Alternative Color Channelizing Devices in Work Zones

Philip M. Garvey
Martin Pietrucha
Scott Himes

The Larson Transportation Institute
The Pennsylvania State University
(2007-2009)
Background

- In a work zone that runs through an exit, crossroad, or driveway.

- Determine where to exit along the string of drums or panels.

- Often the only cue is a larger gap between the devices.
Background

• The foreshortening effect.

• Faulty placement or loss of a device.

• Erratic maneuvers, driver confusion, and potentially dangerous excursions into the work zone.
Background

- PennDOT wanted a low cost safety strategy.
- Different color channelizing devices to mark exits.
Background

- 2002, Myer Pooled Fund Study (four lane hwy)
  - No significant speed reduction

- 2005, Gannett Fleming (four lane hwy, three arterials)
  - 50% reduction in erratic maneuvers
  - 84% driver preference

- FHWA required additional experimentation
Research Method

1. Literature Review
2. Test Track Evaluation - Human Subjects
3. Field Evaluation (four-six active work zones)
Test Track Evaluation
Method

- Penn State’s 1 mile oval test track
- Single 1/3 mile work zone with right exit
- Approach spacing 40 ft, exit spacing 20 ft
- 80 subjects representing U.S. driving population in age and gender
- Daytime and night
Variables

• Independent
  – Channelizing device layout
Variables

- Dependent (MOEs)
  - Exit detection distance
  - Speed profile (safety and confidence)
  - Questionnaire (comprehension and preference)
Procedure

- Subjects drove 2006 Chevy Impala
- 25 mph through an approach curve
- 35 mph on the tangent toward the exit
Procedure

• Each subject drove through all treatments and two “catch trials.”
• Using a DMI, the experimenter recorded the exit detection distance and speed at various points through the work zone.
Daytime Results by Device Type

Exit Detection (ft)

- Drums: 150 ft (32%)
- Panels: 140 ft (26%)
- Both: 170 ft (22%)
Nighttime Results by Device Type

Exit Detection (ft)

- Drums: 110
- Panels: 160
- Both: 180

32% 22% 44%
Field Evaluation
Method

- 5 Limited Access Highway Locations (I-84, I-99 and Route 220)
- 2 Major Arterial Locations (Route 22 and Route 29)
- Approximately two to three weeks using an A-B-A design
- Videotape turn signal activation and erratic maneuvers
- Driver survey
Field Evaluation
Highway Route 220
Field Evaluation
Route 220
Field Evaluation
Highway I-84
Field Evaluation
I-84
Field Evaluation
Highway I-99
Field Evaluation
I-99
Field Evaluation
I-99
Field Evaluation
Arterial Route 22
Field Evaluation
Route 22
Field Evaluation
Arterial Route 29
Field Evaluation
Route 29
Field Evaluation
Route 29
Field Evaluation
Videotape
Field Evaluation
Videotape Results (Highway)
23,000 Vehicles Exited

• Excursions into Work Zone
  – 4 Experimental
  – 21 Standard

• Turn Signal Activation
  • Site 1 Experimental: 99% daytime 94% night
  • Site 1 Standard: 88% day and night
  • Site 2 Experimental: 73% daytime 90% night
  • Site 2 Standard: 48% day and 61% night
Field Evaluation
Videotape Results (Arterial)
2,800 Vehicles Exited

• Erratic Maneuvers
  – 0 Experimental
  – 4 Standard (1 excursion and 3 exits into the entrance)
### Field Evaluation Survey

<table>
<thead>
<tr>
<th>How often do you use this exit?</th>
<th>Daily</th>
<th>Weekly</th>
<th>Seldom</th>
<th>1st Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>When exiting, would you say finding where to leave the highway was:</td>
<td>Very Easy</td>
<td>Neither Easy nor Difficult</td>
<td>Very Difficult</td>
<td></td>
</tr>
</tbody>
</table>

---

If experimental conditions were present, the next question was asked.

<table>
<thead>
<tr>
<th>Was there anything different about the barrels (or panels) near the exit?</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

---

If yes, the next question was asked.

<table>
<thead>
<tr>
<th>Did the different colored barrels (or panels) help you find the exit?</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>
Field Evaluation
Survey Results

• Survey (n=246 Standard; n=303 Experimental)
  – 75% Experimental Condition found the exit “easy” or “very easy” to find
  – 63% Standard Condition
  – 40% Experimental Condition found the exit was “very easy”
  – 11% Standard Condition

• 90% stated that the different color devices helped them find the exit.
Conclusions

- PennDOT submitted a request to FHWA for interim approval in the MUTCD.
- FHWA denied the request and asked for additional data.