AROUSAL STRENGTH OF SIGNAL WORDS

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Current standards and guidelines on warning design recommend the use of an appropriate signal word for the purpose of conveying the level of hazard involved. The three most frequently used signal words, DANGER, WARNING, and CAUTION, are often purported to convey high to low degrees of hazard, respectively. The first purpose of the present research was to examine whether these terms imply different levels of hazard. The second purpose was to determine whether an additional set of five terms that have been suggested in guidelines or used in previous research differs in connoted level of hazard. The third purpose was to explore the possibility of increasing the number of words that connote different levels of hazard. Participants rated a list of 84 potential signal words on six questions assessing strength, severity of implied injury, likelihood of implied injury, attention-gettingness, carefulness, and understandability. The results indicated that DANGER signaled greater strength or arousal than WARNING and CAUTION, but the results failed to show a difference between WARNING and CAUTION. Among the other words tested, DEADLY had the strongest arousal connotation and NOTE had the least. From the list of 84 terms, a "shorter" list of 20 signal words was selected based on measures of understandability, interpretation consistency, and conciseness. It is suggested that an expanded list of signal words might alleviate potential problems of habituation from overuse of the currently recommended terms.

Most current standards and guidelines on warning design recommend the use of signal words on warnings for the purpose of calling attention to the safety sign and conveying the degree of potential seriousness of the hazard. Usually the warning guidelines suggest

that signal words communicate two to four levels of hazard. The American National Standards Institute (ANSI, 1972) guidelines, *Z35.1*, recommend that the word DANGER be used to indicate hazards of immediate and grave peril and those capable of producing irreversible damage or injury. The word CAUTION is recommended for warnings that call attention to potential hazards that could result in severe but not irreversible injury or damage. Thus, ANSI recommends the term DANGER on warnings that are intended to communicate a greater level of hazard level than the word CAUTION.

Other guidelines advocate more than just two levels of hazard. The *Product Safety Sign and Label System* (FMC Corporation, 1985) recommends using DANGER, WARNING, and CAUTION, with the appropriate selection of the term based on the probability and degree of severity. The term DANGER is retained for warnings involving immediate hazards that *will* result in severe personal injury or death. WARNING is reserved for warnings involving hazards or unsafe practices that *could* result in severe personal injury or death. CAUTION is used for hazards or unsafe practices that could result in minor personal injury or product or property damage. A more recent draft of the ANSI (1988) guidelines, *Z535.4*, makes similar recommendations. The *Westinghouse Product Safety Label Handbook* (Westinghouse Printing Division, 1981) extended the list by adding a fourth term, NOTICE, indicating important information that does not involve potential risk or hazard.

Although a number of guidelines on signal words exist, only a few studies have investigated whether people actually perceive these words to have different connotations of hazard. That is, do people know that DANGER connotes a greater level of hazard than WARNING or CAUTION and that WARNING connotes a greater level of hazard than CAUTION? Research on this is equivocal. Bresnahan and Bryk (1975) found that DANGER implies greater hazard levels than CAUTION. Leonard, Matthews, and Karnes (1986), however, found no significant differences among DANGER, WARNING, or CAUTION on perceptions of risk. Other research has also failed to find differences between experimental conditions in which signal words were manipulated (e.g., DANGER vs. CAUTION vs. no signal word in Ursic, 1984; WARNING vs. NOTE in Wogalter et al., 1987).

In recent research, Leonard, Karnes, and Schneider (1988) found a strong positive relation between ratings of a set of symbols and the words DEADLY, DANGER, WARNING, CAUTION, BE CAREFUL, and ATTENTION. In a follow-up report, Leonard, Hill, and Karnes (1989) found that people could appropriately assign the five words DEADLY, DANGER, WARNING, CAUTION, and ATTENTION to a set of hazard scenarios that had been previously rated on risk. However, it was not clear from either of these studies whether there were significant differences in arousal strength among the words.

Thus, research has not strongly substantiated the recommendations of current warning standards and guidelines. The current study had three objectives. Because three levels of signal words, DANGER, WARNING, and CAUTION, are recommended in warning guidelines for conveying high to low degrees of hazard, one purpose was to determine whether these terms differ in implied or connoted strength. Because several other words have also been recommended or used in research, a second purpose was to determine whether they too differ in implied hazard level.

The third purpose was to explore the possibility of enlarging the number of potential signal words. Given the limited number of signal terms that are usually recommended, overuse is possible. That is, the terms might be seen so frequently on various hazards that people are habituated to them. Thus, with continued exposure, the signal words may no longer attract attention (Cowan, 1988). For example, consider the industrial worker who is frequently exposed to the term DANGER in the course of using job-related equipment. Suppose that some newer equipment presenting an even greater hazard than the older equipment is introduced into the workplace. According to the standards, the signal word DANGER should be used on warnings for the newer equipment to convey the maximum level of hazard. Because of prior overexposure, the term DANGER may no longer attract attention and may therefore fail to adequately communicate the hazardousness of the new equipment. Clearly, it would be desirable to substitute another term to cue the hazard. In the present research an objective procedure was planned a priori to select a list of potential signal words, using criteria taken from warning design guidelines.

Method

Subjects

Twenty-eight University of Richmond undergraduates from an introductory psychology course participated to satisfy a research requirement. Another group of 34 undergraduates participated in a subsequent study for the purpose of obtaining rating reliabilities.

Materials and Stimuli

A list of potential signal words was selected from *Roget's College Thesaurus* (Morehead, 1982) and a synonym dictionary (Devlin, 1982). From this initial selection, 111 terms potentially representing a wide range of implied strength were obtained. Only single terms were included in the first list (e.g., the term CAREFUL was used instead of BE CAREFUL; cf. Leonard et al., 1988). Words that appeared inappropriate for signaling warnings were deleted from further consideration (e.g., WOUND, CALAMITOUS, IMPAIR). This determination was made by three judges (Michael S. Wogalter, N. Clayton Silver, and an undergraduate research assistant). Words could be deleted at this stage only if all three judges agreed to its unsuitability as a signal word. Unsuitability was defined as the inability to imagine any kind of warning using the term as a signal word. The retained list of 84 terms is shown in Table 1.

These terms were arranged into four random orders and presented to the participants, who rated the terms on six questions. Responses were based on 9-point Likert-type scales, ranging from 0, denoting absence of quantity, to 8, indicating maximum quantity. The questions and anchors were as follows:

1. "What is the *strength* of this term?" The anchors were 0 (not at all strong), 2 (slightly strong), 4 (strong), 6 (very strong), and 8 (extremely strong).
2. "What is the *severity of injury* implied by this term?" The anchors were 0 (not severe), 2 (slightly severe), 4 (severe), 6 (very severe), and 8 (extremely severe).
3. "What is the *likelihood of injury* implied by this term?" The anchors were 0 (never), 2 (unlikely), 4 (likely), 6 (very likely), and 8 (extremely likely).
4. "How *attention-getting* is this term?" The anchors were 0 (not at all attention-getting), 2 (slightly attention-getting), 4

TABLE 1   Alphabetical List of the 84 Words Rates by Participants

ACIDIC	HALT	POISON
ADMONITION	HARMFUL	POISONOUS
ALARM	HAZARD	PRECARIOUS
ALERT	HAZARDOUS	PRECAUTION
ATTENTION	HEED	PREVENT
	HOT	PROHIBIT
BEWARE		PROHIBITED
	IMPERATIVE	
CAREFUL	IMPORTANT	QUARANTINED
CAUSTIC	INFECTIOUS	
CAUTION	INFORMATION	REFRAIN
CEASE	INJURIOUS	RELEVANT
COMPULSORY		REMINDER
CONSEQUENTIAL	JEOPARDIZE	REQUIRED
CONTAMINATION		REQUISITE
CORRODE	LETHAL	RISKY
CORROSIVE		
CRITICAL		SERIOUS
CRUCIAL	MANDATORY	SEVERE
	MEMORANDUM	SIGNIFICANT
		STOP
DANGER	NECESSARY	SUGGESTION
DANGEROUS	NEEDED	SUSPEND
DEADLY	NEVER	
DESTRUCTIVE	NO	TOXIC
DIRECTIONS	NOTE	
DISASTROUS	NOTICE	UNPREDICTABLE
DISCONTINUE	NOTIFICATION	UNPROTECTED
DON'T	NOXIOUS	UNSAFE
		UNSOUND
ESSENTIAL	OBLIGATORY	URGENT
EXPLOSIVE		
	PARAMOUNT	VITAL
FATAL	PERILOUS	
FORBIDDEN	PERTINENT	WARNING

(attention-getting), 6 (very attention-getting), and 8 (extremely attention-getting).

5. "How *careful* would you be after seeing this term?" The anchors were 0 (not at all careful), 2 (slightly careful), 4 (careful), 6 (very careful), and 8 (extremely careful).

6. "How *understandable* is this term? In making your rating

please consider whether the term would be understood by ALL people in the general population (including young children, visiting foreigners, etc.)?" The anchors were 0 (not at all understandable), 2 (somewhat understandable), 4 (understandable), 6 (very understandable), and 8 (extremely understandable).

Procedure

Every participant received a different order of the six questions and one of four random orders of the terms. Participants were first told to read the entire list of terms to familiarize themselves with the variety of words listed. Next they were told to work on one question at a time and to rate all words on that particular question before beginning the next question. Participants were told that even though some of the values on the scales had verbal anchors, they could use any whole number from 0 to 8.

Results

Intercorrelations

The first set of analyses examined the intercorrelations of signal word means (collapsed across participants) for the six questions. Table 2 shows that responses to five of the six questions (except understandability) are highly intercorrelated (rs ranged from .90 to .96). Correlations with understandability, although positive and significant ($ps < .05$), were considerably lower.

To check the reliability of these data, another group of 34 undergraduates rated the 84 words on understandability, strength, and carefulness. The reliabilities of the ratings with the first group of participants were .93, .96, and .95, respectively. Among the second group of participants, strength and carefulness ratings were highly correlated ($r = .94$). Strength and carefulness were also significantly correlated with understandability, but the magnitudes were lower ($rs = .60$ and .51, respectively; $ps < .05$).

Arousal Strength Measure

The high intercorrelations among five of the questions in the original sample indicated that they were measuring a similar dimension

TABLE 2 Intercorrelations of Mean Signal Word Ratings Among Questions

	Strength	Severity of injury	Likelihood of injury	Attention-getting	Carefulness
Severity of injury	.93	—			
Likelihood of injury	.92	.96	—		
Attention-getting	.96	.93	.90	—	
Carefulness	.94	.96	.96	.93	—
Understandability	.34	.25	.32	.38	.32

of judgment. This overall dimension could be termed *arousal strength*. Further confirmation of the similarity among the responses for these five questions came from a repeated-measures analysis of variance (ANOVA) that indicated no significant differences, $F(4, 108) = 1.84$, $p > .05$. Because the five questions did not differ, these data were averaged, creating a single set of 84 *overall* arousal strength (mean) scores. These arousal strength scores are used in later analyses to simplify the presentation of results.

Objective Word Measures

The word-rating data were also examined with respect to objective characteristics of the words: frequency of use in the English language (Francis & Kucera, 1982; Thorndike & Lorge, 1944) and numbers of letters and syllables in the words. Understandability was positively related with word frequency (Thorndike–Lorge count, $r = .52$, $p < .0001$; Francis–Kucera count, $r = .43$, $p < .0001$) and was negatively related to the number of letters ($r = -.49$, $p < .0001$) and the number of syllables ($r = -.46$, $p < .0001$) in the words. Thus, the most understandable words have fewer letters and fewer syllables and are used most frequently. However, the correlations of the objective word measures and the five arousal strength questions were much smaller: With the Thorndike–Lorge count, the *r*s ranged from $-.04$ to $.03$; with the Francis–Kucera count, the *r*s ranged from $-.02$ to $.05$; with the number of letters, the *r*s ranged from $-.30$ to $-.18$; and with the number of syllables, the *r*s ranged from $-.27$ to $-.18$.

Three Standard Signal Words

One primary interest was to determine whether the three commonly recommended signal words connote different levels of hazard. DANGER, WARNING, and CAUTION had mean arousal strengths of 6.09, 5.31, and 5.26, respectively. A one-way, repeated-measures ANOVA indicated a significant effect of signal word, $F(2, 54) = 11.94$, $p < .0001$. Subsequent Newman–Keuls range tests showed that DANGER produced significantly higher arousal than either WARNING or CAUTION (both $ps < .05$), and that WARNING and CAUTION did not differ ($p > .05$). The ratings for each of the five arousal questions were also examined separately. The ANOVAs were significant for severity of injury, $F(2, 54) = 13.01$, $p < .0001$; likelihood of injury, $F(2, 54) = 6.59$, $p < .003$; and carefulness, $F(2, 54) = 5.89$, $p < .005$. Subsequent Newman–Keuls range tests for these effects showed that the only significant differences were between DANGER and WARNING and between DANGER and CAUTION ($ps < .05$).

Rated understandability of the terms was also examined. The means for DANGER, WARNING, and CAUTION were 6.86, 6.46, and 6.14, respectively. A repeated-measures ANOVA indicated a significant effect of word, $F(2, 54) = 5.78$, $p < .006$. Subsequent Newman–Keuls range tests showed only one reliable difference: DANGER was rated significantly more understandable than CAUTION ($p < .05$).

Additional Words

Another interest of the present research was whether several other terms that have been recommended in guidelines or used in previous research differ. In these analyses, five additional words, DEADLY, CAREFUL, ATTENTION, NOTICE, and NOTE, were added to the data set that included DANGER, WARNING, and CAUTION. The arousal strength means for DEADLY, CAREFUL, ATTENTION, NOTICE, and NOTE were 7.34, 3.81, 3.45, 2.80, and 2.12, respectively. A repeated-measures ANOVA indicated a significant effect of word, $F(7, 189) = 83.02$, $p < .0001$. Subsequent Newman–Keuls range tests showed that all differences among the arousal strength means were significant (ps

< .05), except between ATTENTION and CAREFUL and, as indicated earlier, between WARNING and CAUTION.

The understandability means for DEADLY, CAREFUL, ATTENTION, NOTICE, and NOTE were 6.07, 6.50, 6.29, 5.25, and 5.50, respectively. The ANOVA showed a significant effect of word, $F(7, 189) = 5.84$, $p < .0001$). Subsequent Newman–Keuls range tests showed that NOTICE was rated significantly less understandable than all of the other words except NOTE. In addition, NOTE was judged to be significantly less understandable than WARNING, CAREFUL, and DANGER (ps < .05). There were no other reliable differences.

"Short" List of Signal Words

Efforts were also directed to the development of a "short" list of signal words that covered a range of implied strength. The selection process began with the 84-word list. The objective criteria used to select the shorter list of words involved measures of understandability, interpretation consistency, and conciseness. Terms that received mean understandability ratings in the bottom one third of the list were deleted. Related to understandability is interpretation consistency. It is desirable to have terms that people interpret in the same way. High variability of the ratings suggests that people have differing perceptions of the terms. An overall measure of variability was computed by summing the variances for the five individual arousal questions and dividing by 5 (the number of arousal questions). The square root of this average variance was considered the standard deviation. Terms for which the standard deviation exceeded an apparent breakpoint in the data were deleted ($SD = 2.0$). Another measure of understandability is frequency in the language. Terms were deleted for which Thorndike and Lorge (1944) and Francis and Kucera (1982) indicated very infrequent occurrence (less than 2 per million words) in the English language. Last, words were selected with respect to their conciseness. Because the size of a signal word affects its salience (i.e., larger type is more discriminable) and label or sign space is often limited, terms with more than seven letters were deleted. Using these criteria, a "short" list of 20 signal words was formed from the original list of 84. This list is shown in Table 3, ordered on arousal strength. This table shows the means and standard deviations for the arousal strength measure and the individual questions.

TABLE 3 Twenty Selected Words Ordered on Arousal Strength

Word	Arousal strength		Strength		Severity of injury		Likelihood of injury		Attention-getting		Carefulness		Understand-ability	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
NOTE	2.12	1.90	2.46	2.03	1.61	1.97	1.64	1.45	2.57	1.93	2.32	2.07	5.50	2.12
NOTICE	2.80	1.87	2.89	1.59	2.39	1.99	2.75	1.90	2.96	2.03	3.00	1.80	5.25	1.65
NEEDED	3.16	1.92	3.29	2.03	2.86	1.69	2.82	1.79	3.25	1.55	3.57	2.40	5.86	1.74
PREVENT	3.67	1.93	4.21	1.59	3.25	1.97	3.36	2.38	3.71	1.70	3.82	1.89	4.86	1.92
CAREFUL	3.81	1.98	3.96	2.19	3.32	1.96	3.54	1.99	3.57	1.79	4.68	1.96	6.50	1.26
ALERT	4.47	1.95	4.89	1.97	3.93	1.65	4.36	1.97	4.82	1.98	4.36	2.13	5.61	1.55
ALARM	5.19	1.75	5.61	1.71	4.64	1.99	5.04	1.69	5.32	1.59	5.36	1.75	5.96	1.64
CAUTION	5.26	1.82	5.32	1.85	4.79	1.75	5.50	1.67	5.32	1.76	5.39	2.06	6.14	1.43
HARMFUL	5.26	1.76	4.86	1.82	5.50	1.75	5.68	1.66	5.07	1.74	5.21	1.83	5.93	1.58
WARNING	5.31	1.73	5.39	1.99	5.18	1.83	5.07	1.58	5.39	1.83	5.50	1.35	6.46	1.67
BEWARE	5.41	1.78	5.32	1.95	5.46	1.43	5.36	1.70	5.50	1.75	5.39	2.01	6.57	1.91
URGENT	5.41	1.84	6.00	1.83	4.93	1.82	4.21	2.35	5.86	1.63	6.04	1.43	5.43	1.55
SERIOUS	5.51	1.72	5.46	1.44	6.04	1.62	5.50	1.75	4.79	1.81	5.79	1.93	6.07	1.58
SEVERE	5.55	1.70	5.89	1.59	5.68	1.39	5.75	1.92	4.93	1.74	5.50	1.79	4.25	1.69
VITAL	5.80	1.84	6.36	1.39	5.68	1.76	5.43	2.28	5.86	1.82	5.68	1.81	4.18	1.59
HAZARD	5.84	1.68	6.04	1.60	5.54	1.86	5.68	1.83	5.79	1.66	6.18	1.39	5.21	2.02
DANGER	6.09	1.86	5.89	2.02	6.14	1.69	6.04	1.83	6.00	2.09	6.36	1.61	6.86	1.56
POISON	6.74	1.69	6.54	1.37	6.79	1.87	6.75	1.69	6.64	1.81	7.00	1.63	6.93	1.46
FATAL	7.20	1.44	7.54	.69	7.39	1.57	7.07	1.30	7.04	1.35	6.96	1.97	5.75	2.01
DEADLY	7.34	1.32	7.11	1.59	7.68	.86	7.29	1.46	7.11	1.47	7.54	1.07	6.07	1.98

Discussion

The results showed that DANGER implies a more serious level of hazard than the word CAUTION, confirming Bresnahan and Bryk's (1975) finding. The results also showed that DANGER implies greater hazard than WARNING. However, the results failed to show that WARNING implies greater hazard than CAUTION. Thus, the purported difference between the terms WARNING and CAUTION in current standards and guidelines was not supported in the current research. Apparently, the participants did not meaningfully discriminate between the terms with regard to hazard level. One possible reason for the commonality of WARNING and CAUTION is that lay people may process their meaning using similar semantic information. Dictionary definitions usually reflect semantic or lexical connotations of terms acquired from actual usage in the language. In lexical terms, WARNING is defined as "something serving to warn, caution, or admonish" and CAUTION means "a warning or admonition" (*New Webster's Dictionary of the English Language,* 1975). People have probably acquired similar connotations for these two words from personal experiences rather than from information received directly from warning signs.

The present research also examined the arousal strength of an additional set of five words because they had been used in previous research or recommended in guidelines. Analysis showed that the word DEADLY had significantly greater arousal strength than the other terms. NOTE and NOTICE implied the lowest levels of hazard. All of the words showed a range of different arousal strength levels, except between ATTENTION and CAREFUL and between WARNING and CAUTION. The ordering of words corroborates the rankings of Leonard et al. (1988), although the rank order of ATTENTION and CAREFUL (or BE CAREFUL; cf. Leonard et al., 1988) was reversed.

The intercorrelations among the five arousal-related questions were substantial, indicating that the dimensions evoked quite similar perceptions. Apparently, greater word strength reflects not only a greater sense of injury likelihood and severity, but also the potential precaution a person might take. That words of greater strength connote greater hazard and promote intentions to behave cautiously is desirable. Their association suggests the potential of warnings in reducing injury by promoting safe behavior.

Current warning guidelines recommend using a limited number of words to signal a wide range of hazards. Consequently, the arousal quality of the words might be reduced with continued or repeated exposure. In short, habituation is a potential problem. One way to alleviate possible habituation effects is to use a word having the appropriate arousal strength but greater novelty than an existing term. For this purpose, a list of 20 words that semantically connote a range of hazard was developed based on measures of understandability, interpretation consistency, and conciseness. Recall the situation presented earlier in which newer, more dangerous equipment is introduced into a workplace already having many pieces of equipment with warnings possessing the term DANGER. The term DANGER may no longer be useful in communicating extreme levels of hazard because of its overexposure. In this situation, another term might be considered, for example, DEADLY or FATAL. However, there is also a potential tradeoff between people's habituation to a limited set of terms and the notion that with consistent use the terms will be properly interpreted. Children and other groups of people who do not have a strong command of English might have difficulty understanding the hazard connotations of a larger list of words, and thus a shorter list may be justified. In addition, several other important factors must be kept in mind when selecting the appropriate signal word: the hazard involved (the severity of injury), the suitability of the word (POISON makes no sense on an electrical hazard), personal factors (target group's knowledge and familiarity), and environmental factors (circumstances and surroundings). Progress on the factors related to signal-word selection for given hazards is beginning. For example, Leonard et al. (1989) have recently reported that people can appropriately and consistently assign signal words to a set of hazards. However, it should be emphasized that further testing is needed before any firm recommendations can be made regarding signal word selection.

Last, there are three additional limitations to consider when interpreting the results of the present study. The first is that the signal words were presented out of context. Participants rated a series of words, which makes it difficult to know the words' arousal quality when placed in real-world settings. Further evaluation of signal words is needed to determine whether the level of hazard

connoted by the word changes with respect to the perceived hazard of the product, the situation, and the rest of the warning information. Similarly, perceptions of product or situation hazardousness might be influenced by the level of signal word used. If so, this would be important in situations where a product is perceived to be less hazardous than it really is. Would adding a stronger signal word raise hazard perceptions to the appropriate level?

The second limitation is that the sampled population was limited to college students. However, it should be noted that the current results agree with the differential hazard interpretation of DANGER and CAUTION found by Bresnahan and Bryk (1975), using industrial workers. In addition, because selection of the 20-word list was primarily based on measures of understandability, it seems likely that the meaning of these terms will be recognized by large segments of the population. Indeed, according to a standard text for elementary school teachers (Johnson, Moe, & Baumann, 1983), the grade level of these words (based on frequency of occurrence in samples of elementary-level reading material) did not exceed the sixth-grade level, except for the term BEWARE. The entire list had a mean reading level between third and fourth grades (M = 3.6). However, even with this supporting evidence, further evaluation using appropriate subject populations is necessary to determine whether their interpretation and understanding of the words are consistent with the results found here.

The third limitation concerns the short list of 20 words. One should keep in mind that this list was developed with certain criteria that were rather arbitrary. The goal was to base the selection on a set of seemingly appropriate, objective criteria. Using other criteria, other lists could be formed. For example, the term ATTENTION was not included in the final list primarily because it contains nine letters and only words of seven letters or less were retained. It is currently unclear which criteria are the most important, how much weight should be accorded to each criterion, and what order should be used in the selection process. Other appropriate selection criteria probably could be used that retain the term ATTENTION. Nevertheless, informal examination of other word lists based on different selection criteria (e.g., number of syllables and different cut-off points) showed them to be generally similar and consistent with the 20-word set presented here.

References

American National Standards Institute. (1972). *American national standard specification for accident prevention signs: Z35.1.* New York: Author.

American National Standards Institute. (1988). *American national standard on product safety signs: Z535.4—Draft.* New York: Author.

Bresnahan, T. F., & Bryk, J. (1975, January). The hazard association values of accident-prevention signs. *Professional Safety,* pp. 17–25.

Cowan, N. (1988). Evolving conceptions of memory storage, selective attention, and their mutual constraints within the human information-processing system. *Psychological Bulletin, 104,* 163–191.

Devlin, J. (1982). *A dictionary of synonyms and antonyms.* New York: Warner Books.

FMC Corporation. (1985). *Product safety sign and label system.* Santa Clara, CA: Author.

Francis, W. N., & Kucera, M. (1982). *Frequency analysis of English usage.* Boston: Houghton Mifflin.

Johnson, D. D., Moe, A. J., & Baumann, J. F. (1983). *The Ginn word book for teachers.* Lexington, MA: Ginn.

Leonard, S. D., Hill, G. W., & Karnes, E. W. (1989). How does the population interpret warning signals? In *Proceedings of the 33rd Annual Meeting of the Human Factors Society* (pp. 550–554). Santa Monica, CA: Human Factors Society.

Leonard, S. D., Karnes, E. W., & Schneider, T. (1988). Scale values for warning symbols and words. In F. Aghazadeh (Ed.), *Trends in ergonomics/human factors V* (pp. 669–674). Amsterdam: Elsevier.

Leonard, S. D., Matthews, D., & Karnes, E. W. (1986). How does the population interpret warning signals? In *Proceedings of the 30th Annual Meeting of the Human Factors Society* (pp. 116–120). Santa Monica, CA: Human Factors Society.

Morehead, A. H. (1982). *Roget's college thesaurus.* New York: World.

New Webster's dictionary of the English language. (1975). New York: Consolidated Book Publishers.

Thorndike, E. L., & Lorge, I. (1944). *The teacher's word book of 30,000 words.* New York: Teachers College Press.

Ursic, M. (1984). The impact of safety warnings on perception and memory. *Human Factors, 26,* 677–682.

Westinghouse Printing Division. (1981). *Westinghouse product safety label handbook.* Trafford, PA: Author.

Wogalter, M. S., Godfrey, S. S., Fontenelle, G. A., Desaulniers, D. R., Rothstein, P. R., & Laughery, K. R. (1987). Effectiveness of warnings. *Human Factors, 29,* 599–612.