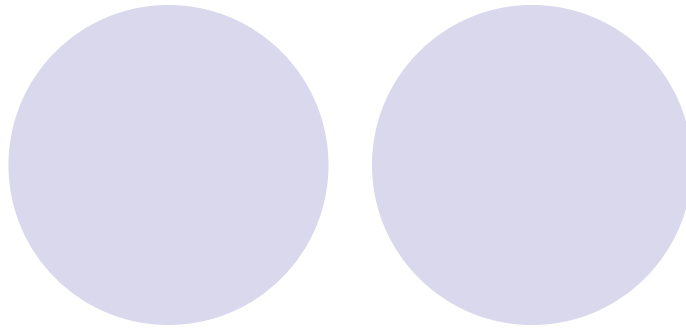




Enhancing the functionality and preparedness of the Rhode Island Transportation System in natural or human-caused disasters via VMS/DMS



Irene Soria
Jeff Severson
Aaron Clark
Dr. Jyh-Hone Wang
Dr. V. Maier-Sperdelozzi

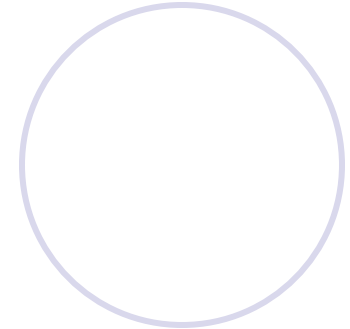
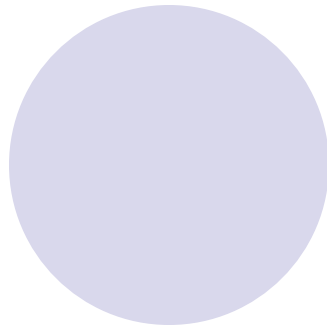
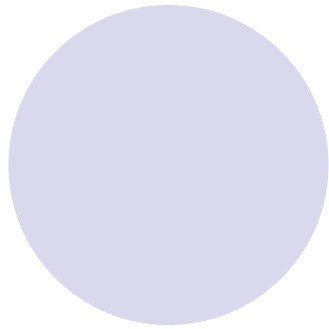
University of Rhode Island
University of Puerto Rico at Mayaguez
July 20, 2007



Presentation Outline

- Background and Project Objectives
- Methodology
- Results and Statistical Analysis
- Conclusion and Recommendations

Background and Project Objectives





Project Goals

- Recruitment of subjects to fill demographics gaps.
- Evaluate DMS/VMS message design factors as they relate to driver preferences.
- Comparison of data for each experiment.
- Making conclusions and generating a guide list for successful VMS Design.



Literature review

To familiarize and comprehend the project and the objectives we searched for literature. Also to learn about other recent projects on the same issues we are researching.

Yang C. M., Waters D., Cabrera C. C., Wang J. H., and Collyer C. E.

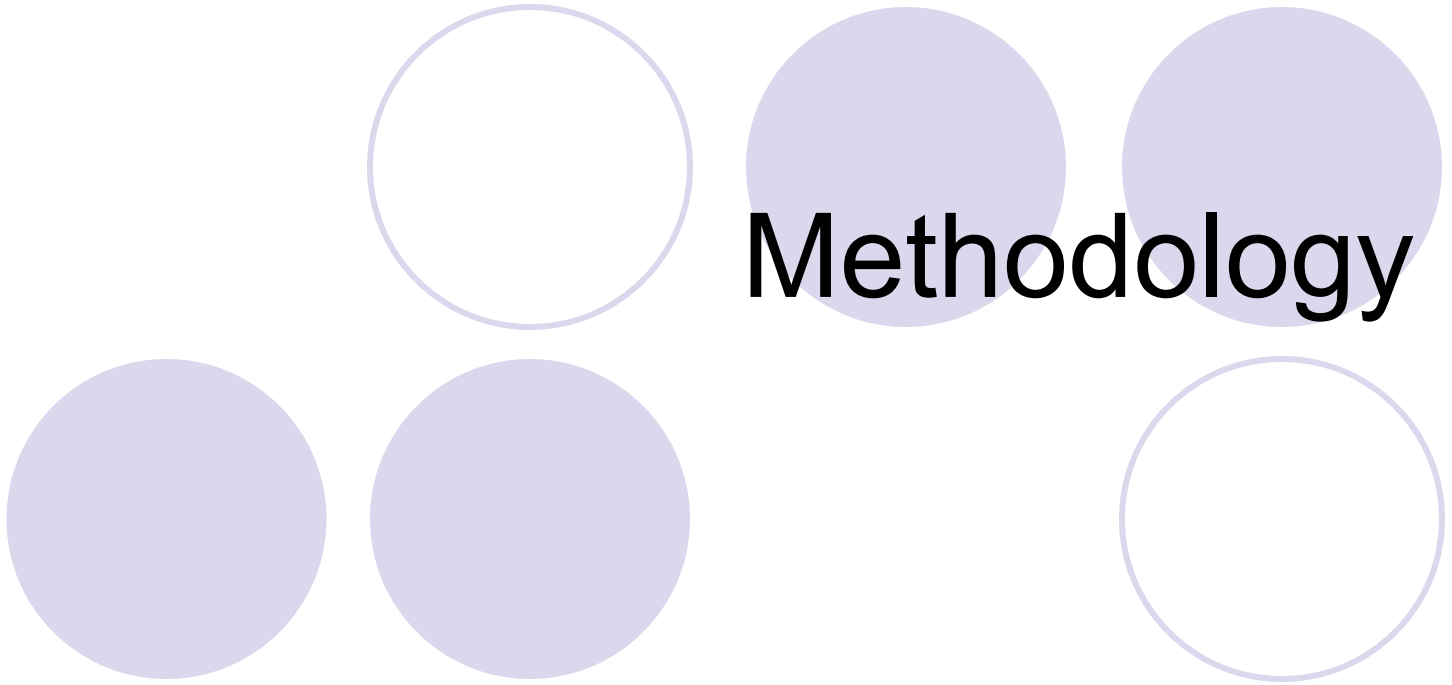
(2005) Enhancing the Messages Displayed on Dynamic Message Signs, 3rd International Driving Symposium on Human Factors in Driver Assessment, Training, and Vehicle Design, Rockport, Maine, USA

Federal Highway Administration (FHWA), MUTCD 2003-Manual on Uniform Traffic Control Devices, U.S. Department of Transportation, Washington, D.C., 2003.

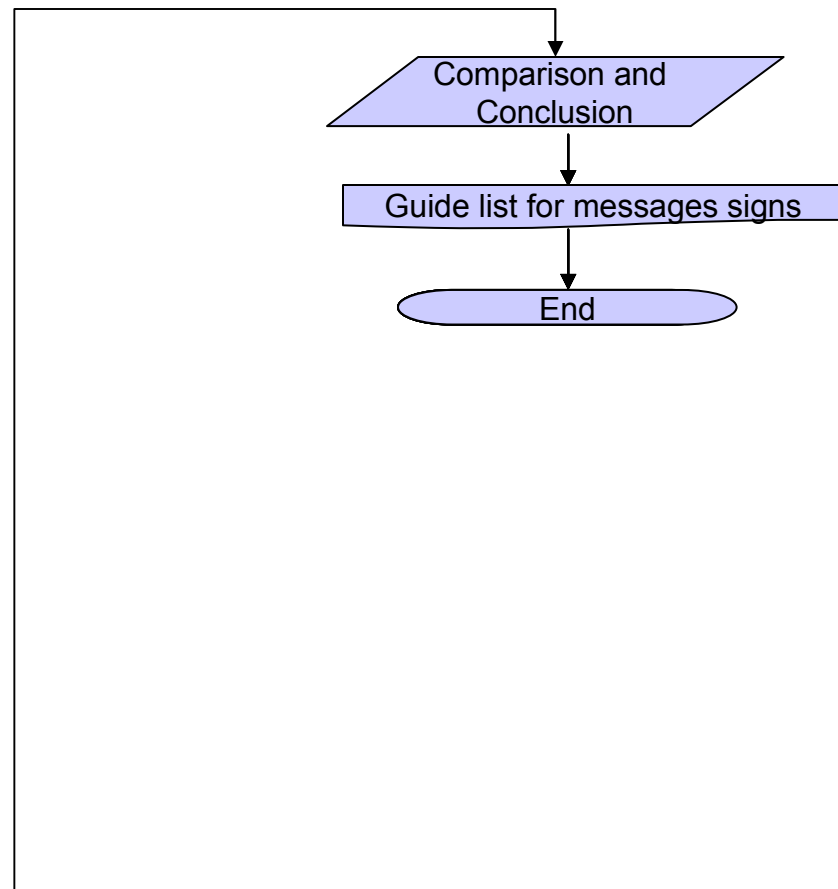
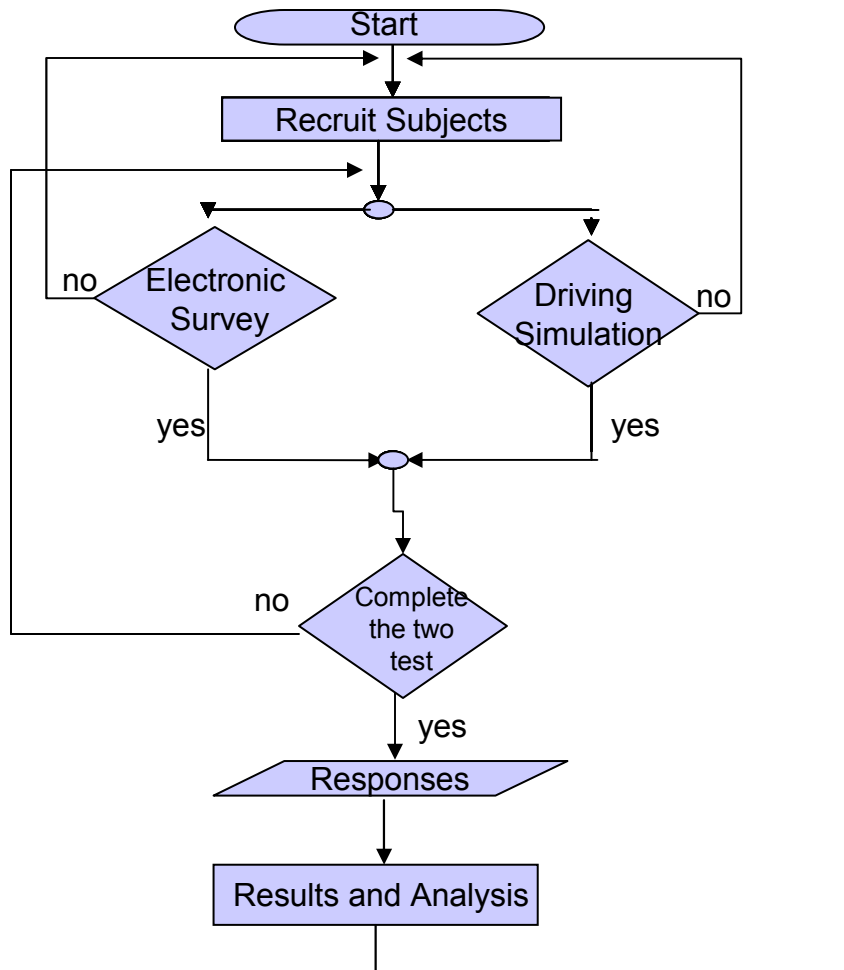
Wang J.H. and Cao Y. (2005) Assessing Message Display Formats of Portable Variable Message Signs, Journal of Transportation Research Board, no.1937, Washington D.C., 113-119.

Severson J.C, Wang J.H, Collyer C., and Maier-Speredelozzi V. Disseminating Variable message Signs Times Of Emergency, Rhode Island Department of Transportation, University of Rhode Island

Dudek C. Trout N., Durkop B., Booth S., Ulman G. (2001) Improving Dynamic Message Sign Operations, Texas transportation Institute, Texas A & M University System



Flowchart



Recruitment of subjects



- Senior centers and retirement communities to recruit elder people.
- Churches bulletins.
- Arranged schedules for the simulation and survey tests.

Identifying potential disaster scenarios

- Searched for all the bridges in Rhode Island.

| Num | Name | City | Street | Num | Name | City | Street |
|-----|----------------------|----------------------|--------------------------------|-----|----------------------|------------------------|--------------------------------|
| 10 | Wickford | NORTH KINGSTOWN | US 1A Boston Neck Rd. | 56 | Third Carolina South | RICHMOND-CHARLESTOWN | RI 112 Richmond Town House Rd. |
| 20 | Wakefield | SOUTH KINGSTOWN | US 1A Main St. | 58 | New Pawcatuck River | RICHMOND-CHARLESTOWN | Shannock Rd. |
| 23 | Pocasset River | CRANSTON | RI 2 Reservoir Ave. | 95 | Dolly Cole | FOSTER | Old Danielson Pike |
| 34 | Big River | WEST GREENWICH | RI 3 Nooseneck Hill Rd. | 96 | Hopkins Mill | FOSTER | Old Danielson Pike |
| 41 | First Barberville | HOPKINTON-RICHMOND | Old Nooseneck Hill Rd. | 105 | Oakland | BURRILLVILLE | Old RI 102 Victory Highway |
| 43 | Wyoming North | HOPKINTON-RICHMOND | Arcadia Rd. | 145 | Greystone Sluiceway | N. PROVIDENCE-JOHNSTON | Angel Rd. |
| 44 | Wyoming South | RICHMOND | Arcadia Rd. | 148 | Kenyon Arch | CHARLESTOWN-RICHMOND | Kenyon Rd. |
| 54 | First Carolina North | RICHMOND | RI 112 Richmond Town House Rd. | 178 | Peacedale Stone Arch | SOUTH KINGSTOWN | RI 108 Kingston Rd. |
| 55 | Second Carolina | RICHMOND-CHARLESTOWN | RI 112 Richmond Town House Rd. | 187 | Sayles | LINCOLN | Walker St. |



Identify potential disaster scenarios

- Natural gas and Petroleum companies and their location.

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Sign In & Personalize >

North Providence, RI

Search Again [Submit Your](#)

Saved Map Locations [11](#)

Recent Searches

Current selections: [Hide](#) [Remove](#)

- Petroleum companies

Show Business Names Containing **Petroleum companies**

- Bottled & Bulk Liquefied Petroleum
- Gas Equipment & Supplies

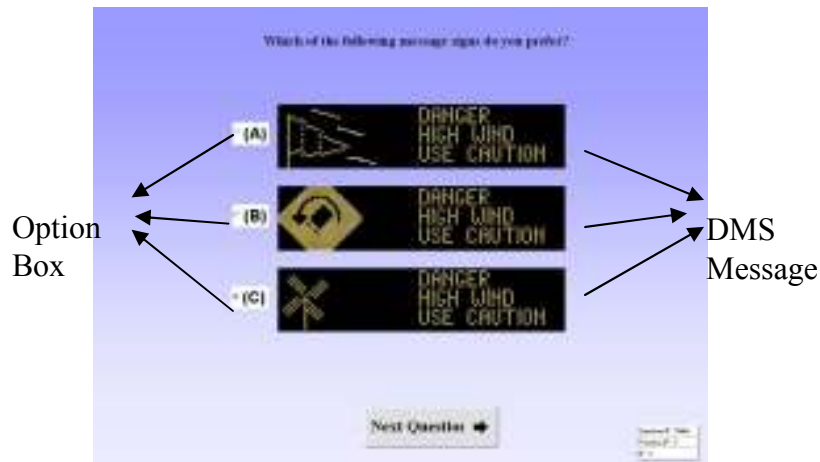
Results 1-15 of 160

- 1 Providence Petroleum
- 2 **Drake Petroleum CO Inc**
3.5 miles from center
365 Alens Avenue, Providence, RI 02905
<http://www.drake.com>
- 3 A-T
Phone
- 4 Rating:
- 5 ATI
Business Profile
- 6 CVS
[Add to Saved Locations](#)
- 7 [Zoom to street level](#)
- 8 [Send to mobile | email](#)
- 9 [Directions: Start | End](#)
- 10 [Driving Directions](#)



Computer-Based Survey

- Evaluates drivers' preferences and identifies variations in drivers' interpretations of VMS/DMS messages.
- Design factors such as: message justification, flashing guidewords, message color, graphics added vs. Text only messages, animation in messages, word choice, graphic choice, text outlining, graphic color, abbreviation.



Personal Data

First Name:

Last Name:

Age: 18-40 41-60 61 and above

Gender: Male Female

Native language: English Spanish

Other:

Education: Primary School Middle School High School College Post-Graduate

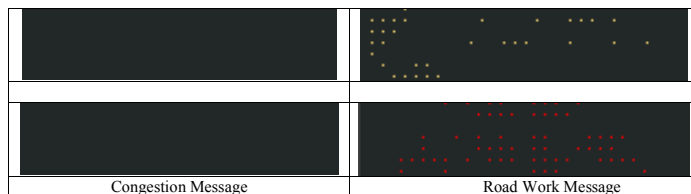
Are you color blind: Yes No

Do you wear glasses/contacts: Yes No

The image shows a "Personal Data" form with various input fields and checkboxes. The fields include First Name, Last Name, Age (with radio buttons for 18-40, 41-60, and 61 and above), Gender (with radio buttons for Male and Female), Native language (with radio buttons for English and Spanish), and Other (with a text input field). The Education field has radio buttons for Primary School, Middle School, High School, College, and Post-Graduate. There are also checkboxes for "Are you color blind" and "Do you wear glasses/contacts". A "SUBMIT" button is at the bottom.

Driving Simulation Experiment

- Measure drivers' reaction time and accuracy when interacting with simulated VMS/DMS messages.
- Validate the findings of the surveys regarding specific features of VMS/DMS messages.
- Test the actual performance of potential emergency messages in a situation more closely reality driving.



Statistical analysis and Comparing of Survey and Simulation Data

| Participants | | |
|--------------|---------|-------|
| | Initial | Final |
| Survey | 475 | 465 |
| Simulation | 166 | 157 |
| Both | | 140 |

Survey Initial Demographics

| Age | | Gender | | Language | | Education | | Color blind | | Glasses | |
|--------------|-----|--------|-----|----------|-----|-----------|-----|-------------|-----|---------|-----|
| 18-40 | 279 | Women | 200 | English | 431 | High Sch. | 124 | no | 447 | no | 209 |
| 41-60 | 115 | Men | 265 | Other | 31 | College | 272 | yes | 17 | yes | 256 |
| Over 60 | 70 | | | | | Post Grad | 68 | | | | |
| Total | 464 | | 465 | | 462 | | 464 | | 464 | | 465 |

Survey and Simulation Demographics

| Age | | Gender | | Language | | Education | | Color blind | | Glasses | |
|--------------|-----|--------|-----|----------|-----|------------|-----|-------------|-----|---------|-----|
| 18-40 | 73 | Women | 58 | English | 126 | High Sch. | 50 | no | 135 | no | 67 |
| 41-60 | 43 | Men | 82 | Other | 13 | College | 69 | yes | 5 | yes | 73 |
| Over 60 | 24 | | | | | Post Grad. | 21 | | | | |
| Total | 140 | | 140 | | 139 | | 140 | | 140 | | 140 |

Statistical analysis and Comparing of Survey and Simulation Data

Survey & Simulation Abbreviations

| Slide No. | 37 | 27 | 22 | 39 | TOTAL | Goodness of Fit X ² | Non Emergency | Emergency | Proportion Test Z value |
|-----------|---------------|---------------|--------------|---------------|---------------|--------------------------------|---------------|---------------|-------------------------|
| Some | 24 17.14% | 28 20.00% | 78 55.71% | 8 5.71% | 138 24.69% | | 28 20.00% | 110 26.25% | 1.83 |
| None | 112 80.00% | 107 76.43% | 48 34.29% | 126 90.00% | 393 70.30% | | 107 76.43% | 286 68.26% | |
| All | 4 2.86% | 5 3.57% | 14 10.00% | 5 3.57% | 28 5.01% | | 5 3.57% | 23 5.49% | |
| | | | | | 559 | 376.30 | | | |

| Abbreviation | | Gender | | Age | | | Language | | Education | | | Corrective Lenses | |
|--------------|------|---------------|---------------|---------------|---------------|---------------|----------------|--------------|---------------|---------------|---------------|-------------------|---------------|
| | | F | M | 18-40 | 41-60 | 61+ | English | Other | High Sch. | College | Post Grad | No | Yes |
| Nonemergency | SOME | 43 21.72% | 49 18.49% | 36 13.00% | 34 29.57% | 22 30.99% | 83 19.30% | 9 27.27% | 28 22.76% | 47 17.34% | 17 24.64% | 42 20.19% | 50 19.61% |
| | NONE | 148 74.75% | 207 78.11% | 230 83.03% | 79 68.70% | 46 64.79% | 333 77.44% | 22 66.67% | 88 71.54% | 217 80.07% | 50 72.46% | 160 76.92% | 195 76.47% |
| | ALL | 7 3.54% | 9 3.40% | 11 3.97% | 2 1.74% | 3 4.23% | 14 3.26% | 2 6.06% | 7 5.69% | 7 2.58% | 2 2.90% | 6 2.88% | 10 3.92% |
| Emergency | SOME | 185 30.94% | 220 27.85% | 242 29.02% | 109 31.69% | 54 25.71% | 368 28.59% | 37 36.63% | 101 27.52% | 242 29.84% | 62 29.52% | 188 30.13% | 217 28.40% |
| | NONE | 398 66.56% | 546 69.11% | 569 68.23% | 226 65.70% | 149 70.95% | 883 68.61% | 61 60.40% | 246 67.03% | 557 68.68% | 141 67.14% | 411 65.87% | 533 69.76% |
| | ALL | 15 2.51% | 24 3.04% | 23 2.76% | 9 2.62% | 7 3.33% | 36 2.80% | 3 2.97% | 20 5.45% | 12 1.48% | 7 3.33% | 25 4.01% | 14 1.83% |
| Total | SOME | 228 28.64% | 269 25.50% | 278 25.02% | 143 31.15% | 76 27.05% | 451 26.27% | 46 34.33% | 129 26.33% | 289 26.71% | 79 28.32% | 230 27.64% | 267 26.20% |
| | NONE | 546 68.59% | 753 71.37% | 799 71.92% | 305 66.45% | 195 69.40% | 1216 70.82% | 83 61.94% | 334 68.16% | 774 71.53% | 191 68.46% | 571 68.63% | 728 71.44% |
| | ALL | 22 2.76% | 33 3.13% | 34 3.06% | 11 2.40% | 10 3.56% | 50 2.91% | 5 3.73% | 27 5.51% | 19 1.76% | 9 3.23% | 31 3.73% | 24 2.36% |

Statistical analysis and Comparing of Survey and Simulation Data

Survey & Simulation
Color

| Slide No. | 26 | 42 | 16 | 6 | 36 | 18 | 8 | 52 | TOTAL | Goodness of Fit X ² | Non Emergency | Emergency | Proportion test Z value |
|-----------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|---------------|--------------------------------|---------------|---------------|-------------------------|
| Amber | 65 46.43% | 55 39.29% | 43 30.71% | 41 29.29% | 77 55.00% | 73 52.14% | 61 43.57% | 77 55.00% | 492 44.09% | | 256 45.96% | 236 42.22% | 1.26 |
| Red | 74 52.86% | 85 60.71% | 96 68.57% | 99 70.71% | 61 43.57% | 67 47.86% | 79 56.43% | 63 45.00% | 624 55.91% | | 301 54.04% | 323 57.78% | |
| | | | | | | | | | 1116 | 0.78 | | | |

| Text Color | | Gender | | Age | | | Language | | Education | | | Corrective Lenses | |
|--------------|-------|---------------|----------------|----------------|---------------|---------------|----------------|---------------|---------------|----------------|---------------|-------------------|----------------|
| | | F | M | 18-40 | 41-60 | 61+ | English | Other | High Sch. | College | Post Grad | No | Yes |
| Nonemergency | Amber | 433 54.33% | 459 43.80% | 563 50.77% | 197 43.20% | 132 47.14% | 836 48.86% | 56 41.79% | 187 38.48% | 557 51.57% | 148 53.05% | 357 43.17% | 535 52.55% |
| | Red | 364 45.67% | 589 56.20% | 546 49.23% | 259 56.80% | 148 52.86% | 875 51.14% | 78 58.21% | 299 61.52% | 523 48.43% | 131 46.95% | 470 56.83% | 483 47.45% |
| Emergency | Amber | 427 53.64% | 433 41.32% | 545 49.32% | 185 40.48% | 130 46.10% | 808 47.22% | 61 42.96% | 173 35.52% | 539 50.00% | 148 53.05% | 356 43.10% | 504 49.51% |
| | Red | 369 46.36% | 615 58.68% | 560 50.68% | 272 59.52% | 152 53.90% | 903 52.78% | 81 57.04% | 314 64.48% | 539 50.00% | 131 46.95% | 470 56.90% | 514 50.49% |
| Total | Amber | 860 53.99% | 892 42.56% | 1108 50.05% | 382 41.84% | 262 46.62% | 1644 48.04% | 108 40.45% | 360 56.34% | 1096 50.79% | 296 53.05% | 713 43.13% | 1039 51.03% |
| | Red | 733 46.01% | 1204 57.44% | 1106 49.95% | 531 58.16% | 300 53.38% | 1778 51.96% | 159 59.55% | 279 43.66% | 1062 49.21% | 262 46.95% | 940 56.87% | 997 48.97% |

Statistical analysis and Comparing of Survey and Simulation Data

Survey & Simulation

Animation

| Slide No. | 23 | 32 | 7 | 51 | TOTAL | Goodness of Fit χ^2 |
|-----------|--------------|--------------|---------------|--------------|---------------|--------------------------|
| No | 44 31.43% | 48 34.29% | 21 15.00% | 63 45.00% | 176 31.43% | |
| Yes | 96 68.57% | 92 65.71% | 119 85.00% | 77 55.00% | 384 68.57% | |
| | | | | | 560 | 77.2571429 |

Survey & Simulation

Flashing

| Slide No. | 9 | 20 | 31 | 48 | TOTAL | Goodness of Fit χ^2 |
|-----------|---------------|---------------|--------------|---------------|---------------|--------------------------|
| No | 24 17.14% | 29 20.71% | 48 34.29% | 33 23.57% | 134 23.97% | |
| Yes | 116 82.86% | 111 79.29% | 91 65.00% | 107 76.43% | 425 76.03% | |
| | | | | | 559 | 151.49 |

Statistical analysis and Comparing of Survey and Simulation Data

Survey & Simulation

Graphic Color

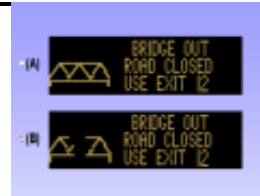
| Slide No. | 28 | 49 | 40 | 13 | TOTAL | Goodness of Fit X^2 | Non Emergency | Emergency | Proportion test Z value |
|-----------|---------------|---------------|--------------|--------------|---------------|-----------------------|---------------|---------------|-------------------------|
| Amber | 33 23.57% | 31 22.14% | 50 35.71% | 59 42.14% | 173 31.00% | | 64 22.94% | 109 39.07% | 4.12 |
| Red | 107 76.43% | 108 77.14% | 89 63.57% | 81 57.86% | 385 69.00% | | 215 77.06% | 170 60.93% | |
| | | | | | 558 | 80.54 | | | |

| Graphic Color | | Gender | | Age | | | Language | | Education | | | Corrective Lenses | |
|---------------|-------|---------------|---------------|---------------|---------------|---------------|----------------|--------------|---------------|---------------|---------------|-------------------|---------------|
| | | F | M | 18-40 | 41-60 | 61+ | English | Other | High Sch. | College | Post Grad | No | Yes |
| Nonemergency | Amber | 202 50.75% | 226 43.13% | 295 53.44% | 80 34.78% | 53 37.86% | 403 47.19% | 25 36.76% | 85 35.27% | 202 43.07% | 69 49.29% | 179 43.55% | 249 48.73% |
| | Red | 196 49.25% | 298 56.87% | 257 46.56% | 150 65.22% | 87 62.14% | 451 52.81% | 43 63.24% | 156 64.73% | 267 56.93% | 71 50.71% | 232 56.45% | 262 51.27% |
| Emergency | Amber | 134 33.84% | 136 26.00% | 180 32.49% | 49 21.78% | 41 29.29% | 259 30.40% | 11 16.42% | 46 18.93% | 178 33.21% | 46 32.86% | 111 27.01% | 159 31.30% |
| | Red | 262 66.16% | 387 74.00% | 374 67.51% | 176 78.22% | 99 70.71% | 593 69.60% | 56 83.58% | 197 81.07% | 358 66.79% | 94 67.14% | 300 72.99% | 349 68.70% |
| Total | Amber | 336 42.32% | 362 34.57% | 475 42.95% | 129 28.35% | 94 33.57% | 662 38.80% | 36 26.67% | 131 27.07% | 452 41.97% | 115 41.07% | 290 35.28% | 408 40.04% |
| | Red | 458 57.68% | 685 65.43% | 631 57.05% | 326 71.65% | 186 66.43% | 1044 61.20% | 99 73.33% | 353 72.93% | 625 58.03% | 165 58.93% | 532 64.72% | 611 59.96% |

Statistical analysis and Comparing of Survey and Simulation Data

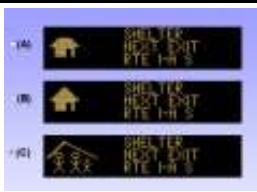
Survey & Simulation
Graphic Type

| Slide No. | 25 | 5 | 11 |
|-----------|---------------|--------------|--------------|
| A | 24 17.14% | 41 29.29% | 97 69.29% |
| B | 115 82.14% | 98 70.00% | 12 8.57% |
| C | | | 30 6.45% |



Survey & Simulation
Graphic Type

| Slide No. | 3 | 4 | 10 |
|-----------|--------------|--------------|--------------|
| A | 79 56.43% | 54 38.57% | 29 20.71% |
| B | 29 20.71% | 84 60.00% | 56 40.00% |
| C | 29 6.24% | | 54 11.61% |



Statistical analysis and Comparing of Survey and Simulation Data

Survey & Simulation

Justification

| Slide No. | 46 | 17 | 41 | 34 | TOTAL | Goodness of Fit X ² | Non Emergency | Emergency | Proportion Test Z value |
|-----------|--------------|---------------|--------------|--------------|---------------|--------------------------------|---------------|--------------|-------------------------|
| Left | 71 50.71% | 13 9.29% | 36 25.71% | 61 43.57% | 181 32.50% | | 120 28.78% | 61 43.57% | 3.34 |
| Center | 44 31.43% | 119 85.00% | 92 65.71% | 63 45.00% | 318 57.09% | | 255 61.15% | 63 45.00% | |
| Right | 24 17.14% | 6 4.29% | 12 8.57% | 16 11.43% | 58 10.41% | | 42 10.07% | 16 11.43% | |
| | | | | | 557 | 182.22 | | | |

| Justification | | Gender | | Age | | | Language | | Education | | | Corrective Lenses | |
|---------------|--------|---------------|---------------|---------------|---------------|---------------|---------------|--------------|---------------|---------------|---------------|-------------------|---------------|
| | | F | M | 18-40 | 41-60 | 61+ | English | Other | High Sch. | College | Post Grad | No | Yes |
| Nonemergency | Left | 81 40.91% | 115 44.06% | 117 42.70% | 48 42.11% | 31 43.66% | 180 42.25% | 16 48.48% | 56 46.28% | 109 40.67% | 31 44.29% | 90 43.48% | 106 42.06% |
| | Center | 88 44.44% | 121 46.36% | 124 45.26% | 55 48.25% | 30 42.25% | 196 46.01% | 13 39.39% | 51 42.15% | 130 48.51% | 28 40.00% | 96 46.38% | 113 44.84% |
| | Right | 29 14.65% | 25 9.58% | 33 12.04% | 11 9.65% | 10 14.08% | 50 11.74% | 4 12.12% | 14 11.57% | 29 10.82% | 11 15.71% | 21 10.14% | 33 13.10% |
| Emergency | Left | 184 30.77% | 248 31.23% | 246 29.53% | 109 31.78% | 72 34.12% | 400 31.10% | 27 26.73% | 102 27.79% | 252 31.07% | 73 34.93% | 180 28.89% | 247 32.33% |
| | Center | 362 60.54% | 480 60.45% | 530 63.63% | 205 59.77% | 107 50.71% | 785 61.04% | 57 56.44% | 210 57.22% | 519 64.00% | 113 54.07% | 385 61.80% | 457 59.82% |
| | Right | 52 8.70% | 66 8.31% | 57 6.84% | 29 8.45% | 32 15.17% | 101 7.85% | 17 16.83% | 55 14.99% | 40 4.93% | 23 11.00% | 58 9.31% | 60 7.85% |
| Total | Left | 265 33.29% | 358 34.10% | 363 32.79% | 157 34.35% | 103 36.52% | 580 33.88% | 43 32.09% | 158 32.38% | 361 33.46% | 104 37.28% | 270 32.53% | 353 34.74% |
| | Center | 450 56.53% | 601 57.24% | 654 59.08% | 260 56.89% | 137 48.58% | 981 57.30% | 70 52.24% | 261 53.48% | 649 60.15% | 141 50.54% | 481 57.95% | 570 56.10% |
| | Right | 81 10.18% | 91 8.67% | 90 8.13% | 40 8.75% | 42 14.89% | 151 8.82% | 21 15.67% | 69 14.14% | 69 6.39% | 34 12.19% | 79 9.52% | 93 9.15% |

Statistical analysis and Comparing of Survey and Simulation Data

Survey & Simulation Outline Color

| Slide No. | 43 | 33 | 50 | 14 | TOTAL | Goodness of Fit X ² | Non Emergency | Emergency | Proportion Test Z value |
|----------------------|--------------|--------------|--------------|--------------|---------------|--------------------------------|---------------|---------------|-------------------------|
| Amber w/ Red Outline | 31 22.14% | 29 20.71% | 25 17.86% | 33 23.57% | 118 21.15% | | 31 22.14% | 87 20.81% | 1.71 |
| Amber | 57 40.71% | 64 45.71% | 71 50.71% | 70 50.00% | 262 46.95% | | 57 40.71% | 205 49.04% | |
| Red w/ Amber | 52 37.14% | 47 33.57% | 43 30.71% | 36 25.71% | 178 31.90% | | 52 37.14% | 126 30.14% | |
| | | | | | 558 | 56.26 | | | |

| Outline Color | | Gender | | Age | | | Language | | Education | | | Corrective Lenses | |
|---------------|--------------|---------------|---------------|---------------|---------------|---------------|---------------|--------------|---------------|---------------|---------------|-------------------|---------------|
| | | F | M | 18-40 | 41-60 | 61+ | English | Other | High Sch. | College | Post Grad | No | Yes |
| Nonemergency | Amber w/ Red | 107 17.89% | 180 22.87% | 148 17.81% | 73 21.28% | 66 31.28% | 237 20.92% | 25 24.75% | 103 28.07% | 154 19.04% | 30 14.35% | 135 21.77% | 152 19.87% |
| | Amber | 330 55.18% | 355 45.11% | 414 49.82% | 172 50.15% | 99 46.92% | 561 49.51% | 50 49.50% | 131 35.69% | 430 53.15% | 124 59.33% | 282 45.48% | 403 52.68% |
| | Red w/ Amber | 161 26.92% | 252 32.02% | 269 32.37% | 98 28.57% | 46 21.80% | 335 29.57% | 26 25.74% | 133 36.24% | 225 27.81% | 55 26.32% | 203 32.74% | 210 27.45% |
| Emergency | Amber w/ Red | 33 16.50% | 50 18.94% | 40 14.39% | 24 20.87% | 19 23.46% | 77 17.91% | 6 17.65% | 34 27.42% | 36 13.33% | 13 18.57% | 37 17.70% | 46 18.04% |
| | Amber | 99 49.50% | 97 36.74% | 117 42.09% | 48 41.74% | 31 38.27% | 181 42.09% | 15 44.12% | 34 27.42% | 125 46.30% | 37 52.86% | 78 37.32% | 118 46.27% |
| | Red w/ Amber | 68 34.00% | 117 44.32% | 121 43.53% | 43 37.39% | 31 38.27% | 172 40.00% | 13 38.24% | 56 45.16% | 109 40.37% | 20 28.57% | 94 44.98% | 91 35.69% |
| Total | Amber w/ Red | 140 17.54% | 230 21.88% | 188 16.95% | 97 21.18% | 85 34.14% | 339 19.78% | 31 22.96% | 137 27.90% | 190 17.61% | 43 15.41% | 172 20.75% | 198 19.41% |
| | Amber | 429 53.76% | 452 43.01% | 531 47.88% | 220 48.03% | 130 52.21% | 816 47.61% | 65 48.15% | 165 33.60% | 555 51.44% | 161 57.71% | 360 43.43% | 521 51.08% |
| | Red w/ Amber | 229 28.70% | 369 35.11% | 390 35.17% | 141 30.79% | 34 13.65% | 559 32.61% | 39 28.89% | 189 38.49% | 334 30.95% | 75 26.88% | 297 35.83% | 301 29.51% |

WET PAVEMENT

WET PAVEMENT

WET PAVEMENT

Statistical analysis and Comparing of Survey and Simulation Data

Survey & Simulation
Text vs. Graphic

| Slide No. | 21 | 30 | 35 | 19 | 12 | 29 | 24 | 44 | TOTAL | Goodness of Fit X ² | Non Emergency | Emergency | Proportion Test Z value |
|-----------|--------------|--------------|---------------|--------------|--------------|--------------|--------------|---------------|---------------|--------------------------------|---------------|---------------|-------------------------|
| Text | 80 57.14% | 86 61.43% | 108 77.14% | 93 66.43% | 76 54.29% | 88 62.86% | 99 70.71% | 111 79.29% | 741 66.28% | | 330 58.93% | 411 73.66% | 5.21 |
| Graphic | 60 42.86% | 54 38.57% | 32 22.86% | 47 33.57% | 64 45.71% | 52 37.14% | 41 29.29% | 27 19.29% | 377 33.72% | | 230 41.07% | 147 26.34% | |
| | | | | | | | | | 1118 | 118.51 | | | |

| Text vs. Graphic | | Gender | | Age | | | Language | | Education | | | Corrective Lenses | |
|------------------|---------|----------------|----------------|----------------|---------------|---------------|----------------|---------------|---------------|----------------|---------------|-------------------|----------------|
| | | F | M | 18-40 | 41-60 | 61+ | English | Other | High Sch. | College | Post Grad | No | Yes |
| Nonemergency | Text | 469 59.14% | 706 67.05% | 678 61.03% | 313 68.79% | 184 65.71% | 1102 64.33% | 73 54.89% | 288 58.78% | 721 66.88% | 166 59.71% | 507 60.79% | 668 66.01% |
| | Graphic | 324 40.86% | 347 32.95% | 433 38.97% | 142 31.21% | 96 34.29% | 611 35.67% | 60 45.11% | 202 41.22% | 357 33.12% | 112 40.29% | 327 39.21% | 344 33.99% |
| Emergency | Text | 625 78.72% | 830 78.60% | 855 76.75% | 374 82.38% | 226 80.14% | 1365 79.55% | 90 67.16% | 370 75.05% | 874 81.08% | 211 75.63% | 621 74.91% | 834 81.68% |
| | Graphic | 169 21.28% | 226 21.40% | 259 23.25% | 80 17.62% | 56 19.86% | 351 20.45% | 44 32.84% | 123 24.95% | 204 18.92% | 68 24.37% | 208 25.09% | 187 18.32% |
| Total | Text | 1094 68.94% | 1536 72.83% | 1533 68.90% | 687 75.58% | 410 72.95% | 2467 71.95% | 163 61.05% | 658 66.94% | 1595 73.98% | 377 67.68% | 1128 67.83% | 1502 73.88% |
| | Graphic | 493 31.06% | 573 27.17% | 692 31.10% | 222 24.42% | 152 27.05% | 962 28.05% | 104 38.95% | 325 33.06% | 561 26.02% | 180 32.32% | 535 32.17% | 531 26.12% |

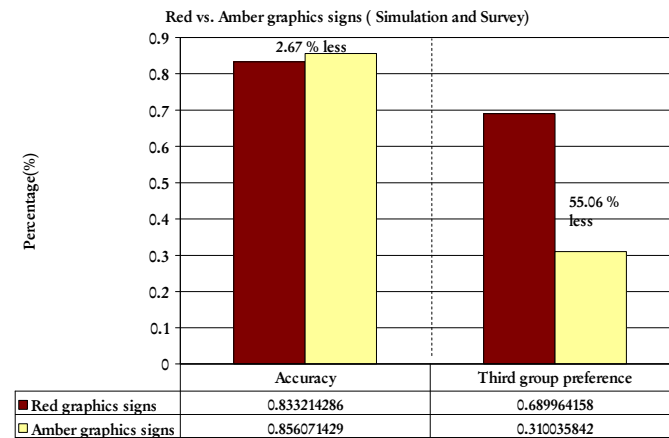
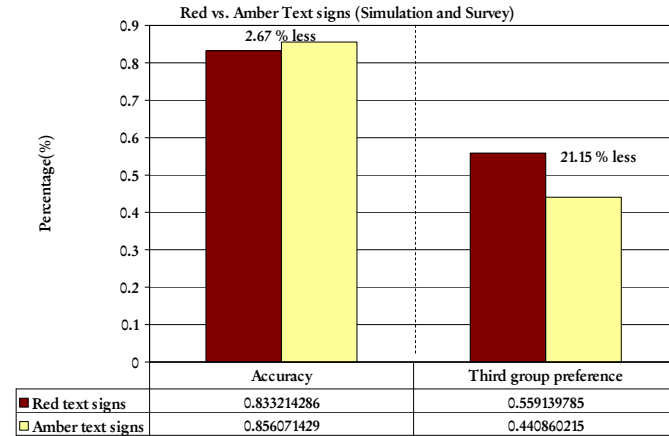
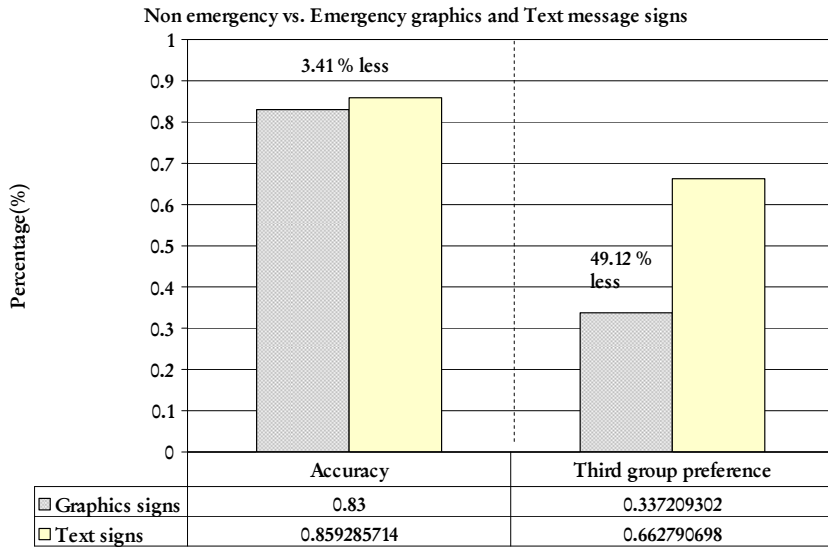
Statistical analysis and Comparing of Survey and Simulation Data

| | | Graphics | | Text | |
|--------------|----------|----------|--------|--------|--------|
| | | Amber | Red | Amber | Red |
| Nonemergency | Time | 12.31 | 14.81 | 15.97 | 17.82 |
| | Accuracy | 84.05% | 77.50% | 86.55% | 85.83% |
| Emergency | Time | 15.79 | 15.60 | 17.28 | 17.90 |
| | Accuracy | 85.89% | 80.54% | 88.39% | 84.82% |

| Variable Tested | Time for Accurate Response | Accuracy |
|-----------------|----------------------------|----------|
| Graphics | 14.17 | 83.00% |
| Text | 17.12 | 85.93% |
| Nonemergency | 15.03 | 84.52% |
| Emergency | 16.57 | 84.38% |
| Red | 16.25 | 83.32% |
| Amber | 15.04 | 85.61% |

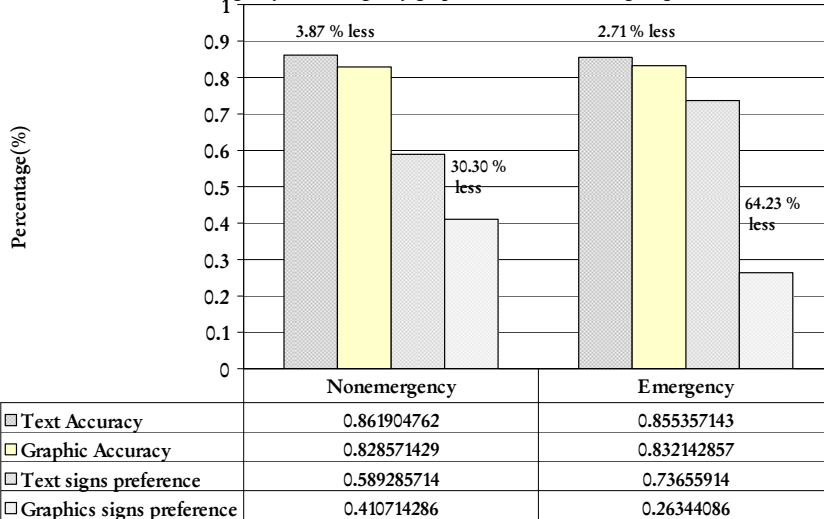
| | | Gender | | Age | | | Language | | Education | | | Corrective Lenses | |
|--------------|----------|--------|--------|--------|--------|--------|----------|--------|-----------|---------|----------|-------------------|--------|
| | | F | M | 18-40 | 41-60 | 61+ | English | Other | High Sch | College | Post Gra | No | Yes |
| Nonemergency | Time | 15.07 | 14.97 | 14.12 | 15.50 | 16.81 | 15.02 | 15.15 | 14.89 | 14.80 | 15.97 | 14.41 | 15.55 |
| | Accuracy | 84.41% | 84.60% | 86.93% | 83.24% | 79.51% | 84.99% | 82.05% | 79.75% | 87.08% | 87.50% | 85.14% | 83.96% |
| Emergency | Time | 16.15 | 16.87 | 16.29 | 16.90 | 16.83 | 16.60 | 15.67 | 16.50 | 16.55 | 16.81 | 16.05 | 17.05 |
| | Accuracy | 82.54% | 85.75% | 88.01% | 84.01% | 74.22% | 84.79% | 78.23% | 81.25% | 86.41% | 85.42% | 84.14% | 84.67% |
| Graphic | Time | 14.27 | 14.09 | 13.46 | 14.45 | 15.79 | 15.90 | 14.14 | 13.94 | 14.07 | 15.01 | 13.45 | 14.83 |
| | Accuracy | 83.45% | 82.74% | 86.99% | 80.58% | 75.42% | 93.24% | 83.46% | 77.50% | 86.30% | 85.48% | 83.88% | 82.26% |
| Text | Time | 16.73 | 17.36 | 16.52 | 17.67 | 17.84 | 19.18 | 16.46 | 17.12 | 16.93 | 17.60 | 16.69 | 17.48 |
| | Accuracy | 83.88% | 87.38% | 87.74% | 86.51% | 79.38% | 97.02% | 77.67% | 83.20% | 87.32% | 87.86% | 85.60% | 86.23% |
| Amber | Time | 14.88 | 15.14 | 14.25 | 15.56 | 16.46 | 15.04 | 15.22 | 15.09 | 14.83 | 15.56 | 14.54 | 15.48 |
| | Accuracy | 84.48% | 86.46% | 87.95% | 85.23% | 79.38% | 86.11% | 83.46% | 82.10% | 87.83% | 86.90% | 86.27% | 85.07% |
| Red | Time | 16.12 | 16.31 | 15.73 | 16.56 | 17.18 | 16.28 | 15.53 | 15.97 | 16.17 | 17.05 | 15.59 | 16.82 |
| | Accuracy | 82.84% | 83.66% | 86.78% | 81.86% | 75.42% | 83.77% | 77.67% | 78.60% | 85.80% | 86.43% | 83.21% | 83.42% |

Statistical analysis and Comparing of Survey and Simulation Data

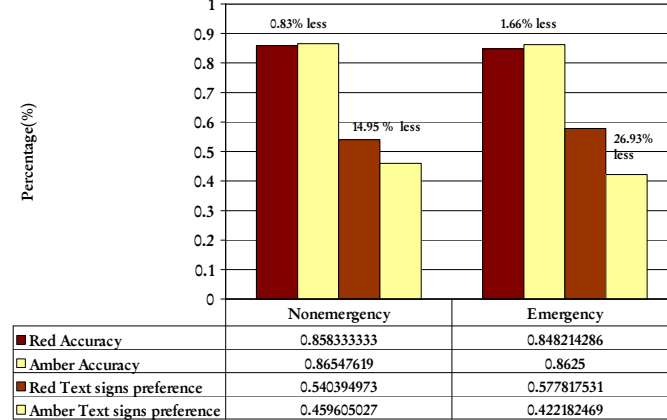


Statistical analysis and Comparing of Survey and Simulation Data

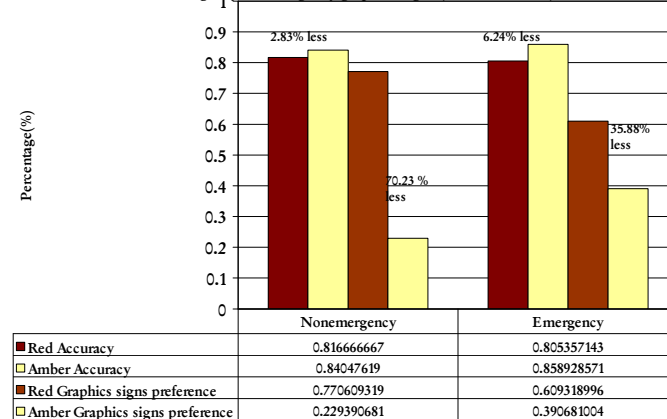
Non emergency vs. Emergency graphics and Text message signs



Nonemergency vs. emergency text signs (Red and Amber)



Nonemergency vs. emergency graphics signs (Red and Amber)



The text is centered and surrounded by seven light purple circles. Two are in the top row (one hollow, two solid), and three are in the bottom row (two solid, one hollow).

Conclusion and recommendations

Example guide list for successful VMS Design

| Library | Message Type | Time (sec) | | Accuracy (%) | | Preference (%) | |
|------------------|---|----------------|----------------|------------------|------------------|---------------------------|---------------------------|
| | | First group | Third group | First group | Third group | First group | Third group |
| Non Emergency | Text | 19.21 | 16.90 | 86.20% | 86.19% | 63.72% | 58.93% |
| | Graphic | 16.24 | 13.16 | 82.43% | 82.86% | 36.28% | 41.07% |
| | Red Text Signs | 17.87 | 17.82 | 85.88% | 85.83% | 51.63% | 54.04% |
| | Amber Text Signs | 16.08 | 15.97 | 86.52% | 86.55% | 48.37% | 45.96% |
| | Red graphic Signs | 13.97 | 14.81 | 81.21% | 77.50% | 70.56% | 77.06% |
| | Amber graphic Signs | 12.31 | 12.31 | 83.65% | 84.05% | 29.44% | 22.94% |
| | Some Abbreviations None Abbreviations All Abbreviations | 15.06 | 15.03 | 84.32% | 84.52% | 19.78% 76.13% 3.44% | 20.00% 76.43% 3.57% |
| Emergency | Text | 19.61 | 17.45 | 85.03% | 85.54% | 78.78% | 73.66% |
| | Graphic | 18.43 | 15.70 | 82.88% | 83.21% | 21.22% | 26.34% |
| | Red Text Signs | 17.91 | 17.9 | 84.39% | 84.82% | 53.42% | 57.78% |
| | Amber Text Signs | 16.98 | 17.28 | 85.67% | 88.39% | 46.58% | 42.22% |
| | Red graphic Signs | 15.47 | 15.6 | 79.94% | 80.54% | 53.58% | 60.93% |
| | Amber graphic Signs | 15.91 | 15.79 | 85.83% | 85.89% | 46.42% | 39.07% |
| | Some Abbreviations None Abbreviations All Abbreviations | 16.57 | 16.57 | 83.96% | 84.38% | 29.15% 68.04% 2.81% | 26.25% 68.26% 5.49% |
| Total | Text | 17.16 | 17.12 | 85.73% | 85.93% | 71.25% | 66.28% |
| | Graphic | 14.16 | 14.17 | 82.61% | 83.00% | 28.75% | 33.72% |
| | Red Text Signs | 17.89 | 17.85 | 85.29% | 85.43% | 52.52% | 55.91% |
| | Amber Text Signs | 16.44 | 16.38 | 86.18% | 86.43% | 47.48% | 44.09% |
| | Red graphic Signs Amber graphic Signs | 14.57 13.75 | 14.65 13.70 | 80.70% 84.52% | 81.21% 84.79% | 62.04% 37.96% | 69.00% 31.00% |



A decorative graphic at the top of the slide consists of two rows of circles. The top row has a solid light purple circle on the left and an outlined light purple circle on the right. The bottom row has a solid light purple circle on the left, an outlined light purple circle in the middle, and a solid light purple circle on the right. The word "Conclusion" is written in a large, bold, black sans-serif font, with the first circle of the top row partially overlapping the letter 'C'.

Conclusion

- Our analysis indicated that successful message signs have the following qualities:
 - little or no abbreviation,
 - centered text,
 - Amber graphic and text
 - animation of a graphic or key word.
- In comparing the preference and comprehension of text and graphic message signs, the subjects favored the text messages and have more accuracy, but have slower response time. This contradicts previous research showing that subjects preferred the graphics signs. This difference could be because the change in the experiment design. Knowing previous results, this project expanded the role of graphics in the messages.
- VMS/DMS can be utilized for emergencies scenarios.



Future Work

- Present findings and recommendations to RIDOT to continue refining the implementation of VMS/DMS messaging.
- Continue to test more factors in emergency message design and enlarge emergency message libraries.
- Study slowdown effects for VMS messaging.

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