

How to Abbreviate on Highway Signs

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This study investigated abbreviations for 80 traffic-related words by having a sample of drivers compose abbreviations and then having a different sample identify the word after being given the most popular abbreviation. Abbreviations were classified by percentage of subjects who correctly identified the words when presented alone and, again, when presented in the context of another word. The study identified strategies employed in abbreviating words, explored the relation between highly stereotyped abbreviations and success in understanding them, and recommended a set of abbreviations that likely could be used successfully on changeable-message signs.

Abbreviations are often necessary on signs when the word message exceeds the sign's capacity. Highway engineers have developed standardized abbreviations for use on street signs such as ST, BLVD, HWY, and N, S, E, and W. With the development of the changeable-message sign (CMS), the need has arisen for a dictionary of abbreviations for words that might be displayed in real-time traffic management. The line capacity of a CMS is often limited, and the substitution of a well-understood abbreviation for a lengthy word would be highly desirable. Therefore, an investigation was undertaken to determine words that could be abbreviated efficiently and abbreviations that would be understood immediately by 85 percent or more of the drivers.

It was suspected at the outset that many words could not be abbreviated efficiently (i.e., abbreviated to a character length not exceeding two-thirds of the length of the original word). For example, the word turnpike is eight characters long, and the most frequent or stereotyped abbreviation, TRNPK, is five-eighths or 62.5 percent of the total word length—only marginally acceptable by the two-thirds rule. A six-character abbreviation for a nine-character word would be inefficient and hardly worth the effort.

The military services employ many very brief abbreviations in communications (1); however, road signing cannot assume that the viewer will have been trained previously in the meaning of the abbreviation. The meaning should be clear on the driver's initial exposure to the abbreviation of the word.

Success in developing a dictionary of abbreviations depends heavily on the users' familiarity with the words in the vocabulary. Staff (2) found that common meteorological terms could be abbreviated, usually in three or four characters (e.g., HURR, TOR, PRES, HUM, and ALT). However, the potential vocabulary for traffic-related words is more lengthy, and well-understood abbreviations for long words may require five or even six characters.

It would be convenient to prescribe a strategy by which any new word could be successfully abbreviated. There are essentially three strategies commonly employed: (a) key consonants, (b) first syllable, and (c) first letter. The first-letter strategy has been popularly used in dictionary abbreviations such as v for verb, n for noun, etc., and it is used for abbreviations of multiword organizations such as USO, CIA, and ROTC. However, the first-letter strategy usually implies learning and has less application to signing except mainly for the cardinal directions and highway numbers (I, US).

Selecting key consonants as a strategy is illustrated by BLVD, RD, CNTR, and PVMT. The vowels are omitted, as are certain consonants, but the first and last consonant in each syllable is usually retained.

The third strategy is taking the first syllable or the first three or four letters of the word. It implies that, if the reader can understand the first part of a word, the remainder may follow from context. Examples are TRAF, INFO, and EMER.

Which of these strategies is more commonly employed will depend somewhat on the words selected for abbreviation, but it was suspected that word length might also be a variable in strategy.

The objective of this research was principally to develop a set of highly stereotyped abbreviations that could be employed on a CMS without significant loss of information for unfamiliar drivers. Secondary interest was in a study of the strategies employed so that acceptable abbreviations could be developed for words not investigated.

METHOD

Subjects

The subjects were largely technicians and clerical workers with a high school education, aged 18 to 62, with an approximately equal number of males and females. All held current drivers licenses. Part 1 employed 41 subjects and part 2 employed 25 subjects.

Word List

Initially, the research staff developed a list of 63 words that had commonly appeared in messages developed for a human factors design guide (3). At the time the design guide was written, a need had arisen for acceptable abbreviations, but the staff was reluctant to abbreviate without evidence the abbreviation would be widely understood.

Later, an additional 25 words were added to the list in response to a request from traffic agencies in various states to provide a list of words they needed to abbreviate in the course of their unique signing operations. Several words were deleted, so the final word list comprised 80 words.

Procedure

Part 1 involved developing easily understood abbreviations by asking a sample of drivers to compose one abbreviation for each word. Instructions were to write the shortest abbreviation that would be understood by other motorists. Each word was presented in random order on a 3x5 card. Individual administration ensured no assistance from others.

Data analysis involved tallying the frequency of each abbreviation given. Frequency data were converted to percentage of the sample that gave each abbreviation. Only the most frequent abbreviation was retained for part 2 of the study. However, whenever two abbreviations of almost equal frequency were the most commonly given, both abbreviations were retained. Strategies employed in abbreviating the most common abbreviations were also noted.

Part 2 employed an entirely different sample of local drivers. The most common abbreviations from part 1 appeared individually on a set of cards in random order. Subjects were presented first with the abbreviation alone and were asked to give the word abbreviated. Responses were recorded on tape. If the word could not be ascertained, no help was

provided by the test administrator and the subject either guessed or left it blank.

Later, the same subjects were given the same set of abbreviations, but this time each abbreviation was given in the context of an unabbreviated word. The unabbreviated word, termed a "prompt word," was one that would commonly appear either before or after the abbreviation in a signed message (e.g., MAJ Accident; CONST Ahead; 15 MIN).

Data analysis was the same as for part 1. The

percentage of drivers correctly identifying the word was computed both for the word alone and with the prompt word.

RESULTS AND DISCUSSION

Part 1--Abbreviation Generation

There were 27 words for which 40 percent or more of the drivers gave the same abbreviation. Table 1 gives these words and abbreviations ranked in terms of the percentage giving the abbreviation. Also, Table 1 gives in code the type of strategy employed by the subjects in abbreviating the word.

Table 2 gives 31 words for which 26-39 percent of the drivers gave the indicated abbreviations. One point of interest was whether or not a word for which there was little agreement as to an abbreviation could still be correctly identified by a new sample of drivers.

Table 3 gives 22 words for which 25 percent or less of the drivers gave the same abbreviation. For these words, many different abbreviations were given and no single abbreviation had much support.

Table 4 gives the strategy used in abbreviating. The key-consonant strategy was adopted by 53.4 percent, the first-syllable strategy by 35.2 percent, and the first-letter strategy by only 11.4 percent. First letters were used mainly for cardinal directions and contractions, such as N BND for northbound.

Table 1. Words for which 40 percent or more gave the same abbreviation.

Word (n = 27)	Abbreviation	Strategy	Agreement (%)
Road	Rd	A	94
Information	Info	B	83
Minute(s)	Min	B	78
Highway	Hwy	A	72
West	W	C	72
South	S	C	67
East	E	C	67
North	N	C	67
Route	Rt	A	66
Boulevard	Blvd	A	61
State highway	St Hwy	A	56
Moderate	Mod	B	56
Temporary	Temp	B	54
Right	Rt	A	54
Lane	Ln	A	54
Miles(s)	Mi	B	51
Clear	Clr	A	51
Heavy	Hvy	A	51
Construction	Const	B	50
Roadwork	Rdwk	A	49
Level	Lvl	A	48
Blocked	Blkd	A	46
Condition	Cond	B	46
Freeway	Frwy	A	44
Major	Maj	B	41
Center	Cntr	A	41
Vehicle	Veh	B	41

Note: A = key consonant, B = first syllable, and C = first letter. The breakdown by strategy is as follows: A = 14, B = 9, and C = 4.

Table 2. Words for which 26-39 percent gave the same abbreviation.

Word (n = 31)	Abbreviation	Strategy	Agreement (%)
Bridge	Brdg	A	39
Prepare	Prep	B	39
Pavement	Pvmt	A	37
Chemical spill	Chem Spl	A/B	35
Tunnel	Tnl	A	35
Upper	Upr	A	35
Local	Loc	B	35
Minor	Mnr	A	34
Service	Serv	B	34
Maintenance	Maint	B	32
Left	Lft/L	A/C	32/27
Entrance	Ent	B	30
Speed limit	Spd Lmt	A/A	30
Normal	Nrml/Norm	A/B	30/26
Stadium	Stad	B	29
Ahead	Ahd	A	29
Beltway	Bltwy	A	29
Traffic	Traf	B	29
N,S,E,W-bound	N-bnd, etc.	C/A	29
Slippery	Slip	B	29
Exit	Ext	A	27
Pollution	Poll	B	26
Quality	Qty/Qual	A/B	26/30
Blizzard	Blzrd	A	26
Stalled	Stld	A	26
Material	Mat	B	26
Lower	Lwr	A	26
Hazardous	Haz	B	26

Note: Strategies are defined in Table 1. The breakdown by strategy is as follows: A = 21, B = 14, and C = 5.

Table 3. Words for which 25 percent or less gave the same abbreviation.

Word (n = 22)	Abbreviation	Strategy	Agreement (%)
Congestion	Cong	B	24
Light	Lt	A	24
Travelers	Trvlrs	A	24
Delay	Dly	A	24
Flooded	Fld	A	24
Accident	Acc	B	22
Turnpike	Trnpk	A	22
Feeder	Fdr	A	22
Access	Acc	B	22
Warning	Wrng/Warng	A/B	22
Oversized	Ovrsz	A	22
Township	Twnshp	A	22
Emergency	Emer	B	19
Expressway	Exwy	A	17
Frontage	Front/Frntg	B/A	17
Express	Exp	B	17
Carpool	C-Pool	C	17
Interchange	Intrchnng	A	15
Parking	Park	B	12
Express lanes			0
Pollutant			0
Motorcycle			0

Note: Strategies are defined in Table 1. The breakdown by strategy is as follows: A = 12, B = 8, and C = 1.

Table 4. Percentage that use various strategies for abbreviating traffic-related words.

Strategy	Total (%)	Group Percentages ^a		
		40 Percent or More	26-39 Percent	25 Percent or Less
A: key consonant	53.4	51.9	52.5	57.1
B: first syllable	35.2	33.3	35.0	38.1
C: first letter	11.4	14.8	12.5	4.8

^a Breakdown of percentages using a strategy by the percentage agreeing to a preferred abbreviation.

Part 2--Abbreviation Understanding

In the second part of the study, subjects were given these abbreviations and asked to generate the word. Table 5 gives 21 words correctly identified by 88 percent or more of the drivers when the abbreviation was given alone or unprompted. Table 6 gives other words understood by 55-84 percent.

Tables 7, 8, and 9 give the results of a study in which the word was given with another word either before or after it. Those prompt words given after the abbreviation are shown with a large dot. Also shown is the percentage improvement from prompting. Certain words improved substantially from the prompt

Table 5. Abbreviations understood by 88 percent or more without prompt words.

Word (n = 21)	Abbreviation	Strategy	Understanding (%)
Freeway	Frwy	A	100
Highway	Hwy	A	100
Left	Lft	A	100
Parking	Pking	^a	100
Service	Serv	B	100
Traffic	Traf	B	100
Warning	Warn	B	100
Boulevard	Blvd	A	96
Speed	Spd	A	96
Center	Cntr	A	92
Entrance	Ent	B	92
Freeway	Fwy	A	92
Information	Info	B	92
Normal	Norm	B	92
Shoulder	Shldr	A	92
Emergency	Emer	B	88
Expressway	Expwy	A	88
Maintenance	Maint	B	88
Travelers	Trvlrs	A	88
Road	Rd	A	88
Slippery	Slip	B	88

Note: Strategies are defined in Table 1. The breakdown by strategy is as follows: A = 11 and B = 9.

^a Last syllable.

Table 6. Abbreviations understood by 55-84 percent without prompt words.

Word (n = 28)	Abbreviation	Strategy	Understanding (%)
Bridge	Brdg	A	84
Quality	Qty	A	84
Access	Accs	A	80
Condition	Cond	B	80
Parking	Park	B	80
Vehicle	Veh	B	80
Construction	Const	B	76
Downtown	Dwntn	A	76
Exit	Ex	B	76
Hazardous	Haz	B	76
Carpool	C-Pool	C	72
Chemical	Chem	B	72
Lane	Ln	A	72
Major	Maj	B	72
Mile(s)	Mi	B	72
Minute(s)	Min	B	72
Oversized	Ovrsz	A	72
Prepare	Prep	B	72
Turnpike	Trnpk	A	72
Ahead	Ahd	A	68
Express	Exp	B	64
Exit	Ext	A	64
Interchange	Intrchng	A	64
Roadwork	Rdwk	A	64
Right	Rt	A	62
Heavy	Hvy	A	60
Blocked	Blkd	A	56
Frontage	Frntg	A	56

Note: Strategies are defined in Table 1. The breakdown by strategy is as follows: A = 15, B = 12, and C = 1.

Table 7. Abbreviations understood by 100 percent and percentage improvement with prompt word indicated.

Abbreviation (n = 18)	Prompt Word	Strategy	Improvement ^a (%)
Ahd	Fog	A	32
Emer	●Vehicle	B	12
Ex	Next	B	24
Frwy, Fwy	(name)	A/A	0
Hwy	●(number)	A	0
Lft	Merge	A	0
Maj	●Accident	B	28
Mi	(number)	B	28
Pking	Coliseum	^b	0
Prep	●To Stop	B	28
Pvmt	Wet	A	88
Rd	(name)	A	12
Rt	Keep	A	38
Serv	●Road	B	0
Shldr	Soft	A	8
Spd	●Limit	A	4
Traf	●Advisory	B	0
W	(name/ number)	C	88

Notes: ● = prompt word given after abbreviation.

Strategies are defined in Table 1. The breakdown by strategy is as follows: A = 10, B = 7, and C = 1.

^a Percentage improvement over understanding without prompt word.

^b Last syllable.

Table 8. Abbreviations understood by 96 percent and percentage improvement with prompt word indicated.

Abbreviation (n = 15)	Prompt Word	Strategy	Improvement (%)
Blkd	Lane	A	40
Blvd	(name)	A	0
Brdg	(name)	A	12
Cntr	●Lane	A	4
Chem	●Spill	B	24
Ent	Freeway	B	4
Maint	●Work	B	8
Ovrsz	●Load	A	24
Qty	Air	A	12
Ext	Next	A	32
Info	Traffic	B	4
Trvlrs	●Warning	A	8
Slip	●Pavement	B	8
Veh	Stalled	B	12
Warn	Blizzard	B	-4

Notes: ● = prompt word given after abbreviation.

Strategies are defined in Table 1. The breakdown by strategy is as follows: A = 8 and B = 7.

Table 9. Abbreviations understood by 88-92 percent and percentage improvement with prompt word indicated.

Abbreviation (n = 13)	Prompt Word	Strategy	Improvement (%)
Accs	●Road	A	8
Const	●Ahead	B	16
Exp	●Lane	B	24
Expwy	(name)	A	0
Haz	●Driving	B	12
I	●(number)	C	44
Min	●(number)	B	16
Mnr	●Accident	A	72
Norm	●Traffic	B	0
Rt	Best	A	48
Trnpk	(name)	A	20
Twnshp	●Limits	A	72
Upr	●Level	A	48

Notes: ● = prompt word given after abbreviation.

Strategies are defined in Table 1. The breakdown by strategy is as follows: A = 7, B = 5, and C = 1.

word, while the words with high understanding when seen alone obviously did not improve much with prompting.

A question of interest related to how well does giving the same abbreviation in part 1 correlate with understanding the abbreviation in part 2. In other words, Is agreement on an abbreviation a valid predictor of understanding the abbreviation? It was found that, for those 16 words that were given by 54 percent or more of the drivers in part 1, all except 2 were understood by 85 percent or more when given with another word. The two exceptions almost reached the criteria. TEMP for temporary was at 84 percent and MOD for moderate was at 75 percent understanding. Therefore, it was concluded that highly stereotyped abbreviations would be understood with a prompt word.

This finding did not hold for the entire list of 80 words (i.e., the higher the initial stereotyping percentage, the higher the understanding percentage was not found to be true). A product-moment correlation between the two distributions yielded a value of only +0.1729. Hence, for all words, the degree of stereotyping is not a strong predictor of understanding in context. Many words with poorly stereotyped abbreviations in part 1 were found to be easily understood, especially when seen with a prompt word.

An interesting finding regarding strategy for abbreviating words was that the length of the word was a factor. For words of nine letters or more, the first-syllable strategy was employed 64 percent of the time in abbreviating. Examples are CONG for congestion and TEMP for temporary. Staff (2), who studied long meteorological words, also found that the first-syllable strategy was used for 16 of the 20 words she studied. Shorter words (5 to 7 letters) typically were abbreviated by key consonants.

There were some other interesting findings regarding the length of abbreviation. Seventy percent of the five-letter words were abbreviated in three letters and 25 percent in two letters, excluding cardinal directions. Words with six to eight letters were abbreviated in three or four letters. Words requiring five or more letters to abbreviate had very low agreement on an abbreviation, i.e., 29 percent or less. Examples were BLTWY, TRVLRS, TRNPK, FRNTG, and OVRSZ. Note that these words were

all abbreviated by the key-consonant strategy. In general, long abbreviations are not efficient and should be avoided if they exceed two-thirds of the word's length.

CONCLUSIONS AND RECOMMENDATIONS

This study identified 21 abbreviations that are understood by more than 85 percent of the drivers when the abbreviation is given alone and an additional 47 words understood by 85 percent when given with a common prompt word. These words may be considered by agencies for use on CMSs. Those that require a prompt word for understanding should be used only if the exact prompt word is used. If other words are substituted, the message should be tested before using the abbreviation.

When abbreviating new words not in the word list, the first-syllable strategy will likely result in better understanding if the word is nine letters or more. For short words of five to seven letters, the key-consonant strategy will likely lead to better understanding, although there are exceptions.

Whenever the best-understood abbreviation is longer than two-thirds of the word itself, abbreviating is discouraged. Some words cannot be efficiently abbreviated, and the agency should consider a synonym, such as FOG for reduced visibility. When the first-syllable strategy results in another word such as RED for reduced or POLL for pollution, the abbreviation should be avoided also.

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Studies of Highway Advisory Radio Messages for Route Diversion

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A series of in situ controlled field studies were conducted to establish the effectiveness of highway advisory radio (HAR) message characteristics in aiding motorists to negotiate diversion routes. The research investigated the effects of language style, message load, manner of message repetition, use of landmarks and other route descriptors, and driver familiarity with the street system. Drivers listened to simulated HAR messages while on a metropolitan Interstate and were then requested to negotiate complex diversion routes by recalling the information given. Recommendations for designing HAR messages are given based on the study findings.

Motorist information systems perform a critical role in the successful operation of real-time corridor

control systems in metropolitan areas. Flexible systems can provide information that enables drivers to use the highway system more efficiently and safely. One method that provides the flexibility to transmit a variety of information is the highway advisory radio (HAR). A HAR system is composed of a low-frequency, low-power (10- to 50-W) transmitter and an antenna that can be positioned beside a roadway to give drivers up-to-the-minute travel information via their AM radios. The number and types of messages are limited only by motorist information needs and processing capability.