					.02	.61
RULER	measure	.19	.75	king	.10	.18					.07	.70
RUNG	ladder	.42	.46	ring	.09	.29	out	.04	.16		.09	1.47
RUNNER	fast	.06	.66	shoe	.09	.21					.13	.79
SACK	potatoes	.26	.78	bed	.05	.06	quarterback	.02	.04	.02	.10	.80
SAGE	spice	.30	.72	wise	.04	.12					.16	.58
SAP	tree	.68	.84	wimp	.02	.06	cry	.01	.02		.08	.46
SASH	belt	.18	.74	curtain	.03	.04					.23	.27
SAW	cut	.15	.66	see	.18	.30					.04	.90
SCALE	weight	.45	.77	fish	.03	.05	building	.01	.05	.06	.06	1.02
SCALLOP	potatoes	.34	.53	fish	.16	.35					.11	.97
SCHOOL	bus	.10	.92								.08	.00
SCOOP	ice-cream	.62	.93	news	.02	.04	neck	.02	.02		.01	.37
SCRAP	metal	.22	.78	fight	.13	.14					.08	.61
SCRATCH	itch	.33	.95	game	.01	.01					.04	.05
SCREEN	movie	.17	.61	door	.19	.30	pass	.01	.01		.08	.99
SCRUB	clean	.21	.97	bush	.02	.02	forget	.01	.01		.01	.19
SEAL	animal	.08	.50	close	.08	.40					.10	.99
SEASON	fall	.25	.97	herb	.01	.01					.02	.08
SECOND	first	.34	.67	minute	.06	.08					.24	.50
SENSE	smell	.27	.74	common	.04	.15					.11	.65
SENTENCE	structure	.17	.72	jail	.07	.21					.07	.77
SET	up	.09	.34	jet	.02	.16	tv	.10	.10	.22	.17	2.34
SHARE	give	.08	.67	money	.03	.09					.24	.51
SHARP	knife	.19	.78	calculator	.08	.11	pain	.02	.06	.02	.03	.98
SHED	tools	.08	.52	hair	.10	.40					.08	.99

Homograph Association Norms (Continued)

Homograph	Primary 1	P1	M1	Primary 2	P2	M2	Primary 3	P3	M3	R	X	U
SHELL	sea	.25	.61	gas	.10	.22	shock	.06	.12		.06	1.27
SHIFT	gears	.15	.71	work	.15	.22	dress	.01	.02		.06	.90
SHIP	boat	.19	.91	across	.01	.03					.05	.21
SHOOT	gun	.34	.96	camera	.01	.02	flower	.01	.01		.02	.20
SHOT	gun	.44	.83	glass	.03	.05	put	.04	.04	.01	.07	.60
SHOWER	clean	.14	.65	rain	.01	.01	bridal	.01	.01		.33	.23
SHUTTLE	space	.35	.90	cock	.03	.04					.06	.24
SIDE	door	.10	.81	friends	.01	.03					.16	.20
SIGN	stop	.31	.64	up	.08	.26					.10	.86
SINK	dishes	.11	.56	swim	.06	.29					.15	.93
SKIRT	dress	.20	.93	around	.01	.02					.05	.12
SLAB	meat	.32	.95	coffee	.01	.01					.05	.05
SLIDE	down	.17	.84	show	.03	.09					.07	.46
SLING	shot	.38	.54	arm	.19	.37	drink	.01	.02		.07	1.11
SLIP	fall	.32	.65	dress	.07	.22	paper	.03	.05		.08	1.09
SLUG	bug	.08	.66	hit	.08	.14	bub	.05	.05	.05	.09	1.22
SMACK	hit	.33	.58	kiss	.14	.29	crack	.01	.02		.11	1.03
SMART	dumb	.28	.71	alec	.05	.07					.22	.43
SMELT	melt	.08	.30	nose	.04	.24	fish	.14	.19		.26	1.56
SNAP	break	.12	.72	button	.06	.09	power	.02	.05	.05	.08	1.12
SOCK	shoe	.34	.88	punch	.01	.03					.09	.22
SOLE	shoe	.41	.60	fish	.17	.22	provider	.03	.09		.09	1.22
SORE	pain	.10	.72	cold	.03	.12	loser	.03	.04		.13	.81
SOUND	music	.20	.93	advice	.00	.01					.06	.08
SOW	pig	.35	.56	seeds	.09	.38					.06	.97
SPADE	shovel	.34	.66	cards	.09	.27					.08	.87
SPARE	tire	.56	.90	bowling	.01	.02	life	.01	.02		.06	.32
SPEAKER	talk	.10	.58	loud	.14	.31					.11	.93
SPEED	fast	.23	.91	drug	.03	.05					.04	.29
SPELL	words	.11	.72	bound	.08	.14					.14	.64
SPOT	stain	.10	.45	dog	.38	.39	see	.05	.09	.01	.07	1.43
SPRAY	water	.17	.99								.01	.00
SPREAD	butter	.33	.72	eagle	.05	.24					.03	.81
SPRING	summer	.15	.57	board	.04	.15	jump	.03	.14	.05	.10	1.49
SQUARE	circle	.28	.79	root	.04	.08	head	.02	.06	.02	.05	.88
SQUASH	racquet	.13	.58	bug	.06	.20	vegetable	.06	.18		.04	1.36
STABLE	horse	.41	.65	unstable	.05	.26					.09	.87
STAFF	work	.10	.80	stick	.03	.11					.10	.52
STAG	party	.41	.70	deer	.12	.22					.08	.79
STAGE	play	.18	.92	coach	.03	.03	early	.01	.01		.04	.27
STAKE	vampire	.08	.63	claim	.05	.11	out	.08	.09		.17	1.04
STALK	hunt	.09	.63	corn	.10	.27					.09	.88
STALL	horse	.26	.55	car	.16	.19	wait	.07	.13		.13	1.32
STAMP	letter	.31	.74	out	.03	.13					.12	.61
STAND	sit	.33	.89	tv	.01	.04					.06	.27
STAPLE	paper	.25	.81	food	.07	.11					.08	.53
STAR	sky	.15	.77	movie	.03	.12					.11	.57
STATE	province	.11	.70	mind	.03	.07	say	.02	.06		.17	.79
STATIC	cling	.34	.82	dynamic	.03	.10					.08	.50
STEEP	hill	.45	.93	cook	.01	.01					.07	.05
STEER	cow	.21	.52	drive	.11	.42					.06	.99
STERN	mean	.15	.72	boat	.10	.21					.07	.77
STEW	beef	.22	.89								.11	.00
STICK	gum	.14	.73	around	.01	.06	up	.03	.05		.16	.68
STILL	quiet	.09	.77	again	.02	.09	booze	.02	.06		.08	.82
STING	bee	.62	.82	music	.04	.09	police	.02	.03		.07	.63
STIR	fry	.20	.91	crazy	.02	.04					.06	.23
STITCH	sew	.52	.86	cramp	.01	.02					.12	.13
STOCK	market	.18	.39	car	.07	.39	cows	.05	.12	.03	.08	1.58
STOLE	thief	.09	.78	fur	.07	.13					.09	.60
STORE	buy	.09	.50	room	.07	.26					.23	.93
STORY	book	.35	.97	two	.01	.02					.02	.12
STRAIN	stress	.07	.69	noodles	.04	.25	culture	.01	.03		.04	.99
STRAND	hair	.58	.80	island	.04	.13					.07	.58
STRAW	hat	.28	.61	drink	.12	.31					.08	.92
STRAY	cat	.55	.88	away	.01	.05					.07	.28
STRESS	school	.15	.84	this	.01	.02					.15	.13
STRIKE	hit	.21	.35	out	.12	.30	workers	.04	.25	.02	.08	1.69
STRIP	tease	.13	.81	paper	.03	.12					.07	.55

Homograph Association Norms (Continued)

Homograph	Primary 1	P1	M1	Primary 2	P2	M2	Primary 3	P3	M3	R	X	U
WOUND	hurt	.29	.77	up	.07	.19					.04	.71
YARD	grass	.14	.63	stick	.15	.29					.08	.90
YARN	wool	.24	.88	story	.02	.04					.08	.24
YELLOW	green	.14	.95	coward	.02	.03					.02	.20
YIELD	stop	.39	.90	crop	.01	.07					.03	.37
YOKE	egg	.60	.68	ox	.07	.27					.05	.86
ZEST	soap	.78	.82	life	.05	.15	lemon	.01	.01		.02	.70

Note—Primary1, Primary2, Primary3 = primary associate to the first, second, and third most frequent meanings. P1, P2, P3 = proportion of primary associate responses to the homograph for the first, second, and third most frequent meanings, respectively. M1, M2, M3 = proportion of responses to the homograph for the first, second, and third most frequent meanings, respectively. R = proportion of responses to the homograph for all remaining meanings, if any. X = proportion of Unclear responses (see text for description). U = overall ambiguity of the homograph, in terms of uncertainty of information.

APPENDIX B

Polarized and Balanced Homographs

Polarized Homographs				Balanced Homographs			
ANGLE	FAST	KEY	SHIP	BAT	DRAFT	MIGHT	SEAL
ANNUAL	FILM	KIND	SHOWER	BEING	DRAG	MISS	SHED
ARM	FINISH	LEAF	SHUTTLE	BOND	EXCISE	MODEL	SLING
BALL	FIRE	LEFT	SIDE	BOW	FALL	NAIL	SMELT
BLUE	FIX	LIP	SKIRT	CAPE	FIT	NUT	SOW
BOIL	FLAT	LIST	SOCK	CARD	FLY	ODD	SPOT
BOX	FLIGHT	MIND	SPARE	CASE	FORM	ORGAN	STEER
BRUSH	FOOT	NAG	SPEED	CAST	FOUL	PANEL	STOCK
COAT	FRAME	PEN	STAGE	CELL	FREE	PARK	STRIKE
COVERED	GAME	PET	STAND	CHANGE	GLARE	PASS	TAB
CRAB	GAS	PILE	STIR	CHARM	HATCH	PAWN	TAG
CRUST	GERM	PLANT	STITCH	CHECK	HOOD	PICKET	TAP
DEEP	GRADE	PRIME	STORY	CHINA	HULL	PIPE	TART
DEPOSIT	GRAVE	PRUNE	STRAY	CHOP	HUSKY	PITCHER	TERMINAL
DESERT	GREEN	RACE	STRESS	CHUCK	INTEREST	POACH	TICK
DIAMOND	GRILL	REAR	SUIT	COMPANY	IRON	POINT	TIE
DIE	GRIND	REEL	SWITCH	COPY	ISSUE	RANGE	TIP
DIRT	HAM	RESORT	TIRE	COURT	LIMP	RARE	VICE
DOWN	HEAD	RIB	TOLL	CRANE	LOUNGE	REFLECT	WELL
DRIP	HEAT	RICH	TOOL	CRICKET	MARBLE	RIGHT	WILL
DRIVE	HOUND	ROSE	TOP	DATE	MARCH	RUNG	
DROVE	INCLINE	SASH	TURN	DIGEST	MASS	SCALLOP	
DUMP	JAM	SCOOP	YARN				
FARE	JAR	SCRUB	YELLOW				

(Manuscript received April 29, 1992;
revision accepted for publication June 4, 1993.)