

Visual Consequences of Greater Hood Heights in Larger Passenger Vehicles



Agenda

- 1** Background
- 2** Literature Review
- 3** Study Objectives
- 4** Field Study Methods
- 5** Results & Conclusions
- 6** City of Lakewood, CO Case Study
- 7** Questions and Discussion

Speaker

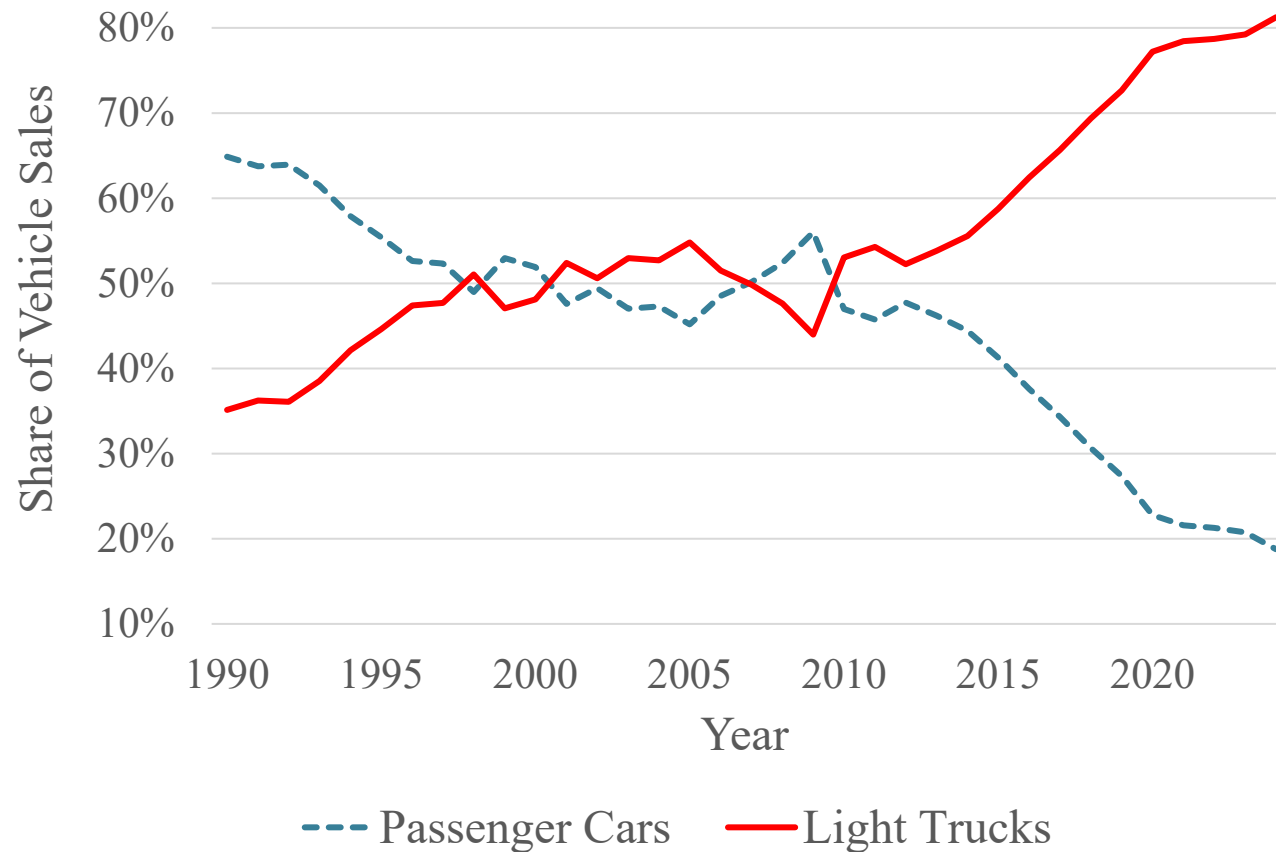


Wyatt Brown, MSCE, EIT

- Civil Engineering BS & MS
- 9 Months Industry Experience at HDR in Bend, OR
- ITE Since March 2021 (5.5 years!)
- 2026 ITE WD Outstanding Technical Paper Award (for this study!)
- ITE Western District Social Media Chair
- TRB AKL12 Committee on Roundabouts and Alternative Intersections Member
- ASCE Oregon Section Bend Younger Member Group Technical Chair



US New Vehicles Sales



Source: Bureau of Transportation Statistics

Reasons (anecdotal):

- Perceived sense of safety
- Lifestyle
- Wanting to look cool

2024 Top 10 Selling Vehicles in the US



8/10 are a pickup truck or SUV

1. **Ford F-Series Pickups**
2. **Chevy Silverado Series Pickups**
3. **Toyota RAV4**
4. **Tesla Model Y**
5. **Honda CR-V**
6. **RAM Series Pickups**
7. **GMC Sierra Series Pickups**
8. Toyota Camry
9. **Nissan Rogue**
10. Honda Civic

Pickup trucks or SUVs highlighted in bold

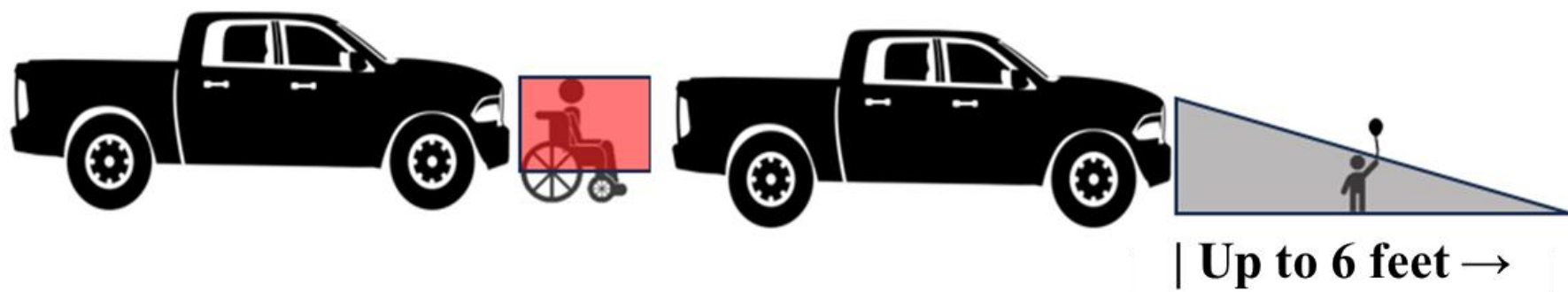
Source: Car and Driver

Measured Vehicle Heights vs Human Heights

Vehicle (Pickup Trucks)	Center hood height (in)
GMC 2024 Sierra 2500 Crew Cab AT4X	<u>59</u>
Chrysler 2024 RAM 2500 Power Wagon Crew Cab	<u>58</u>
Chevrolet 2024 Silverado 3500 SWR Crew LTZ	<u>56</u>

Measured by Randy McCourt on February 4, 2024 at various dealerships in Beaverton, OR

- Average male height - 5' 9" (69 inches)
- Average female height - 5' 4" (64 inches)
- Average wheelchair height - 48 – 51 inches (depending on person and wheelchair)



Pedestrian impact area for tall pickup



Pedestrian impact area for average sedan



Blind spot for tall pickup

Reminder



Research & MUTCD



Little research on hood height vs pedestrian visibility

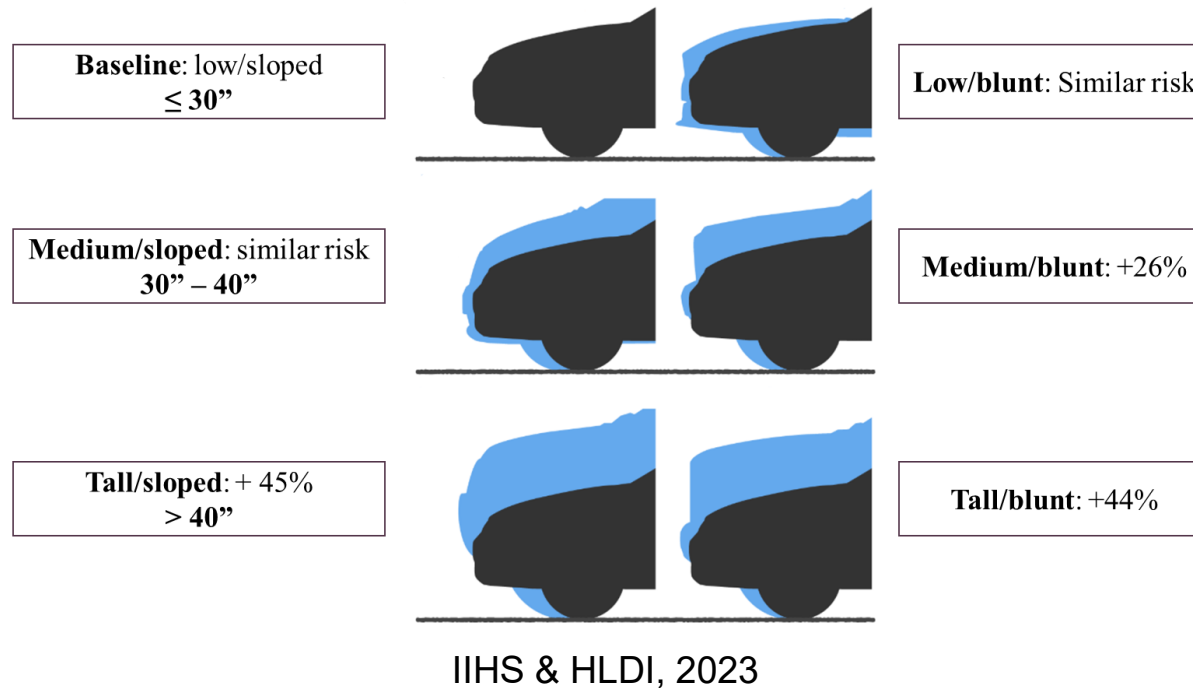
Most research - hood height vs pedestrian injury severity



MUTCD - 4-foot advance stop line is guidance
(recommended practice in typical situations)

Hood Leading Edge & Pedestrian Fatality Risk

- SUVs disproportionately more prone to injuring/killing a pedestrian in a crash compared to passenger cars (Monfort & Mueller, 2020)
- Risk of Pedestrian Fatality by Hood Leading Edge Height and Shape:



Advanced Stop Line Example



Image Source: UCLA News

Bike box

- Space for cyclists to position ahead of vehicles

Study Objectives

Quantify the pedestrian visibility impacts at intersections of:



Driver height



Pedestrian type and position at intersection



Stopped position of vehicle at intersection



Higher hood height pickups and SUVs

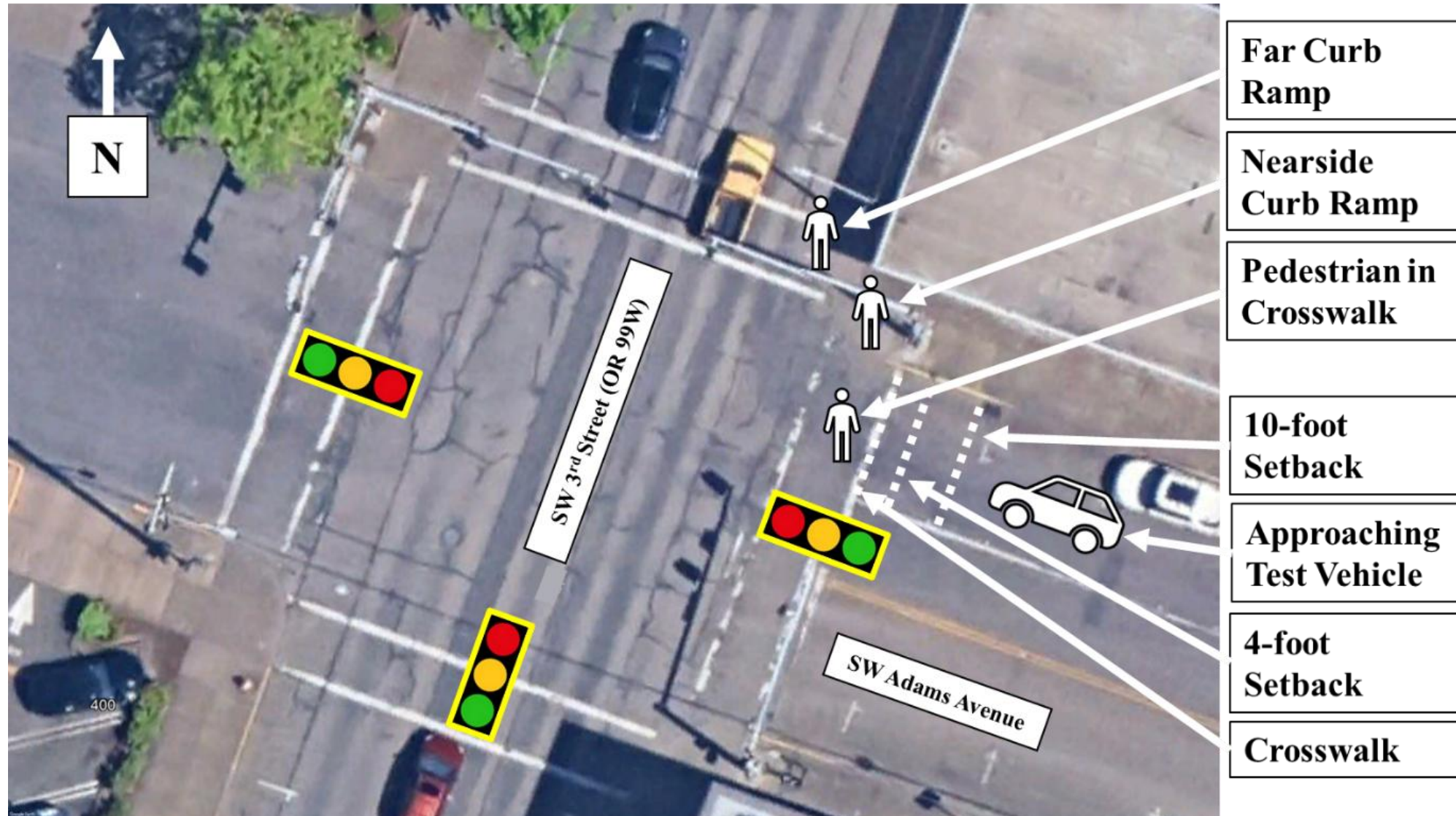
Variables for Testing

Vehicle / Hood Height	Driver Height (in)	Pedestrian Positions	Vehicle Positions	Pedestrian Type
2018 Honda CRV / 38 inches	Shorter (60)	Crosswalk	Zero Setback	Walking
2022 Ford Maverick pickup / 41 inches	Average (70)	Nearside Curb Ramp	Crosswalk	Wheelchair
2018 Ford F250 pickup / 52 inches	Taller (75)	Far Curb Ramp	4-foot Setback	
			10-foot Setback	



$3 \times 3 \times 3 \times 4 \times 2 = 216$ unique scenarios

Test Site - Signalized int. of SW 3rd St and SW Adams Ave in Corvallis, OR



Note

- 0 foot setback - manually placed at crosswalk line
- Other 3 positions – natural stop (about 2-5 ft behind the line)



Driver stopped at crosswalk position
(note 2-5 ft back)

Example Photo Matrix



Phone held up to eye of driver

**Honda
CRV -
Crosswalk**



**Ford
Maverick –
0 ft Setback**



**Ford F250
– 10 ft
Setback**



**Shorter Driver
(5')**

**Average Driver
(5' 10")**

**Taller Driver
(6' 3")**

Example Scenario



Short driver (60 in)



Vehicle positioned at Zero Setback



Pedestrians in all 3 positions,
wheelchair in crosswalk



F250 vehicle (52 in hood height)



Pedestrian Visibility Categories



216 scenarios
2 researchers



195 (90%) agreement

Discrepancies - joint review
and agree on a final rating

Description	Walking	Wheelchair	Rating
Full walking pedestrian/wheelchair			7
Obscured from legs down		N/A	6
Obscured from the waist/mid-chest area down			5
Obscured from the shoulders down			3
Partial head viewable			1
Fully Obscured			-2

Obstructions



Rearview mirror
Sensor assembly
Other pedestrians on the corner



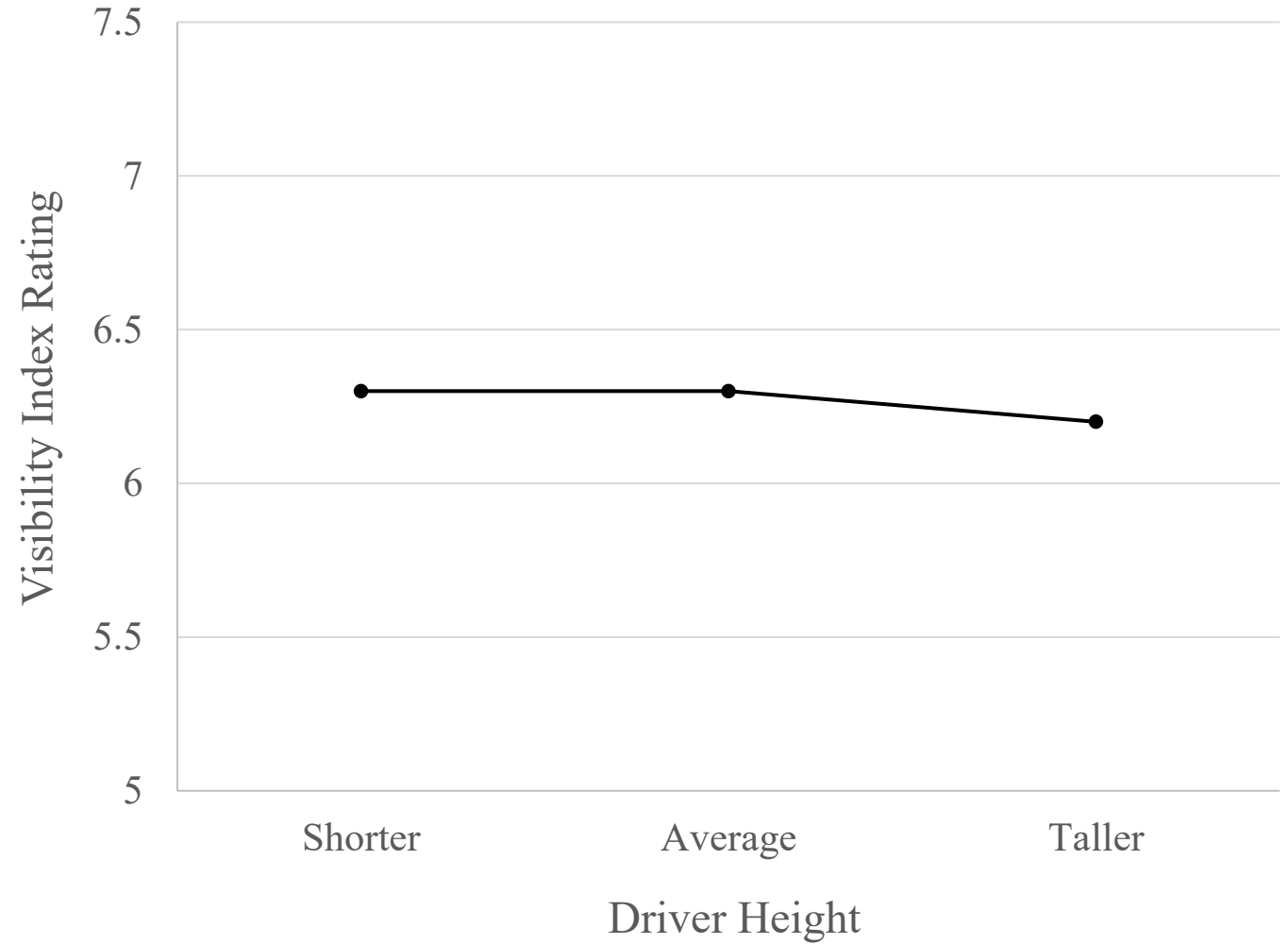
Obstruction-less data presented
to solely analyze variables of interest



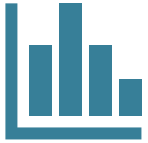
Driver Height



No real difference or
takeaways



Pedestrian Position



Pedestrians in crosswalk are least visible



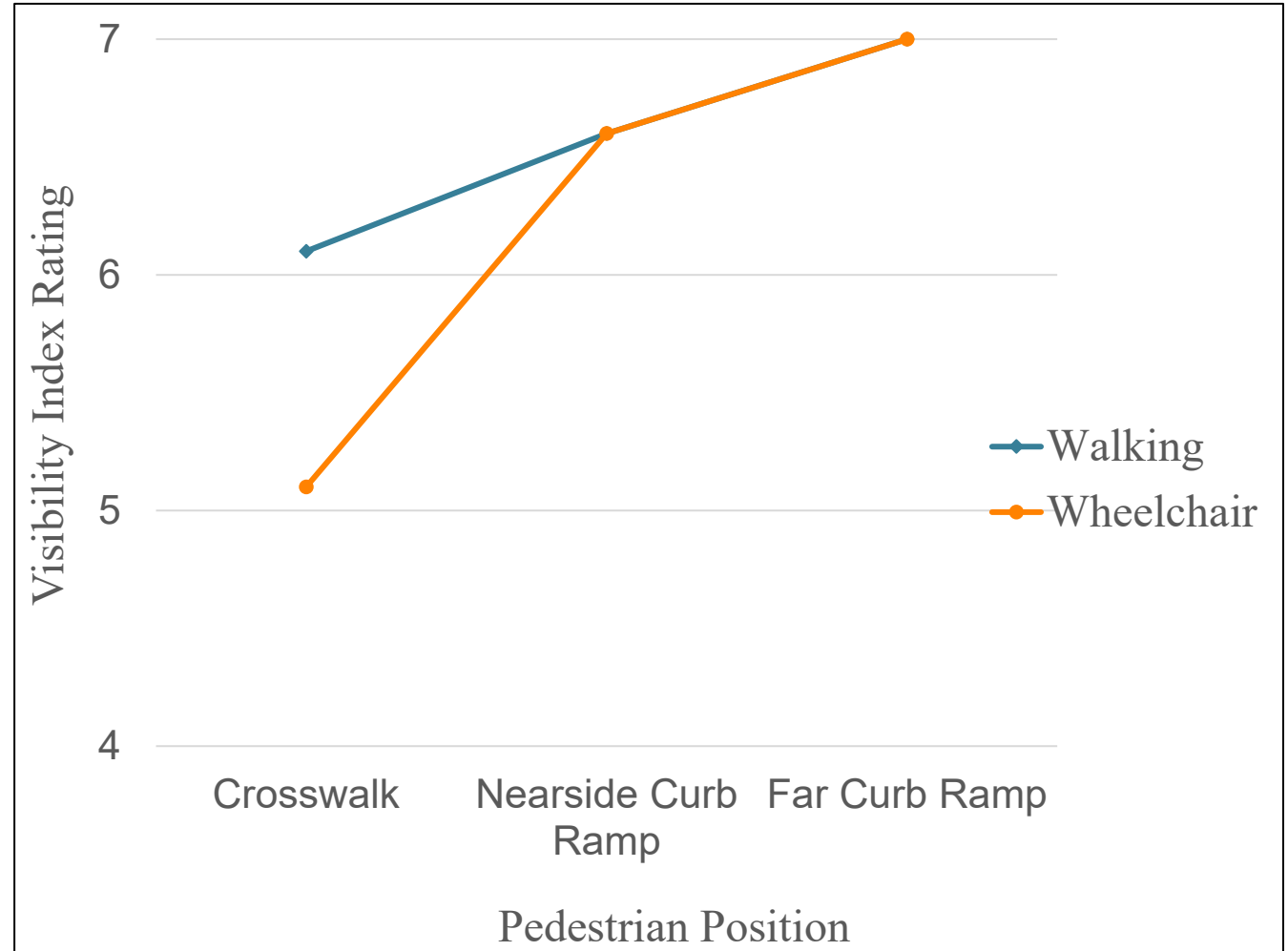
Practical Takeaway

Front facing sensors are increasingly important & intersection design

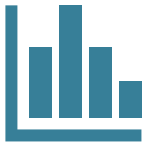


Future Research

Front facing sensors & differing curb radii



Hood Height



Increased hood height =
decreased visibility



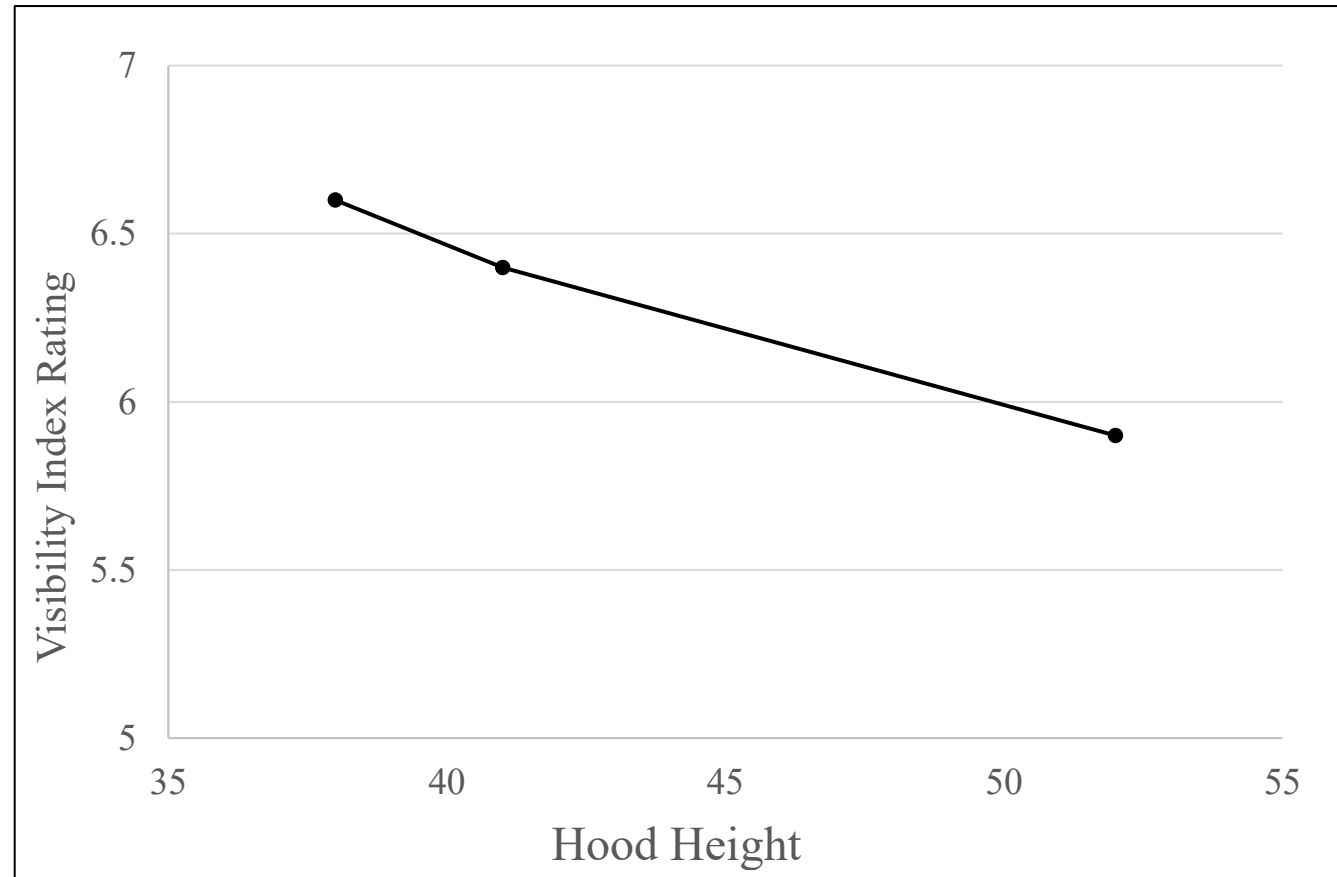
Practical Takeaway

Trend not going away,
need to design accordingly



Future Research

Increased hood heights &
finding critical hood height



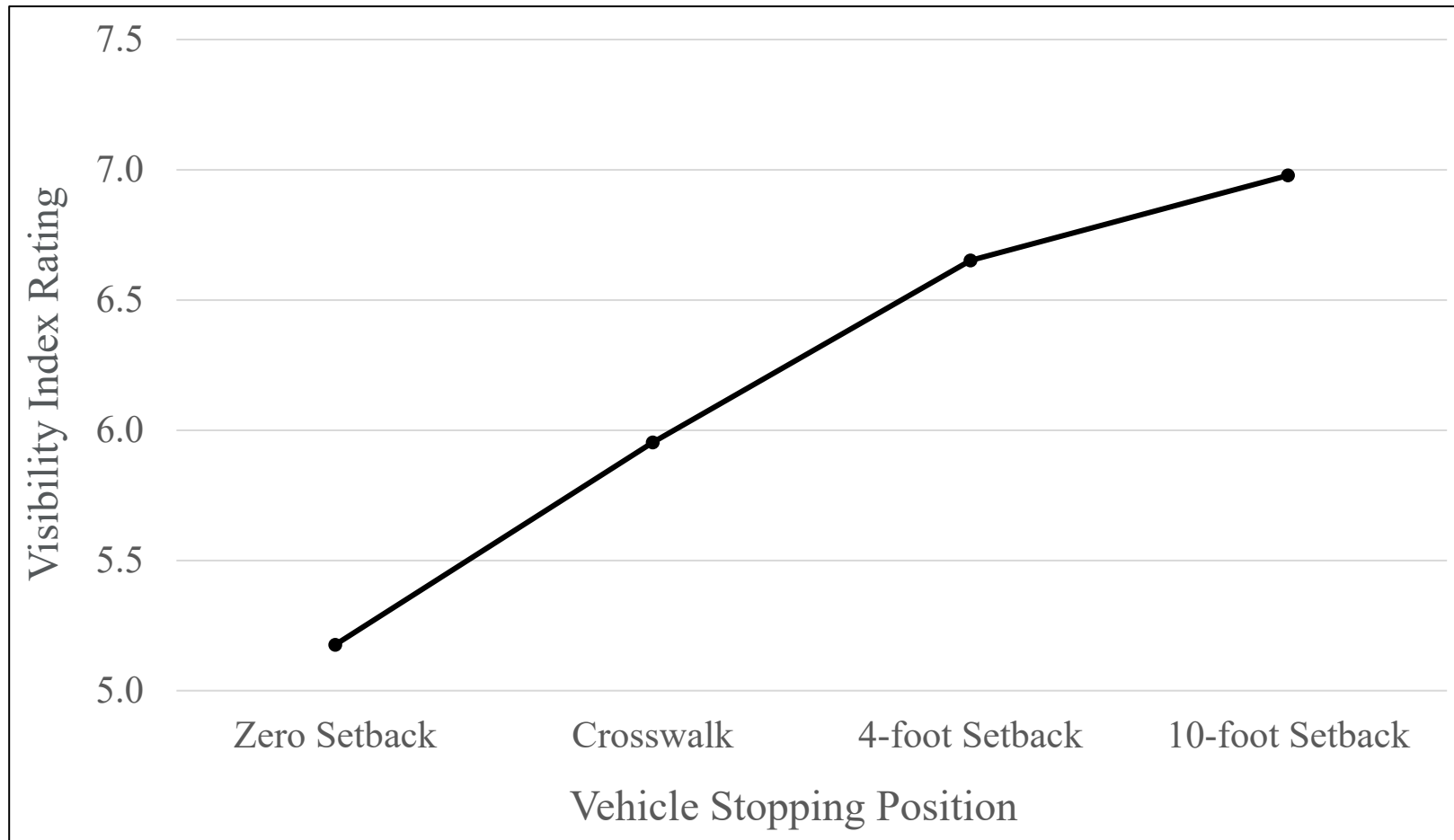
Reminder



Pedestrian (esp. wheelchair/child) + Crosswalk + High Hood = Very Low/No Visibility



Vehicle Stopping Position



Further from crosswalk = higher visibility

Diminishing improvements between 4 ft and 10 ft setback

Practical Takeaway



4 ft advance stop line



practical for achieving meaningful visibility gains
MUTCD - required in urban/pedestrian environments



Future Research

Vehicle adherence at
different setback distances



City of Lakewood, CO



Pre 2024/2025



Most signalized intersections
MUTCD minimum setback of 4-ft



Some signalized intersections
No stop lines



Residential streets or roads posted < 30 mph
No stop lines

Mary's Death



Matt D. Duncan, P.E., PTOE • 1st
Traffic Operations & Safety Engineer

2mo ...

Wyatt, thank you for tagging me, and congratulations to you and the team on the well-deserved recognition!

One reason this award means so much is that the work began with a fatality review in Lakewood, Colorado while I was working with detectives. "Mary," who used a wheelchair, was in a crosswalk when she was struck and killed by a driver turning in a passenger truck. The driver did nothing wrong; he never saw her.

As we reviewed causal factors, two questions stood out: where did the MUTCD minimum 4-foot stop bar setback come from, and could a passenger-truck motorist see a lower-height pedestrian or someone using a wheelchair when stopped at the stop bar? We learned the answer was no, and Lakewood began setting stop bars 8 feet back because of Mary's death.

Through NCUTCD, we looked into the origin of the 4-foot setback, and Randy McCourt helped move the question into research.

The work you and the team have done is outstanding. This award makes me especially happy because it brings attention to a death otherwise unnoticed by almost everyone. I would love to connect, hear more about your study, and share this wonderful news with the detectives who investigated Mary's death. Congratulations again!

Love · 🥰👍🏻 9 | Reply · 1 reply

Post Mary's Death – 2024/2025



All signalized intersection approaches

8-ft advance stop lines



Locations that had 4-ft advance stop lines

Now 8-ft



Locations that did not have advance stop lines (typ. locations <30 mph)

Now 8-ft

Pre 2024/2025



W Mississippi Ave & S Garrison St

Post 2024/2025



W Mississippi Ave & S Garrison St

Pre 2024/2025



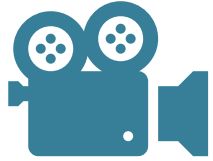
W Mississippi Ave & S Garrison St

Post 2024/2025



W Mississippi Ave & S Garrison St

Case Study Methods



3 hours of video camera footage of 4-ft vs 8-ft advance stop line condition



Approximately 50 signal cycles reviewed for each condition



Same time window (2-4 pm) and similar days of the week

Case Study Results



65% did not encroach over 4-ft stop line

70% did not encroach over 8-ft stop line

Anecdotal: “Change was not noticeable relative to their expectation for stopping at a signalized intersection”



Practical Takeaway:

No need to worry about adherence rates with 8-ft advance stop lines



Future Research:

Yielding rates at Lakewood’s 8-ft advance stop line vs. 4-ft advance stop lines

Study Team

- Wyatt Brown, MSCE – HDR (formerly Oregon State University)
- Hisham Jashami, Ph.D., RSP1 – Oregon State University
- Ransford McCourt, P.E., PTOE – Retired, DKS Past President
- Matt Duncan, P.E., PTOE – City of Lakewood, CO
- David Hurwitz, Ph.D. – Oregon State University



Final Acknowledgements

- Study funded by the Driving and Bicycling Simulator Laboratory at Oregon State University
- Oregon State University Graduate Research Assistants: Jane Bianca Weber, Lena Breuer, Sarah Carr, and Logan Scott-Deeter
- Oregon State University Undergraduate Research Assistants: Rafael Roldan and Nelson Torres
- City of Lakewood for their assistance in the case study
- Randy McCourt for his idea and work on this study



Questions & Discussion