ROUNDABOUT SIGNS AND MARKINGS IN THE NEXT M.U.T.C.D. FOR CANADA

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1.0 ABSTRACT

In 2008 a project was initiated by the Transportation Association of Canada (TAC) to develop a consistent system of signs and markings for roundabouts in Canada. The goal of the project was to provide detailed information on the application of signs and markings at single-lane and multi-lane roundabouts, and recommended corresponding additions or changes to the Manual of Uniform Traffic Control Devices (MUTCD) for Canada.

The project commenced with a literature review of current roundabout signing and marking practices in the United Kingdom, Australia, France, the United States and Canada, followed by a web-based survey to selected road agencies in Canada and the U.S. The objective was to gain an understanding of current signs and markings practices at roundabouts, and identify potential issues and knowledge gaps that could be studied further.

Based on this, a comprehension testing procedure was developed to rationalize the various types of advance signs. The testing involved projecting a number of advance signs or sign combinations on a screen in front of test subjects, and having them fill out a form whereby they make an exit leg choice or entry lane choice after viewing the images. The outcome was the establishment of preferred types of advance signs at roundabouts.

Surveys were then sent to members of the Project Steering Committee (PSC) to gauge preferences concerning a number of details related to these preferred signs, as well as other roundabout signs and markings. The outcome was a series of pavement markings, regulatory and warning signs, and guide and tourism signs for single-lane and multi-lane roundabouts, as well as several example signing and marking applications. They have all been approved by the Chief Engineers' Council, and are expected to be published in 2012 in an update to the MUTCD.

This paper discusses the project and highlights the comprehension testing procedure used to determine the preferred signs for conveying both exit leg choice and entry lane choice at multi-lane roundabouts.

2.0 BACKGROUND AND TESTING RATIONALE

The 2009 Edition of the U.S. Manual on Uniform Traffic Control Devices (MUTCD) specifies a number of new signs and markings schemes for modern roundabouts in the United States (1). Similar guidance in the Manual of Uniform Traffic Control Devices for Canada (MUTCDC) is limited, and mainly applies to single-lane roundabouts (2).

Previous research in the U.S. has focussed on the application of conventional (stack) and diagrammatic guide signs at roundabouts, the use of lane restriction signing at roundabouts (including "fish-hook" arrows), and central island signing (3,4,5,6,7). To date none of the research has specifically investigated what advance signs or sign combinations, including overhead signs, are the most effective at conveying both exit leg and entry lane choice at roundabouts.

The advance diagrammatic sign is the most common guide sign at roundabouts throughout the world. Examples are shown in Figure 2.1. Research has proven its effectiveness in conveying exit leg choice at roundabouts, especially those on skewed intersections or having more than four legs. However, diagrammatic signs may require a considerable amount of boulevard space, which can be a problem in urban areas. Also, approaches with three or more lanes, or a high percentage of large trucks, can make it difficult for drivers to see a ground-mounted diagrammatic sign.



Photo: Transportation Research Corp.



Figure 2.1 Example U.S. and Canadian diagrammatic guide signs.

These two disadvantages have led to the adoption of overhead signs at a small but increasing number of roundabouts in the U.S. and Canada. Some are simply a diagrammatic guide sign mounted overhead, while others have downward-pointing or upward-pointing arrows that may combine the destination information on diagrammatic signs with the lane use information on Lane Designation signs. A wide variety exists in the design of the relatively small number of overhead signs currently in use. Examples of overhead signs with upward-pointing arrows are shown in Figure 2.2.

Accordingly, a comprehension testing procedure was developed with the intent of answering three fundamental questions: 1) if diagrammatic signs are used at roundabouts what other signs, if any, are beneficial; 2) when overhead signs are used (for whatever reason) what type is preferred; and 3) what other signs, if any, are beneficial with overhead signs?



Photo: Ourston Roundabout Engineering Inc.

Photo: Ourston Roundabout Engineering Inc.

Figure 2.2 Example U.S. and Canadian overhead guide signs.

3.0 METHODOLOGY

3.1 ADVANCE SIGN TYPES USED IN THE TESTING

The comprehension testing consisted of evaluating several advance signs to determine their effectiveness in conveying exit leg and entry lane choice at a roundabout. Most studies of multi-lane roundabouts deal with 2 entry lanes and a 4-leg roundabout, and almost all diagrams of roundabouts in guides or elsewhere show a 4-leg roundabout. Unlike other studies a more complex configuration was also considered: a 3-lane entry at a 5-leg roundabout.

The signs used in the testing are shown in Figures 3.1 to 3.6. Figure 3.1 shows two diagrammatic guide signs (for a 4-leg and a 5-leg roundabout). The diagrammatic sign conveys exit leg choice through destination information and the general layout of the intersection. It can be ground-mounted or overhead, although it is used as a ground-mounted sign in the testing. It is referred to as Sign Type 1.



Figure 3.1 Diagrammatic guide signs. This sign type is the most common at roundabouts throughout the world.

Figure 3.2 shows two overhead guide signs with down-arrows, a standard highway design that is intended to convey lane use. It is referred to as Sign Type 2.



Figure 3.2 Down-arrow guide signs. This sign type is typical of overhead highway guide signs.

Figures 3.3 and 3.4 each show two guide signs with up-arrows. The text on these guide signs can be on top of the arrows, below the arrows, to the side of the arrows, or arranged diagrammatically about the arrows.

Up-arrow guide signs with text on top of the arrows correspond to the ground-mounted dedicated lane direction signs used in the U.K. Up-arrow guide signs with text arranged diagrammatically about the arrows have been used as an overhead sign in Wisconsin and in Nova Scotia. These signs are primarily intended to convey lane use, although having the text arranged diagrammatically about the arrows can also have the effect of conveying destination information. They are referred to as Sign Types 3 and 4. Up-arrow signs with text to the side of the arrows would be difficult to implement with three or more entry lanes, and was therefore not considered for testing.



Figure 3.3 Up-arrow guide signs with top text. This sign type is used as a ground-mounted sign in advance of intersections in the U.K.



Figure 3.4 Up-arrow guide signs with diagrammatic text. This sign type has been used as an overhead sign at a few roundabouts in the U.S. and Canada.

Figure 3.5 shows two regulatory Lane Designation signs. These signs can be groundmounted or overhead, and can be normal or fish-hook. In the interests in simplicity only normal ground-mounted Lane Designation signs were used in the testing. It should be noted that in two previous studies in the U.S. no discernable differences in lane choice accuracy were found between normal, normal with dot and fish-hook signs. The normal Lane Designation sign is referred to as Sign Type 5.



Figure 3.5 Lane Designation signs. A variation is the fish-hook Lane Designation sign. A custom sign may be useful at a 5-leg roundabout.

Figure 3.6 shows two Lane Direction signs. This sign is a warning sign used in parts of Australia that schematically displays actual driving paths through a roundabout for each entry lane. It could also be a guide sign. It is referred to as Sign Type 6.



Figure 3.6 Lane Direction signs. This sign type is used as a groundmounted warning sign at some roundabouts in Australia.

3.2 SIGN COMBINATIONS USED IN THE TESTING

The sign combinations used in the comprehension testing are shown schematically in Table 3.1 (for a 2-lane entry at a 4-leg roundabout) and Table 3.2 (for a 3-lane entry at a 5-leg roundabout). The combinations chosen are intended to replicate current practices and propose several logical options.

Sign Types	"Primary" Guide Sign	"Secondary" Sign	Comments
1 only	Westport Kaladar Brighton Diagrammatic Sign	-	 Practice in France and Australia, even at multi-lane roundabouts.
1+5	Westport Kaladar Brighton Diagrammatic Sign	Lane Designation Sign	 Most common practice in Canada and the U.S.
1 + 3	Westport Kaladar Brighton Diagrammatic Sign	Up-Arrow Guide Sign With Top Text	 Practice in the U.K.
2 only	Westport Kaladar Westport Brighton Westport Brighton Westport Brighton Westport Brighton Westport Brighton	-	
2+6	Westport Kaladar Westport Brighton Westport Brighton Westport Brighton Westport Brighton Westport Brighton Westport Brighton	Lane Direction Sign	
2+1	Westport Kaladar Westport Brighton Westport Brighton Westport Brighton Westport Brighton Westport Brighton Westport	Kaladar Brighton Diagrammatic Guide Sign	

 Table 3.1
 Advance Sign Combinations (2-Lane Entry at a 4-Leg Roundabout)

Sign Types	"Primary" Guide Sign	"Secondary" Sign	Comments
4 only	Westport Westport Kaladar Image: Comparison of the second secon	-	 Practice in Wisconsin and Nova Scotia.
4 + 6	Westport Westport Kaladar Image: Comparison of the second secon	Lane Direction Sign	
4 + 1	Westport Westport Kaladar Image: Constraint of the second secon	Kaladar Brighton Diagrammatic Guide Sign	

 Table 3.1
 Advance Sign Combinations (2-Lane Entry at a 4-Leg Roundabout)

 Table 3.2
 Advance Sign Combinations (3-Lane Entry at a 5-Leg Roundabout)

Sign Types	"Primary" Guide Sign	"Secondary" Sign	Comments
1 only	Tamworth Westport Diagrammatic Sign	-	 Practice in France and Australia, even at multi-lane roundabouts.
1 + 5	Tamworth Westport Diagrammatic Sign	Lane Designation Sign	 Most common practice in Canada and the U.S.
1+3	Tamworth Westport Diagrammatic Sign	Up-Arrow Guide Sign With Top Text	 Practice in the U.K.
2 only	Frankford Tamworth ↓ Prankford ↓ Westport ↓ Overhead Down-Arrow Sign	-	
2 + 6	Frankford Tamworth ↓ Frankford ↓ Westport ↓ Overhead Down-Arrow Sign	Lane Direction Sign	
2 + 1	Frankford Brighton Tamworth Frankford ✓ ✓ Overhead Down-Arrow	Tamworth Westport Diagrammatic Guide Sign	



 Table 3.2
 Advance Sign Combinations (3-Lane Entry at a 5-Leg Roundabout)

The testing was expected to establish the diagrammatic sign as a default guide sign at roundabouts. As mentioned, there are certain conditions for which large ground-mounted diagrammatic signs are not feasible or practical and overhead signs are preferred. Diagrammatic signs can be mounted overhead, but usually more efficient use of space is possible with overhead down-arrow or up-arrow signs. Therefore, the tests made use of the diagrammatic sign, the overhead down-arrow sign, and the overhead up-arrow sign with diagrammatic text as the "primary" signs (Sign Types 1, 2 and 4).

These signs were tested in isolation, and in combination with other "secondary" signs. The diagrammatic sign was tested alone, with the Lane Designation sign (Sign Type 5) and the up-arrow guide sign with top text (Sign Type 3). This replicates typical advance signing practice in France and Australia, in the U.S. and Canada, and in the United Kingdom, respectively. The down-arrow and up-arrow guide signs were tested with the same "secondary" signs, in this case Sign Types 6 and 1, to isolate any differences in their contribution to determining roundabout exit leg choice.

3.3 TESTING PROCEDURE

The comprehension testing procedure involved projecting the various signs or sign combinations on a screen in front of a number of test subjects, and having them to fill out a form whereby they make an exit leg or entry lane choice after viewing the images. The testing controlled for legibility of each sign (letter-height to driver distance ratio), and reading time, to be representative of actual driving conditions (8). This meant that each group of subjects had to be kept small so that they could view the screen at an appropriate reading angle and distance.

In the first part of the testing, participants were shown the sign combinations as set out in Tables 3.1 and 3.2, and asked to select what they considered to be the correct exit leg to the destination "Brighton". Example comprehension testing slides are shown in Figure 3.7.



Figure 3.7 Example comprehension testing slides.

After each sign or sign combination was displayed for the appropriate reading time interval, a decision slide showing either a 4-leg or a 5-leg roundabout was displayed as shown in Figure 3.8. At this point the subjects were asked to record their exit leg choice (i.e. 1, 2, 3 or 4) and their confidence in the selection (i.e. Very Sure, Somewhat Sure or Not At All Sure). This latter measure was retained as a means to further differentiate between test results, should it be necessary.



Figure 3.8 Decision slides for exit leg choice.

In this first part of the testing, 36 test runs were carried out comprising 2 runs of each of the 18 signs or sign combinations. The tests were randomized so that Brighton could correspond to any of the destination legs (i.e. a left turn, through movement, etc.). The appearance of the signs on the various slides was counterbalanced to some extent. This means that signs appearing in early test runs also appeared in later test runs, to account for learning effects.

In the second part of the testing, participants were shown 8 randomized overhead downarrow or up-arrow signs, and asked to select what they considered to be the correct entry lane to the destination Brighton. After each sign was displayed for the appropriate reading time interval, a decision slide showing either a 2-lane or a 3-lane entry was displayed as shown in Figure 3.9. At this point the participants were asked to record their entry lane choice (i.e. A, B or C, or any combination) and their confidence in the selection (i.e. Very Sure, Somewhat Sure or Not At All Sure).



Figure 3.9 Decision slides for entry lane choice.

A session comprising the 36 exit leg choice and 8 entry lane choice test runs, plus introductory material, took approximately 40 minutes to complete. After each session test subjects were given \$25. Data were gathered on 106 participants over 9 separate sessions. The participants were all licensed drivers, and ranged in age from 16 to over 70 years.

4.0 RESULTS

4.1 EXIT LANE CHOICE

The results of the tests for exit leg choice are summarized in Tables 4.1 and 4.2. The last column in the tables shows the percentage of correct responses for each sign or sign combination, for both times it was presented, and the exit leg corresponding to the correct choice (Brighton). Also shown is the average of the two test runs. The " \uparrow " or " \downarrow " symbols represent whether the average percentage was significantly higher or lower than the mean percentage correct over all the test runs.

Sign Types	"Primary" Guide Sign	"Secondary" Sign	Correct Exit Leg Choice Responses
1 only	Kaladar Brighton Diagrammatic Sign	-	 92.4% (exit leg 3) ↑ 91.4% (exit leg 2) ↑ Avg. = 91.9%
1 + 5	Westport Kaladar Brighton Diagrammatic Sign	Lane Designation Sign	 97.1% (exit leg 2) ↑ 94.3% (exit leg 3) ↑ Avg. = 95.7%
1 + 3	Westport Kaladar Brighton Diagrammatic Sign	Up-Arrow Guide Sign With Top Text	 90.5% (exit leg 1) 86.7% (exit leg 3) Avg. = 88.6%

 Table 4.1
 Percentage of Correct Exit Leg Responses (2-Lane Entry at a 4-Leg Roundabout)

Sign Types	"Primary" Guide Sign	"Secondary" Sign	Correct Exit Leg Choice Responses
2 only	Westport Kaladar Westport Brighton Westport Brighton Westport Brighton Westport Brighton Westport Brighton Westport Brighton Westport	-	 88.6% (exit leg 2) 62.9% (exit leg 3) ↓ Avg. = 75.8%
2 + 6	Westport Kaladar Westport Brighton Westport Brighton Westport Brighton Westport Brighton Westport Brighton Westport Brighton	Lane Direction Sign	 88.6% (exit leg 2) 62.9% (exit leg 1) ↓ Avg. = 75.8%
2 + 1	Westport Kaladar Westport Brighton Verhead Down-Arrow Sign	Westport Kaladar Brighton Diagrammatic Guide Sign	 97.1% (exit leg 2) ↑ 92.4% (exit leg 3) ↑ Avg. = 94.8%
4 only	Westport Westport Kaladar The second secon	-	 96.2% (exit leg 3) ↑ 93.3% (exit leg 1) ↑ Avg. = 94.8%
4 + 6	Westport Westport Kaladar Image: Comparison of the second secon	Lane Direction Sign	 98.1% (exit leg 2) ↑ 92.4% (exit leg 3) ↑ Avg. = 95.3%
4 + 1	Westport Westport Kalader Image: Constraint of the second secon	Westport Kaladar Brighton Diagrammatic Guide Sign	 96.2% (exit leg 2) ↑ 94.3% (exit leg 3) ↑ Avg. = 95.3%

Table 4.1 Percentage of Correct Exit Leg Responses (2-Lane Entry at a 4-Leg Roundabout)

Table 4.2 Percentage of Correct Exit Leg Responses (3-Lane Entry at a 5-Leg Roundabout)

Sign Types	"Primary" Guide Sign	"Secondary" Sign	Correct Exit Leg Choice Responses
1 only	Frankford Brighton Tamworth Westport Diagrammatic Sign	-	 94.3% (exit leg 4) ↑ 90.5% (exit leg 3) Avg. = 92.4%
1 + 5	Tamworth Westport Diagrammatic Sign	Lane Designation Sign	 93.3% (exit leg 3) ↑ 92.4% (exit leg 4) ↑ Avg. = 92.9%
1+3	Frenkford Brighton Tamworth Westport Diagrammatic Sign	Up-Arrow Guide Sign With Top Text	 92.4% (exit leg 1) ↑ 92.4% (exit leg 4) ↑ Avg. = 92.4%

Sign Types	"Primary" Guide Sign	"Secondary" Sign	Correct Exit Leg Choice Responses
2 only	Frankford Tamworth ↓ Frankford ↓ Westport ↓ Overhead Down-Arrow Sign	-	 70.5% (exit leg 3) ↓ 60.0% (exit leg 4) ↓ Avg. = 65.3%
2 + 6	Frankford Tamworth ↓ Frankford ↓ Westport ↓ Overhead Down-Arrow Sign	Lane Direction Sign	 84.8% (exit leg 1) ↓ 51.4% (exit leg 3) ↓ Avg. = 68.1%
2 + 1	Frankford Tamworth Overhead Down-Arrow Sign	Diagrammatic Guide Sign	 96.2% (exit leg 2) ↑ 89.5% (exit leg 4) Avg. = 92.9%
4 only	Tamworth Prankford Brighton Tamworth Overhead Up-Arrow Sign With Diagrammatic Text	-	 96.2% (exit leg 1) ↑ 90.5% (exit leg 3) Avg. = 93.4%
4 + 6	Tamworth Prankford Brighton Tamworth Overhead Up-Arrow Sign With Diagrammatic Text	Lane Direction Sign	 95.2% (exit leg 2) ↑ 90.5% (exit leg 4) Avg. = 92.9%
4 + 1	Tamworth Frankford Brighton Brighton Tamworth Vestport Overhead Up-Arrow Sign with Diagrammatic Text	Tamworth Westport Diagrammatic Guide Sign	 95.2% (exit leg 3) ↑ 88.6% (exit leg 4) Avg. = 91.9%

	Table 4.2	Percentage of	Correct Exit Leg	Responses	(3-Lane Entry	/ at a 5-Leg Roundabout)
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A number of trends are evident from the results presented in the tables. For both the 4leg and 5-leg roundabouts, the ground-mounted diagrammatic sign and the overhead up-arrow sign with diagrammatic text consistently produced the highest percentage of correct responses, regardless of the presence or type of secondary sign. The overhead down-arrow sign consistently produced the lowest percentage of correct exit leg choice responses, unless a secondary diagrammatic sign was shown. The use of other secondary signs (the Lane Designation regulatory sign and Lane Direction warning sign) did not generally override the effects of the primary sign.

A likely explanation for the success of the diagrammatic sign and the up-arrow sign with diagrammatic text is that the two sign types contain symbols or arrows that correspond to the configuration of the intersection and the direction of the destination.

Tables 4.3 and 4.4 display results for selected signs or sign combinations. In these tables, the overhead down-arrow signs have been removed, even when in combination with a diagrammatic sign. The combination of the up-arrow sign with diagrammatic text plus the diagrammatic sign has also been removed, as there appears to be no significant

benefit to showing both signs. (In reality, if both signs are installed in the field then they should be sufficiently separated to avoid information overload.)

Sign Types	"Primary" Guide Sign	"Secondary" Sign	Correct Exit Leg Choice Responses
1 only	Kaladar Brighton Diagrammatic Sign	-	 92.4% (exit leg 3) ↑ 91.4% (exit leg 2) ↑ Avg. = 91.9%
1+5	Westport Kaladar Brighton Diagrammatic Sign	Lane Designation Sign	 97.1% (exit leg 2) ↑ 94.3% (exit leg 3) ↑ Avg. = 95.7%
1+3	Westport Kaladar Brighton Diagrammatic Sign	Up-Arrow Guide Sign With Top Text	 90.5% (exit leg 1) 86.7% (exit leg 3) Avg. = 88.6%
4 only	Westport Westport Kalader Image: Comparison of the second secon	-	 96.2% (exit leg 3) ↑ 93.3% (exit leg 1) ↑ Avg. = 94.8%
4 + 6	Westport Westport Kaladar Image: Comparison of the second secon	Lane Direction Sign	 98.1% (exit leg 2) ↑ 92.4% (exit leg 3) ↑ Avg. = 95.3%

 Table 4.3
 Selected Exit Leg Responses (2-Lane Entry at a 4-Leg Roundabout)

One combination, the diagrammatic sign plus the up-arrow sign with top text, produced good results for a 3-lane entry at a 5-leg roundabout, but only fair results for a 2-lane entry at a 4-leg roundabout. This sign combination corresponds to practice in the U.K. A possible explanation is information overload, although why this would manifest itself for one roundabout and not another is unknown.

In looking at the averaged results for the 4-leg and 5-leg roundabouts, the use of a secondary Lane Designation regulatory sign along with the diagrammatic sign produced a small but statistically significant 2.1% improvement in correct exit leg choice (94.3% versus 92.2%). The use of a secondary Lane Direction warning sign along with the overhead up-arrow sign produced the same averaged results (94.1%). There appears to be some benefit in terms of exit leg choice to supplementing diagrammatic signs with secondary Lane Direction signs, but no benefit to supplementing overhead up-arrow signs with secondary Lane Direction signs.

Sign Types	"Primary" Guide Sign	"Secondary" Sign	Correct Exit Leg Choice Responses
1 only	Tamworth Westport Diagrammatic Sign	-	 94.3% (exit leg 4) ↑ 90.5% (exit leg 3) Avg. = 92.4%
1 + 5	Tamworth Westport Diagrammatic Sign	Lane Designation Sign	 93.3% (exit leg 3) ↑ 92.4% (exit leg 4) ↑ Avg. = 92.9%
1 + 3	Tamworth Westport Diagrammatic Sign	Up-Arrow Guide Sign With Top Text	 92.4% (exit leg 1) ↑ 92.4% (exit leg 4) ↑ Avg. = 92.4%
4 only	Frankford Tarmworth Overhead Up-Arrow Sign With Diagrammatic Text	-	 96.2% (exit leg 1) ↑ 90.5% (exit leg 3) Avg. = 93.4%
4 + 6	Frankford Frankford Brighton Tamworth Yamworth Westport Overhead Up-Arrow Sign With Diagrammatic Text	Lane Direction Sign	 95.2% (exit leg 2) ↑ 90.5% (exit leg 4) Avg. = 92.9%

Table 4.4	Selected Exit Leg Respons	ses (3-Lane Entry at a	a 5-Leg Roundabout)
	Colocica Exit Ecg (Copolis	See to Lane Lind y at	a o Log Roundabout)

It can be seen from Table 4.2 (and Table 4.4) there may be a practical limit to the effectiveness of the up-arrow signs with diagrammatic text. There was a significantly lower percentage of correct responses for the 5-leg roundabout if the destination was the third of fourth exit leg, as opposed to the first or second leg. This was the case either with this sign alone or in combination with a secondary sign. A likely explanation is information overload. Accordingly, efforts should be made to limit the amount of information on these signs, and to ensure sufficient reading time is available under actual driving conditions.

4.2 ENTRY LANE CHOICE

In the second part of the testing participants were shown 8 randomized overhead downarrow or up-arrow signs, and asked to select what they considered to be the correct entry lane to the destination Brighton. The results are summarized in Table 4.5, averaged between a 2-lane entry and a 3-lane entry. They show a 0.9% difference in correct responses between the down-arrow and up-arrow guide signs (98.3% versus 97.4%), an amount not determined to be statistically significant.

It is interesting to note that when two entry lanes were available the same destination, participants usually indicated one lane or the other as correct, rather than both lanes. This correlates with studies elsewhere (4,6).



Table 4.5 Averaged Entry Lane Responses

5.0 CONCLUSIONS

In terms of exit leg choice, the preferred sign or sign combination is a diagrammatic guide sign plus a Lane Designation sign, or an overhead up-arrow guide sign with diagrammatic text. These sign types are presented in Table 5.1. Because there was no statistical difference in how they performed when averaged for a 4-leg roundabout and a 5-leg roundabout (94.3% versus 94.1%), the final decision as to which to install in the field should depend on factors other than comprehension.

Table 5.1	Recommended	Signs for	Exit Leg	Choice wit	h Averaged Res	sponses

Sign Types	"Primary" Guide Sign	"Secondary" Sign	Correct Exit Leg Choice Responses
1 + 5	Kaladar Brighton Frankford Brighton Tamworth Westport Diagrammatic Signs	Lane Designation Signs	• Avg. = 94.3%
4 only	Kaladar Westport Kaladar Frankford Brighton Tamworth Frankford Brighton Westport Overhead Up-Arrow Signs With Diagrammatic Text	-	• Avg. = 94.1%

In terms of entry lane choice, the testing found no significant difference in how the overhead down-arrow and up-arrow guide signs performed. Considering only entry lane choice, the smaller size of the down-arrow sign gives it a lower cost, and an effective combination could be created if it were used with an advance diagrammatic guide sign. However, if only one type of advance guide sign is installed in the field then there is more benefit to the up-arrow sign with diagrammatic text, since in addition to entry lane choice it also more effectively conveys exit leg choice.

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