CHAPTER 5

DRIVER INFORMATION LOAD MODEL COMPUTATIONAL TOOL

INTRODUCTION

A computational tool was developed using software and analytical capabilities of readily available off-the-shelf computer programs. This software tool allows the user to readily compute the driver information load (DIL) based on the model developed under this project and described in detail in the earlier chapters. As discussed earlier, the model of DIL uses information about the roadway and signage as input and provides a quantitative index of the information load associated with each set of signs present on a section of roadway as output. DIL is a quantitative index of the information load for each set of signs on a section of roadway associated with a particular destination (e.g., an exit off the freeway). It refers to the level of demand placed on the driver in order to process and respond to the information presented about the subject exit within the section of highway preceding that exit.

The tool was developed to make the DIL model easy to use for evaluating and analyzing information loads associated with an array of guide signs on freeways. The tool can be used to identify potential information overload problems and to compare alternatives for the design and placement of signs. However, it must be recognized that the model and the associated software tool deal specifically with the problem of DIL, that is, the ability of the driver to safely process the amount of information in the time available. The model does not address the full process of designing an informational sign system, including consideration of motorist information needs, the accuracy or clarity of the message, the choice of wording or destinations, and other features. Managing the information load is only one part of the process, and it is the part dealt with in a quantitative fashion by this tool.

A detailed description on how to use this tool and some underlying theory of the model are presented in the User's Manual, which is attached as Appendix F. Appendix F includes illustrations of the input screens and output formats and a glossary that defines the terms and concepts used in the program.

DIL COMPUTATIONAL TOOL DEVELOPMENT

The DIL software tool was first developed in a spreadsheet format for analytical purposes, that is, generating the DIL values and its various components. It was realized that the data entry, including scrolling through the look-up tables could be very tedious and time consuming. Hence, an input module with forms, drop-down list, and check boxes was developed using the database program. This was done to make the model more user-friendly and simple to use. An interface between the input module and the analysis (output) module was created so that once the data are entered in the input module, they could be sent to the output module by a click of the mouse button. All the analysis is automatically performed and the user can open the output module to see the results.

The output is provided in both tabular and graphic format, and shows the overall DIL rating at each sign location as well as contributions of various component elements of the model to the overall information load. The graphical output is easier to understand by most people. It shows the distance of each sign array from the subject exit gore and the DIL rating and its components, thereby creating a "profile" for DIL distribution. This allows the user to assess the demand on the freeway driver imposed by a sign array in relation to other factors. The term "sign array" refers to a set of individual sign panels that are installed together at a given point on the roadway, typically on the same sign mounting structure or assembly. For example, three individual sign panels mounted on an overhead mast would constitute a single sign array.

The model is based on the use of roadway sections, where a section ends at the point where a driver makes a navigational maneuver, such as an exit or a change into the appropriate lanes at a diversion point. The road section is defined as the section from the exit gore point at one end to an upstream point normally 11,000 ft from the gore. This distance is slightly more than 2 mi, thus encompassing where the initial advance signing for an exit typically occurs. A particular sign array might be included in multiple segments defined by different exit points. Even though the sign array itself would be constant, the information load associated with dealing with the sign may vary because of the changing road segment and proximity to the choice point. Therefore, the DIL computed for a sign array is specific to the assumption made about where the navigation maneuver takes place.

As such, the DIL software tool's input module requests data from the user regarding the section first, then the sign arrays, and then the individual signs on each array. Details on the use of this tool and data that should be assembled prior to using it are presented in the User's Manual section in Appendix F.

USING THE DIL PROFILE TO IDENTIFY DIO

While the DIL model does not provide any thresholds for driver information overload (DIO), it can be used to compare relative complexities of alternative information systems. At the heart of the model is the DIL "Profile," as described in Chapter 3. An example of using the DIL for an actual situation, where several interchanges exist in close proximity and is believed to exhibit DIO, is presented here.

Application of the Model

A comparison of the DIL Profile for an alternate signing scheme is also provided. This example is for a section of NB I-395 toward the District of Columbia from Virginia ending at the interchange for the George Washington Memorial Parkway. An inventory of the then-existing signs was conducted by BMI on the subject highway for a project in 1997 and recommendations were made to modify several guide signs to improve navigation. The current DIL model was not available then, and recommendations were based on standard engineering practices, *MUTCD* guidelines, and knowledge of local conditions. This example illustrates the application of the DIL model to compare the relative complexity of signs for alternative information highway sign information systems.

Existing Signing Conditions

Figure 26 shows the array of signs leading up to the subject interchange. To develop the DIL Profile, the following steps were taken based on the guidelines presented earlier:

1. A computerized program was used to develop the DIL Profile.
2. The total number of sign arrays (multiple signs on a single structure constitute an array) related to the subject interchange was identified and distances of these sign arrays from the exit gore were obtained.
3. Data on geometric features within 11,000 ft of the exit gore, e.g., number of curves, merges, weaves, exits, lane drops, and maximum number of lanes, were obtained and entered into the computer model, which computes the Roadway Density component of the DIL.
4. Each sign within every sign array was related to one of the sign categories listed in the look-up table and a base sign load rating was selected based on the upper and lower bound guidance provided in the look-up table.
5. Elements of a selected sign that were different than the base sign in the selected category were identified. Appropriate modification to the base rating was applied to obtain the adjusted sign rating.
6. Based on all these inputs, the model computes the other components of the DIL, namely, Maneuver Proximity (MP), Local Information Density, and Sign Array Information Demand for each sign array.
7. Finally, the total DIL Profile is shown in Figure 27, which is a numerical value corresponding to each sign array location. This value is shown by the star symbol, with the numeric value immediately above it. It includes the four components of DIL.

The DIL Profile indicates that there is a definitive peaking of information load around Sign Array 105 along with high rating at Sign Array 104 location. At each of these locations, the Sign Array Information Demand component of the DIL is significantly higher than for other signs. This is indicative of high complexity of these two sign arrays. Total DIL for Sign Array 106 is also high. But it should be noted that the Local Information Density Component is largely responsible for this high rating, which is due to its proximity to Sign Array 105. As shown in Figure 27, Sign Arrays 104 and 105 each have multiple signs on a single structure and are complicated, whereas Sign Array 106 is simply an exit gore sign. Hence, the results of the model appear to be reasonable.

Proposed Signing Scheme

As mentioned earlier, a set of modified signs for this section was developed and recommended. Figure 28 shows the array of signs proposed for this section. The DIL Profile was developed for the proposed signing scheme following similar steps as for the existing signs and is shown in Figure 29. It can be seen from this chart that the peak DIL rating (star symbol) at the Sign Array 105 location would be reduced significantly with the proposed signing scheme. Moreover, the model estimates elimination of a sharp "spike" in the DIL Profile and the profile of total information load rating follows more closely to the MP component of the DIL. Comparing the DIL profiles for the two scenarios, there is a marginal increase in the total information load rating estimated to result from the proposed signing scheme at Sign Array 101 location. However, the reductions in the information load at other locations are more significant and important because of their proximity to the exit gore.

Hence, this model provides a tool to evaluate the effectiveness of guide signs in terms of not overburdening the drivers with too much information. This model can be used to identify the critical locations with peak DIL ratings in a busy highway corridor. It also points to factors that highway engineers should investigate further to ascertain the causes of a high DIL rating.

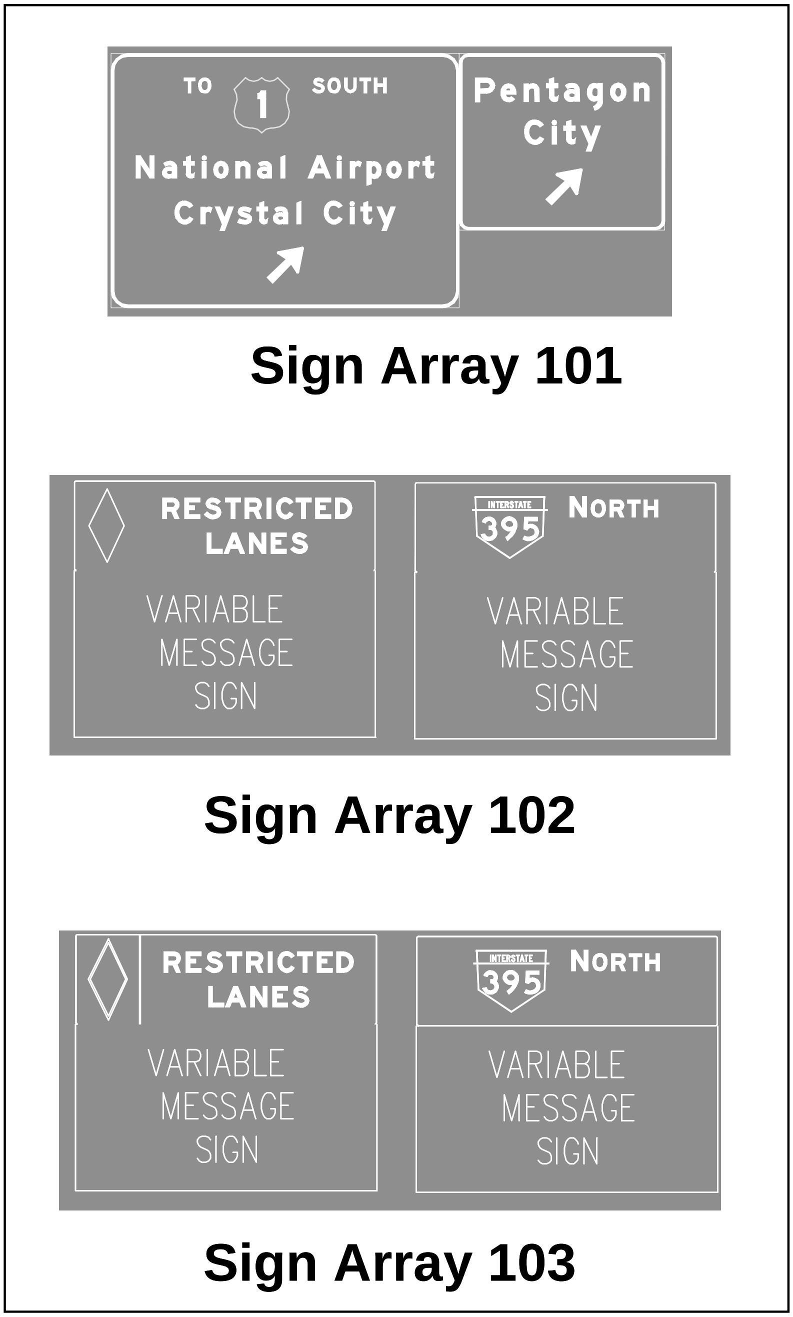

Figure 26. Sign arrays for example—Existing signs.

Evaluation of the Model

The model and the software were presented to the Guide and Motorist Information (GMI) Technical Committee of the National Committee of Uniform Traffic Control Devices (NCUTCD) at their annual meeting in January 2002. Several participants indicated interest in using the DIL tool, and the tool was sent to four interested professionals for their review and comments. All members of the NCHRP Panel for this project were also sent a copy of the DIL program for their review and comments. All recipients of the program were asked to respond to address the following questions:

1. Do you feel this analytical tool is useful for practical application or is it too academic?
2. Are there any improvements you can suggest that would improve its usefulness?
3. Was the program easy to use, understand, and follow?

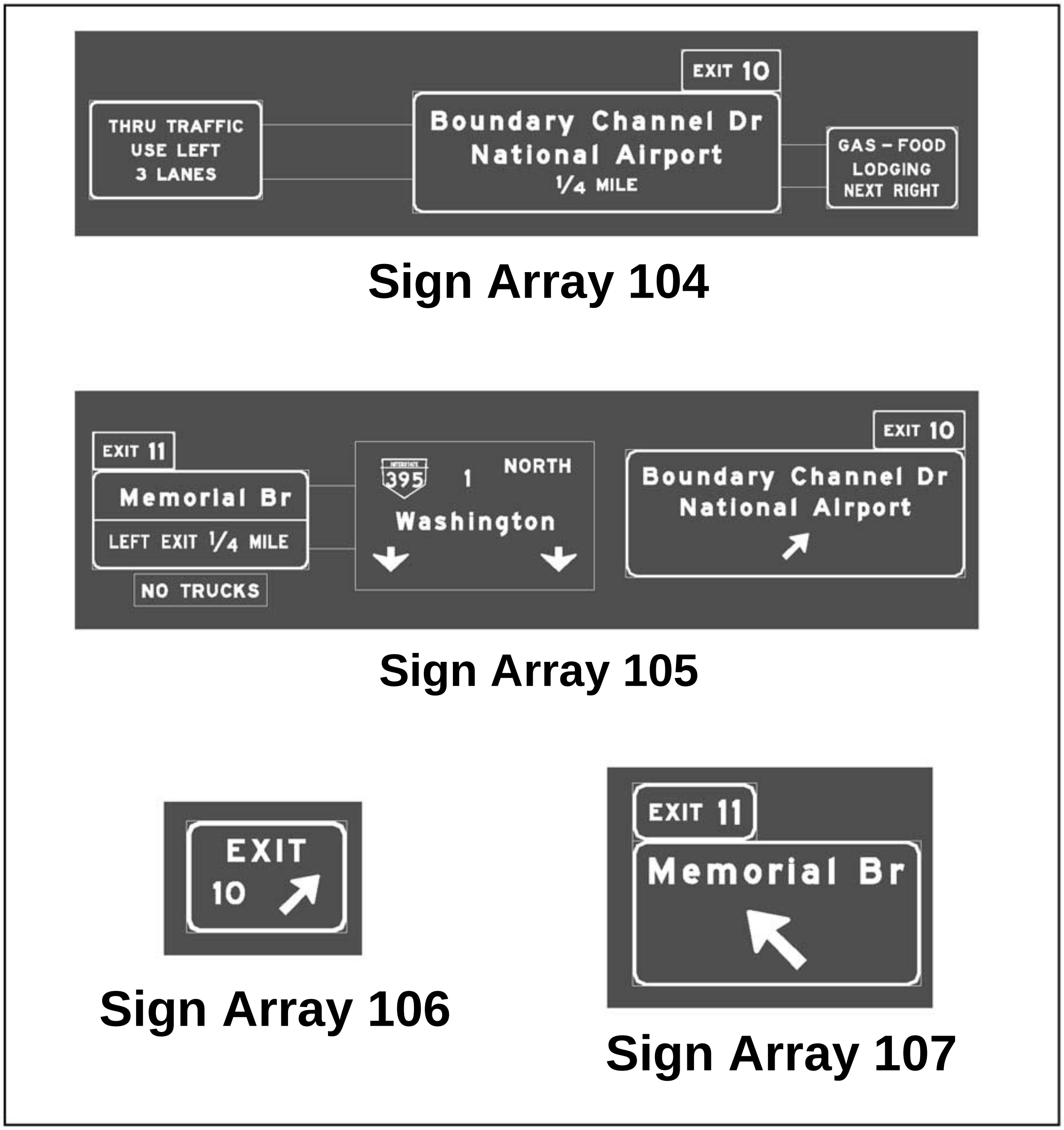

Figure 26. (Continued)

The researchers received four responses from practitioners, one of which was from an NCHRP Panel member. While some respondents indicated that they used the program, none of them actually applied it to any real world situation. Some indicated that they will be using this tool later in the year for evaluating some actual signs.

The responses generally pointed out that for the program to become more practical, there was a need to establish some thresholds for DIL to estimate when an information overload situation will occur. This seemed to be their biggest concern. Also, the respondents felt that this program will not be able to help solve the "urban clutter" caused by closely spaced interchanges and associated signs. Others wanted more "utility" features added to the software.

The program was then presented to the NCHRP Project Panel at a meeting in June 2002. The panel members made some specific comments and suggestions related to the software, including specific situations when the program "crashed," need for additional fields, or the capability to parse unwanted records. The tool was then modified to incorporate those comments.

In terms of responses to the comments, the project team has the following to offer:

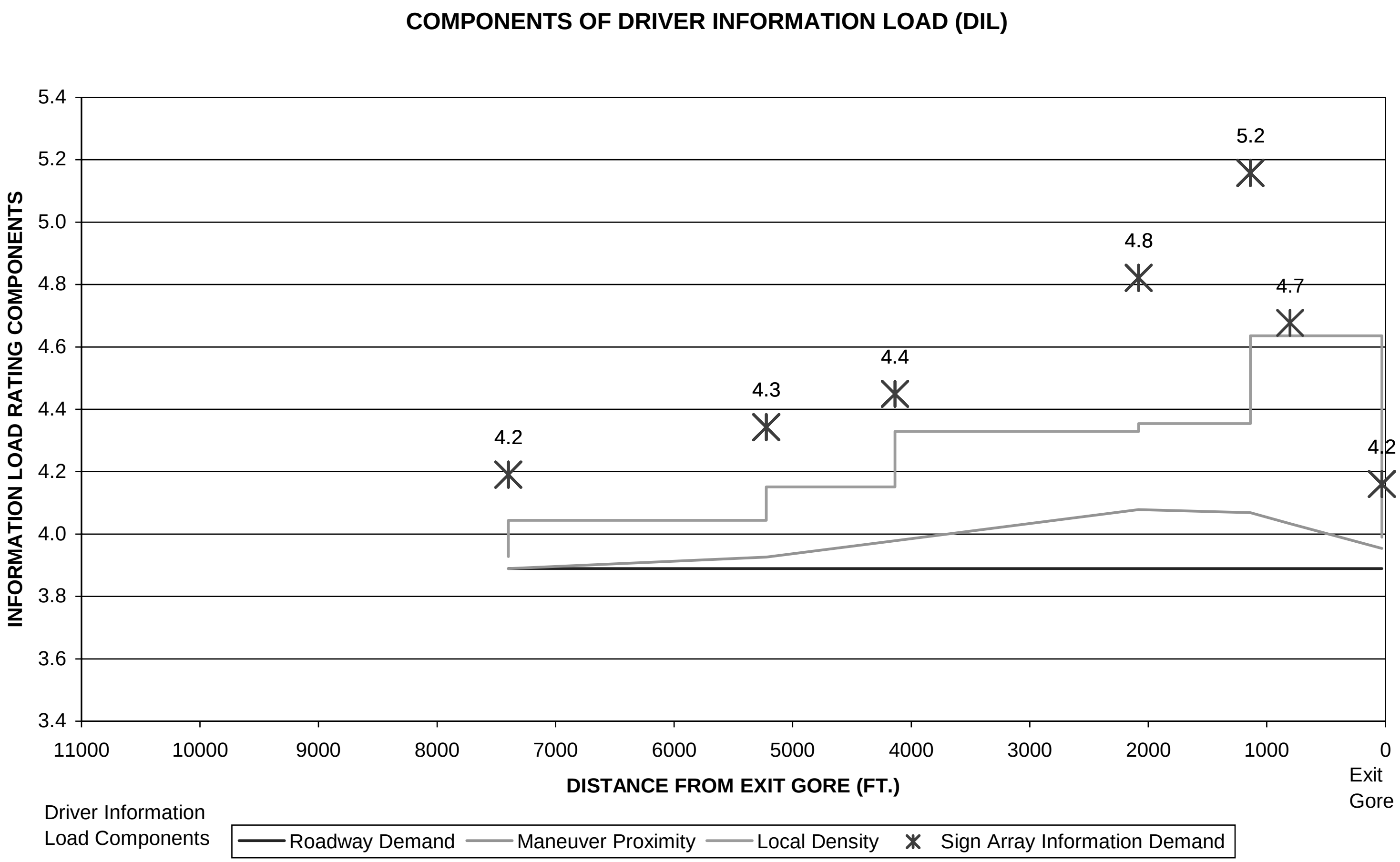

Figure 27. DIL profile for example section—Existing conditions.

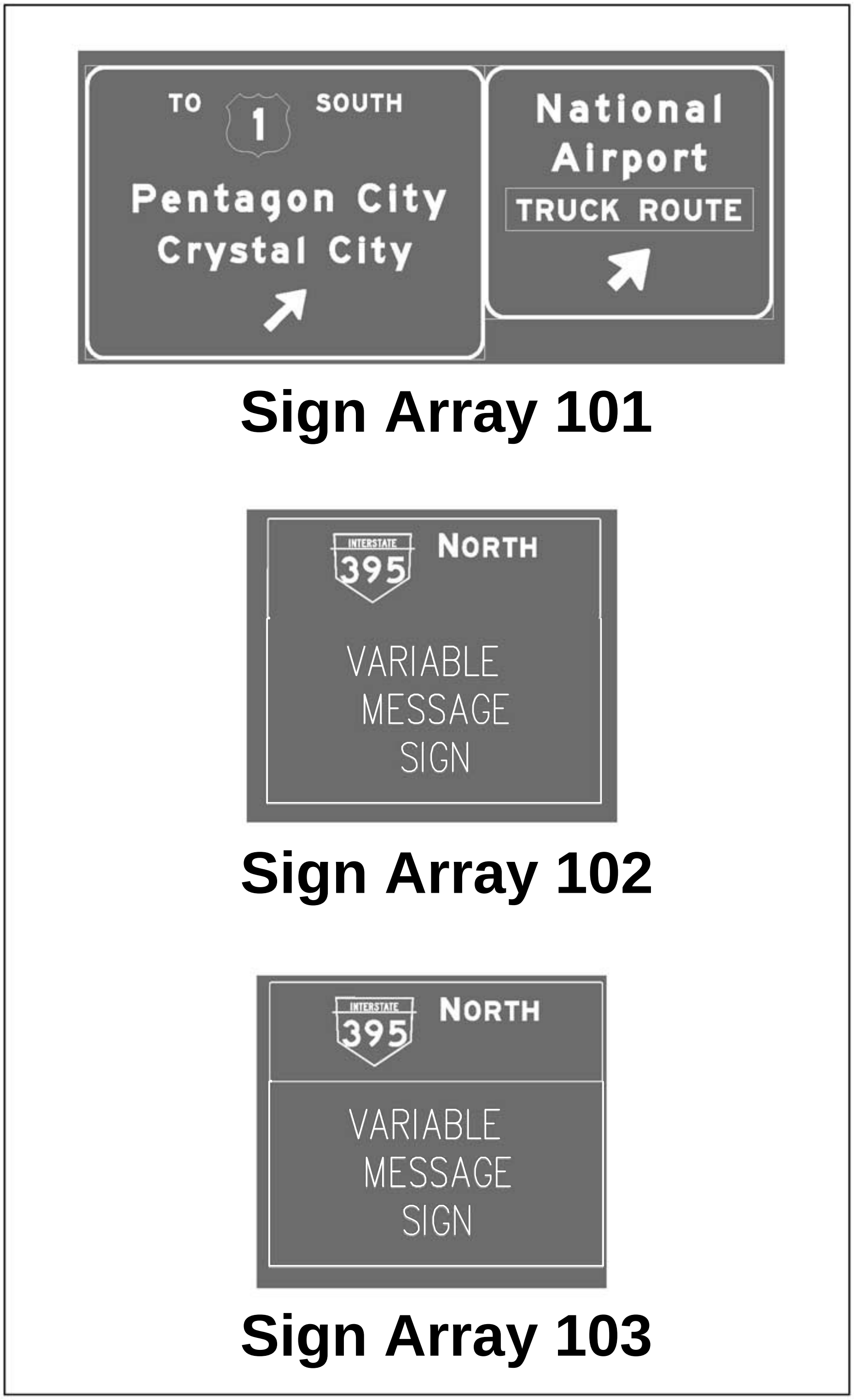

Figure 28. *Sign arrays for example section—Proposed signs.*

Sign Array 104

Sign Array 105

Sign Array 106

Sign Array 107

Figure 28. (Continued)

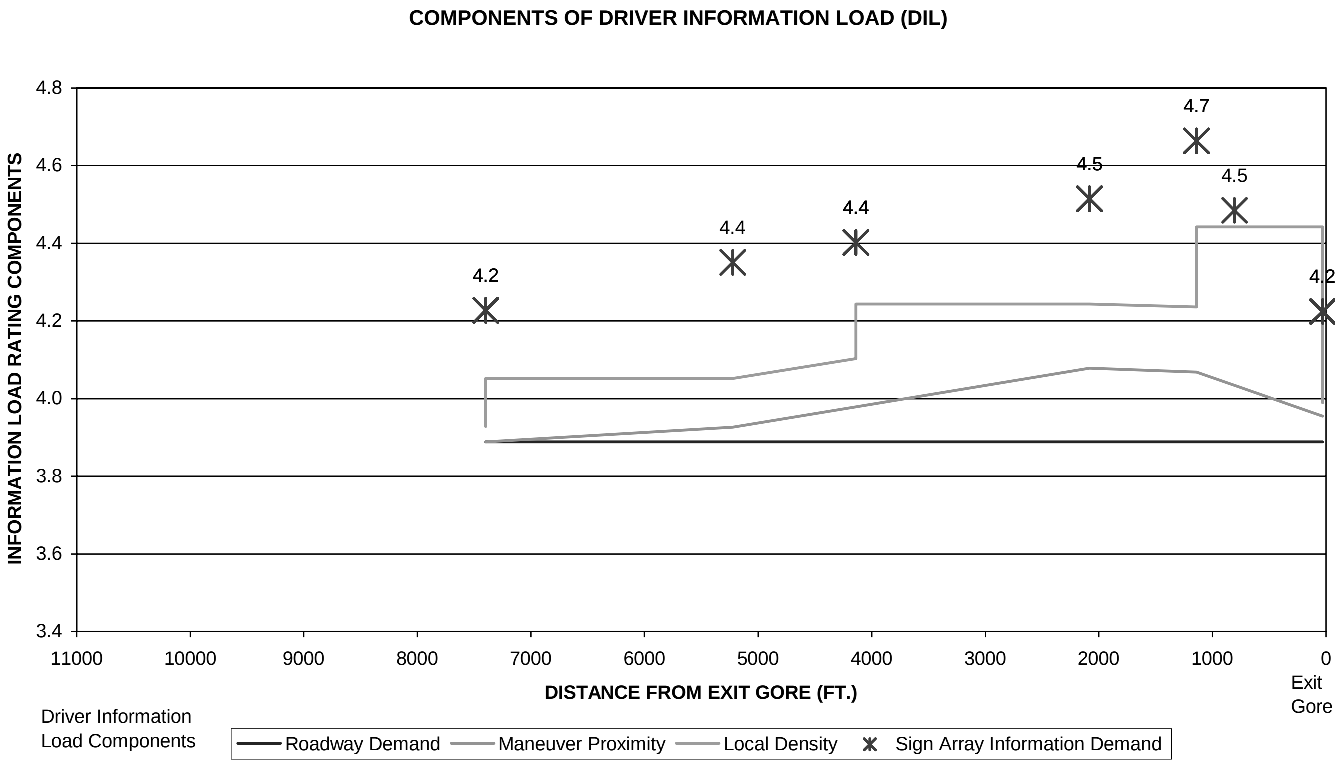

Figure 29. DIL profile for example section—Proposed signs.

- The DIL program is intended to be used by experienced traffic engineers who would assemble all the required information before using the tool.
- Once the data are properly assembled, the actual data entry into the input module takes a very short time to complete.
- Urban freeway segments with closely spaced interchanges can be analyzed and evaluated using this tool. In fact, this tool provides an excellent opportunity to identify the problem locations and contributing factors within the scope of the model. This has been illustrated in the “Application of the Model” section of this chapter.

CHAPTER **6**

GUIDELINES FOR IDENTIFYING AND PREVENTING DRIVER INFORMATION OVERLOAD RELATED TO GUIDE SIGNS ON FREEWAYS

INTRODUCTION

Normally driving is a relatively simple task and does not overly tax the ability of the driver to process information and respond in a correct, efficient, and safe manner. However, there are situations when a significant percentage of the drivers, especially the elderly drivers or inexperienced younger drivers, find that there simply is so much information, or possibly confusing information, that they either have to compensate by reducing speed, or knowingly or unknowingly miss information that is critical to their driving task. Also, drivers of all ages and experience unfamiliar with the highway, especially in the vicinity of urban areas, may have similar experiences. Driver information overload (DIO) is commonly used as a rubric for this condition.

DIO can occur, for certain drivers, when there is more information presented than can be processed in sufficient time. The information can come from all types of traffic control devices identified in the *MUTCD*, but most notably from traffic signs. It can also stem from the roadway geometrics, e.g., complicated interchanges with left- and right-side ramps, and can be compounded under heavy-volume, high-speed traffic and in work zone areas. Non-highway features, such as billboards or signs on buildings can also add to the information load. While there are numerous contributors to DIO and it can occur on all types of roads, this study has focused on what is believed to be the more frequent condition, guide and related signs on freeways.

Highway guide signs are critical devices that provide guidance and navigation information to the driver. For the driver unfamiliar with the route, they are crucial for finding one's way. Even with adequate trip preparation and use of a map (now with the possibility of in-vehicle navigation systems), motorists would not be able to find their destination without adequate guide signs. Motorists have many destinations and are hopeful that highway guide signs will provide those destinations in their sign messages. However, this is not practical with fixed highway signs. Providing too many destinations and other guidance and way-finding information on a specific sign or group of signs would certainly cause DIO.

The guidelines that are provided here are meant to assist the engineer responsible for designing and/or maintaining roadway information systems to avoid DIO, at least for the vast majority of the driving public. The guidelines are structured as follows:

- A working definition of DIO, at least with respect, to highway guide and related signing, is provided.
- Guidance is provided on how to identify DIO with current or proposed signing.
- Guidance is provided on what measures can be taken to minimize the driver information loading through the application of already established principles of information, i.e., sign design.

The guidance is drawn from the research conducted for this study, already existing state-of-the-art knowledge, and the combined judgments of the research staff.

DEFINITION OF DIO

Most people feel that there are locations or situations (combination of location, traffic, etc.) where, as motorists, they have felt "information overload." They know it when they experience it, but they have difficulty defining or describing it. They likely felt uncomfortable and/or confused, may have had to reduce their speed, were possibly not sure of their direction, and possibly even took the wrong turn (perhaps even making an erratic maneuver in doing so). Even traffic engineers are not unanimous as to what constitutes DIO.

In the early stages of this project, a questionnaire was sent to 20 state and 20 local traffic engineers selected to represent all areas of the country. Responses were received from 27 persons. For one of the questions, those surveyed were asked to define DIO. While most stated that, in essence, it was too much information for the motorist to process in sufficient time, there were a few who believed that other signing deficiencies could contribute to information overload, such as small letter size, missing or misleading information, etc. Therefore, a definition of DIO is needed, at least with regard to this study, and the following is offered:

> *DIO occurs when the driver cannot process the roadway information in sufficient time to respond properly and safely at the design speed or the 85th percentile operating speed, whichever is higher.*

This definition is explained as follows:

Roadway information—While the roadway features, design elements, and the various traffic control devices (signs, markings, signals, etc.) collectively provide the roadway information upon which decisions about a driver's desired guidance and control are made, this project focused on roadway signing, and in particular, guide and guide-related signing (signs found in Section 2E of the *MUTCD*, Millennium Edition). Hence, ***guide sign information*** could replace ***roadway information*** for the purposes of this study.

Driver—Guide signing is designed primarily to meet the needs of the unfamiliar driver who must rely on the message for way-finding. It must accommodate those segments of the driving population who are likely to require longer than average processing and response times, such as the elderly and novice drivers.

Process—This term is meant to include all elements of information processing from initial detection of the device, to reading and comprehension of the message, to making an appropriate decision on whatever maneuver may be required, and ending with initiation of the required response based on the decision made.

Sufficient time to respond properly and safely at the design speed—This term means that the driver has been able to process the information (signing) at a distance upstream sufficient to accommodate the desired maneuver (e.g. lane change for exiting) at the design speed or the 85th percentile operating speed, whichever is higher.

WHY IS DIO A PROBLEM?

DIO is problematic to the driver for a number of reasons. If the driver is confronted with information overload, then he/she may reduce his/her speed in order to have more time to process the information; this action could result in traffic slow downs, conflicts, and possibly collisions. At a freeway exit, where this overload is likely to occur, the driver may make a late exit resulting in an erratic maneuver, such as crossing the gore area or even backing up on the shoulder or the ramp to correct the wrong turn. That erratic maneuvers are more frequent at locations with high-information load has been shown in an earlier research by Taylor and McGee (*21*). In an NCHRP study entitled, "Improving Traffic Operations and Safety at Exit Gore Areas," they evaluated what factors caused drivers to make erratic maneuvers when exiting the freeway. Their findings were that there are numerous reasons, which relate to the deficiencies of the driver (distracted, not sure of direction, etc.), the information (confusing sign legend, insufficient advance warning, etc.), and the geometrics of the interchange (e.g., sight distance to the ramp). While the study did not attempt to relate erratic maneuver occurrence to the amount of sign information, it is noted from their study that of the nine sites that were studied, the two sites that experienced the highest erratic maneuver rate (erratic maneuvers per volume) were those that had the highest sign density and highest information loading on the guide signs.

HOW TO DETERMINE IF DIO EXISTS

Specifying when DIO exists is not easy. There are no precise rules or values that resulted from this research, nor has there been any offered from previous research. What this project did develop is an evaluation tool—the DIL Profile—that can be used for evaluating alternative sign systems based on the relative DIL produced. That tool was discussed in Chapter 5.

The DIL Profile is partially based on the results of the experiment discussed in Section 4.2. The results of that experiment are found in Table 2, which provides a load rating value for numerous sign types. Although these values cannot be used directly to determine if any given sign or array of signs has too much information, they provide a simple means of estimating a rough relative demand.

Aside from using the DIO model, some general guidance, drawn from the results of this project and from previous research, about when an individual guide sign will likely cause DIO is as follows:

- The number of destinations exceeds two, especially if the word length is long (eight letters or more); and
- The number of route markers exceeds two; a sign with more than two destinations and/or more than two route symbols is likely to cause an information processing problem for some drivers.

For situations where there are multiple signs on a sign structure, DIO can result from the following:

- Two sign panels with more than two destination names and two route symbols on any one sign;
- Three guide sign panels with any one sign having more than two destination names; or
- More than three sign panels, regardless of message content.

DIO is likely to occur at those locations that have heavy density of information in terms of proximity of signs and sign message content. More specifically, DIO is likely under the following condition:

- Spacing between two guide signs, including supplemental signs, is less than 800 ft, where there is one destination on the second sign, and 1,200 ft where there are two or three destinations on the second sign.

Figure 30 shows a simple advance guide sign for a freeway exit. This certainly would not be considered information overload for any reasonable driver. Figure 31 shows an array of signing for a freeway location that has interchanges in close proximity. Some drivers experiencing this situation for the first time are likely to consider this as DIO. From these examples it is easy to say what may or may not be DIO. However, it is not so easy to provide guidelines on when DIO begins for drivers of varying information processing capabilities. Nonetheless, it can be stated that, in general, DIO can occur with:

- An individual sign with too much message content;
- Multiple sign panels at the same location with or without an individual sign having too much information;
- Signs in close proximity (i.e., short spacing between signs), with or without an individual sign having too much information; or
- Other situations when other distracting factors may cause DIO.

These situations are elaborated upon with examples below.

Figure 30. Example of sign with low-information load.

Figure 31. Example of a sign array with high-information load.

Too Much Information on One Sign

There is no doubt that a single guide sign panel or other navigation-related sign can have too much information in the form of destinations (i.e., place name, street name, and route symbol), cardinal directions, exit numbers, arrows, and other exit directions. Figure 32 shows a sign that is not a typical highway guide sign, but it has so much information content that most would agree it could cause DIO. What determines "too much" is based on many interrelated factors including the size of the sign legend, the complexity of the message (word length), the driver's visual and information processing capabilities, and the vehicle speed.

Examples of signs with multiple destinations can be often found on our highways, as shown in Figure 33. But the question related to these signs is, "Is it too much information?"

There is no standard in the *MUTCD* as to the maximum amount of legend allowed on one guide sign. However, the *MUTCD* does provide guidance (i.e., should statements) on this item where it states in Section 2D-07 regarding guide signs on conventional roads:

> *. . . the legend on a guide sign must be kept to a minimum to be legible at a glance during the few moments that a driver can turn his eyes from the road. Guide signs should be limited to three lines of principal legend . . . Principal legend includes only place name, route numbers, and street names. Symbols, action information, cardinal directions, and exit numbers may make up other lines of legend, within reasonable limits.*

For guide signs on expressways, the *MUTCD* provides the following guidance in Section 2E-09:

> *No more than two destination names or street names should be shown on any Advance Guide Sign or Exit Direction sign. A city name and street name on the same sign should be avoided. Where two or three signs are placed on the same supports, destinations or names should be limited to one per line, or to a total of three in the display. Sign legends should not exceed three lines of copy.*

Figure 32. Example of a sign with too much message content.

Figure 33. Examples of signs with a lot of information—Is it too much information?

Providing message content that exceeds these guidelines, does not necessarily mean that the sign(s) will cause DIO, but they are reasonable thresholds beyond which the possibility increases significantly.

Multiple Sign Panels at the Same Location

While an individual sign's message content may not be considered information overload, DIO can occur where there is more than one sign on a sign structure. Figure 34 shows four sign panels on a single overhead structure; this is likely to be considered information overload for some drivers.

Section 2E-10 of current version of the *MUTCD*, which deals with the number of signs at an overhead installation, states that

> *. . . the number of signs at these locations [i.e. where overhead signs are warranted] should be limited to only those essential in communicating pertinent destination information to the road user. Exit Direction signs for a single exit and the Advance Guide signs should have only one panel with one or two destinations. Regulatory signs, such as speed limits, should not be used in conjunction with overhead guide sign installations. Because road users have limited time to read and comprehend sign messages, there should be no more than three guide signs displayed at any one location either on the overhead structure or its support.*

Signs in Close Proximity

Motorists need time to detect, read, process the information, and make a decision and respond, if appropriate, to each and every sign. This time equates to a distance that varies by the highway speed. In urban areas, interchanges are frequently close to one another or there are several destinations for which directional guidance is deemed necessary. In these situations, spacing between signs can be so short that the motorist may have difficulty processing the needed information, which constitutes a DIO situation.

As part of an improvement feasibility study for a section of I-395 in Northern Virginia, the guide signs were evaluated to determine if they could be simplified or otherwise improved. Along a 3.33-mi section from Glebe Road to the Potomac River bridges, there are three interchanges that have a combined count of 20 sign structures with 40 individual sign panels. Many of the sign panels have three lines of copy. In some areas, the spacing between signs is less than the minimum 800 ft specified in the *MUTCD*. This area is well known for

Figure 34. Example of potential DIO situation due to multiple sign panels at one location.

causing navigational problems for drivers unfamiliar with the area and can be considered as an area of DIO.

As noted above, the current Millennium Edition of the *MUTCD* offers the following guidance regarding spacing between signs:

> *. . . Guide signs placed in advance of an interchange deceleration lane should be spaced at least 240 m (800 ft) apart. (Section 2E.7)*

Other than this spacing guidance, the following statements are provided in the *MUTCD*:

- Where there is less than 800 ft between interchanges, Interchange Sequence Series signs should be used instead of the Advance Guide sign for the affected interchanges. [Section 2E-37]
- If only one advance guide sign is used, the supplemental sign should follow by at least 800 ft. [Section 2E-32]
- With regard to Specific Service Signing [Section 2F.06]: ". . . There should be at least 800 feet spacing between Specific Service signs, except for Specific Service ramp signs." [As depicted by Figure 2F-2 in the *MUTCD*, this spacing applies to distances between two logo signs and between a logo sign and a guide sign.]

Other Situations Causing DIO

It was observed from both the early field reconnaissance drive by the research team and during the on-road experiments that drivers felt uncomfortable (overloaded) at complex interchanges, especially under high volume conditions. This was observed even where the signs themselves may not suggest excessive information load. At these locations, the driver must pay attention to driving control tasks.

At least two other situations, occurring on freeways, can result in or influence DIO:

- One geometric situation that occurs frequently in urban areas is where an interchange is in close proximity of the merge of two major Interstate roadways. In this situation, motorists who wish to exit at the interchange have to weave across a heavy volume of merging traffic from the other Interstate. These maneuvers take up much of the attention of the driver making it more difficult for the driver to process the guide sign information. The example shown in Figure 2 earlier represents such situations. As the signs indicate, there are interchanges in close proximity, one with a left-hand exit, another with a right-hand exit, and the third one has a lane drop. Besides, this sign is located where there are other interchanges in close proximity upstream of the sign location.
- Any time there is construction on a freeway, especially near an interchange, it is more difficult for the motorists to give full attention to the signing. Quite often in construction zone areas, there is a lane reduction, lane width reduction, or a lane shift. Attending to these situations detracts from the motorist's ability to process the information from the signing.

HOW TO AVOID OR MINIMIZE DIO

Since DIO is partly a function of the information processing capability of the driver, and since there is a wide range of information processing capabilities among the driving population, it is unlikely that DIO could be eliminated. Some drivers will experience DIO at certain situations no matter how well the information is presented. Nonetheless, a variety of principles can be followed that will at least minimize the occurrence of DIO for the vast majority of drivers. These principles are enumerated below.

Avoid Complex Highway Design Configurations

It has been often stated within the highway engineering community that "if you can't sign it, don't design it." Sometimes, especially in urban areas, highway designers will prepare designs of interchanges that are fairly complex with left and right exits, exit ramps that split, lane drops, exit ramps in close proximity, etc. These designs often are dictated by the need to design within a given right-of-way. The designs result in multiple decision points in close proximity making it difficult to adhere to principles of good sign design. Recognizing that there are budget and right-of-way limitations, the designer should seek a plan that avoids these multiple decision points and will result in a less dense signing plan.

Consider Signing Needs Early and Throughout the Road Design Process

During the preliminary engineering phase of a new or reconstructed facility, the traffic engineering department or those responsible for sign design should be consulted about the ability to adequately sign for the design options. This is especially true for complex designs as discussed above, but should hold for even relatively simple designs.

Throughout the design process, the sign designer should think beyond what specific sign would be needed at a certain location. The designer should consider the demands placed upon the driver from the road design as well as from the expected traffic levels. Well ahead of peak demand points, which are in an area of about 1,500 ft from the gore, the designer should clearly provide the information the driver needs to resolve any uncertainty. The signs, markings, and geometry should work together to clarify answers to: where must I be, when must I be there, and what is coming up?

Follow Standards and Guidelines of the MUTCD

While the *MUTCD* is not a "how to" manual, it provides several guideline-type statements that, if followed, will minimize the occurrence of signing systems causing DIO. Several excerpts from the current edition of the *MUTCD* that directly or indirectly provide sign guidance for expressway/freeway signs to avoid DIO have been presented earlier. Adherence to these guidelines should minimize the possibility of a sign information system that would cause DIO.

Spreading of Information Load

As has been discussed, DIO occurs when there is too much information presented at any one location for the motorist to process in sufficient time. The information load profile conceptually demonstrates how the information loading significantly increases with sign message density, as determined by number of destinations, length of words, number of symbols, exiting information, spacing of signs, etc. There may be opportunities where this sign message density can be reduced by spreading some of the information along the route, i.e., moving less critical information to other locations away from the high density area.

Another example of sign spreading would be the use of supplemental signs. At some locations, it may be necessary to provide directional information for several destinations. The *MUTCD* recommends that no more than three destinations be on any one guide sign. However, even a single sign with three destinations along with route symbols and exiting information can be a problem for some motorists on a high-volume, urban freeway. Consideration should be given to using a supplemental sign where the third, or even a fourth, destination could be placed. In this way the information load is spread out along the route. However, based on the results of the studies conducted for this project, it appears that the advantages of spreading sign density are not seen until about 800 ft of separation, which is consistent with the guidance provided in the *MUTCD*. Because of the interaction and competition for the driver's information processing time, signs too close can be more demanding as one sign with the same information.

Sign Repetition

Sign repetition is defined as repeating the same sign message on another sign downstream. In general it is not a good sign practice to repeat a sign as this leads to excessive signing and would unnecessarily add to the information overload. However, in the case of a complex interchange, where there must be multiple signs on a sign structure, DIO could occur. If this cannot be avoided, then it may be advisable to provide another sign support further downstream with all or a portion of the sign information repeated. This, in essence provides another opportunity for the motorist to "take in" the entire message, and respond accordingly. Obviously, to accomplish this there needs to be sufficient distance upstream of the interchange to provide the additional sign(s) and still maintain at least the 800-ft spacing recommended in the *MUTCD*.

Increase the Size of the Legend

The time and distance it takes to read a sign are partly due to the size of the legend, and more specifically, the size of the letters and symbols. The former rule of thumb for the provision of letter size of "1 in. of letter height for every 50 ft of legibility distance" has been updated in the current *MUTCD* to be "1 in. of letter height for every 40 ft of legibility distance" based on research on letter size as required by the elderly driver, which increases the legend sizes by as much as 20%. Specific sizes of letters and numerals are specified in the *MUTCD* and range from 8 to 30 in. depending upon the type of interchange and sign placement (i.e., overhead or ground-mounted). The FHWA *Highway Design Handbook for Older Drivers and Pedestrians* recommends "not more than 33 ft of legibility distance for each 1 in. of letter height." If followed, this would increase the letter sizes by up to 18% more than the current *MUTCD* guidelines.

For situations where there has to be high information load to meet the guidance information requirements, it may be advisable to increase the size of the sign legend. By doing so, it will afford the motorist longer distance to read the sign, thereby compensating, to some degree, for the possible information overload. Figure 35 shows an example of signs with larger than standard route markers. As it can be seen, this sign array has too much information, including four destinations and seven route designations combined. The middle sign has four route marker symbols along with their cardinal directions. Hence, larger route designation symbols have been used for the U.S. routes to compensate for too many routes on one sign.

Figure 35. Example of signs with larger symbols to offset information overload.

Maintain High Level of Sign Legibility at Night

It is important that all signs are legible at night. This is accomplished by using retro-reflective materials, of varying quality, for all guide signs and for some overhead signs and by also using external illumination. Retro-reflective materials have improved over the years and materials are now available that will provide a high level of brightness, thereby, allowing the driver to read the sign well within the required legibility distance. Adding sign lighting enhances the legibility of the sign even more.

It is advisable, therefore, that signs within a section of high information load be made of the brightest practical retro-reflective material and, if overhead, be illuminated by sign lighting.

POTENTIAL ADVANCES AND APPLICATIONS OF THE INFORMATION LOAD PROGRAM

In Chapter 5, the concept of the DIL Profile diagram was presented and examples of its application were shown. While the DIL in its current state should be a good tool for analyzing highway information systems to determine if they may cause DIO, further research is needed to validate the model with more data and potentially develop thresholds for quantifying information overload situations. That is, a measure of information load needs to be developed so that the vertical scale on the diagram has an absolute meaning. Researchers need to better understand and quantify how individual signs and signs as a system affect this measure of information load. They also need to understand how different road types affect the various components of DIL. Then a threshold level of DIO is needed. As this is likely to vary by one or more driver characteristics, it is likely that this threshold will need to be presented as a percentile of the driving public.

Once these issues are resolved, the engineers developing and evaluating sign systems can use the DIL model more effectively during the sign design stage. With existing computer hardware and software advances, it should be relatively simple to automatically create the DIL in a computer-aided design (CAD) environment. Information load ratings could be assigned to each sign using the values generated by the software tool already developed. Also with the horizontal and vertical plans available in the CAD file, the load ratings for the Driving Task Demand (DTD) component would come from values based on various geometric and traffic elements. A review of the DIL would then identify whether or not a potential DIO situation exists with the proposed sign design.

CHAPTER **7**

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APPENDIXES A, C, D, AND E

UNPUBLISHED MATERIAL

Appendixes A, C, D, and E as submitted by the research agency are not published herein. For a limited time, they are available from the NCHRP. Their titles are as follows:

- Appendix A: Review of Selected Literature
- Appendix C: Description of Stimuli Presented in the Experiment on Combination Rules for Sign Arrays
- Appendix D: On-road Sequence of Sites for Primary On-road Experiment
- Appendix E: Primary On-road Experiment Instructions and Protocol

APPENDIX B

SUMMARY TABLES FOR SIGN CATEGORIES FROM “INDIVIDUAL FREEWAY SIGN INFORMATION LOAD EXPERIMENT”

TABLE B-1 Information load ratings for signs in bracket set

Sign Type and Category	*MUTCD Reference (1988 Edition)*	Sign Complexity	Definition	Rating
Advance Major Guide, Separate Exit	Fig. 2-9, Signs E1-1 and E1-5	Upper	Long Word, 2 Dest., 1 R.M., 0 Icon, No Lane, No Dir.	26
		Lower	Short Word, 1 Dest., 1 R.M., 0 Icon, No Lane, No Dir.	20
Advance Major Guide, Integrated Exit	Fig. 2-9, Sign E1-1a	Upper	Long Word, 2 Dest., 1 R.M., 0 Icon, No Lane, No Dir.	17
		Lower	Short Word, 1 Dest., 1 R.M., 0 Icon, No Lane, No Dir.	12
Advance Major Guide, Separate Exit and Lane Drop	Fig. 2-9, Signs E1-1, E1-5, and Fig. 2-33, Sign E11-1	Upper	Long Word, 2 Dest., 1 R.M., 0 Icon, Lane, No Dir.	20
		Lower 1	Short Word, 1 Dest., 1 R.M., 0 Icon, No Lane, No Dir.	20
		Lower 2	Short Word, 1 Dest., 1 R.M., 0 Icon, Lane, No Dir.	14
Advance Major Guide, Integrated Exit and Lane Drop	Fig. 2-9, Sign E1-1a and Fig. 2-33, Sign E11-1	Upper	Long Word, 2 Dest., 1 R.M., 0 Icon, Lane, No Dir.	29
		Lower	Short Word, 1 Dest., 1 R.M., 0 Icon, Lane, No Dir.	25
Advance Minor Guide, without Route	Fig. 2-9, Sign E1-2	Upper	Long Word, 2 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	17
		Lower	Short Word, 1 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	16
Advance Minor Guide	Fig. 2-9, Sign E1-3	Upper	Long Word, 2 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	20
		Lower	Short Word, 1 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	6
Next Exit	Fig. 2-10	Lower	N/A Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	5
Multiple Destination Exit	Fig. 2-11	Upper	Long Word, 2 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	26
		Lower	Short Word, 1 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	3
Multiple Destination, Next Right		Upper	Long Word, 2 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	19
		Lower	Short Word, 1 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	3
Exit Direction	Fig. 2-13	Upper	Long Word, 2 Dest., 1 R.M., 0 Icon, No Lane, Dir.	21
		Lower	Short Word, 1 Dest., 1 R.M., 0 Icon, No Lane, Dir.	14
Gore, Separate	Fig. 2-14, Signs E5-1 and E5-2	Lower	N/A Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	3
Gore, Integrated	Fig. 2-14, Sign E5-1a	Lower	N/A Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	4

Pull Thru, Small Shield	Fig. 2-15, Sign E6-2	Upper	Long Word, 1 Dest., 1 R.M., 0 Icon, No Lane, Dir.	7
		Lower	Short Word, 1 Dest., 1 R.M., 0 Icon, No Lane, Dir.	7
Pull Thru, Large Shield	Fig. 2-15, Sign E6-2a	Upper	Long Word, 1 Dest., 1 R.M., 0 Icon, No Lane, Dir.	12
		Lower	Short Word, 1 Dest., 1 R.M., 0 Icon, No Lane, Dir.	12
Post-Interchange Distance	Fig. 2-17, Sign E7	Upper	Long Word, 3 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	21
		Lower	Short Word, 1 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	3
Interchange Sequence	Fig. 2-18, Sign E8-1	Upper	Long Word, 3 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	33
		Lower	Short Word, 1 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	4
Community Interchange	Fig. 2-19, Sign E8-2	Upper	Long Word, 3 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	33
		Lower	Short Word, 1 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	13
Next (X) Exits	Fig. 2-20, Sign E-9	Upper	Long Word, 1 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	7
		Lower	Short Word, 1 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	4
Park & Ride	Fig. 2-26	Lower	N/A Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	18
Milepost	Sign D10-3	Upper	N/A Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	9
		Lower	N/A Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	4
Diagrammatic Guide, Separate Exit	Fig. 2-32	Upper	Long Word, 2 Dest., 2 R.M., 0 Icon, No Lane, Dir.	34
		Lower	Short Word, 1 Dest., 2 R.M., 0 Icon, No Lane, Dir.	22
Diagrammatic Guide, Integrated Exit	Fig. 2-32	Upper	Long Word, 2 Dest., 2 R.M., 0 Icon, No Lane, Dir.	28
		Lower	Short Word, 1 Dest., 2 R.M., 0 Icon, No Lane, Dir.	23
Diagrammatic Guide, Integrated Exit and Lane Drop	Fig. 2-32 and Fig. 2-33, Sign E11-1	Upper	Long Word, 2 Dest., 2 R.M. 0 Icon, Lane, Dir.	37
		Lower	Short Word, 1 Dest., 2 R.M., 0 Icon, Lane, Dir.	25

(continued on next page)

TABLE B-1 ***(Continued)***

Sign Type and Category	*MUTCD Reference (1988 Edition)*	Sign Complexity	Definition	Rating
Diagrammatic Guide, Separate Exit and Land Drop	Fig. 2-32 and Fig. 2-33, Sign E11-1	Upper	Long Word, 2 Dest., 2 R.M., 0 Icon, Lane, Dir.	33
		Lower	Short Word, 1 Dest., 2 R.M., 0 Icon, Lane, Dir.	23
Next Services	Fig. 2-43	Lower	N/A Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	5
Services, Integrated	Fig. 2-43	Upper	N/A Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	19
		Lower	N/A Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	3
Services, Separate	Fig. 2-43	Upper	N/A Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	17
		Lower	N/A Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	2
Rest Area, Gore	Fig. 2-44	Lower	N/A Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	2
Rest Area, Advance Guide		Upper	N/A Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	12
		Lower	N/A Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	2
Rest Area, Exit Direction		Upper	N/A Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	7
		Lower	N/A Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	5
Route Marker, U.S. Route	Fig. 2-45	Upper	N/A Word, 0 Dest., 1 R.M., 0 Icon, No Lane, Dir.	1
		Lower	N/A Word, 0 Dest., 1 R.M., 0 Icon, No Lane, No Dir.	1
Route Marker, Interstate	Fig. 2-46	Upper	N/A Word, 0 Dest., 1 R.M., 0 Icon, No Lane, Dir.	2
		Lower	N/A Word, 0 Dest., 1 R.M., 0 Icon, No Lane, No Dir.	1
Gas & Lodging, Double	Fig. 2-47	Upper 1	N/A Word, 0 Dest., 0 R.M., 4 Icon, No Lane, No Dir.	27
		Upper 2	N/A Word, 0 Dest., 0 R.M., 6 Icon, No Lane, No Dir.	32
		Lower	N/A Word, 0 Dest., 0 R.M., 2 Icon, No Lane, No Dir.	21
Gas & Lodging, Single	Fig. 2-47	Upper 1	N/A Word, 0 Dest., 0 R.M., 4 Icon, No Lane, No Dir.	29
		Upper 2	N/A Word, 0 Dest., 0 R.M., 6 Icon, No Lane, No Dir.	23
		Lower	N/A Word, 0 Dest., 0 R.M., 1 Icon, No Lane, No Dir.	7

Radio Information, Weather	Sign D12-1	Upper	N/A Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	24
		Lower	N/A Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	6
Radio Information, CB Channel 9	Sign D12-3	Upper	Long Word, 0 Dest., 1 R.M., 0 Icon, No Lane, No Dir.	15
		Lower	Short Word, 0 Dest., 1 R.M., 0 Icon, No Lane, No Dir.	5
Radio Information, Traffic		Upper	N/A Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	21
		Lower	N/A Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	10
Car Pool Information, Car	Sign D12-2	Lower	N/A Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	8
Car Pool Information, Van		Lower	N/A Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	9
Weigh Station, Advance Guide	Fig. 2-8, Sign D8-1	Upper	N/A Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	4
		Lower	N/A Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	1
Weigh Station, Exit Direction	FIg. 2-8, Sign D8-2	Lower	N/A Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	5
Weigh Station, Gore	Fig. 2-8., Sign D8-3	Lower	N/A Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	2
Recreational Guide, Integrated Icons	Fig. 2-52	Upper	Long Word, 1 Dest., 0 R.M., 3 Icon, No Lane, No Dir.	15
		Lower	Short Word, 1 Dest., 0 R.M., 1 Icon, No Lane, No Dir.	7
Recreational Guide, Separate Icons	Fig. 2-52	Upper	Long Word, 1 Dest., 0 R.M., , 3 Icon, No Lane, No Dir.	17
		Lower	Short Word, 1 Dest., 0 R.M., , 1 Icon, No Lane, No Dir.	7
Recreational Guide, Distance	Fig. 2-52	Upper	Long Word, 1 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	18
		Lower	Short Word, 1 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	10
Recreational Guide, Direction	Fig. 2-52	Upper	Long Word, 1 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	10
		Lower	Short Word, 1 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	6

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TABLE B-1 *(Continued)*

Sign Type and Category	*MUTCD Reference (1988 Edition)*	Sign Complexity	Definition	Rating
Boundary, County		Upper	Long Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	4
		Lower	Short Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	4
Boundary, State		Upper	Long Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	5
		Lower	Short Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	1

Key:

Rating = Information load rating (1-100)
Upper = Maximum number of all sign components present as specified in the MUTCD
Lower = Minimum number of all sign components present as specified in the MUTCD
Word = Word length of destinations (Long, Short, N/A)
Dest. = Number of destinations (0-4)
R.M. = Number of route markers (0-3)
Icon = Number of icons (0-6)
Lane = Presence or absence of a lane indicator arrow
Dir. = Presence or absence of a cardinal direction

TABLE B-2 Information load ratings for added sign components

Sign Type and Category	"Upper" Complexity Definition	"Upper" Complexity Rating	Added Component	Definition	Rating
Advance Major Guide, Separate Exit	Long Word, 2 Dest., 1 R.M. 0 Icon, No Lane, No Dir.	26	2 Destinations	Short Word, 3 Dest., 1 R.M. 0 Icon, No Lane, No Dir.	18
			3 Destinations	Short Word, 4 Dest., 1 R.M. 0 Icon, No Lane, No Dir.	27
Advance Major Guide, Integrated Exit	Long Word, 2 Dest., 1 R.M., 0 Icon, No Lane, No Dir.	17	1 Destination	Short Word, 2 Dest., 1 R.M. 0 Icon, No Lane, No Dir.	17
			1 Route Marker	Short Word, 1 Dest., 2 R.M. 0 Icon, No Lane, No Dir.	19
			Long Word	Long Word, 1 Dest., 1 R.M. 0 Icon, No Lane, No Dir.	15
Advance Major Guide, Separate Exit and Lane Drop	Long Word, 2 Dest., 1 R.M., 0 Icon, Lane, No Dir.	20	2 Destinations	Long Word, 4 Dest., 1 R.M. 0 Icon, Lane, No Dir.	40
Multiple Destination Exit	Long Word, 2 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	26	2 Destinations	Short Word, 3 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	27
Exit Direction	Long Word, 2 Dest., 1 R.M., 0 Icon, No Lane, Dir.	21	1 Destination	Short Word, 2 Dest., 1 R.M. 0 Icon, No Lane, Dir.	16
			Long Word	Long Word, 1 Dest., 1 R.M. 0 Icon, No Lane, Dir.	24
			2 Destinations	Long Word, 4 Dest., 1 R.M. 0 Icon, No Lane, Dir.	45
			1 Destination	Long Word, 3 Dest., 1 R.M. 0 Icon, No Lane, Dir.	23
			1 Route Marker	Short Word, 1 Dest., 2 R.M. 0 Icon, No Lane, Dir.	23
			3 Destinations	Short Word, 4 Dest., 1 R.M. 0 Icon, No Lane, Dir.	20
Pull Thru, Small Shield	Long Word, 1 Dest., 1 R.M., 0 Icon, No Lane, Dir.	7	Lane Indicator	Long Word, 1 Dest., 1 R.M. 0 Icon, Lane, Dir.	12
Pull Thru, Large Shield	Long Word, 1 Dest., 1 R.M., 0 Icon, No Lane, Dir.	12	1 Route Marker	Short Word, 1 Dest., 2 R.M. 0 Icon, No Lane, Dir.	25
Post-Interchange Distance	Long Word, 3 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	21	1 Destination	Long Word, 4 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	27
			Long Word	Long Word, 1 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	6
			2 Destinations	Short Word, 3 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	20
			3 Destinations	Short Word, 4 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	28
Interchange Sequence	Long Word, 3 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	33	1 Route Marker	Short Word, 1 Dest., 1 R.M. 0 Icon, No Lane, No Dir.	11

(continued on next page)

TABLE B-2 ***(Continued)***

Sign Type and Category	"Upper" Complexity Definition	"Upper" Complexity Rating	Added Component	Definition	Rating
Interchange Sequence (Ct'd.)			3 Route Markers	N/A Word, 3 Dest., 3 R.M. 0 Icon, No Lane, No Dir.	30
			Long Word	Long Word, 1 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	10
			2 Destinations 2 Route Markers	Short Word, 3 Dest., 2 R.M. 0 Icon, No Lane, No Dir.	30
			2 Destinations	Short Word, 3 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	26
			1 Destination	Long Word, 4 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	41
			1 Route Marker	N/A Word, 1 Dest., 1 R.M. 0 Icon, No Lane, No Dir.	9
			1 Destination 1 Route Marker	N/A Word, 2 Dest., 1 R.M. 0 Icon, No Lane, No Dir.	21
Community Interchange	Long Word, 3 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	33	2 Destinations 2 Route Markers	Short Word, 3 Dest., 2 R.M. 0 Icon, No Lane, No Dir.	29
			1 Route Marker	Short Word, 1 Dest., 1 R.M. 0 Icon, No Lane, No Dir.	23
			2 Destinations	Short Word, 3 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	33
			1 Route Marker	N/A Word, 1 Dest., 1 R.M. 0 Icon, No Lane, No Dir.	17
			Long Word	Long Word, 1 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	24
			3 Route Markers	N/A Word, 3 Dest., 3 R.M. 0 Icon, No Lane, No Dir.	30
			1 Destination 1 Route Marker	N/A Word, 2 Dest., 2 R.M. 0 Icon, No Lane, No Dir.	25
			3 Destinations	Short Word, 4 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	33
Diagrammatic Guide, Separate Exit	Long Word, 2 Dest., 2 R.M., 0 Icon, No Lane, Dir.	34	1 Direction	Short Word, 1 Dest., 2 R.M. 0 Icon, No Lane, Dir.	29
			1 Route Marker	Short Word, 1 Dest., 3 R.M. 0 Icon, No Lane, Dir.	30
Services, Integrated	N/A Word, 0 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	19	3 Icons	N/A Word, 0 Dest., 0 R.M. 3 Icon, No Lane, No Dir.	13
			6 Icons	N/A Word, 0 Dest., 0 R.M. 6 Icon, No Lane, No Dir.	20
			1 Icon	N/A Word, 0 Dest., 0 R.M. 1 Icon, No Lane, No Dir.	1
Route Marker, Interstate and U.S. Route	N/A Word, 0 Dest., 1 R.M., 0 Icon, No Lane, Dir.	Interstate = 2 U.S. Route = 1	1 Route Marker	N/A Word, 0 Dest., 2 R.M. 0 Icon, No Lane, Dir.	15
			1 Route Marker	N/A Word, 0 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	4

Recreational Guide, Integrated Icons	Long Word, 1 Dest., 0 R.M., 3 Icon, No Lane, No Dir.	15	3 Icons	Short Word, 1 Dest., 0 R.M. 4 Icon, No Lane, No Dir.	17
Recreational Guide, Separate Icons	Long Word, 1 Dest., 0 R.M., , 3 Icon, No Lane, No Dir.	17	5 Icons	Short Word, 1 Dest., 0 R.M. 6 Icon, No Lane, No Dir.	25
Recreational Guide, Distance	Long Word, 1 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	18	Green Color	Long Word, 1 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	10
			1 Destination	Long Word, 2 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	19
			2 Destinations	Long Word, 3 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	29
Recreational Guide, Direction	Long Word, 1 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	10	1 Destination	Long Word, 2 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	14

Key:

"Upper" Complexity = Maximum number of all sign components present as specified in the MUTCD
"Upper" Complexity Rating = Mean information load rating for the defined "upper" complexity sign (1-100)
Rating = Mean information load rating for the defined sign with added components (1-100)
Word = Word length of destinations (Long, Short, N/A)
Dest. = Number of destinations (0-4)
R.M. = Number of route markers (0-3)
Icon = Number of icons (0-6)
Lane = Presence or absence of a lane indicator arrow
Dir. = Presence or absence of a cardinal direction

TABLE B-3 General effects of sign components on information load

Sign Component	Type and Category	Definition	Rating	Difference
Word Length	Advance Major Guide, Integrated Exit	Short Word, 1 Dest., 1 R.M. 0 Icon, No Lane, No Dir.	12.48	
		Long Word, 1 Dest., 1 R.M. 0 Icon, No Lane, No Dir.	14.95	+2.47
		Short Word, 2 Dest., 1 R.M. 0 Icon, No Lane, No Dir.	17.46	
		Long Word, 2 Dest., 1 R.M. 0 Icon, No Lane, No Dir.	17.46	0
	Advance Major Guide, Integrated and Lane Drop	Short Word, 1 Dest., 1 R.M. 0 Icon, Lane, No Dir.	24.99	
		Long Word, 1 Dest., 1 R.M. 0 Icon, Lane, No Dir.	29.14	+4.15
	Exit Direction	Short Word, 1 Dest., 1 R.M. 0 Icon, No Lane, Dir.	14.06	
		Long Word, 1 Dest., 1 R.M. 0 Icon, No Lane, Dir.	23.58	+9.52
		Short Word, 2 Dest., 1 R.M. 0 Icon, No Lane, Dir.	16.07	
		Long Word, 2 Dest., 1 R.M. 0 Icon, No Lane, Dir.	21.21	+5.14
		Short Word, 4 Dest., 1 R.M. 0 Icon, No Lane, Dir.	20.33	
		Long Word, 4 Dest., 1 R.M. 0 Icon, No Lane, Dir.	45.37	+25.04
	Post-Interchange Distance	Short Word, 1 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	3.15	
		Long Word, 1 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	6.02	+2.87
		Short Word, 4 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	27.75	
		Long Word, 4 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	26.63	-1.12
	Interchange Sequence	Short Word, 1 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	4.21	
		Long Word, 1 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	10.3	+6.09

Sign Component	Type and Category	Definition	Rating	Difference
Word Length (Ct'd.)	Interchange Sequence (Ct'd.)	Short Word, 3 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	26.36	
		Long Word, 3 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	32.77	+6.41
	Community Interchange	Short Word, 1 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	12.82	
		Long Word, 1 Dest., 0 R.M., 0 Icon, No Lane, No Dir.	24.15	+11.33
		Short Word, 3 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	33.48	
		Long Word, 3 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	33.36	-0.12
	Recreational Guide, Distance	Short Word, 1 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	10.33	+7.8
		Long Word, 1 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	18.13	
Number of Destinations	Advance Major Guide, Separate Exit	Short Word, 1 Dest., 1 R.M. 0 Icon, No Lane, No Dir.	20.01	
		Short Word, 3 Dest., 1 R.M. 0 Icon, No Lane, No Dir.	18.42	-1.59
		Short Word, 4 Dest., 1 R.M. 0 Icon, No Lane, No Dir.	27.37	+7.36
	Advance Major Guide, Separate Exit and Lane Drop	Long Word, 2 Dest., 1 R.M. 0 Icon, Lane, No Dir.	19.9	
		Long Word, 4 Dest., 1 R.M. 0 Icon, Lane, No Dir.	39.73	+19.74
	Multiple Destination Exit	Short Word, 1 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	3.15	
		Short Word, 3 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	27.03	+23.88
	Exit Direction	Short Word, 1 Dest., 1 R.M. 0 Icon, No Lane, Dir.	14.06	
		Short Word, 2 Dest., 1 R.M. 0 Icon, No Lane, Dir.	16.07	+2.01
		Short Word, 4 Dest., 1 R.M. 0 Icon, No Lane, Dir.	20.33	+6.27
		Long Word, 1 Dest., 1 R.M. 0 Icon, No Lane, Dir.	23.58	
		Long Word, 3 Dest., 1 R.M. 0 Icon, No Lane, Dir.	23.45	-0.13
		Long Word, 4 Dest., 1 R.M. 0 Icon, No Lane, Dir.	45.37	+21.79

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TABLE B-3 ***(Continued)***

Sign Component	Type and Category	Definition	Rating	Difference
Number of Destinations (Ct'd.)	Post-Interchange Distance	Short Word, 1 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	3.15	
		Short Word, 3 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	19.63	+16.48
		Short Word, 4 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	27.75	+24.6
		Long Word, 1 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	6.02	
		Long Word, 3 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	21.27	+15.25
		Long Word, 4 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	26.63	+20.61
	Interchange Sequence	Short Word, 1 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	4.21	
		Short Word, 3 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	26.36	+22.15
		Long Word, 1 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	10.3	
		Long Word, 3 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	32.77	+22.47
		Long Word, 4 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	40.62	+30.32
	Community Interchange	Short Word, 1 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	12.82	
		Short Word, 3 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	33.48	+20.66
		Short Word, 4 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	33.02	+20.2
	Recreational Guide, Direction	Long Word, 1 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	9.59	
		Long Word, 2 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	14.27	+4.68
Number of Route Markers	Advance Major Guide, Integrated Exit	Short Word, 1 Dest., 1 R.M. 0 Icon, No Lane, No Dir.	12.48	
		Short Word, 1 Dest., 2 R.M. 0 Icon, No Lane, No Dir.	18.89	+6.41
	Exit Direction	Short Word, 1 Dest., 1 R.M. 0 Icon, No Lane, Dir.	14.06	
		Short Word, 1 Dest., 2 R.M. 0 Icon, No Lane, Dir.	22.82	+8.76
	Interchange Sequence	Short Word, 1 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	4.21	
		Short Word, 1 Dest., 1 R.M. 0 Icon, No Lane, No Dir.	10.66	+6.45

Sign Component	Type and Category	Definition	Rating	Difference
Number of Route Markers (Ct'd.)	Interchange Sequence (Ct'd.)	Short Word, 3 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	26.36	
		Short Word, 3 Dest., 2 R.M. 0 Icon, No Lane, No Dir.	29.84	+3.48
		N/A Word, 1 Dest., 1 R.M. 0 Icon, No Lane, No Dir.	8.53	
		N/A Word, 2 Dest., 2 R.M. 0 Icon, No Lane, No Dir.	21.4	+12.87
		N/ A Word, 3 Dest., 3 R.M. 0 Icon, No Lane, No Dir.	29.84	+21.31
	Community Interchange	Short Word, 1 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	12.82	
		Short Word, 1 Dest., 1 R.M. 0 Icon, No Lane, No Dir.	22.52	+9.7
		Short Word, 3 Dest,. 0 R.M. 0 Icon, No Lane, No Dir.	33.48	
		Short Word, 3 Dest., 2 R.M. 0 Icon, No Lane, No Dir.	29.03	-4.45
		N/A Word, 1 Dest., 1 R.M. 0 Icon, No Lane, No Dir.	17.14	
		N/A Word, 2 Dest., 2 R.M. 0 Icon, No Lane, No Dir.	24.61	+6.96
		N/A Word, 3 Dest., 3 R.M. 0 Icon, No Lane, No Dir.	30.17	+13.03
	Diagrammatic Guide, Separate Exit	Short Word, 1 Dest., 2 R.M. 0 Icon, No Lane, No Dir.	21.97	
		Short Word, 1 Dest., 3 R.M. 0 Icon, No Lane, No Dir.	29.88	+7.91

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TABLE B-3 ***(Continued)***

Sign Component	Type and Category	Definition	Rating	Difference
Number of Icons	Recreational Guide, Integrated	Short Word, 1 Dest., 0 R.M. 1 Icon, No Lane, No Dir.	6.74	
		Short Word, 1 Dest., 0 R.M. 4 Icon, No Lane, No Dir.	17.1	+10.36
	Recreational Guide, Separate	Short Word, 1 Dest., 0 R.M. 1 Icon, No Lane, No Dir.	7.46	
		Short Word, 1 Dest., 0 R.M. 6 Icon, No Lane, No Dir.	24.59	+17.13
Sign Color	Recreational Guide, Distance	Long Word, 1 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	18.13	
		Long Word, 1 Dest., 0 R.M. 0 Icon, No Lane, No Dir.	9.59	-8.54

Key:

Rating = Mean information load rating for the defined sign (1-100)

Difference = The difference in the ratings for the two signs under comparison. The rating of the first sign is subtracted from the rating for the second sign. In the case of a three-sign comparison, differences are calculated for the first and second signs and the first and third signs. The difference appears next to the row containing the second sign in the comparison.

Dest. = Number of destinations (0-4)

R.M. = Number of route markers (0-3)

Icon = Number of icons (0-6)

Lane = Presence or absence of a lane indicator arrow

Dir. = Presence or absence of a cardinal direction