Norms as a tool for the study of homography

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Four continuous word associations to each of 107 homographs were obtained from 50 male and 50 female undergraduates. Included in the word sample were 12 nonhomophonic homographs (heterophones). The data were analyzed to derive two indexes. A dominance score was defined on the basis of the frequency that a particular meaning was associated to each homograph. A stability score was a measure of the likelihood that the continuous associations were consistent with the first associate. Norms were provided for these measures. Comparison of heterophones to homophones indicates that the former are significantly more stable.

A large proportion of English words have principal meanings ranging in distinctiveness from shades of meaning that add precision to communication to examples of nonoverlap of the attributes of a single homographic entry with the sole exception of the orthographic representation (e.g., "bass," which denotes specific meanings, i.e., as a fish and in relation to music, and is pronounced as bass or bass to correspond to the meaning). The existence of polysemy has provided a fertile ground for speculation and research for students of language and the structure and utilization of knowledge.

In our review of possible factors that influence performance in situations involving homographs, we find two main factors of interest. One of these has been attended to in a number of studies, this being the variable of associative dominance. Such a measure is defined on the basis of word association data as the proportion of subjects who produce first associations related to a particular meaning of a homograph. A second variable of interest is the stability of the association. One study in the literature has had that variable as its principal focus. Geis and Winograd (1974) define stability on the basis of a repeated testing of the homograph in separate sessions at different times. In the present study, we adopt the procedure of Bilodeau and Howell (1965), asking for continued associations, and define a measure, "stability," on the basis of the sequential probability that associations to a particular homograph differ in their meaning.

The present study also includes a particular class of homographs, those whose meanings have different pronunciations, that is, are nonhomophonic ("heterophones"). Heterophones are of particular interest, because in print they are ambiguous; nevertheless, the meaning referred to by a subject is clear when the subject is required to pronounce the item. (See Warren & Warren, 1976, for an illustration of this use.) Since

heterophone pronunciation provides excellent pointer readings to their meanings, it is of particular interest to examine how heterophones compare to homographs. They will be useful in our attempts to elucidate polysemy to the extent that they are comparable to homophonic homographs. None of the available norm tables (Cramer, 1970; Geis & Winograd, 1974; Perfetti, Lindsey, & Garson, Note 1) provides information on more than a few heterophones.

The sophisticated researcher of traditional human verbal learning and memory must carefully select materials and cautiously seek to apply conclusions only in the realm of the normative frequencies manipulated. The absence of such caution has on more than one occasion led to findings that were misleading, as in the experiments involving mixed vs. unmixed designs (Twedt & Underwood, 1959). An examination of the literature with respect to homographs indicates, however, little systematic attempt to investigate the range of homography. Although some studies employ either available norms or locally generated norms (cf. Yates, 1978), other studies report that they use homographs whose two meanings "appeared about equal" (Schvaneveldt, Meyer, & Becker, 1976). Those studies that have employed normative information have tended to restrict their application of the data to a limited range of the possible variations in homographs generally in the 50% to 65% range of dominance. Nevertheless, researchers show a strong tendency to generalize their conclusion to the full range of homography. The most systematic attempt to look at the full range of homographs (Tanenhaus, Leiman, & Seidenberg, 1979) uses dictionary information exclusively, and not cultural norms, in evaluating hypotheses with respect to homograph access.

METHOD

Materials

A number of words were selected from a variety of sources, including previous norm-gathering attempts (Geis & Winograd, 1974; Perfetti et al. Note 1), that were judged by the experimenters to have two distinct meanings in common use. Materials were selected in an effort to include a full range of ambiguity when words were presented for association without a context sufficient to disambiguate them. A full range of dominance was

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desired, from words having both meanings of equal frequency to words having one meaning occurring as an association 100% of the time. Twelve additional homographs¹ were included that possessed the unique feature that, when they were uttered, the pronunciation was sufficient to disambiguate the two meanings, as in *bäss*, a fish, or *bäss*, a musical sound in the low range. An additional number of words judge by the authors to be relatively nonambiguous were selected as filler items. Three filler words were selected for each homograph. (Subsequent analysis of data obtained indicated several words chosen to be unambiguous were in fact homographic. These were included in the data reported.)

Test Booklets

Five homographs and 15 filler words were assigned to each test page. The position of the homographs were random on the page with respect to order, and each page was examined to try to minimize the possibility that any of the filler items would be related to either expected meaning of the homographs. Test booklets were created containing seven pages, which in pilot work seemed to be about the number of pages a subject could do in the time available. Three sets of test booklets were prepared to exhaust the item pool. Pages within booklets were in random order.

Procedure

Subjects were tested in small groups in a classroom. The procedure was similar to that of Bilodeau and Howell (1965). Each subject was given a test booklet that contained seven pages of 20 lines. Each line contained a single word repeated four times, with each repetition followed by an underlined space in which subjects were to write their answer. Subjects had written instructions that appeared on the cover page of the booklet, which also requested they indicate their age and sex. The instructions centered on the cover page are shown in Figure 1. Unlimited time was allowed.

Subjects

The testing continued until we had 50 male and 50 female students' responses to each of the words under study. Slightly in excess of 150 male and 150 female Adelphi undergraduates under the age of 25 years served in the experiment to fulfill a course requirement. Each student contributed information on about 35-40 ambiguous words.

Scoring

Two raters were employed to score the materials.² A small sample of words were scored by both raters, and since agreement tended to be very high (almost 100%), most of the data represent the scoring of a single rater. The rater examined first associations to each letter string to find classifications for these associations. All but 11 of the 107 homographs could be classified as having two distinct meanings; the others had three or four principal senses.

RESULTS

The data were analyzed separately for the 50 male and 50 female subjects and then combined for certain analyses. Two main measures were derived from the raw data. The first was a dominance measure: Each meaning of a homograph was scored with respect to dominance, that is, the percentage of subjects whose first association corresponded to that particular meaning. For example, 38 of the 50 female subjects produced first associations to the homograph "bark" that were related to its meaning as "animal cry." This was considered the primary meaning and received a dominance score of 76. The 12 remaining subjects' first associations denoted a "tree covering." This was considered the secondary meaning and received a dominance score of 24. The second was a stability-of-meaning measure: The first association to each homograph determined its dominance. The participant then gave three additional associations to each homograph. The stability score represents the proportion of individuals who did not change the meaning of these additional associations from their first meaning. Thus, in the example above, of the 38 females who had a first association of "animal cry" to "bark," 10 individuals did not alter their meaning over the three remaining associations. The stability score is 15/38 or 40%.

Sex Differences

Our first comparisons were for the effect of the sex of the subject. For the purpose of this analysis, only the 96 words that could be classified as having two meanings were employed. A correlation coefficient between the male and female norms was obtained and the regression-line predictions from one sex to the other.

The measures of dominance correlated .953 ($df = 190$), and the respective stability scores correlated .806. The analysis of regression lines predicting dominance score from one sex to the other showed six words having significant (>2) standard residuals from both prediction lines (male from female and vice versa). Of the six, four were cases of more extreme dominance in one sex or the other (see Table 1). Only two items were of opposite polarity: "deed" and "iron."

This booklet contains many words. Look at a word
and write the first word it makes you think of.
The words are printed four times. Write a different
word for each; do not repeat.
Here is an example:

BITTER sweet BITTER sour BITTER taste BITTER lemon

DO NOT SKIP ANY WORDS. WORK RAPIDLY, BUT LEGIBLY.
WORK FROM LEFT TO RIGHT.

Figure 1. Instructions from cover page.

Table 1
Items That Differ Between the Sexes

Homo-graph	Male		Female	
	Dominant Sense	Score	Dominant Sense	Score
Capital	Major	66	Major	90
Charge	Related to Price	54	Related to Price	80
Deed	Legal Document	54	Action	66
Iron	Metal	74	Press Clothes	62
Mint	Flavor	68	Flavor	96
Pit	Hole	72	Hole/Fruit Stone	50

Dominance and Stability

Although we obtained slight sex differences as described above, it did not seem necessary to eliminate any items for our analysis of the general relationship between homograph dominance and stability. Accordingly, we combined the performance of the two groups by averaging their respective measures on dominance and stability. The obtained correlation between dominance and stability in the combined sample was $r = .813$ ($df = 190$). An examination of the line of best fit predicting stability from dominance revealed an interesting effect. Of the 24 points (12 items by two response types for each) for the heterophones, 22 fell above the regression line. We therefore analyzed the data separately for the 12 heterophonic and 84 homophonic homographs.

In the case of the 84 homophones, the correlation between dominance and stability ($r = .838$, $df = 166$) indicates that knowledge of dominance will enable us to account for 70% of the variance in the stability measure. Similarly, for the 12 heterophones, the obtained correlation ($r = .845$, $df = 22$) accounts for 70% of the variance in the much smaller number of cases.

Table 2 presents the norms for the combined male and female samples. Examination of the scores clearly shows that the heterophone items are more stable in meaning than are items of equal dominance.

Regional Differences

Geis and Winograd (1974) have provided norms for Emory University (Atlanta, Georgia) for 50 homographs based on the responses of 68 undergraduates (sex unspecified). Of these 50 items, 45 had been included in norms gathered at Adelphi. However, two words had been eliminated on the basis of pilot work: "sage," since less than 75% of Adelphi undergraduates could produce a single classifiable association to that string, and "volume," which had elicited three distinct meanings in a pilot study. Three additional words, "club," "sole," and "toll" had produced four, three, and three distinct meanings, respectively, at Adelphi and, therefore, were omitted from the comparison. It should be noted that Geis and Winograd report only the classification of the first two associations in terms of dominance in their table.

A total of 42 words (84 meanings) remained common to the two studies. The obtained correlation (.904) for dominance was quite satisfactory. The regression line predicting Emory scores from the Adelphi sample was computed, and those items that showed a high standard residual (2 or greater) were examined for the nature of the difference. Three such items were discovered: "organ," "pot," and "right." Of these, the word "organ" was not quite as extremely polarized toward "musical instrument" in the Adelphi sample, whereas the other two showed reversal in dominant meaning. While "pot" produced first associations that can be classified as "kitchen utensil" in 77% of the Emory sample, 52% of the Adelphi group produced associations related to "marijuana." Finally, "right" produced a preponderance (82%) of associations scorable as meaning "correct" in the Atlanta sample, but 65% of the Long Island sample produced responses to "right" as a "direction" (i.e., as opposed to "left").

The Pittsburgh norms of Perfetti et al. (Note 1), based on a sample of 100 undergraduates, overlapped

Table 2
Dominance and Stability Scores for 96 Homographs

Homograph	Primary Meaning	Dominance	Stability	Secondary Meaning	Dominance	Stability
ADMIT	Acknowledge	65	60	Let In	35	51
ARMS	Appendages	94	82	Weapons	6	17
ARTICLE	Written Piece	74	72	Item	26	15
BAND	Group of People	84	65	Circular Strip	16	0
BANK	Depository	99	93	River Side	1	0
BARK	Animal Cry	78	33	Tree Cover	22	14
BASS*	Instrument	69	72	Fish	31	61
BAT	Baseball Bat	54	29	Animal	46	45
BEAM	Ray of Light	67	48	Timber	33	58
BLACKJACK	Card Game	94	77	Bludgeon	6	57
BOIL	Bubble	97	86	Sore	3	0
BOWL	Concrete Object	55	56	Game	45	53
BOXER	Fighter	82	73	Dog	18	0
BREAD	Bakery Product	94	84	Money	6	0
BRIDGE	Construction	79	86	Card Game	21	10
CABINET	Furniture	95	93	Council	5	40
CALF	Baby Cow	72	68	Leg Muscle	28	4
CAPITAL	Major	79	70	Assets	21	19
CHANGE	Alteration	50	50	Coins	50	14

Table 2 Continued

Homograph	Primary Meaning	Dominance	Stability	Secondary Meaning	Dominance	Stability
CHARGE	Price	67	34	Attack	33	48
CLOSE*	Shut	51	62	Near	49	71
COACH	Instructor	65	75	Type of Transportation	35	46
COAT	Article of Clothing	94	81	Cover	6	0
CONDUCT*	Behavior	62	62	Guide	38	58
CONTENT*	Happy	54	76	Ingredient	46	70
COUNT	Add Numbers	80	45	Nobility	20	0
DEED	Action	57	37	Legal Document	43	60
DIAMOND	Jewel	98	96	Ball Field	2	0
DOVE*	Bird	95	97	Past Tense of Dive	5	40
DUCK	Animal	96	92	Dodge	4	25
EARTH	Planet	73	74	Dirt	27	4
EXPRESS	Mode of Transportation	92	72	Articulate	8	50
FANCY	Elegant	100	96	Idea	0	0
FAST	Quick	98	86	Hunger	2	0
FENCE	Enclosure	93	80	Sport	7	25
FIRM	Strong	87	72	Company	13	7
FLOUNDER	Fish	96	63	Be Unsteady	4	75
GRAVE	Burial Place	98	84	Serious	2	0
HEAD	Body Part	98	82	Chief	2	0
HIDE	Conceal	89	72	Animal Skin	11	45
HOST	Entertain	93	82	Eucharist	7	43
IRON	Metal	56	57	Press Clothing	44	45
LEAD*	Direct	53	74	Metal	47	53
LEAN	Without Fat	66	53	Incline	34	32
LETTER	Communication	85	81	Alphabet	15	7
LIE	Falsehood	78	65	Recline	22	18
LIKE	Affection	91	74	Similar	9	44
LIMP	Lame Walk	67	85	Not Stiff	33	63
MAD	Angry	58	52	Crazy	42	20
MARCH	Month	57	19	Walk	43	14
MATCH	Fire Stick	62	42	Pairing Act	38	29
MEAL	Food	98	96	Grain	2	0
MINT	Flavor	82	73	Money Mint	18	0
MINUTE*	Unit of Time	90	78	Tiny	10	60
MOLD	Fungus	60	45	Shape	40	68
MUG	Container	80	54	Assault	20	20
ORGAN	Musical Instrument	62	44	Body Part	38	46
PAGE	Leaflet	90	61	Messenger	10	0
PALM	Type of Tree	55	31	Part of Hand	45	42
PARK	Recreational Area	87	84	Leave	13	15
PEN	Writing Pen	98	85	Enclosure	2	0
PERCH	Mount	82	78	Fish	18	33
PICK	Instrumental Act	86	73	Tool	14	14
PIT	Hole	61	49	Fruit Stone	39	18
PITCHER	Ball Player	53	20	Container	47	23
PLAY	Recreational Activity	93	90	Drama	7	29
POKER	Card Game	98	83	Metal Rod	2	50
PORT	Commercial Port	87	67	Wine	13	0
POT	Marijuana	51	18	Container	49	39
PRIVATE	Personal	97	94	Military Status	3	0
PUPIL	Student	63	52	Part of Eye	37	5
RACE	Speed Contest	75	77	Ethnic Group	25	32
RASH	Skin Eruption	92	88	Hasty	8	25
REFUSE*	Deny	86	83	Waste	14	57
RIGHT	Direction	64	16	Correct	36	19
RING	Circular Form	84	54	Sound	16	25
SCOTCH	Drink	79	61	Nationality	21	5
SEAL	Animal	57	51	To Close	43	42
SEASON	Time of Year	98	86	Flavoring	2	0
SECOND	Ordinal Number	60	53	Unit of Time	40	33
SENTENCE	Grammar Unit	93	89	Penalty	7	0
SHIFT	Change	90	80	Time Period	10	40
SOW*	Plant	79	84	Pig	21	60
STABLE	Animal Pen	67	34	Steady	33	48
STERN	Strict Discipline	75	79	Boat Part	25	20
SWALLOW	Gulp	74	72	Bird	26	12
TABLE	Furniture	100	95	Schedule	0	0

Table 2 Continued

Homograph	Primary Meaning	Dominance	Stability	Secondary Meaning	Dominance	Stability
TEAR*	Cry	72	76	Rip	28	61
TIRE	Vehicle Part	96	86	Grow Weary	4	0
TOP	High Point	84	60	Toy	16	6
TRAIN	Transportation Vehicle	100	95	Teach	0	0
WATCH	Time Piece	73	27	Look Out for	27	19
WIND*	Weather	96	97	Twist	4	0
WOUND*	Injury	90	93	Past Tense of Wind	10	29
YARD	Three Feet	61	26	Plot of Land	39	49
YARN	Thread	95	88	Story	5	0

Note—Sample size ($N = 100$) is maximum score. *Heterophone (i.e., homograph for which pronunciation depends on meaning).

the Adelphi sample of homographs quite substantially (50 items) even when words that had produced more than two meanings had been eliminated.

Once again, we see a fair degree of commonality in response, although the correlation of dominance measures ($r = .825$) was somewhat smaller than between Adelphi and Emory. A test of deviations from the regression line predicting Pittsburgh dominance from Adelphi again showed three items with large standard residuals: "express," "park," and "right." The last followed the same pattern as the Emory-Adelphi difference, with "right" meaning "correct" being the predominant (91%) response in the Perfetti et al. norms. "Express," as opposed to "local," was seen as a form of transit by 92% of the Adelphi population, but only 48% of the Pittsburgh group produced a first association in that direction. Finally, "park" tended to connote a recreational area for the New Yorkers (87%), whereas 55% of the Pittsburgh sample saw it in relation to the act of leaving a car.

A closer examination of the individual items (see Table 3) indicates that there are five items that differed markedly in dominance between our sample and those of the other two schools: "organ," "pot," "right," "express," and "park." Of the five, the Emory and Adelphi samples differed to a large degree on all but one word, "park," and the Pittsburgh and Adelphi samples differed on the three cited: "express," "park," and "right."

A major purpose of the present study was to provide materials for the explanation of the relationship between dominance and stability. In addition to their association

measure, Geis and Winograd (1974) report a test-retest measure for semantic sense of associations. This would be equivalent to a stability score based on a change from first to second association in our norms, except that our subjects were required to produce more than one association, whereas Geis and Winograd's group could produce the same word on each occasion of testing. The semantic context of association was free to change in the Geis and Winograd norms from test to retest (the homograph was embedded in different words); in continuous association, any change in meaning must be self-generated. Nevertheless, for comparison purposes, we computed a second stability measure (Stability 2), the likelihood of no change in meaning from the first to second association by our subjects. The correlation between stability and Stability 2 for the 42 items (84 meanings) was .84.

The correlations between the Adelphi stability scores (stability and Stability 2) and the Emory test-retest measure, although statistically reliable, were fairly small ($r = .54$ and $r = .41$, respectively). In fact, the Geis and Winograd (1974) dominance score correlated more highly with the Adelphi score we have labeled stability ($r = .75$) than it did with the Emory stability score ($r = .64$). An examination of only the high dominant meanings of the homographs show that the Geis and Winograd words showed an overall tendency to keep the same meaning on retest of 85% and 82% of the Adelphi sample kept meaning constant from their first to second association. Since these words showed a mean stability index of 65.5%, this indicates that about 52% of the words that will change meaning at all do so on the first opportunity.

Table 3
Five Items Showing High Standard Residual in Using Adelphi Norms as a Predictor

Word	Adelphi		Emory		Pittsburgh	
	Dominant Sense	Percent	Dominant Sense	Percent	Dominant Sense	Percent
Express	Mode of Transport	92	Articulate	52*	Mode of Transport	63*
Organ	Musical Instrument	62	Musical Instrument	90*	Musical Instrument	59
Park	Recreational Area	87	Recreational Area	60	Leave Car	55*
Pot	Marijuana	51	Kitchen Utensil	77*	Marijuana	55
Right	Direction	64	Correct	82*	Correct	91*

*High standard residual compared to Adelphi.

DISCUSSION

The Norms

The major purpose of this study was to achieve a set of norms for homographs that would provide a range of materials for investigators of language. Homographs were viewed as varying in two ways that were potentially of importance in understanding meaning. Homographs vary in both their tendency to elicit an initial response related to a particular interpretation (dominance) and their tendency to maintain that meaning over subsequent associative attempts (stability).

The range of dominance in the norms for homographs varies quite nicely, with at least 10 words through each 10% of dominance, thus providing a full range of alternatives for the investigator. Our comparisons with other samples (South at Emory, and Mideast at University of Pittsburgh) indicates that while there are some regional differences, the degree of consistency is high enough to apply these norms to other college samples. It is suggested that the experimenter could detect some of the regional differences by examination. (The investigator will be, in most cases, a member of the language group; for example, the word "TAP" in New York is an acronym for Tuition Assistance Plan and, hence, has three meanings regionally.)

Heterophones

Because of the relationship between meaning and pronunciation, those nonhomophonic homographs called heterophones appear ideal for investigations of language and, in particular, the effects of semantic context on meaning. However, the comparison of these words in our norms suggests the need for some degree of caution in generalizing from heterophones to other words of the language. It is clear from the examination of our data that once a particular meaning is achieved, heterophones are significantly more stable than other homographs of equal dominance. How this might affect performance in language-based tasks would seem to be a fertile topic for investigation.

The basis of the heterophonic distinction in stability may be based on form of acquisition. To the degree that language is acquired aurally, it should not be surprising that the pronunciation difference is accompanied by a much higher degree of stability than that obtained for homographs of equal dominance. It could be interesting to compare this effect with norms from congenitally deaf individuals of the same degree of education. It should be noted that subjects in this study were not required to pronounce the items when producing their written associations to the printed stimuli.

Dominance and Stability

The correlation between dominance and stability is quite high in this study. Possibly, the true correlation is even higher, if we consider the unreliability in the com-

putation of the stability metric. The stability score is essentially a conditional probability; that is, it is based on the fact that one meaning has already been chosen, and it is the likelihood of change to the other meaning. In the case of the low end of the dominance scale, it would be based on only a small number of cases, and thus a small change in absolute frequency of change would produce a large change in stability. At the low end of the distribution, values obtained from the regression line might be a better estimate of the stability score of an item than the actual value in the study sample is.

The significant correlation of dominance and stability is consistent with the results reported by Geis and Winograd (1974), although our use of shifts in continuous association as a measure of stability differs from their measure of test-retest reliability. That stability and dominance are correlated for test and retest had also been established for nonhomographs in continuous association by Szalay and Deese (1978). Similar findings have been obtained for discrete associations (Howes, 1957).

Norms as Cultural Indicators

The norms themselves can serve as indicators of the knowledge of the (language) cultural group. Szalay and Deese (1978) have produced detailed arguments for this use of word association across languages. In our fairly cursory analysis of the data drawn from three universities, we have been able to detect some interesting differences and identify a large base of common understanding. Since the purpose of the present study was not a sociology of language, we will leave further analysis to those students and merely suggest that the available norms are well worth examining.

Further Research Required

As we mentioned in the introduction, while the question of the language use of homographs has been broad, little has been done to examine the range of polysemy. Studies that have purported to support dual access models of comprehension (i.e., initially, multiple meanings of a homograph are available, and then, the appropriate one is selected) are particularly vulnerable to artifact (see Hogaboam & Perfetti, 1975). A recent study of context effects, which seems to distinguish between a single appropriate meaning being available most of the time with an occasional lapse to the nonappropriate meaning and dual access all the time, is that of Onifer and Swinney (1981). Nevertheless, a test of the dual availability hypotheses with the full range of dominance (stability?) would enable us to distinguish which of these alternative possibilities are supported for all levels of dominance (stability). In the case of this occasional lapse hypothesis, the likelihood of a lapse to the nonprimed sense should be an inverse function of the dominance (stability) of the item tested. If high-dominant (95%) in-context items elicit as much secondary meaning as do

low-dominant (5%) in-context words, then the dual access hypothesis will have received convincing support.

Finally, the correlation between dominance and stability is quite high. A study making use of partial correlations or other regression techniques will be necessary to evaluate whether the two have separate psychological import. Of particular interest will be the relationship of the two variables to the differential effect of post-ambiguity interval reported by Onifer and Swinney. In their study, the meaning unrelated to context quickly loses its priming effect. Conceivably, rate of loss could be related to stability of meaning.

REFERENCE NOTE

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NOTES

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