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Public Opinion, Traffic Performance, the Environment, and Safety After Construction of Double-Lane Roundabouts

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Intersection crashes

2012

- 42% of all police-reported crashes
- 46% of injury crashes
- 23% of fatal crashes
 - 7,696 deaths

Safety benefits of converting traditional intersections to roundabouts

European, Australian, and U.S. research

- 35-61% reductions in all crashes
- 25-87% reductions in injury crashes
- Greater safety benefits for single-lane roundabouts than for double-lane roundabouts
 - Smaller reductions in crashes at double-lane roundabouts, or
 - Increases in crashes at double-lane roundabouts

Traffic and environmental benefits of converting traditional intersections to roundabouts

Previous research

- 13-89% reductions in vehicle delays
- 14-52% reductions in the proportion of vehicles stopped
- Vehicle emissions and fuel consumption reduced
- Roundabout construction often part of larger construction project; unclear in prior studies whether effects of roundabouts separated from other construction effects

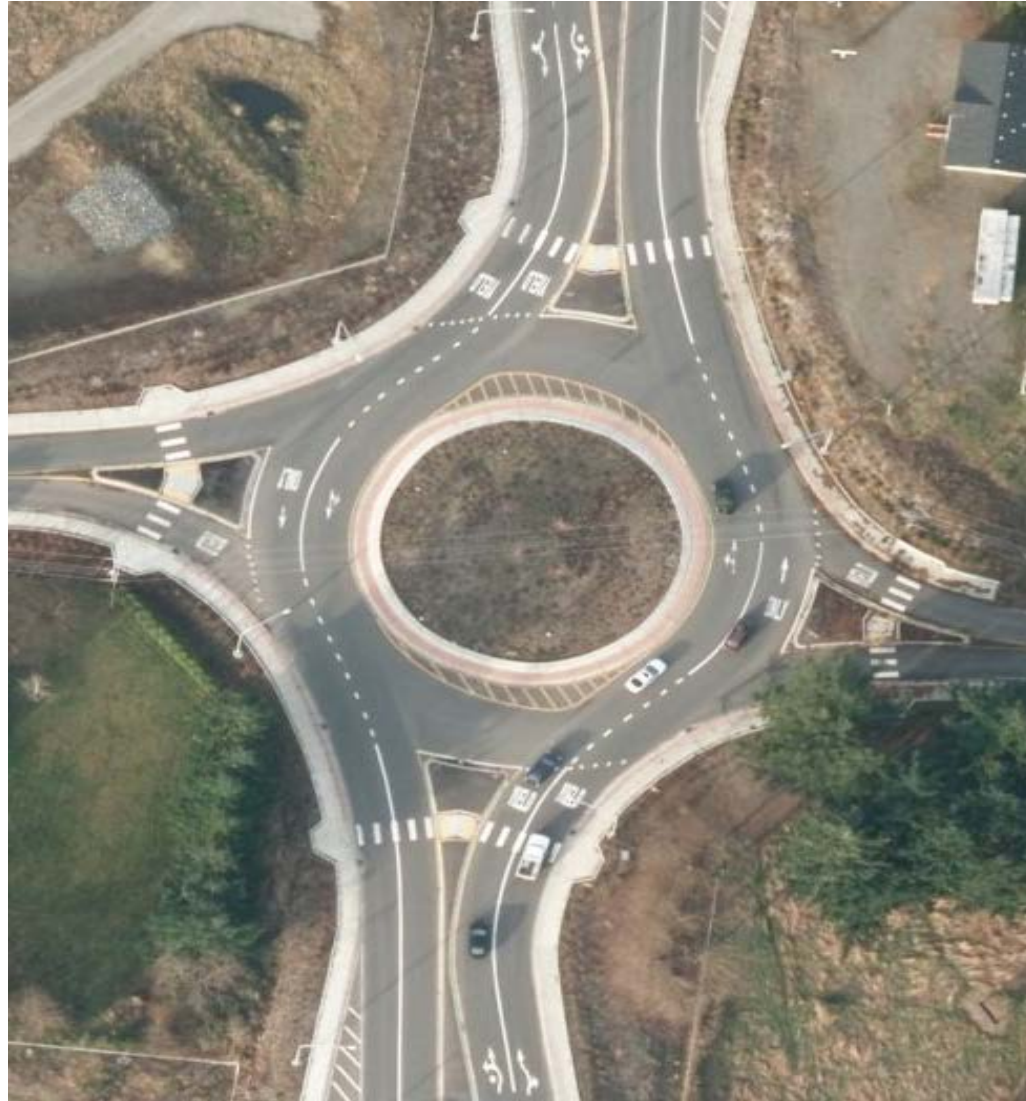
Potential benefits of roundabouts for older drivers

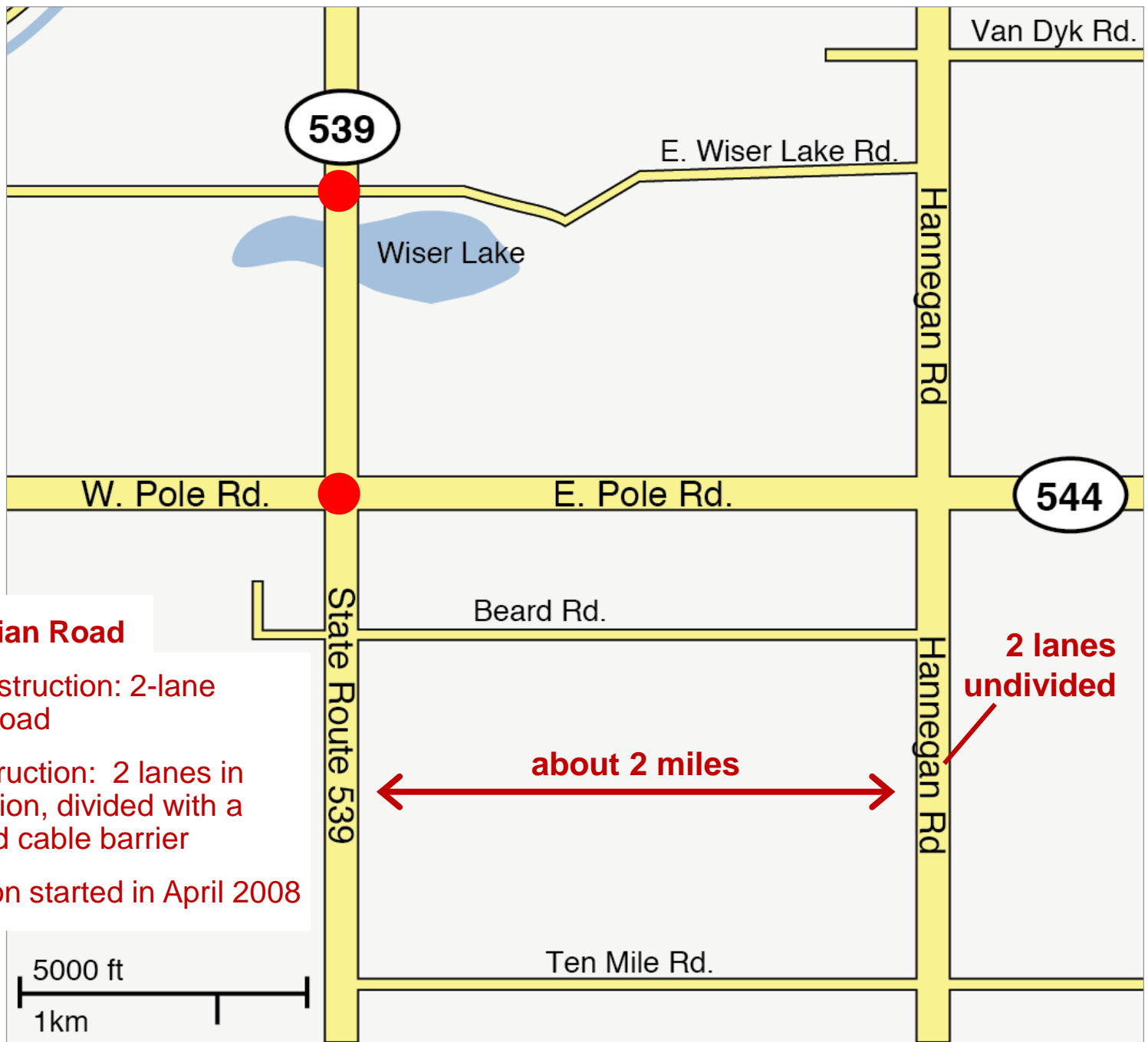
- Older drivers are over-involved in intersection crashes
- A study of at-fault drivers in nonfatal intersection crashes found older drivers more likely than younger drivers to be cited for failure to yield the right-of-way
- Consequences of failing to yield likely less severe at roundabouts than at traditional intersections
- A 2007 study found support for roundabouts was lower among drivers 65 and older than among younger drivers 1 year or longer after construction
- Concerns that older drivers will choose alternative routes to avoid roundabouts

Study of conversions of two traditional intersections to double-lane roundabouts near Bellingham, Washington

- Limited research on multi-lane roundabouts in the United States
- Evaluate the impacts of the double-lane roundabouts on:
 - Public attitudes
 - Traffic performance and the environment
 - Crashes
- Evaluate whether older drivers avoided roundabouts by taking an alternative route

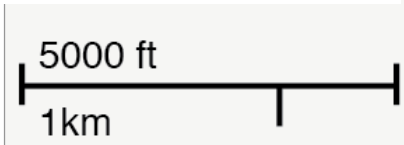
Study roundabout





Guide Meridian Road

- Before construction: 2-lane undivided road
- After construction: 2 lanes in each direction, divided with a median and cable barrier
- Construction started in April 2008



Study roundabouts

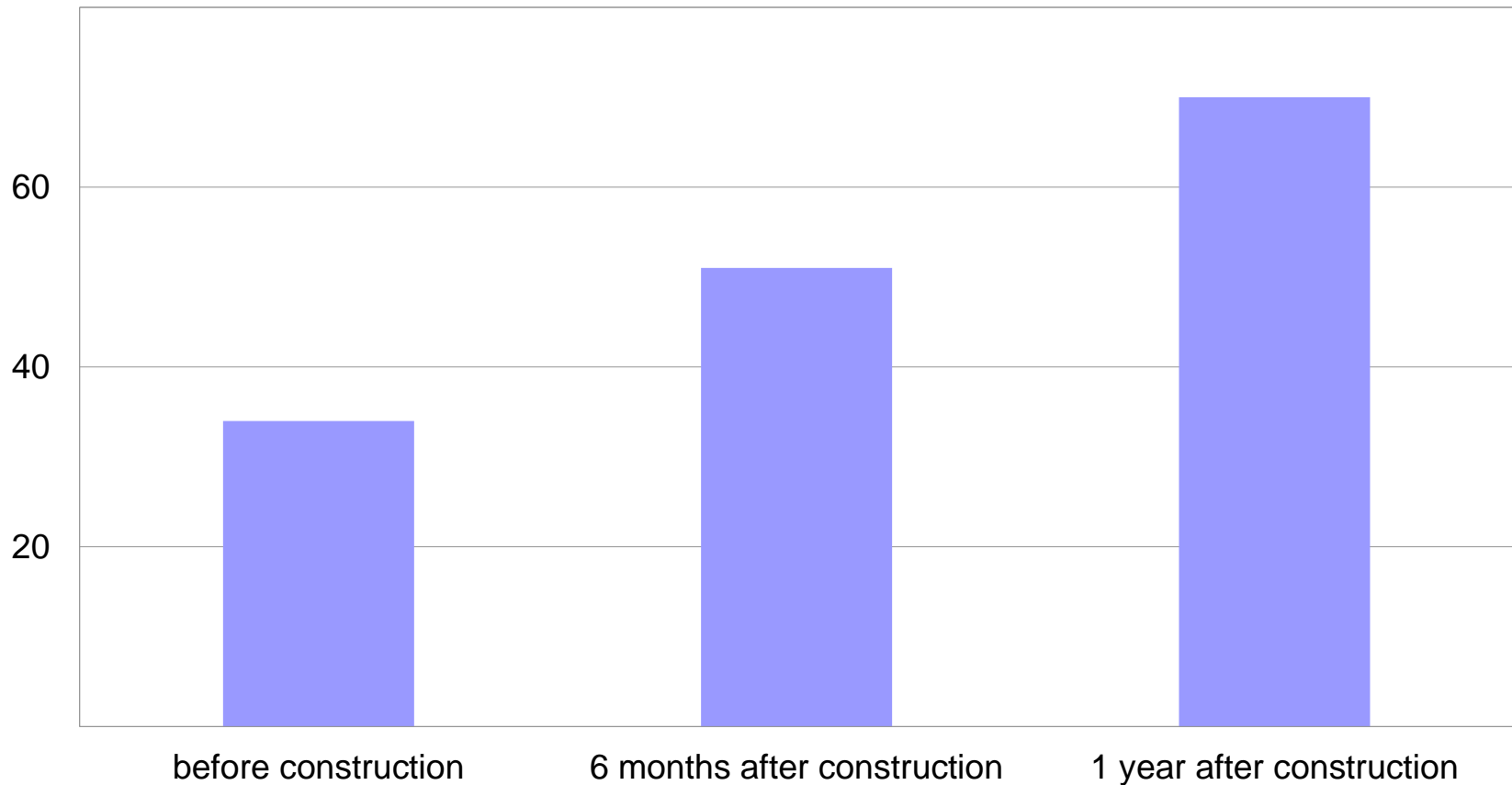
- Guide Meridian-Pole Road roundabout
 - Traffic signal-controlled before conversion
 - Fully operational in August 2009
- Guide Meridian-Wiser Lake Road roundabout
 - Two-way stop-controlled before conversion
 - Fully operational in October 2009



Public attitudes and perceptions

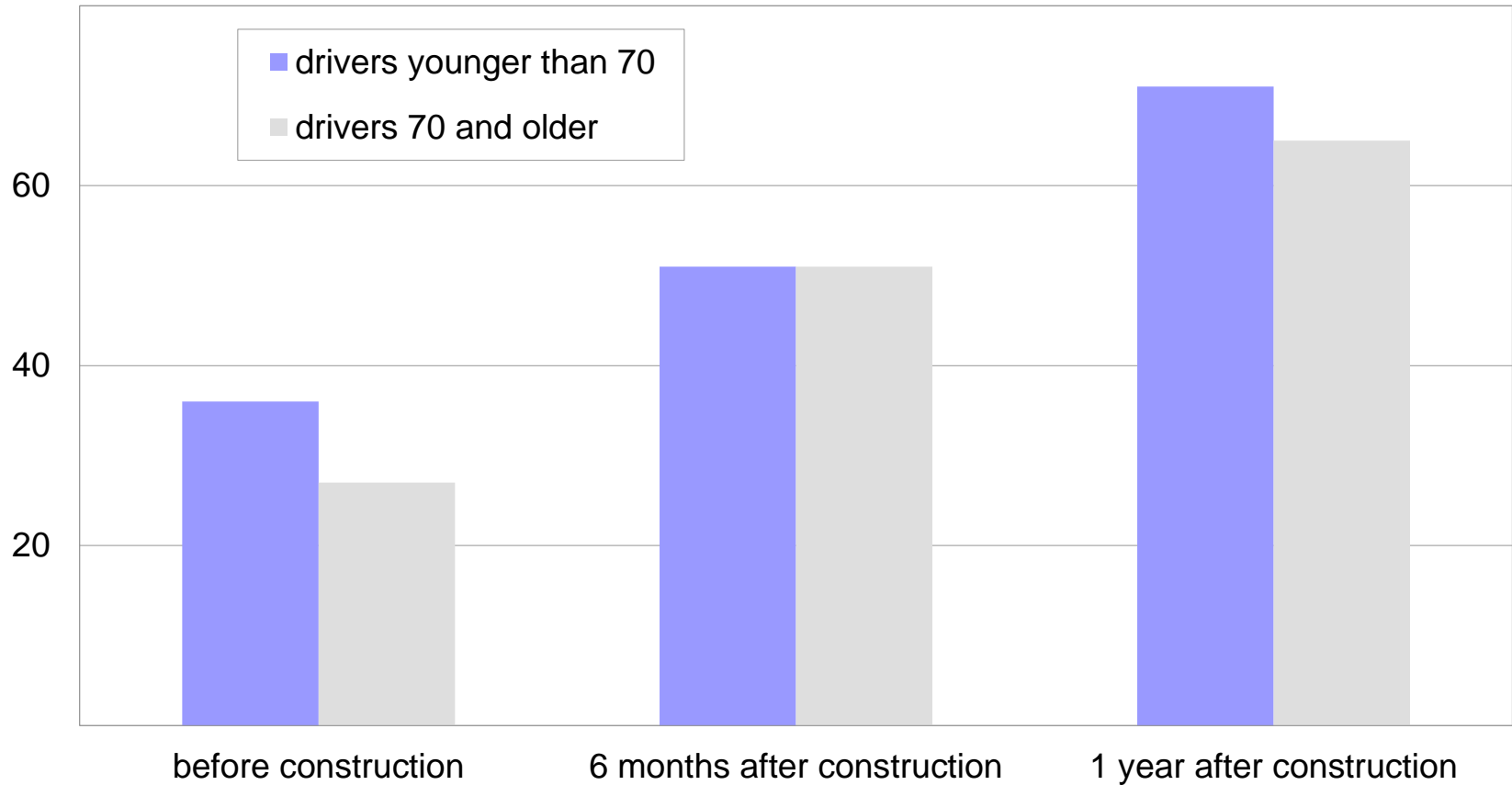
Percent of drivers who support roundabouts

Telephone surveys of Bellingham area residents



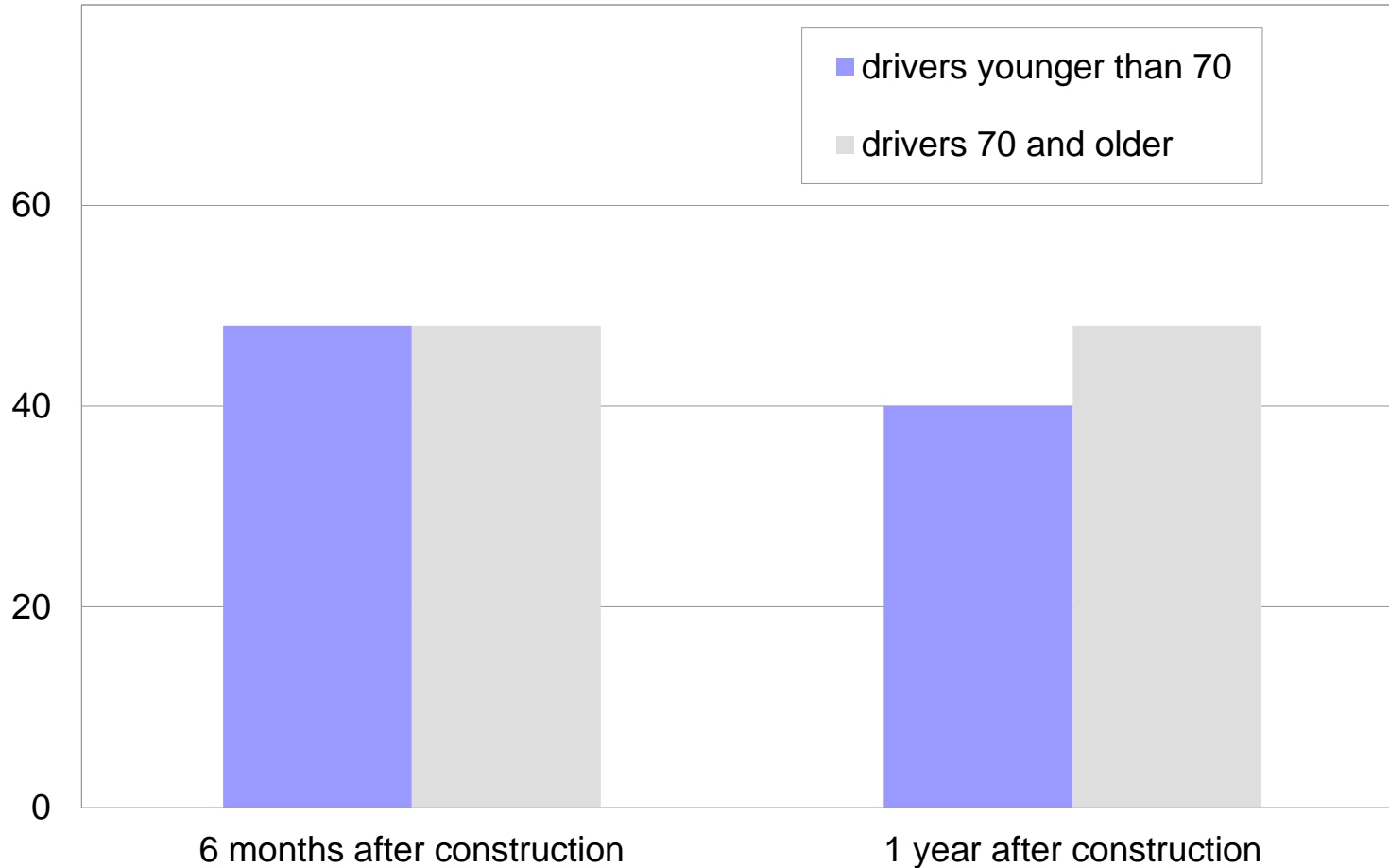
Percent of drivers who support roundabouts

By driver age



Percent of drivers who reported taking an alternate road to Guide Meridian

By driver age



Reasons for opposing roundabouts

- Top reason before and after construction
 - Roundabouts are unsafe
- Other frequent responses before construction
 - Roundabouts are confusing
 - Prefer traffic signal
- Other frequent responses 6 months and 1 year after construction
 - Problems with right-of-way or yielding
 - Problems with large trucks

Percent of drivers who agreed that signs and pavement markings clearly conveyed...

One year after construction

that drivers are approaching a roundabout	88
which lane drivers needs to be in to exit	69
what speed drivers should travel	59
which lane has the right-of-way to exit	55
that drivers should not drive beside large trucks in a roundabout	52



Traffic performance analysis

Data and modeling software

- Traffic recorded during 7 a.m. – 7 p.m. on three weekdays shortly before and 4 months after roundabout construction
- Peak hour traffic analyzed: 7 a.m.– 9 a.m., 11 a.m.– 2 p.m., and 4 p.m.– 6 p.m.
- Intersection characteristics before and after roundabout construction obtained from Washington DOT
- Analysis performed with SIDRA INTERSECTION 5.1
 - Highway Capacity Manual 2010 model

Traffic performance analysis scenarios

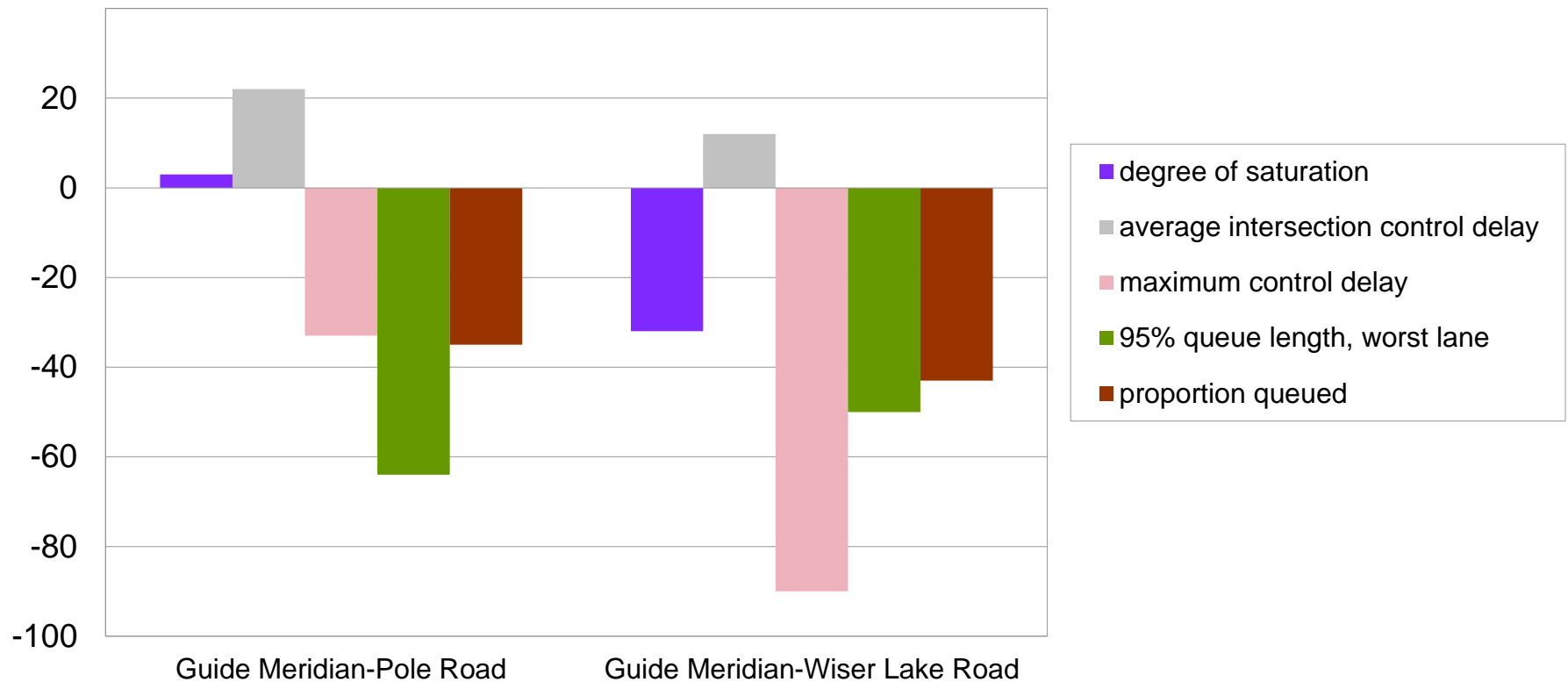
- To isolate effects of roundabout conversions from increased traffic capacity, hypothetical intersections were developed with original traffic controls but additional travel lanes
- Traffic performance evaluated for:
 - Before-construction intersections with before traffic volumes
 - Before-construction intersections with after traffic volumes
 - Hypothetical intersections with after traffic volumes
 - Roundabouts with after traffic volumes
- Effects of roundabouts estimated as difference between roundabout performance and hypothetical intersection performance

Measures of traffic performance and environmental effects

- Traffic performance
 - Degree of saturation, or vehicle/capacity ratio
 - Average intersection control delay
 - Maximum control delay
 - 95% queue length of the worst lane
 - Proportion queued
 - Level of service
- Environmental effects
 - Fuel consumption
 - Emissions of carbon dioxide, hydrocarbon, carbon monoxide, and nitrogen oxide

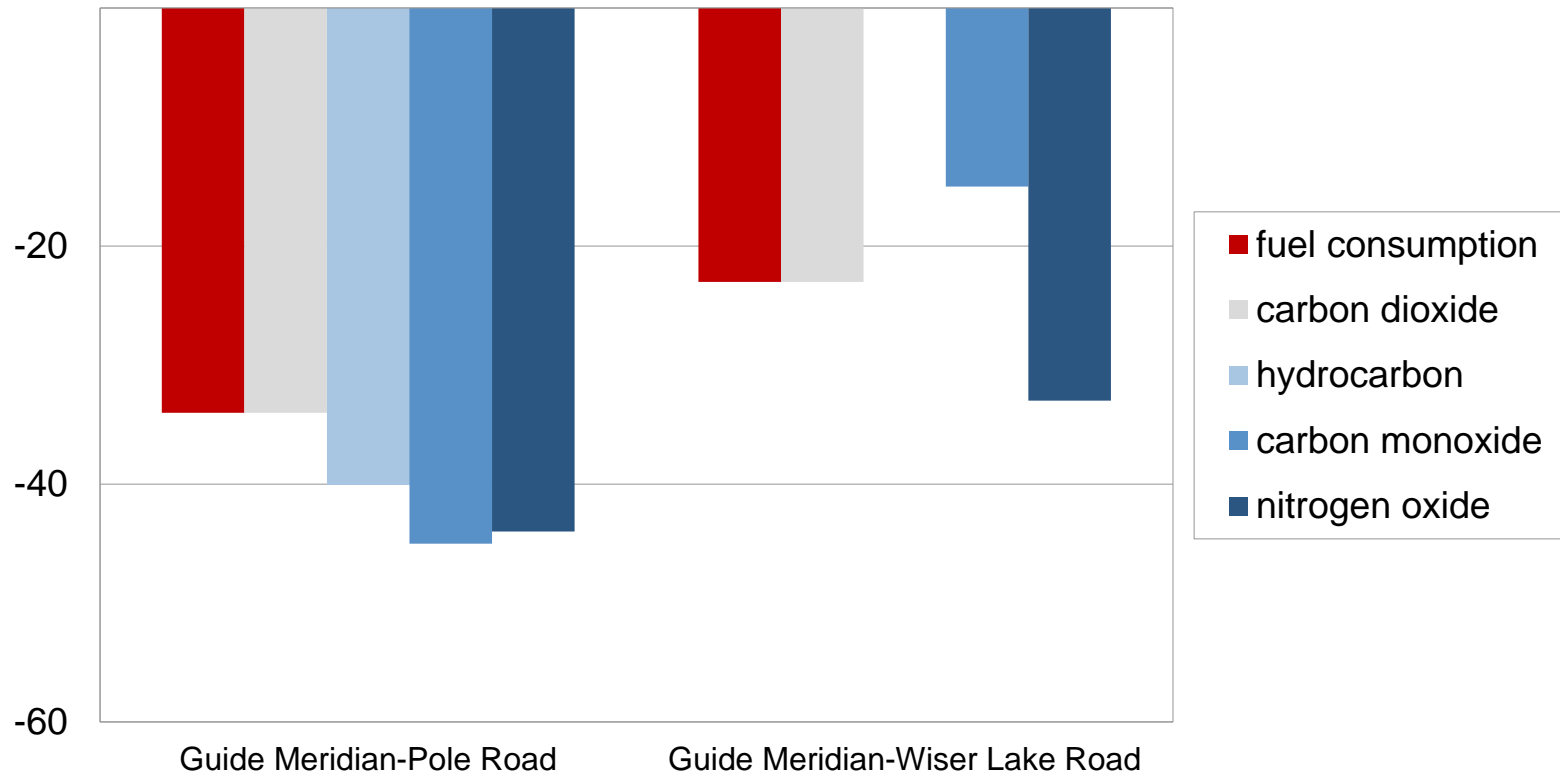
Percent change in traffic performance measures

Roundabouts vs. hypothetical intersections with additional lanes



Percent change in environmental measures

Roundabouts vs. hypothetical intersections with additional lanes





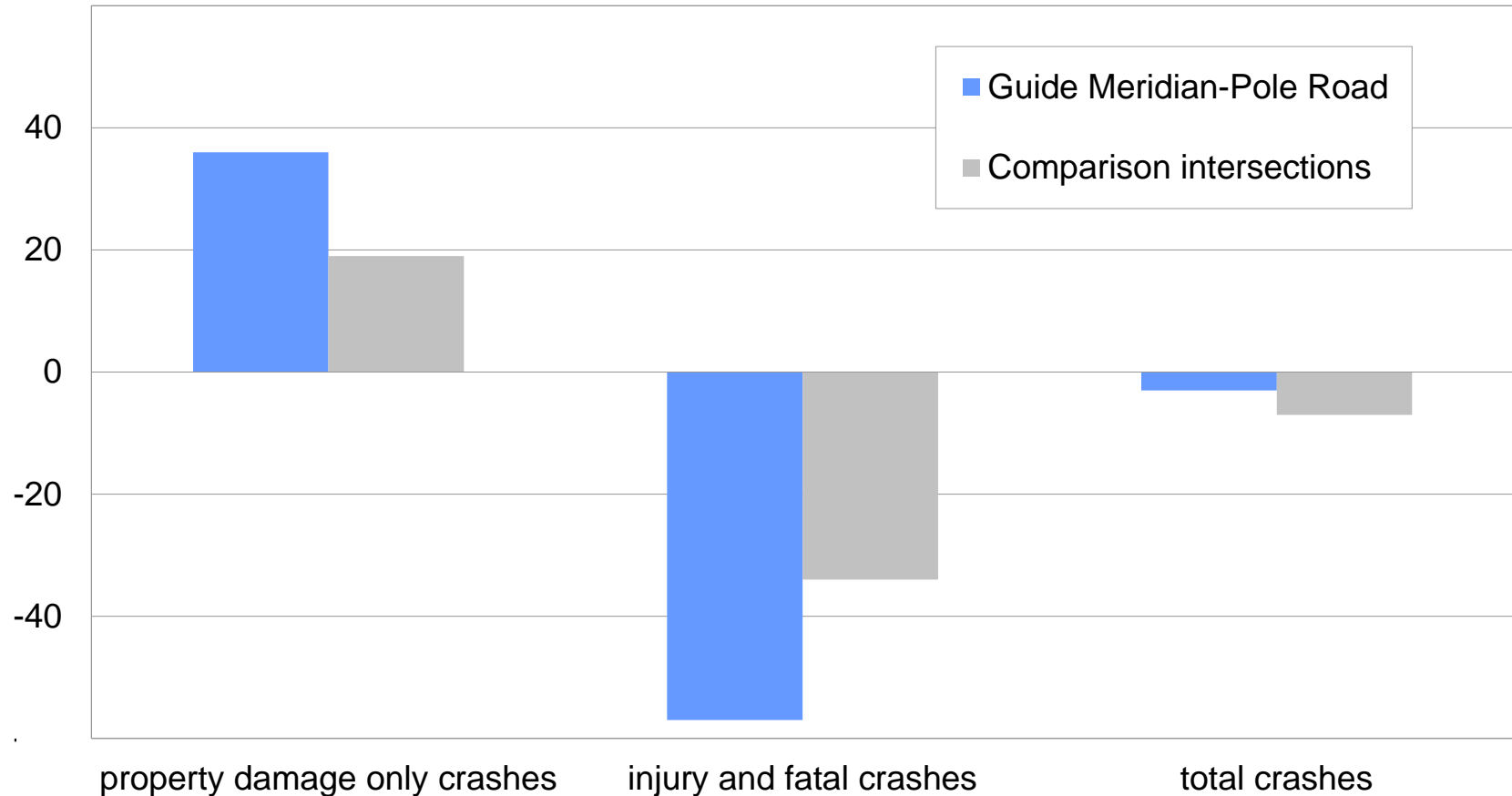
Crash analysis

Methods

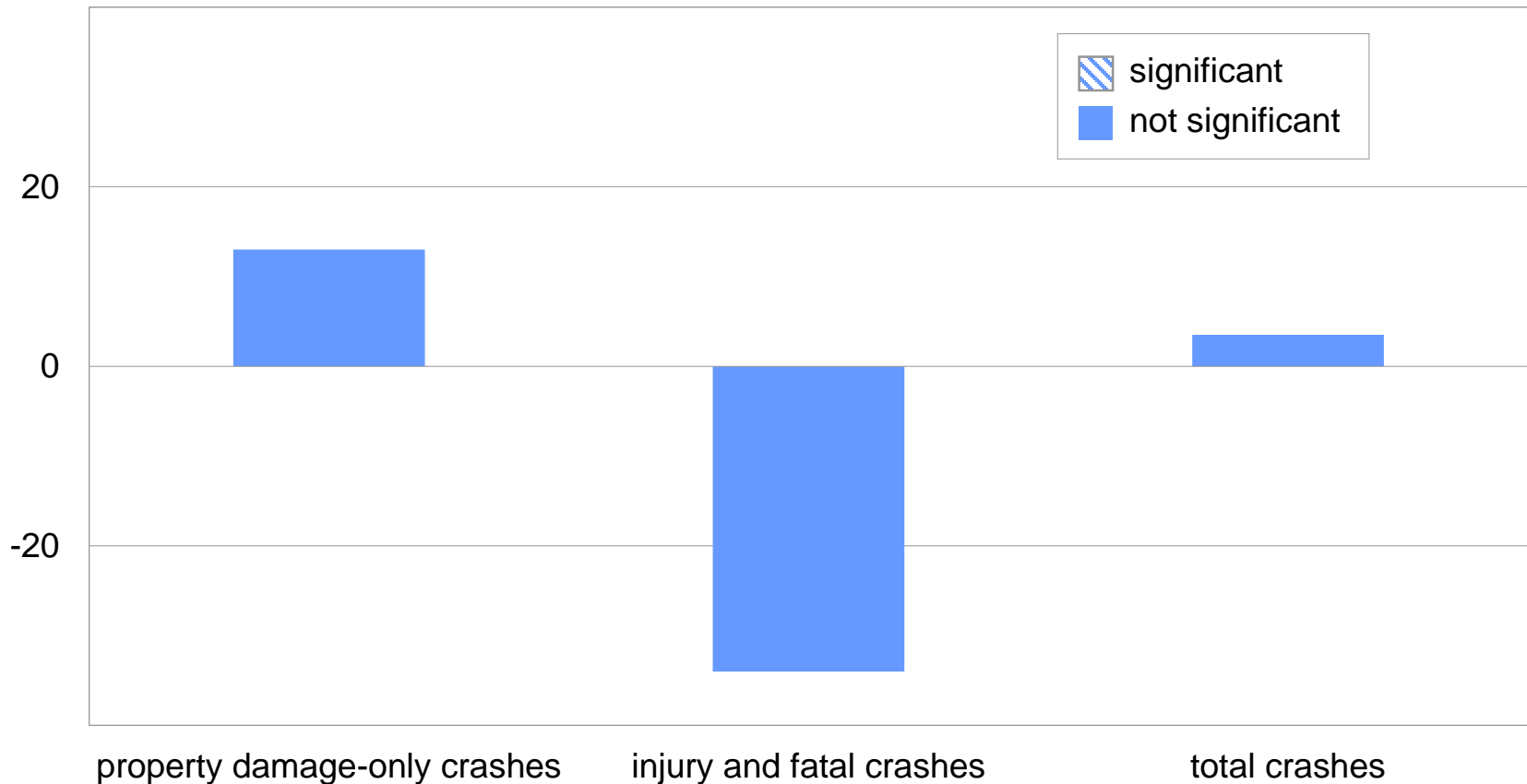
- Before and after analysis with comparison intersections
- Selected comparison intersections based on similarity in traffic control, intersection layout, and traffic volumes
 - Guide Meridian-Pole Road: 5 sites
 - Guide Meridian-Wiser Lake Road: 8 sites
- Study periods
 - Before: January 2003-December 2007
 - After: January 2010-December 2011
- Included crashes occurring at intersection or intersection-related
- Crash rates computed with average annual daily traffic counts
- Poisson regression for all crashes, property damage-only crashes and injury and fatal crashes combined

Percent change in crash rates at Guide Meridian-Pole Road and comparison intersections

After vs. before roundabout construction

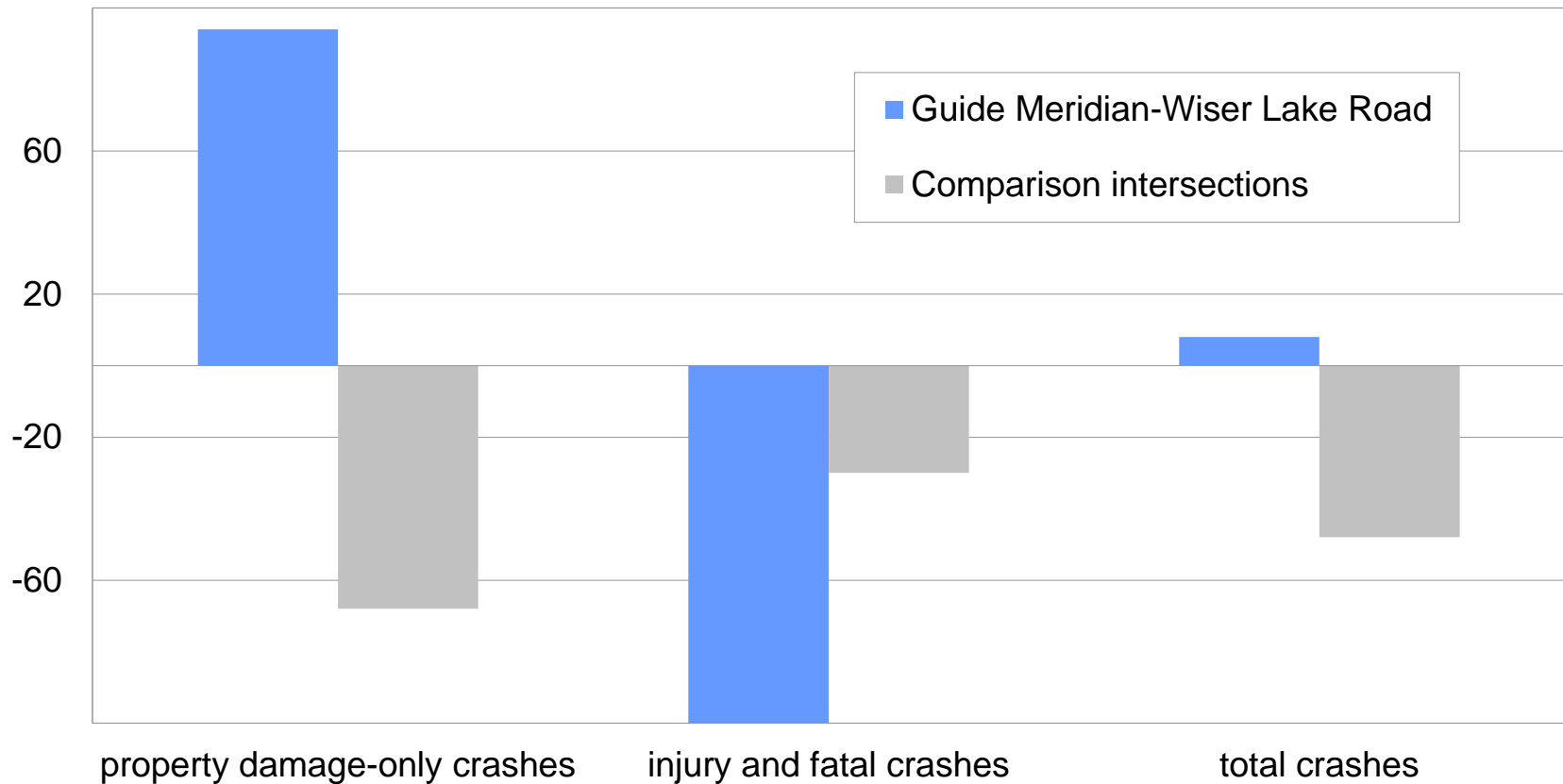


Percent differences in actual crash rates at Guide Meridian-Pole Road vs. expected rates without roundabout conversion

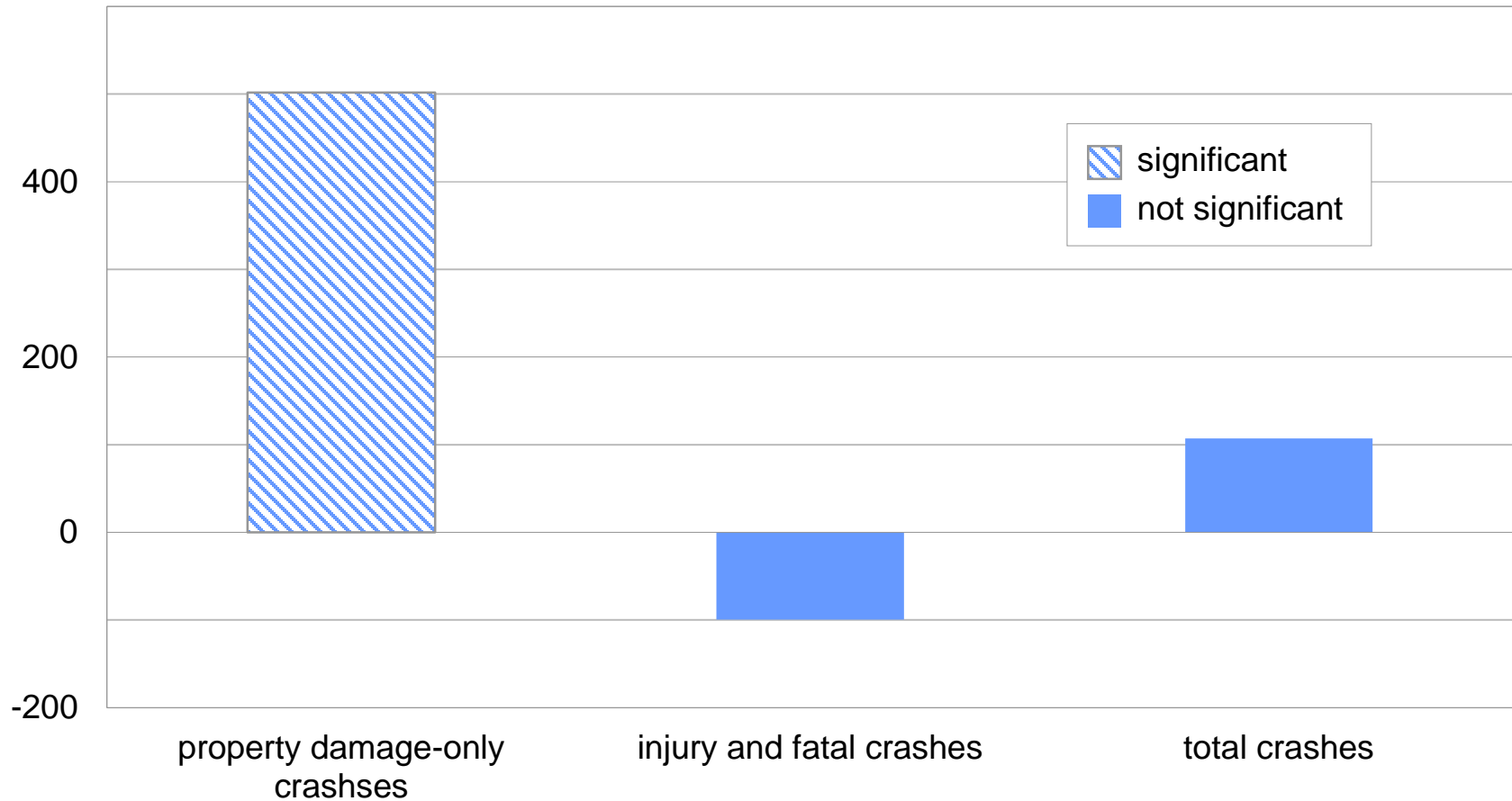


Percent change in crash rates at Guide Meridian-Wiser Lake Road and comparison intersections

After vs. before roundabout construction



Percent differences in actual crash rates at Guide Meridian-Wiser Lake Road vs. expected rates without roundabout conversion





Older driver travel patterns

Methods

- Drivers photographed before and 4 months after roundabout construction
 - 2 locations along Guide Meridian study corridor
 - 2 comparable locations on Hannegan Road
- Driver age category coded by researchers
 - Younger than 20, 20-59, 60-69, 70 and older
- Odds ratio computed for whether drivers 70 and older were more likely to take Guide Meridian vs. Hannegan Road after the roundabout construction than before

Proportions of drivers 70 and older on Guide Meridian Road and Hannegan Road

Before and after roundabout construction



- Odds Ratio = 0.32; i.e., odds that older drivers would travel on Guide Meridian vs. Hannegan Road after roundabout construction was 0.32 times lower than before
- Proportions of older drivers were very small (< 5 percent)

Conclusions

- Drivers' acceptance of roundabouts improved over time
- Substantial benefits in traffic operations and environmental effects
- Serious crash rates declined at roundabouts although not significantly
- Increased complexity of double-lane roundabouts may present challenges
 - Confusion about navigating roundabouts persisted one year after
 - Some older drivers may be taking an alternative route to avoid roundabouts
 - Property damage-only and total crash rates increased
- Relatively short-term effects of roundabout conversions examined
- When roundabouts are part of a larger effort to increase capacity on a roadway, effects on traffic performance, emissions, and even safety may accrue some years after construction



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