

## ROADWAY SAFETY INSTITUTE

Advancing roadway safety with user-centered solutions

# ***USING TECHNOLOGY TO ADDRESS THE SILVER TSUNAMI***

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## Older Drivers

- The US driving population is rapidly aging <sup>[2, 3]</sup>
  - 1 in 5 Americans will be 65 or older by 2030
- Older drivers represent:
  - 2<sup>nd</sup> highest injury and fatality rate per 10,000 licensed drivers (next to teenage drivers)
  - 1<sup>st</sup> in fatalities per 100 million miles driven <sup>[1, 4]</sup>
- Older drivers (75+ years) are represented in a relatively low percent of total US crashes (~3%), but account for nearly 11% of driver deaths <sup>[10]</sup>

## Older Driver Crash Involvement

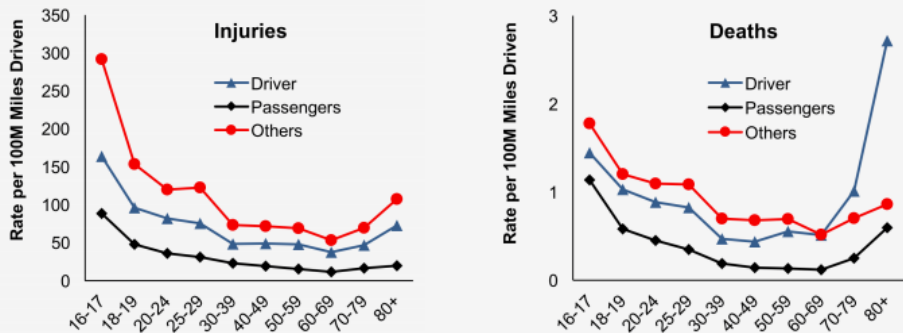


Figure 2. Injuries (left) and deaths (right) in crashes involving a driver of age shown per 100 million miles driven by drivers of that age, by role of person injured or killed, United States, 2014-2015.

Source: [9] Tefft, B.C. (2017). Rates of Motor Vehicle Crashes, Injuries and Deaths in Relation to Driver Age, United States, 2014-2015. AAA Foundation for Traffic Safety.

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## Older Driver Risks

- Disproportionate crash risk is linked to:
  - Normal declines in information processing [5]
  - Decreased visual search abilities [6]
  - Declined physical factors and maladaptive behavioral factors:
    - Failure to yield [7]
    - Lower seatbelt use [7]
    - Overall fragility [8, 10]



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## Preparing Tech for Older Drivers

- **Design work:** adapt the Teen Driver Support System (TDSS) smartphone application into an Older Driver Support System
  - Carefully address the needs and limitations of aging drivers.
- Advanced in-vehicle sensing and warning systems are well-positioned to offer tailored support for older drivers
  - Iterative design and testing to determine user requirements



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## Talking with Older Drivers

- Focus Groups:
  - Tech-Savvy Older Drivers
    - Rejected ODSS premise
    - Did not want a system catered for their age group
    - Resisted notion of needing support in 10 years time
    - **Wanted system for ALL Drivers**
  - Non-tech Savvy Older Drivers
    - More accepting of system
    - Open to use



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## Immersive Usability Test

- Tested interface in driving simulator
  - Automated driving mode
  - Recorded user feedback



- Results:
  - Drivers reported lower than expected mental workload and distraction from system
  - Additional contextual information felt like overkill
  - Under-speeding feedback went unnoticed

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## Overall Usability Study Results

- Older drivers can best be supported with a **universally designed system**, created to address the needs and risks of all drivers: Not specifically targeted for older drivers.



Credit: National Associate of City Transportation Officials

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## Universal Design

- Final recommendations for adapting the teen system for older drivers revealed *few to no significant necessary changes*
- Outcome: Create a universal platform of the TDSS to serve all drivers
  - RoadCoach
  - Increase buy-in of all age groups to use the system



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## Controlled Field Test

- 11 older drivers (66-80;  $M = 70.64$  years,  $SD = 3.85$ )
  - 8 males and 3 females
  - All licensed drivers with no impairments that inhibited driving
  - 10 reported to drive at least 5-6 days a week
- Test vehicle
  - Lab vehicle: Chevy Impala
  - Samsung Galaxy S7 mounted to dash
  - Forward facing camera used

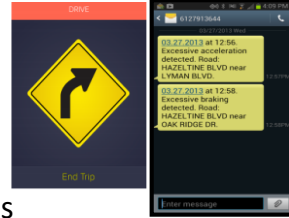


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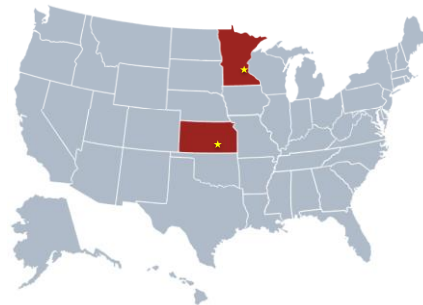
## User Satisfaction

- Rating Scale of Mental Work Effort (0-100)
  - Average score: 26 (11.53 SD) – *a little effort*
- System Usability Scale
  - Average score: 93.86 (8.01 SD)
  - *Typical system score is 68*
- Likes
  - *Help stay focused*
  - *Warnings (speed/curve)*
  - *7 MPH threshold*
  - *Simplicity of interface*
- Dislikes
  - *Voice used for audio*
  - *Occasional speed mismatch*
  - *Aggressive driving maneuvers*
  - *Optional text message feature*



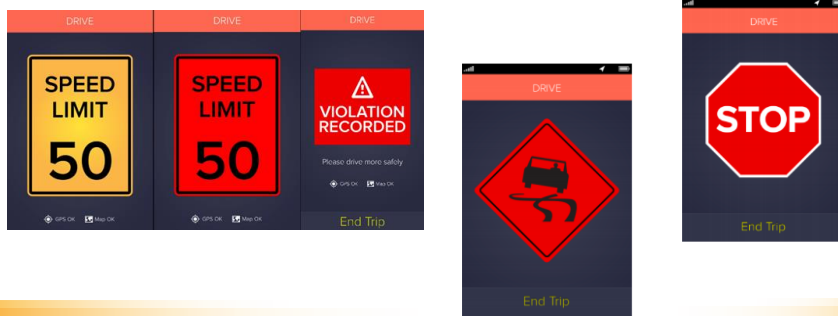
## Field Operational Test

- Purpose: test driver performance and user satisfaction of RoadCoach over prolonged time
- 28 drivers participated
  - 14 Minneapolis-St. Paul, MN
  - 14 from Wichita, KS
  - Female=14
  - Mean age=69.5 (SD=2.93)



## ABA Study Design

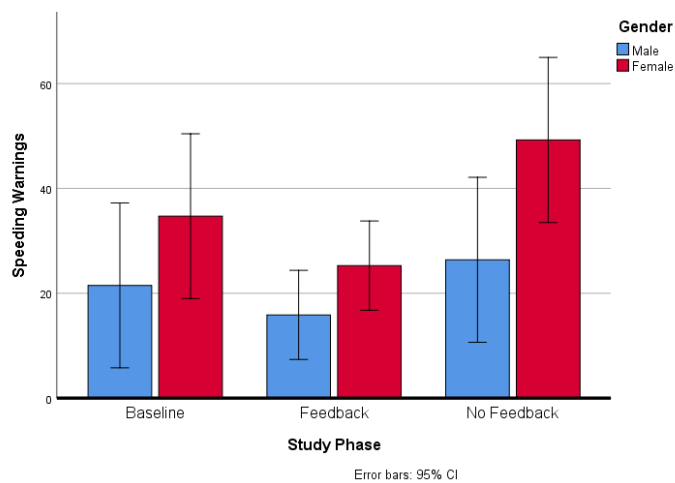
- Baseline Performance: 3 weeks
- Feedback Performance: 6 weeks
- Post-Feedback Performance: 3 weeks



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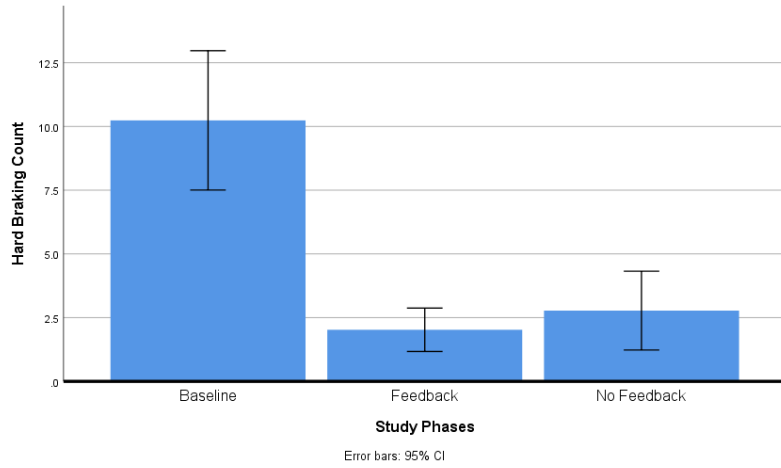
## Results: Speeding



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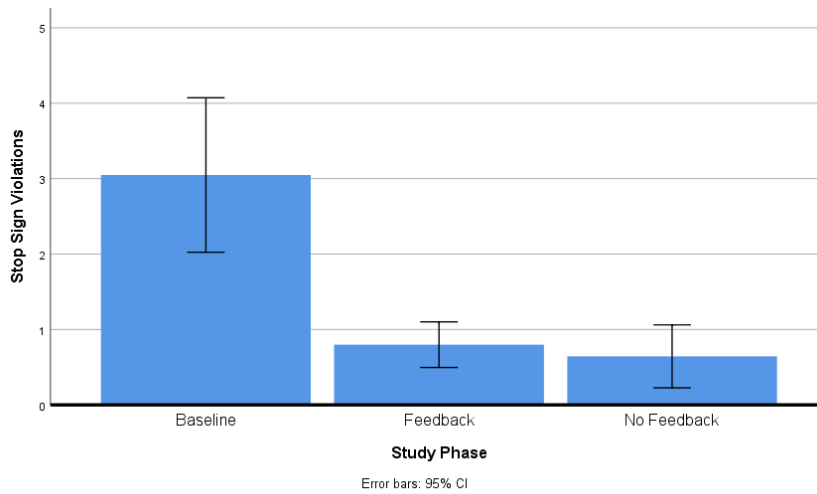
## Results: Hard Braking



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## Results: Stop Sign Violations



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## Subjective Results

- Low mental workload
  - Driving Activity Load Index
    - Situational stress (external stress) was the greatest to impact app use
- Good usability (above average score)
  - System Usability Survey
    - Not as high as original controlled field test
- System trustworthy although somewhat annoying



## Pros and Favorite Features

- Positive feedback overall
  - “Keeps your attention on the road”
  - “Helps not speed so much”
  - “Helps you be more aware of your driving”
  - “Might be good for people having problems as they age”
  - “Informs you when you run a stop sign”
  - “Simple easy to use”
  - “Informs you of changing speed limits”



## Cons and Undesirable Features

- Some limitations
  - “Might be distracting in difficult traffic”
  - “Voice and wording are annoying enough that it will be turned off sometimes”
  - “Hard braking is too sensitive”
  - “Speed limits and stop signs occasionally inaccurate”



## Next Steps

- Possible design iterations
  - Could add more customizability
  - Address voice issues (change to male voice)
- Thinking **BIGGER!**
  - Conduct large scale FOT
  - Expand to drivers with mild cognitive impairment
    - Assessment of MCI
  - Integrate into dash or vehicle infotainment
  - Examine if this technology can help prolong safe and independent driving for older drivers

# Thank you!

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## Contact Information

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