



Insurance Institute for Highway Safety  
Highway Loss Data Institute

# Mitigating cognitive distraction and its effects with interface design and collision avoidance systems

NHTSA cognitive distraction forum  
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[iihs.org](http://iihs.org)

**IIHS** is an independent, nonprofit scientific and educational organization dedicated to reducing the losses — deaths, injuries and property damage — from crashes on the nation's roads.

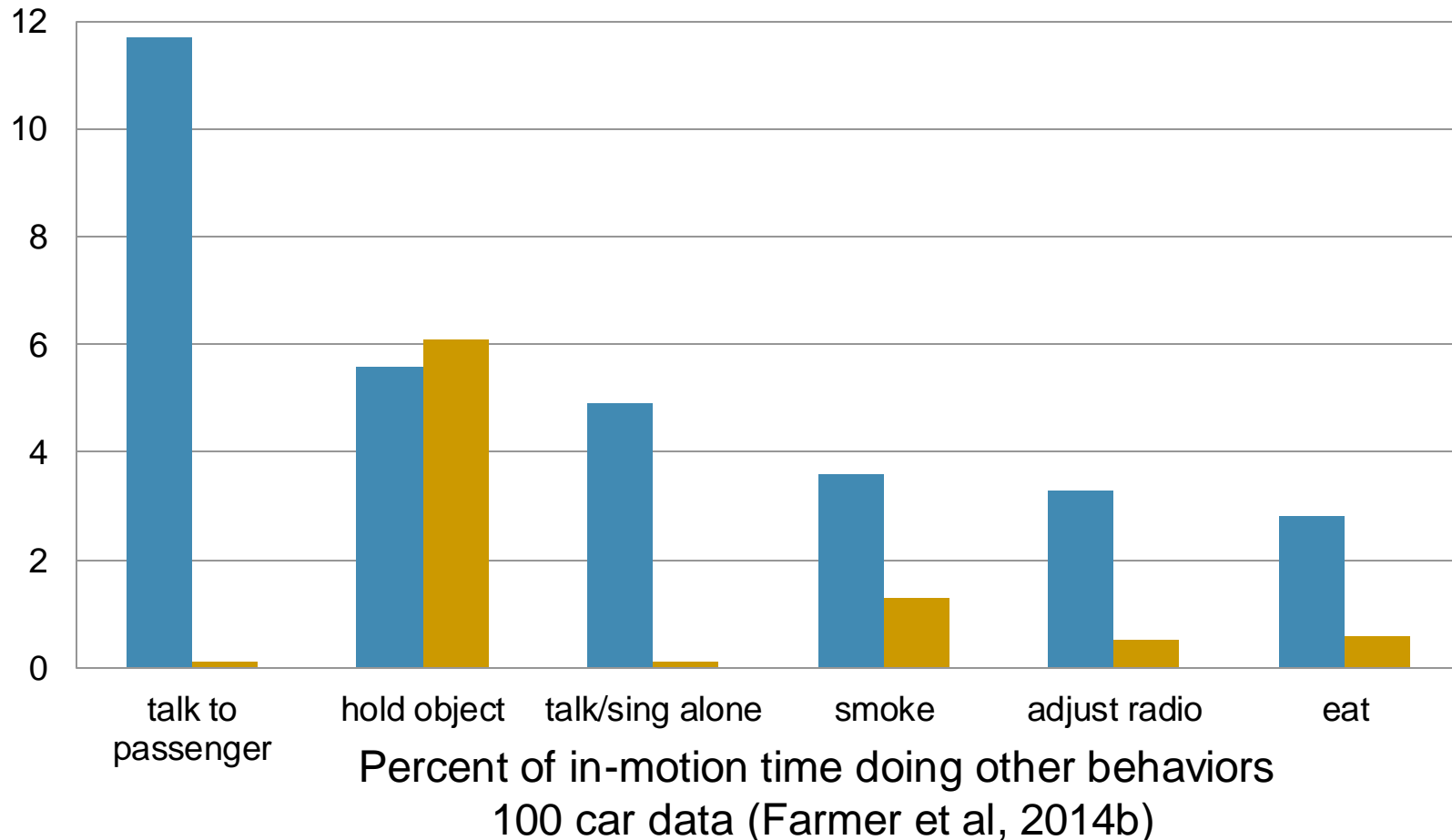
**HLDI** shares this mission by analyzing insurance data representing human and economic losses from crashes and other events related to vehicle ownership.

Both organizations are wholly supported by auto insurers.

# In the current driving environment, completely mitigating cognitive distraction is unlikely

- ▶ Effective mitigation implies being able to identify the targeted behavior reliably
- ▶ Analyses of phone conversations during naturalistic driving studies exemplify the challenge of identifying/measuring cognitive distraction
  - Lack of increased crash\near-crash risk associated with ‘just talking’ on a phone in naturalistic studies (e.g., Farmer et al, 2014a; Fitch et al 2013)
  - Drivers tend to look out the front windshield and at the mirrors more when ‘just talking’ (e.g., Farmer et al. 2014b)

# When talking on the phone, drivers tended to avoid all other secondary behaviors except holding another object



# Vehicle infotainment interface design

# Identifying interface design features that limit driver workload

- ▶ IIHS – MIT Agelab collaborative field experiment (Mehler et al., 2015; Reimer et al., 2015)
- ▶ To what extent do different implementations of in-vehicle infotainment systems affect driver workload (Knowles, 1963)?
  - How easy is this equipment to operate?
  - How much attention is required?

# Steps needed to call a phone contact for one-shot (2013 Chevrolet MyLink) and menu-based (2013 Volvo Sensus) voice interfaces

	system	visual or manual steps	auditory or vocal steps	total steps
voice interface	Chevrolet Mylink	2	1	3
	Volvo Sensus	3	4	7



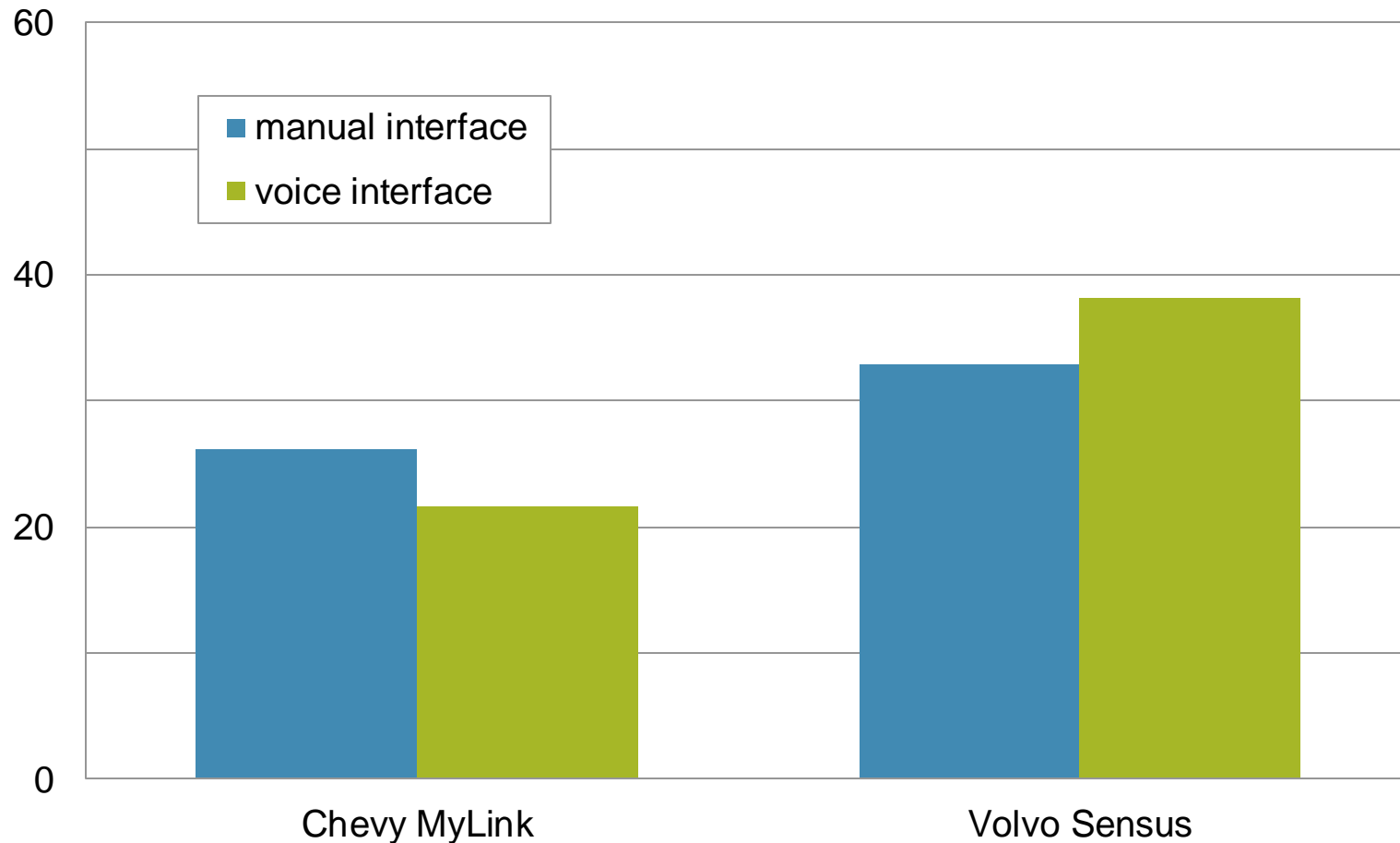
# Evaluation of workload during highway driving

- 80 naive volunteer drivers ages 20-66 years
  - 40 used Volvo's Sensus
  - 40 used Chevrolet's MyLink
- Drove 65 mph on an interstate while:
  - Calling contacts in phone book using manual and voice interfaces
  - Entering destinations into navigation system using voice interface



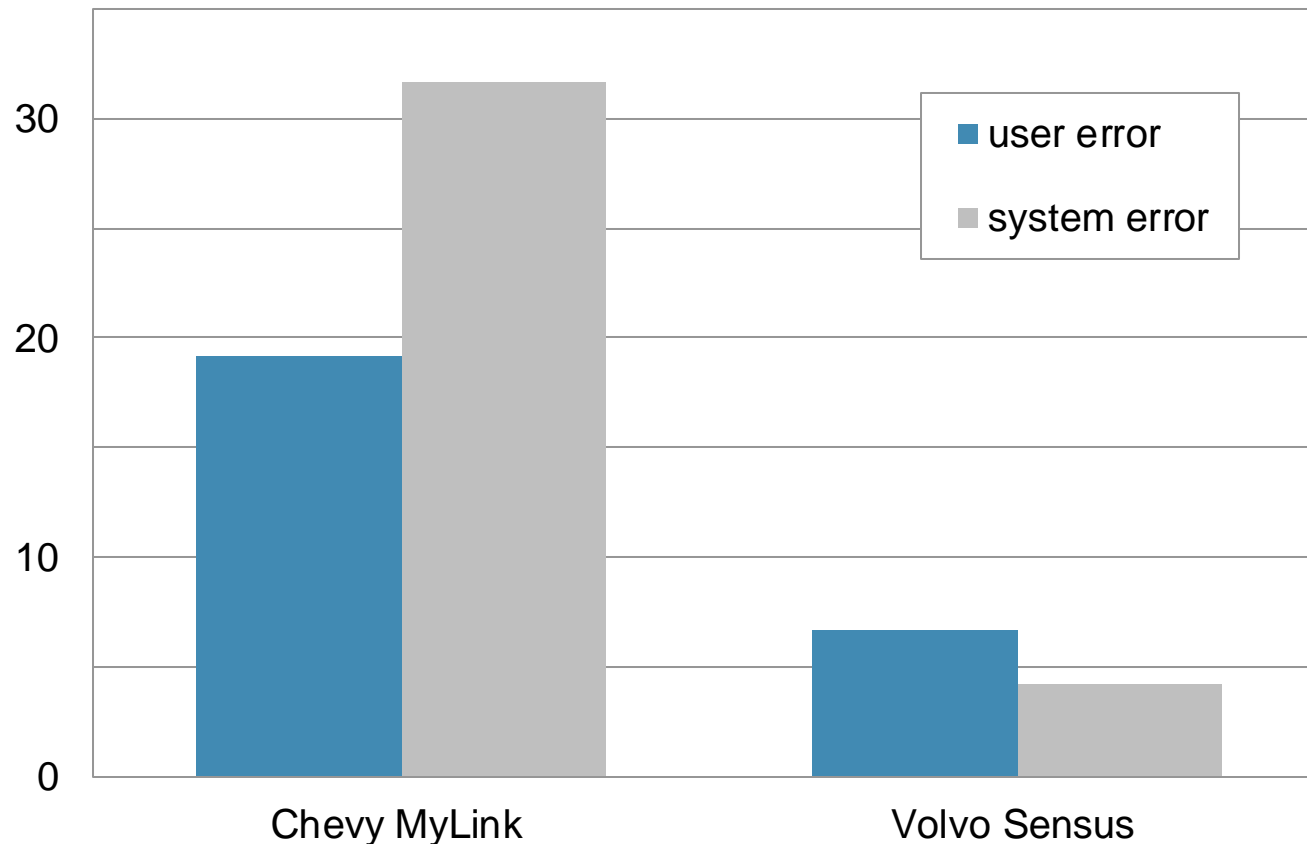


# Drivers made phone calls fastest, on average, when using the one-shot MyLink voice interface

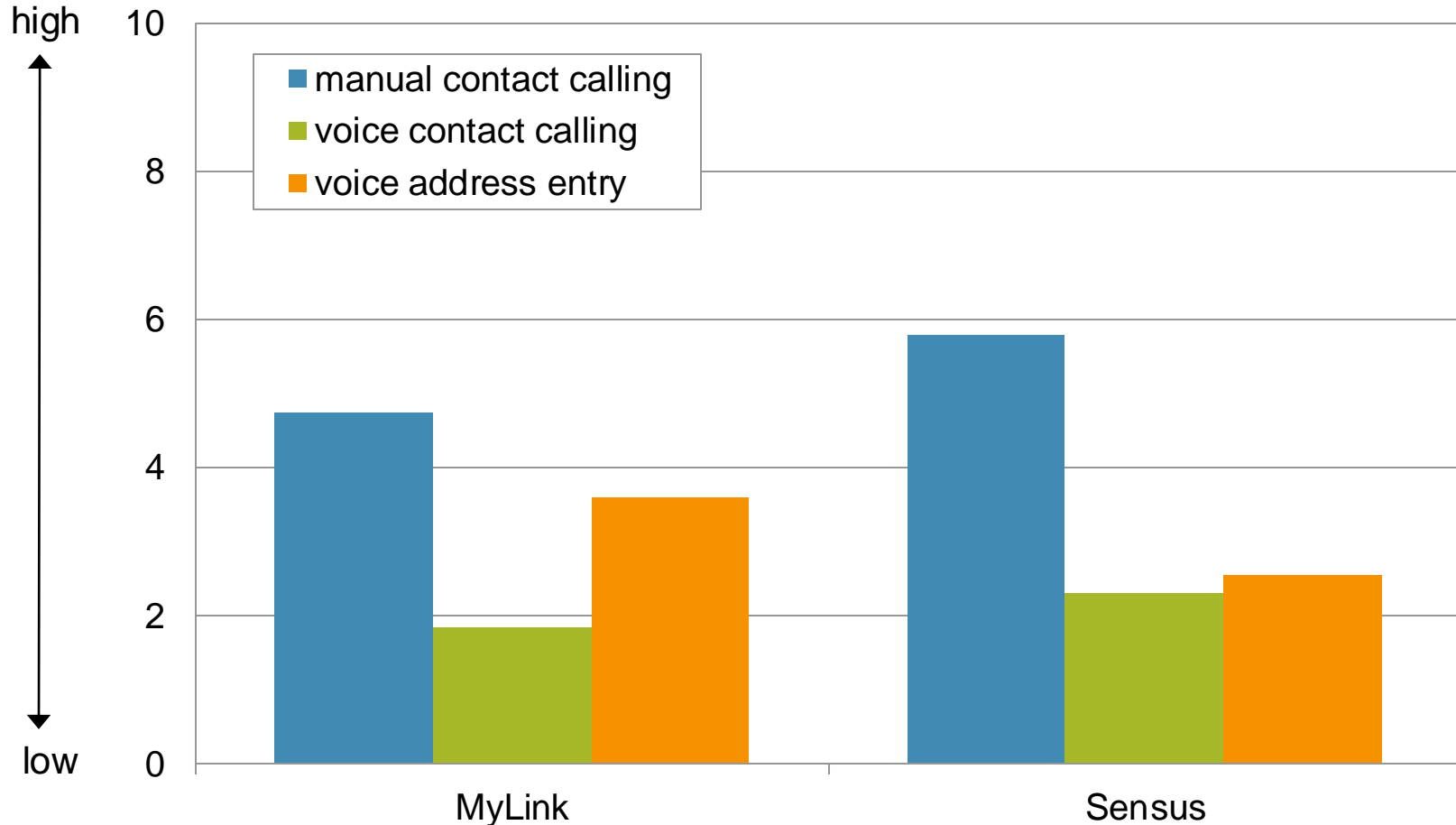


# MyLink's one-shot approach resulted in more errors when entering addresses than Sensus's menu-based approach

Percent of address entry trials with errors



# Voice interaction reduced self-reported workload when error rate was low

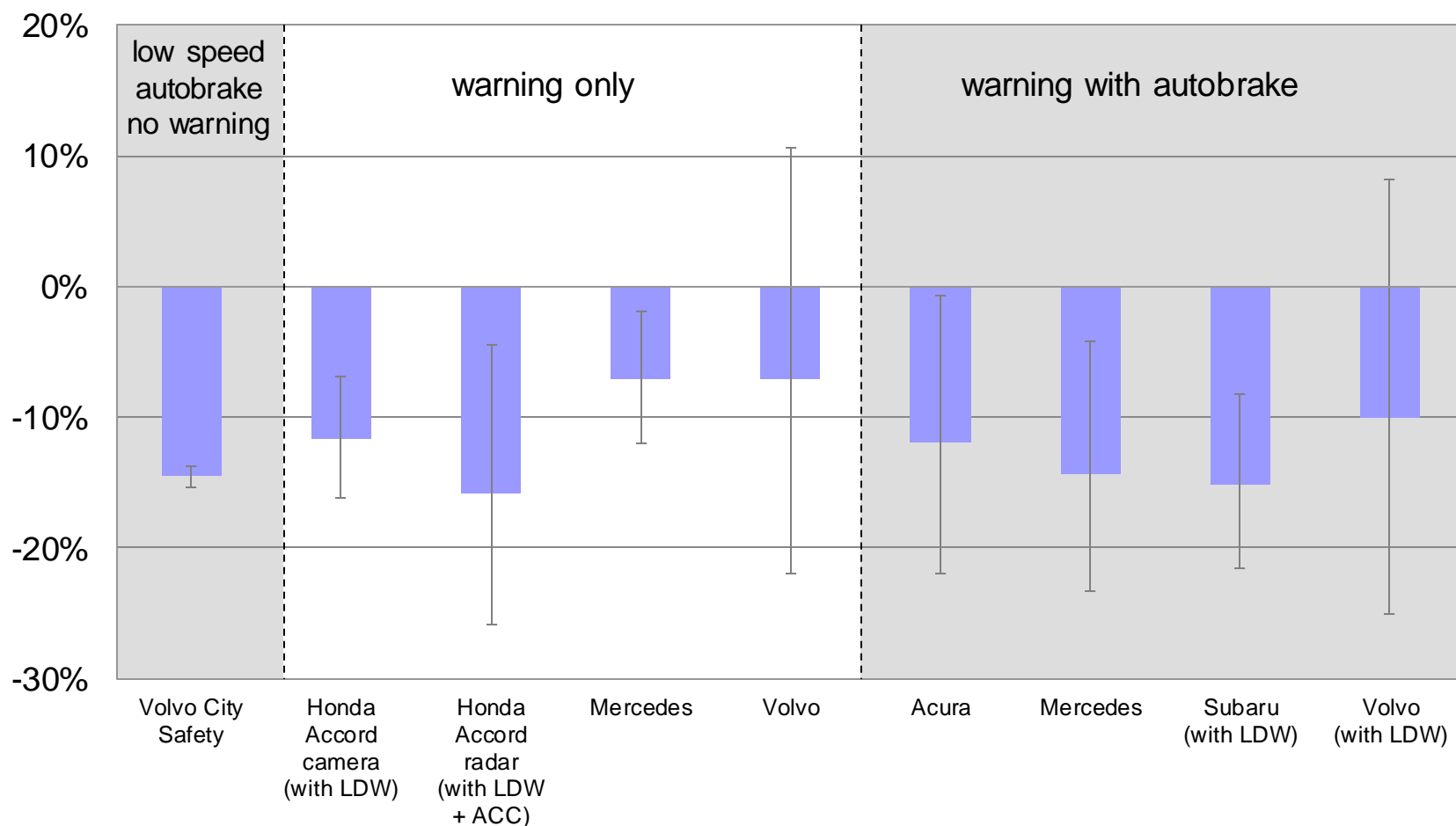


# Crash avoidance systems

# Crash avoidance technologies can eliminate or mitigate the effects of distraction

- ▶ Provide safety-relevant warnings to redirect wandering attention
- ▶ Reduce attentional demand or increase safety margins to reduce consequences of cognitive distraction
- ▶ Prevent or mitigate crashes by taking action when driver fails to act appropriately to prevent a crash (e.g., automatic braking, electronic stability control)

# Property damage liability claim frequency is consistently lower for vehicles with front crash prevention relative to the same or similar make/model vehicles without front crash prevention



# Summary

- ▶ The biggest challenge to reducing or eliminating cognitive distraction is that we can not, from a practical perspective, reliably identify the phenomenon when it is occurring
- ▶ Human factors research can inform interface design so drivers experience minimal cognitive demand when interacting with vehicle interfaces
- ▶ Crash avoidance technologies show a lot of promise in reducing crashes associated with distraction irrespective of the source (e.g., manual, visual, cognitive)



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# References

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5. Mehler et al. (2015). Multi-modal assessment of on-road demand of voice and manual phone calling and voice navigation entry across two embedded vehicle systems. IIHS, Arlington, VA.
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