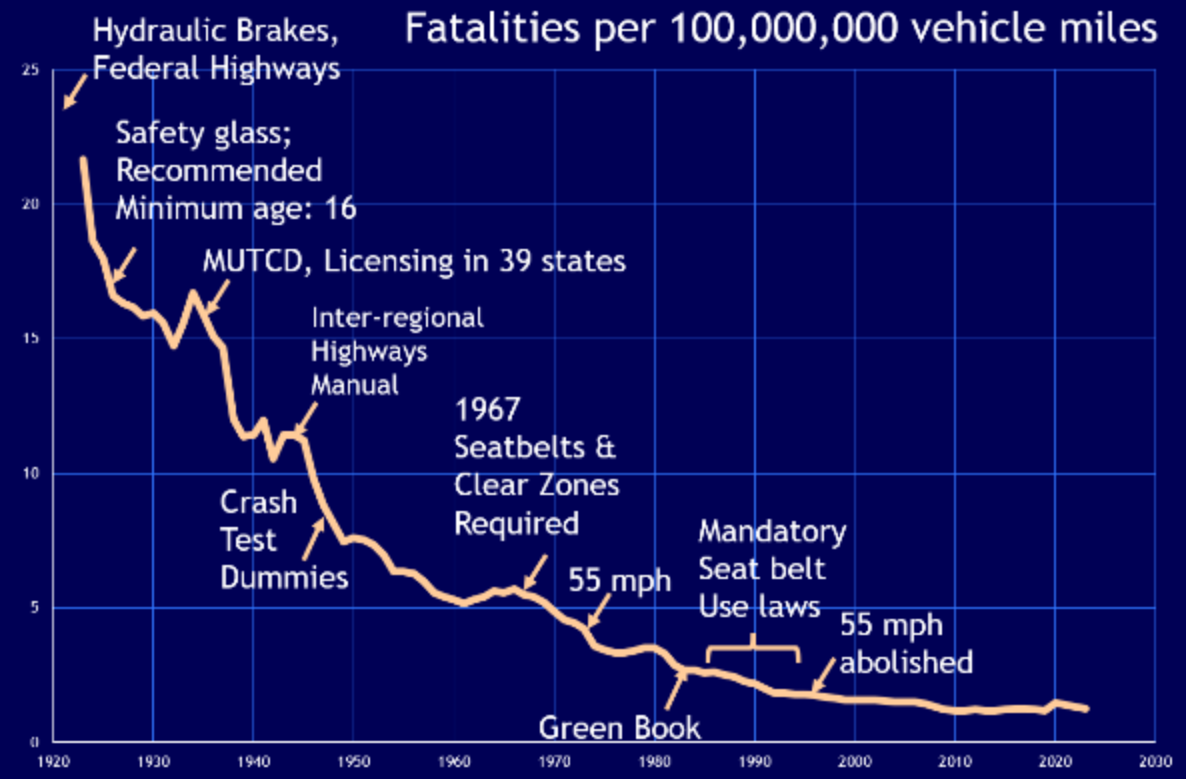
This is Your Brain on the Road

How our built environment fries your brain and what we can do about it.

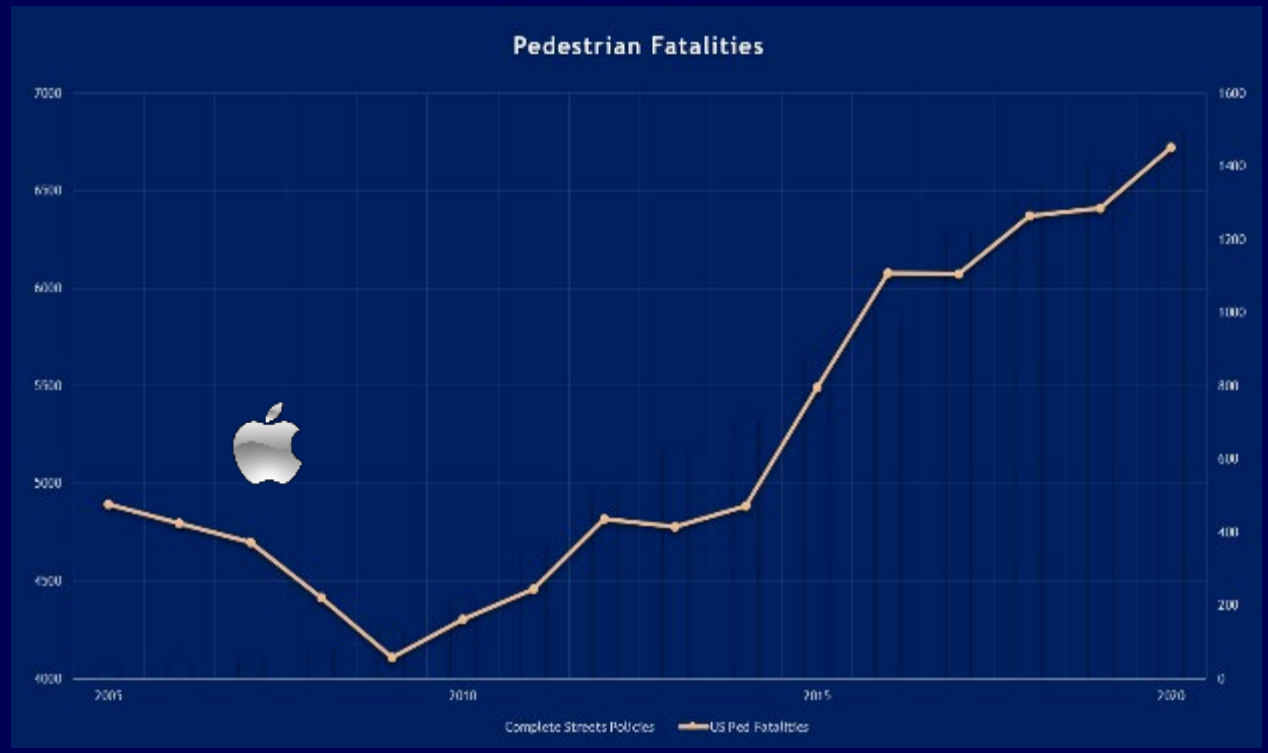
Dr. Patricia Tice, PhD, PE, AICP

We were doing great…



Overall fatality rates have stabilized

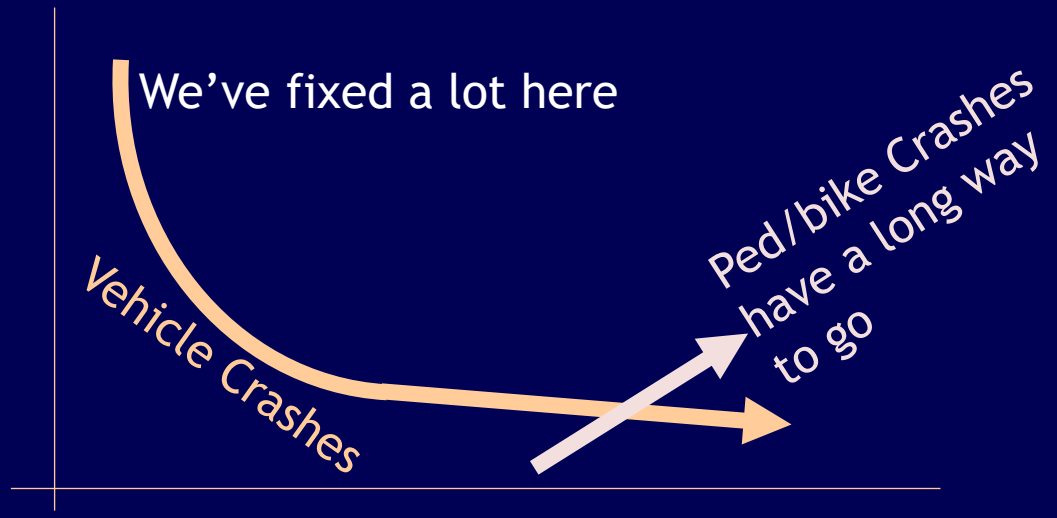
Until we look at peds:

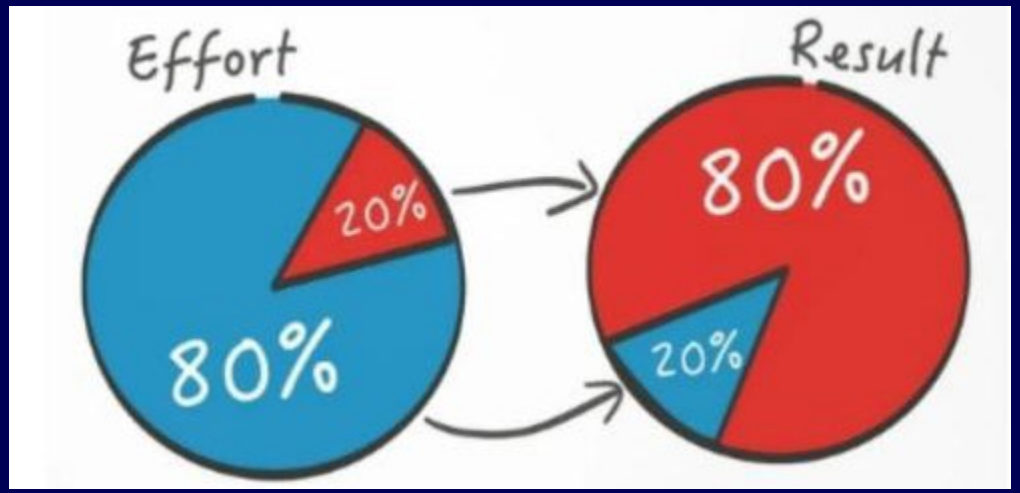


It’s not just distraction—it’s also design.
Complete Streets started in the same timeframe

New tasks mean new risks.

The Pareto Principle:





"The thinking that got us to where we are is not the thinking that will get us to where we want to be." –Albert Einstein

Imagine: A really bad first year

You are the only traffic engineer for a city of a million people, and you lose a middle school child in the first year.

A funeral will shift your priorities quickly.

Prioritizing children

is often what it takes to get to Vision Zero.

It took several years, but Jersey City made it on their own streets.

Check out their
Traffic Calming Toolkit

My intent:

is to show you how your brain drives

So that:

you know what tactics
will work and what won't work
and why.

Which one causes you the most ped/bike problems?

and why?

Stories?

60 sec: discuss with your neighbor

What does the data say?

Which one causes you the most ped/bike problems?

and why?

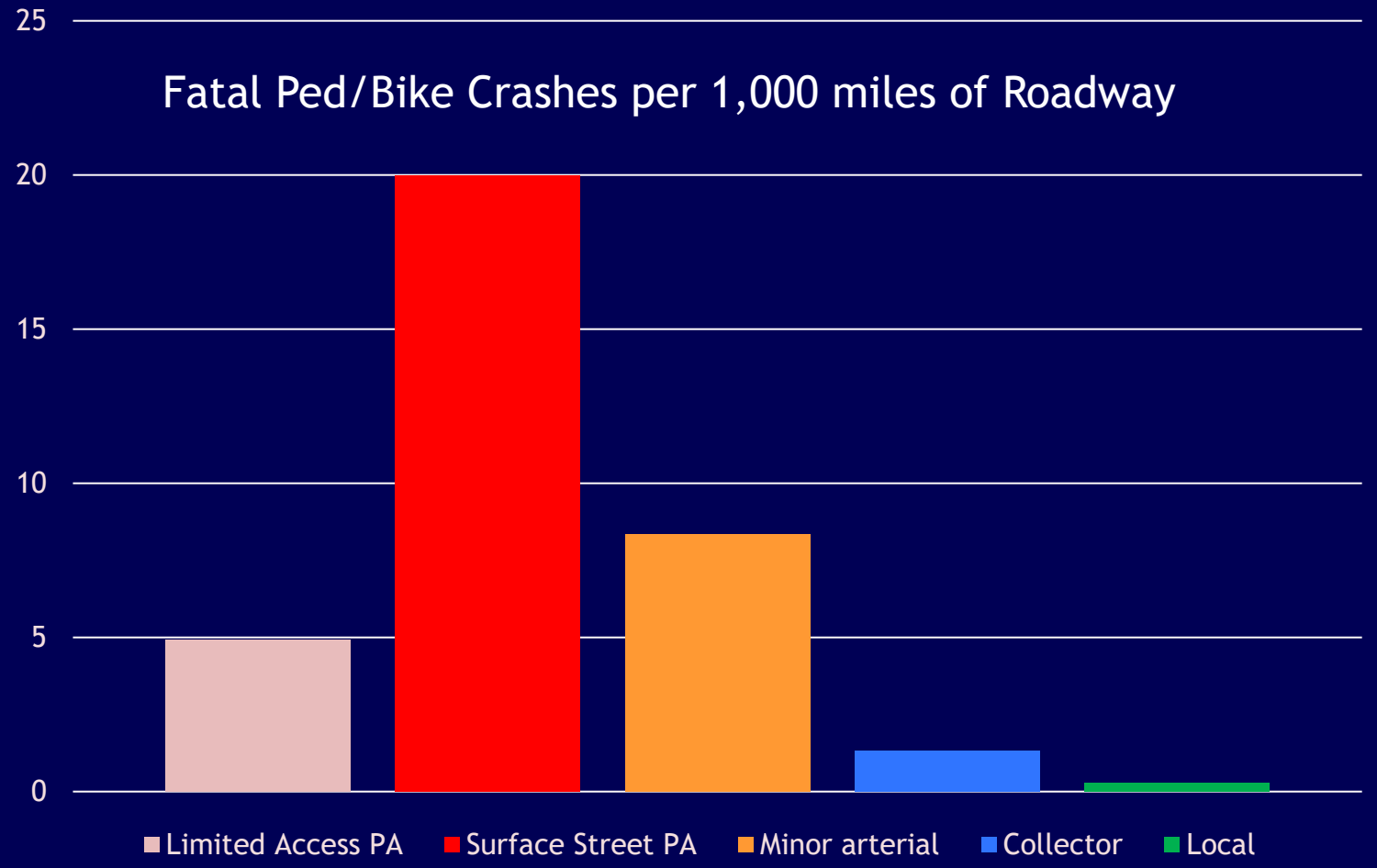
Alabama has a weird issue with highway fatalities.

Which one causes you the most ped/bike problems?

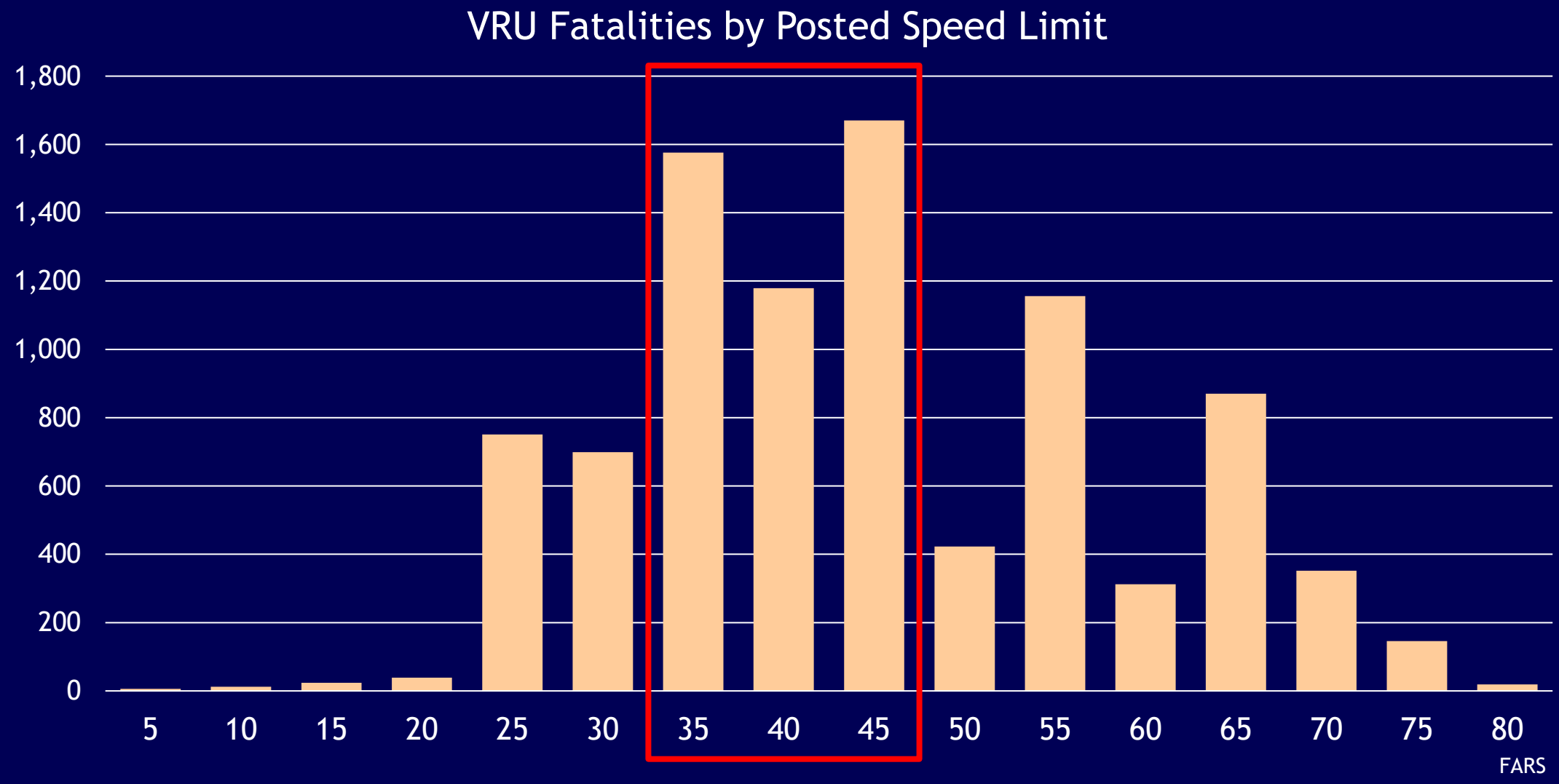
and why?

This is a huge part of the problem and will only get worse over time

The problem is in the regional surface streets

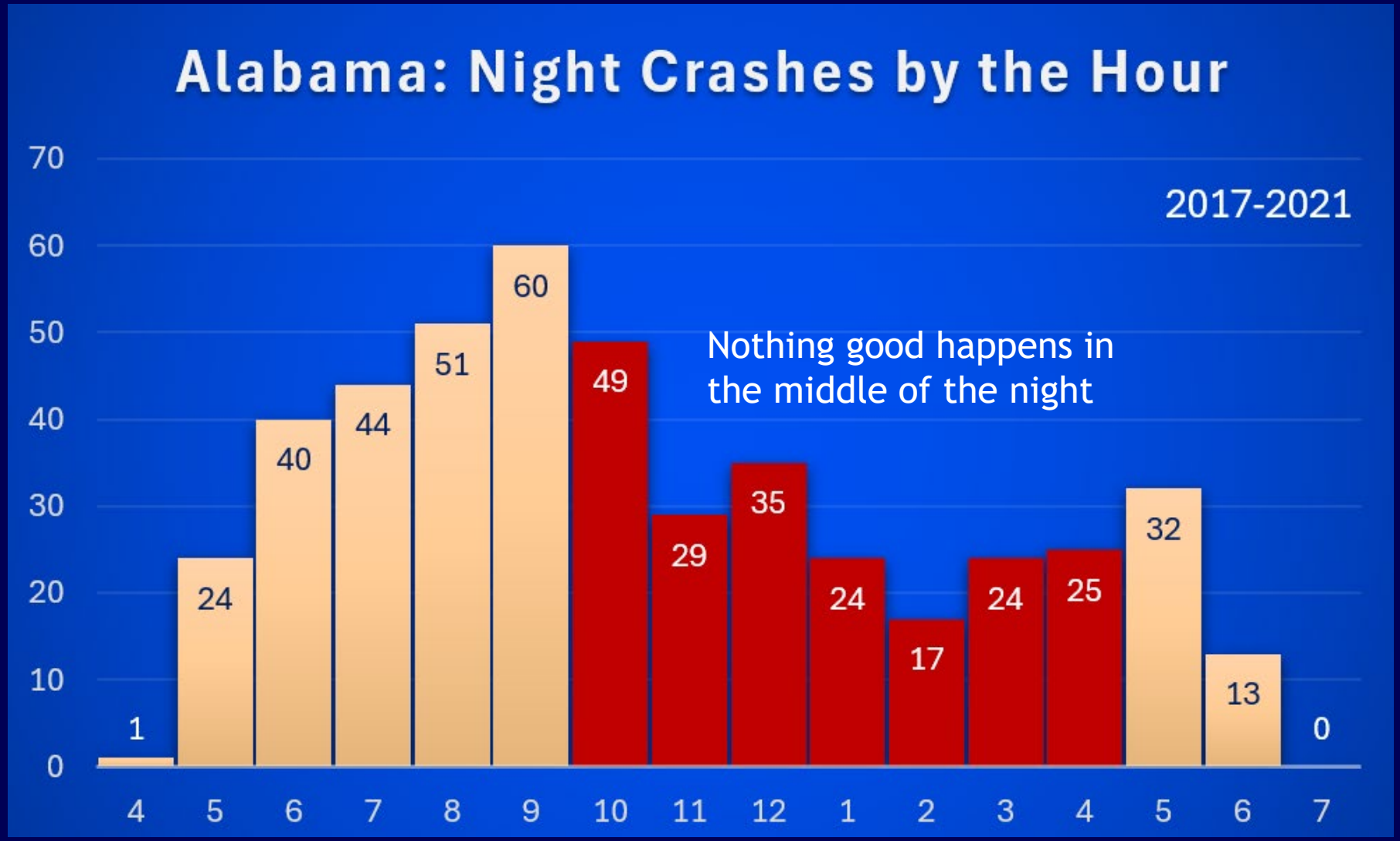


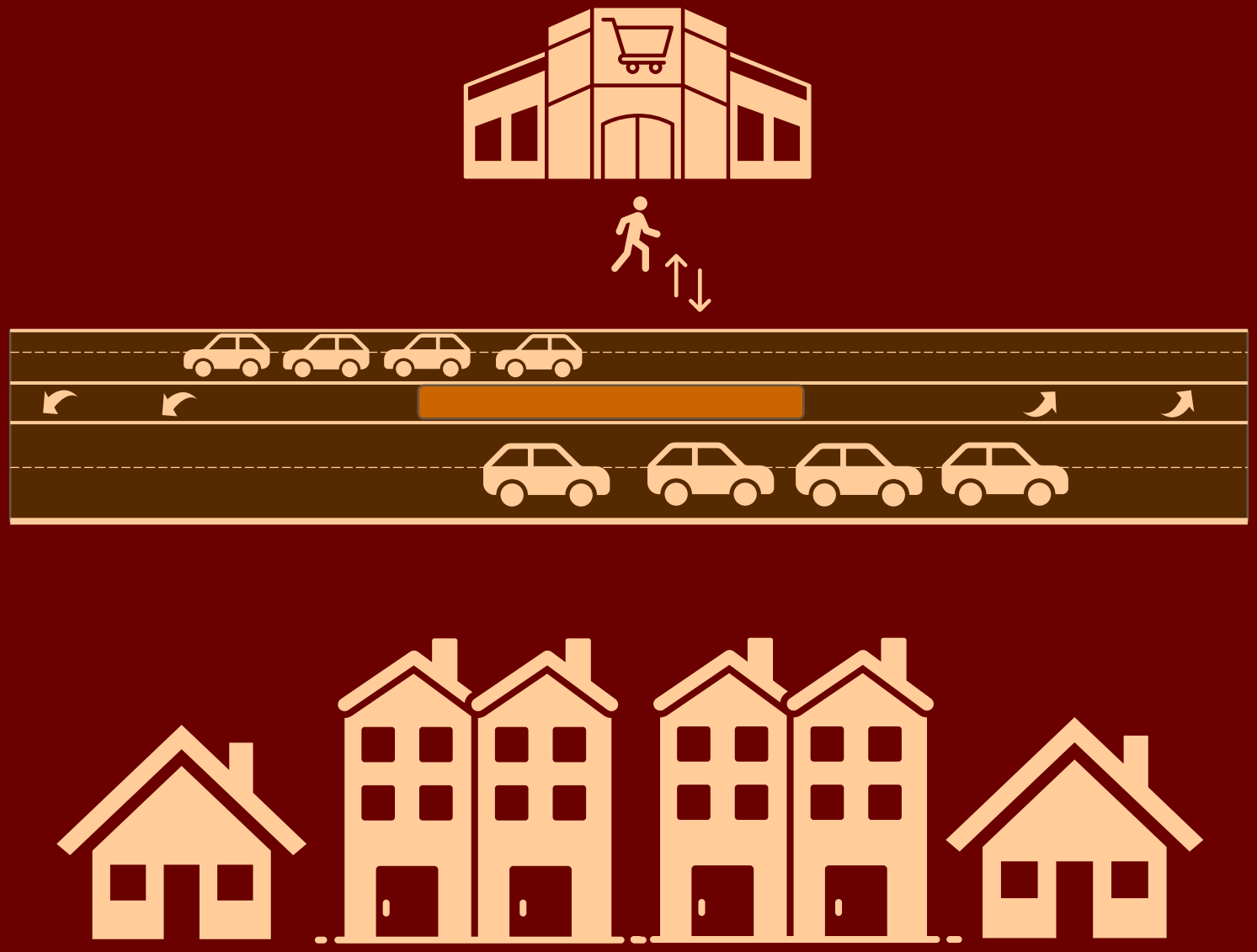
and the mid-range speeds



We also know ¾ are at night

563 daily
422 night
203 mischief
360 functional
~64%





A typical scenario:

Functional fatalities

People getting off from work

Moms getting diapers

The stuff of life and long blocks

Two problems:

We were not created to go that fast

Land use and transportation changes

Problem 1:

Fast Cars, Slow Minds

- 70 mile cars and 15 mile minds
- “Horsepower has outrun brain power”

THE MINOT DAILY NEWS
(AND DAILY OPTIC REPORTER)

1934

H. S. DAVIES, Publisher and General Manager
Published at 20 First Street Southwest, Minot, North Dakota

FAST CARS, SLOW MINDS

The chief cause of increasing traffic accidents, says a thoughtful traffic inspector, is "drivers with 70-mile cars and 15 mile minds."

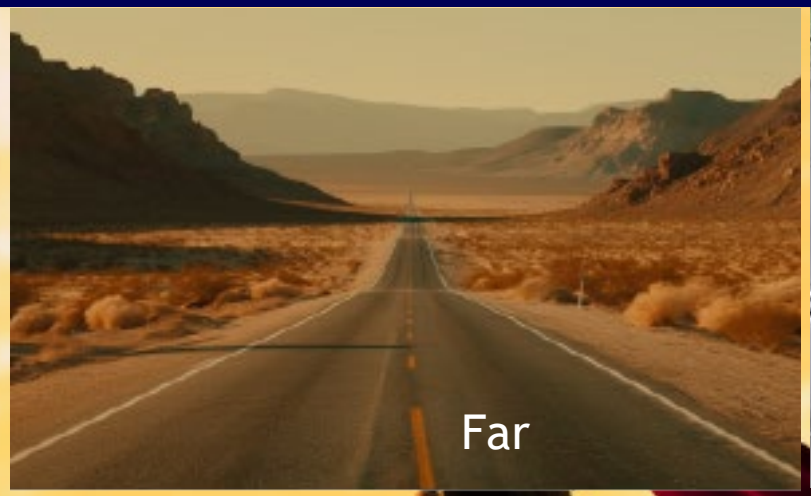
That is an illuminating statement. The horsepower has outrun the brain power. Mighty machines whose operation calls for expert control by mature, highly developed minds, are hurtled along the roads and thru crowded streets by drivers with the minds of boys The drivers enjoy speed, lack judgment take rash chances and kill themselves and others.

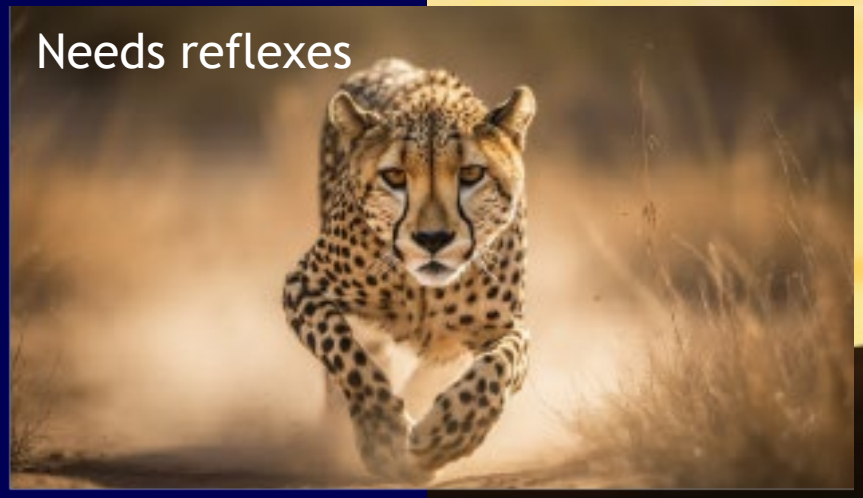
Minds really have gained speed since the advent of the motor car To operate a car at all, the average mind must be more alert than it was in the horse-driving days. And the mental acceleration thus produced extends to other things The automobile has made us nearly all think faster and work faster and play faster Yet we do not gain fast enough mentally to keep up with the traffic requirements while operating the increasingly powerful cars we use We need to think perhaps four times as fast when driving 60 miles an hour as when driving 30 miles, and few of us can do it steadily

We are still far from the locomotive self-control of the birds, which weave about in the air and flash thru woodland traffic mazes But we shall have to develop such skill if the race is to survive its own speed.

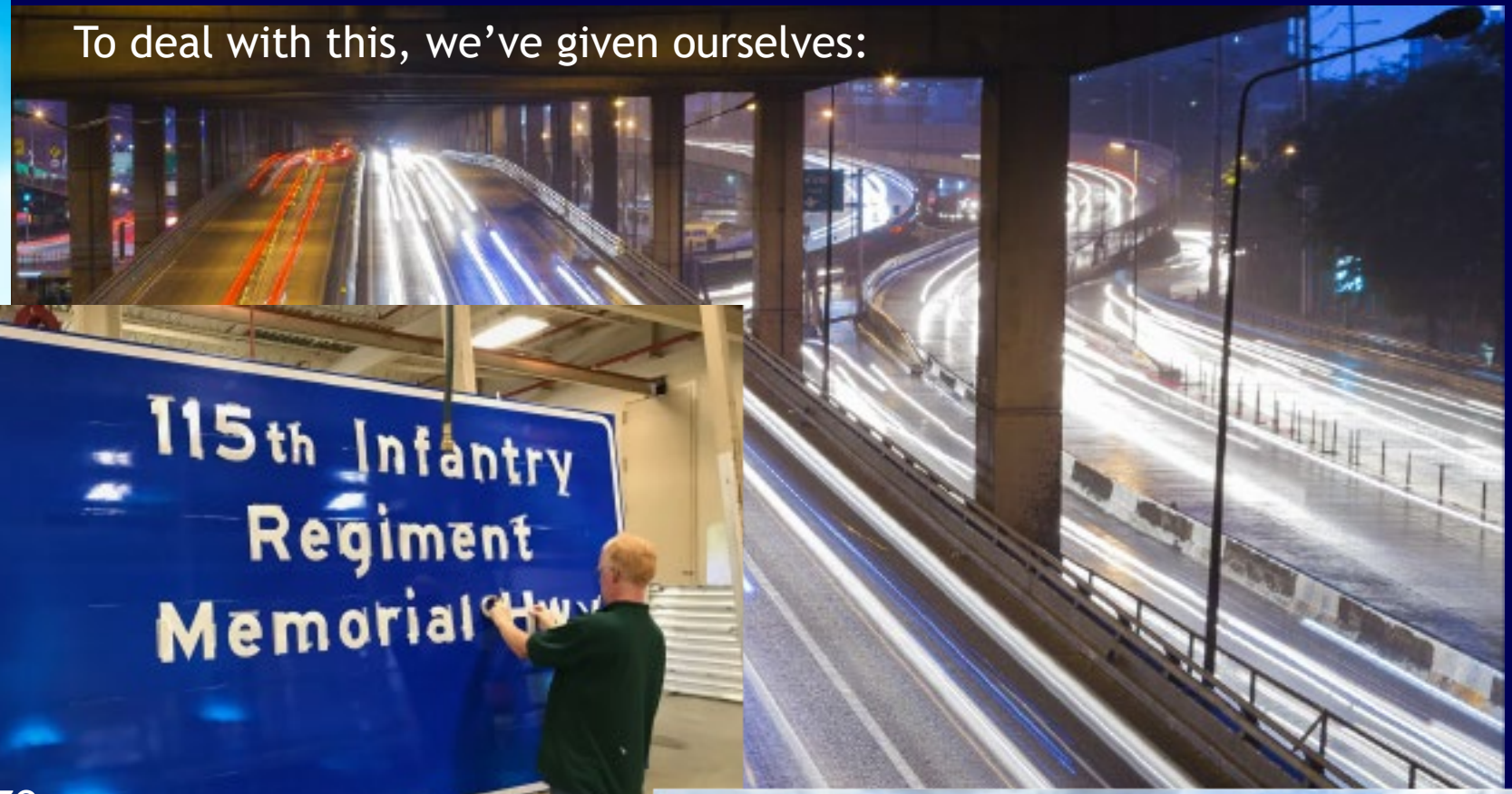
Source: “Fast Cars, Slow Minds,” Minot Daily News, August 24, 1934, p. 4.

Driving is a superpower:

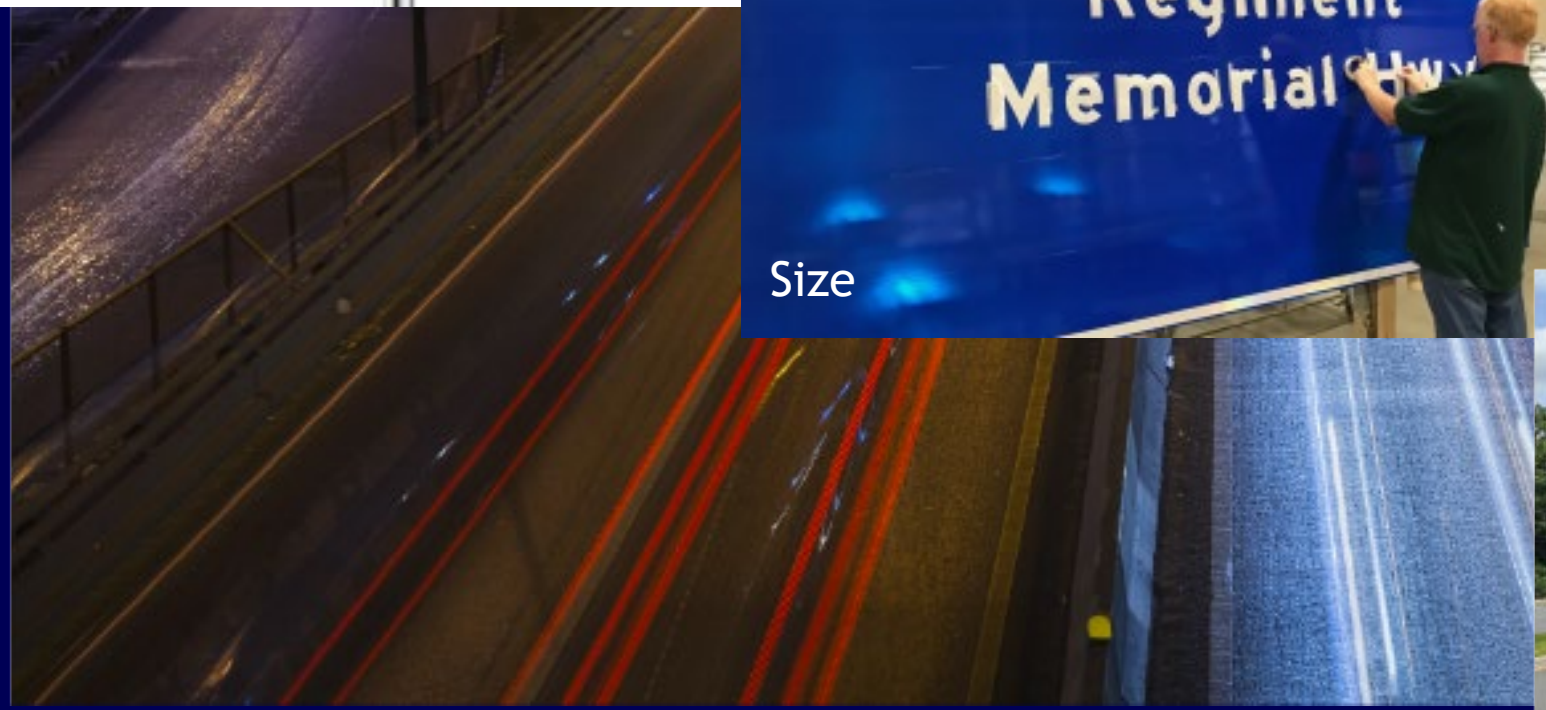




To deal with this, we've given ourselves:



Size



Margin

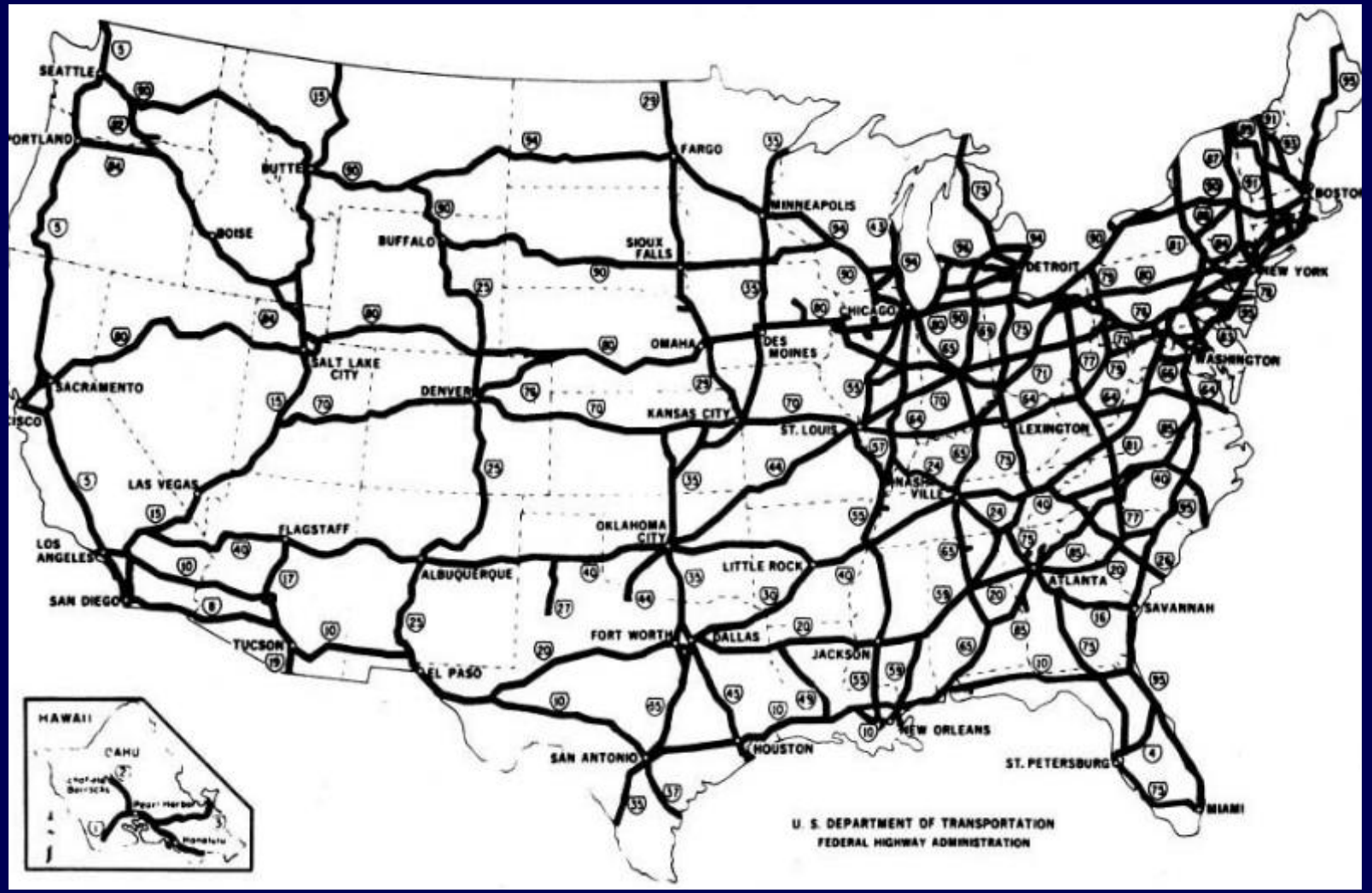
Wide, consistent and fast actively mitigates against seeing pedestrians

We watched this video 4 times in the office before we saw the pedestrians in this sequence

Problem 2: Land Use Sanity is returning

- Cars isolate. Walking connects.
- Subdivisions become a prison for the elderly and the young.
- Affordable housing means apartments, and we want them close to shopping.

Car World Origins: The Eisenhower Bargain



- Before WWII, roads and streets were built based on market demand
- Eisenhower System:
  - 90/10 match
  - FHS: 80/20 match
- After WWII, the slant was toward the FHS.

Congestion trap

- No network →
  - No redundancy, everyone on one road→
    - Road gets full→
      - Road gets widened→
        - First widening is Chemotherapy
        - Second widening kills the patient

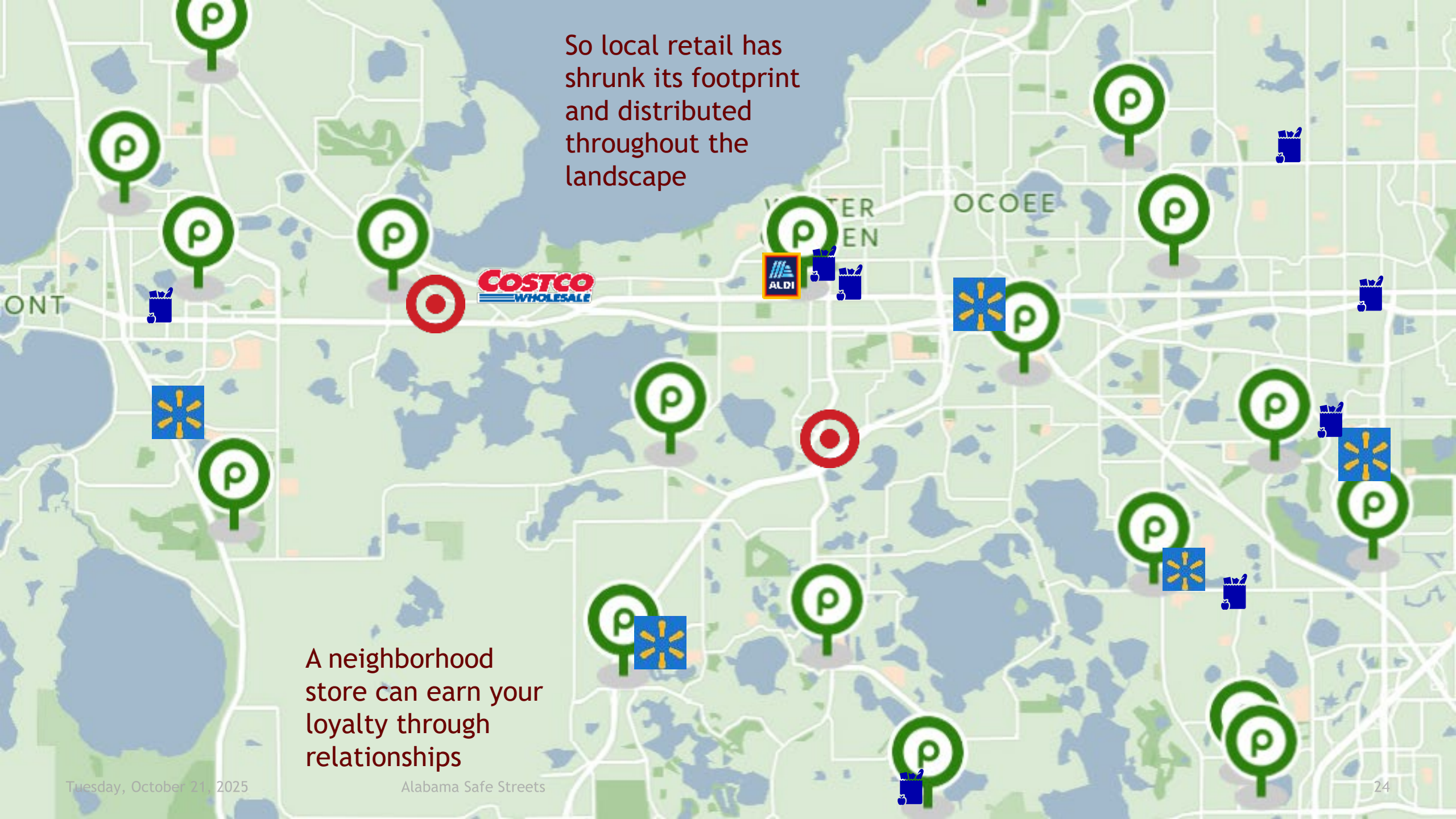
But that land use pattern is rapidly changing:

There are three things Amazon can't do:

Can't get you something in the next 5 minutes

Can't pick out your tomatoes for you

Can't build a relationship with you


So local retail has shrunk its footprint and distributed throughout the landscape
COSTCO WHOLESALE
ALDI
OCOEE
A neighborhood store can earn your loyalty through relationships

Build it and they will come

But they’re scared.

We see the latent demand in the ped/bike crashes

Urban Environments Get Different Behaviors.

Why?

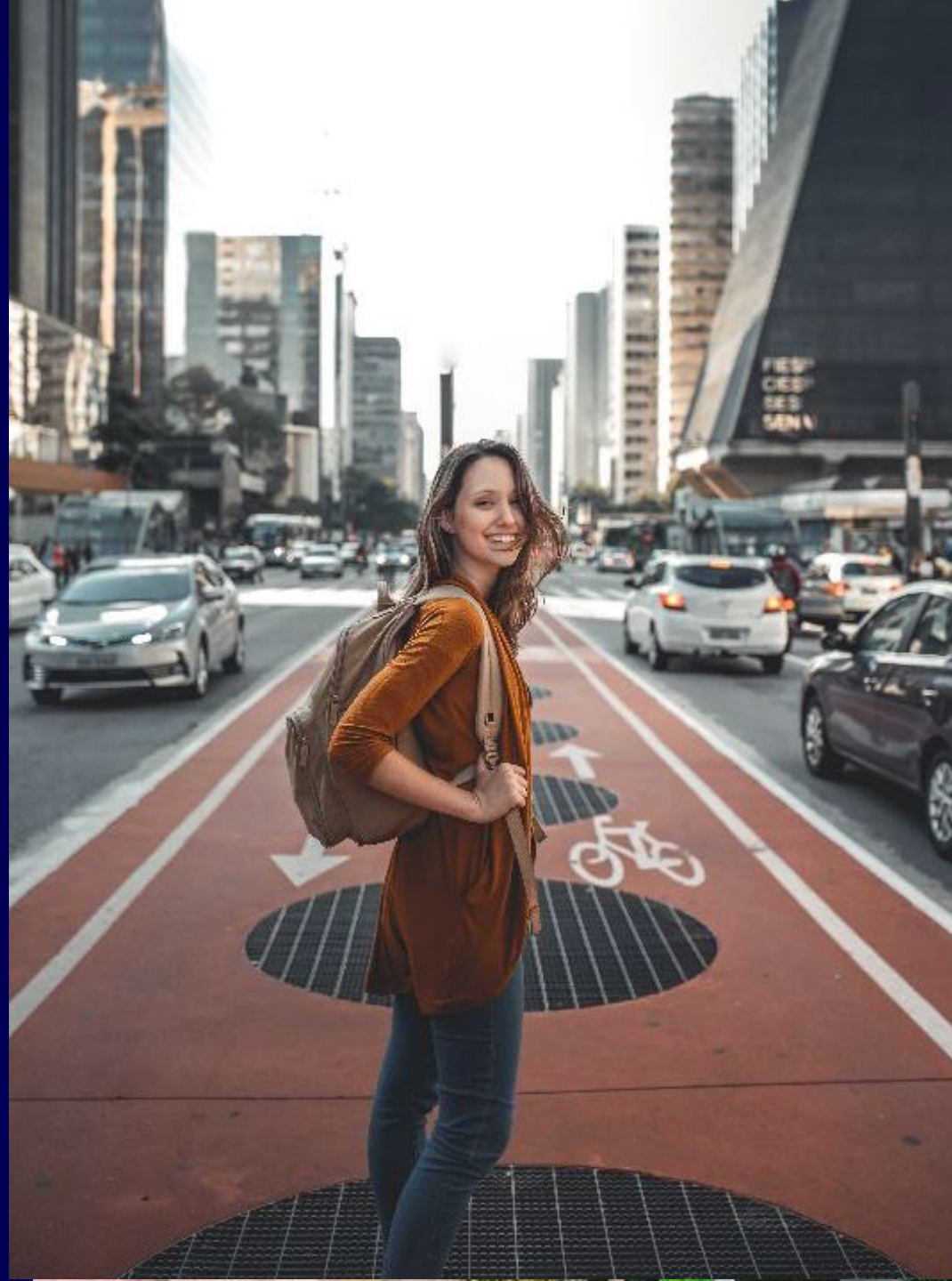
After 4 years of driver behavior analysis:

The Surprise Takeaway:

It was never about what we build.

It’s all about people.

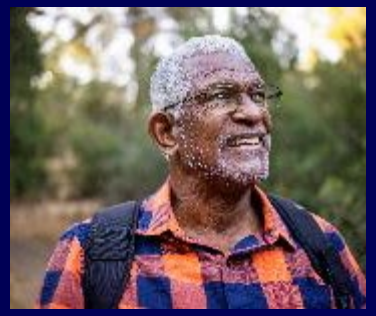
Great walkable places get good behavior



7 Mental Frameworks:

1. Thinking:

fast vs. slow



2. People Priority

3. Proximity

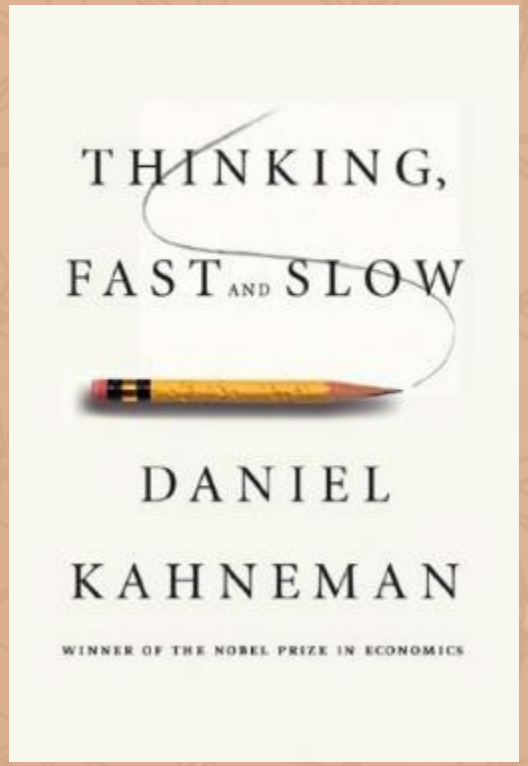
4. Priming

5. Interruptions

6. Workload

7. Transitions

1. Automaticity



System 2: Slow

Trained by learning and conversing

Logical, Sequential

Verbal

Understanding

This is one that takes tests

System 1: Fast

Trained by experience

Probabilistic

Monitoring

Self-preservation

This is one you want driving

Remember learning to drive?

Driving Starts out in System 2 but moves to System 1

Once we learn to drive, we quit watching ourselves.

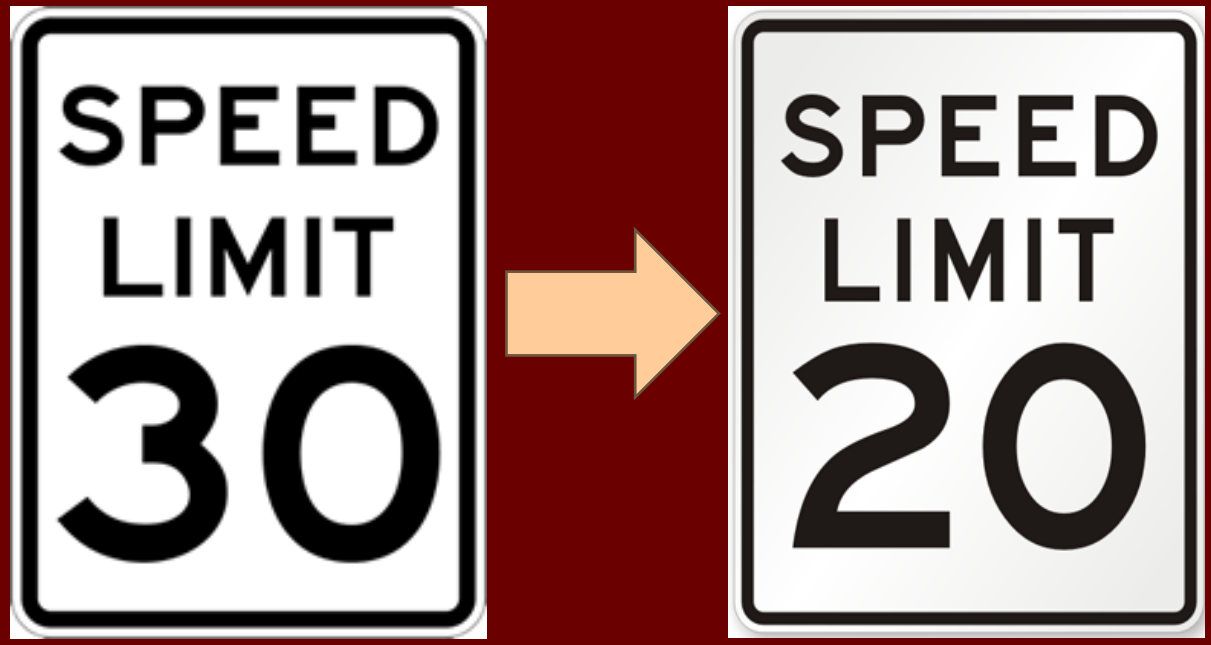
That automaticity makes our superpower safe

We do a lot without thinking

And that's good.

Drivers aren't ignoring our signs.

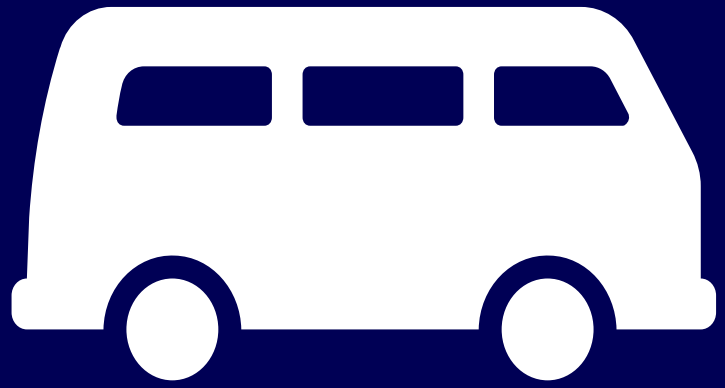
They're not looking at their speedometers.

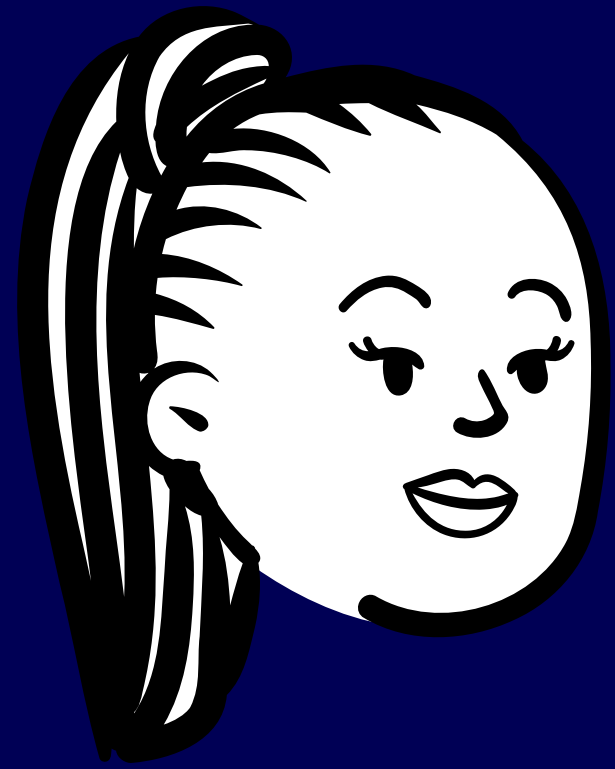


How effective will it be to just change the number on the sign?

Around 1.8 mph for every 10 mph Δ

Flash test: Which image draws your eyes first?



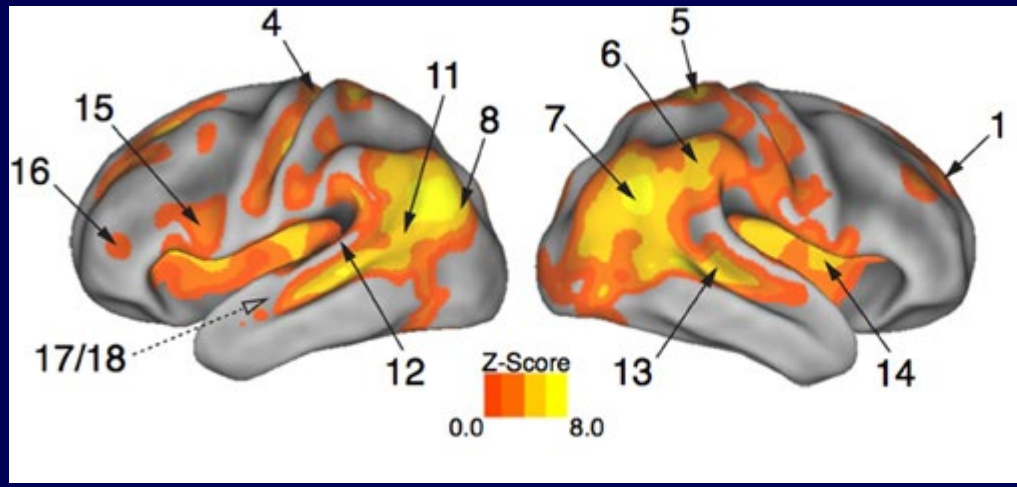


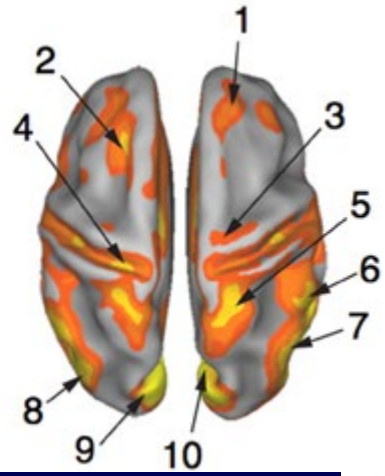
2. People Get Priority

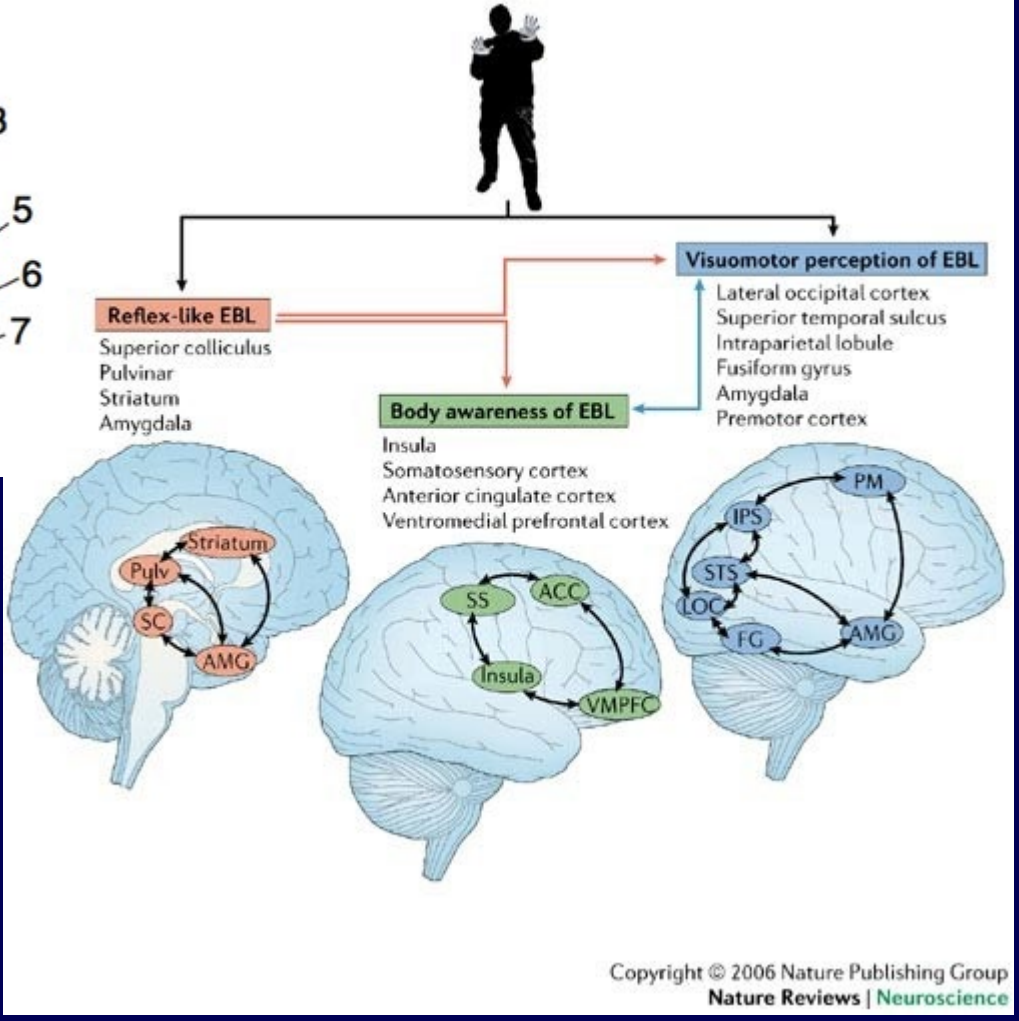
Perceiving another human being is prioritized in the brain for survival reasons

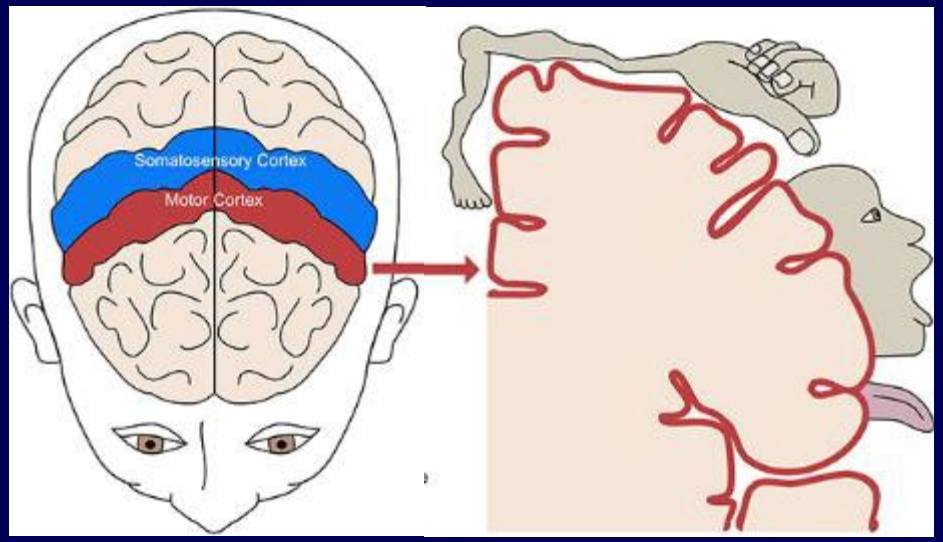
People on the brain

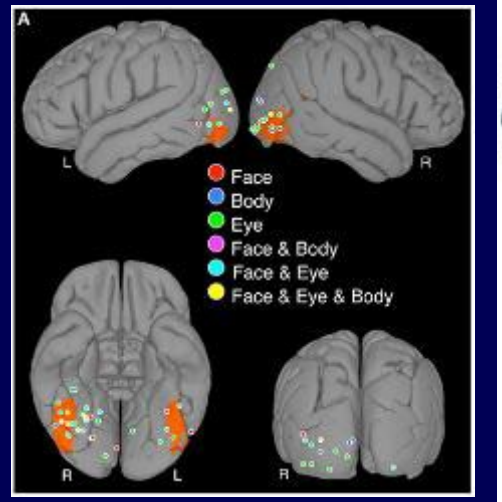
About 2/3 of your grey matter is used when you process human faces and bodies











Engell, A. D., & McCarthy, G. (2014). Face, eye, and body selective responses in fusiform gyrus and adjacent cortex: an intracranial EEG study. *Frontiers in human neuroscience*, *8*, 642.
Tipper, C. M., Signorini, G., & Grafton, S. T. (2015). Body language in the brain: constructing meaning from expressive movement. Frontiers in human neuroscience, 9, 450.
De Gelder, B. (2006). Towards the neurobiology of emotional body language. Nature Reviews Neuroscience, 7(3), 242-249.

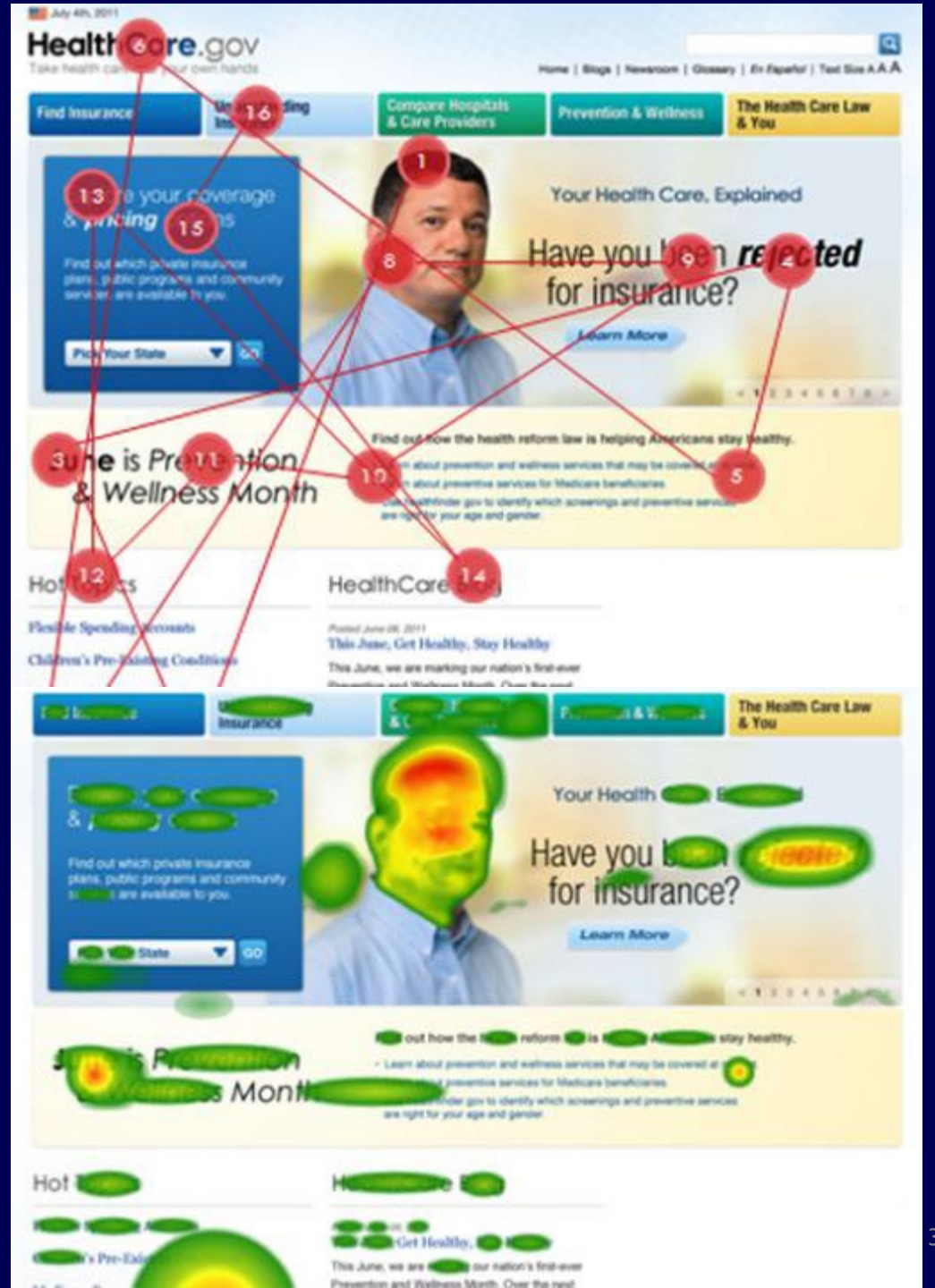
2. People Priority

- We are reflexively drawn to the human face
  - 2/3 of the first fixations were on the person

Fletcher-Watson, S., et al. (2008). "Rapid detection of person information in a naturalistic scene." Perception **37**(4): 571-583.

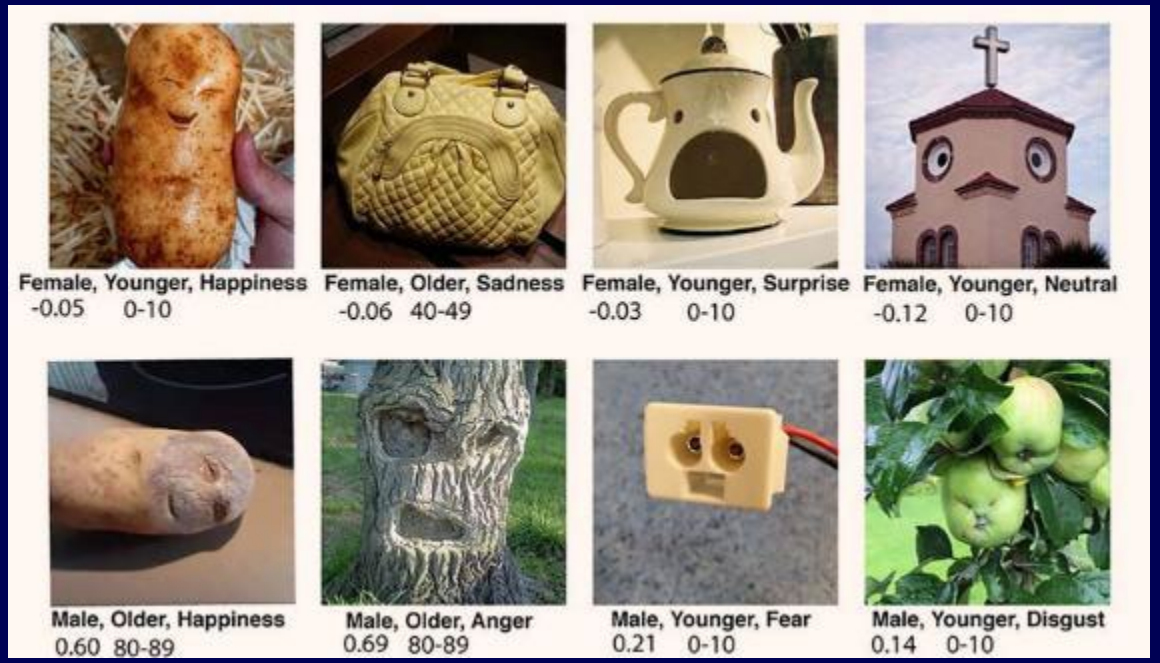
2. People Priority

- We look at faces first and we come back to them



2. People Priority

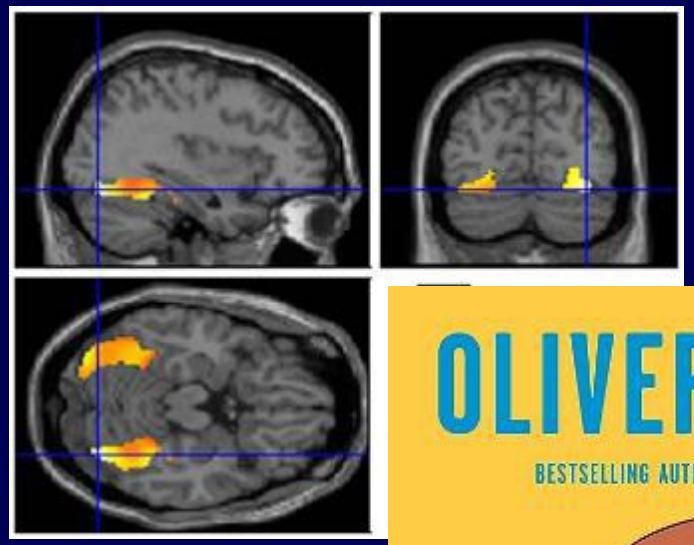
- You see faces even when they’re not there!

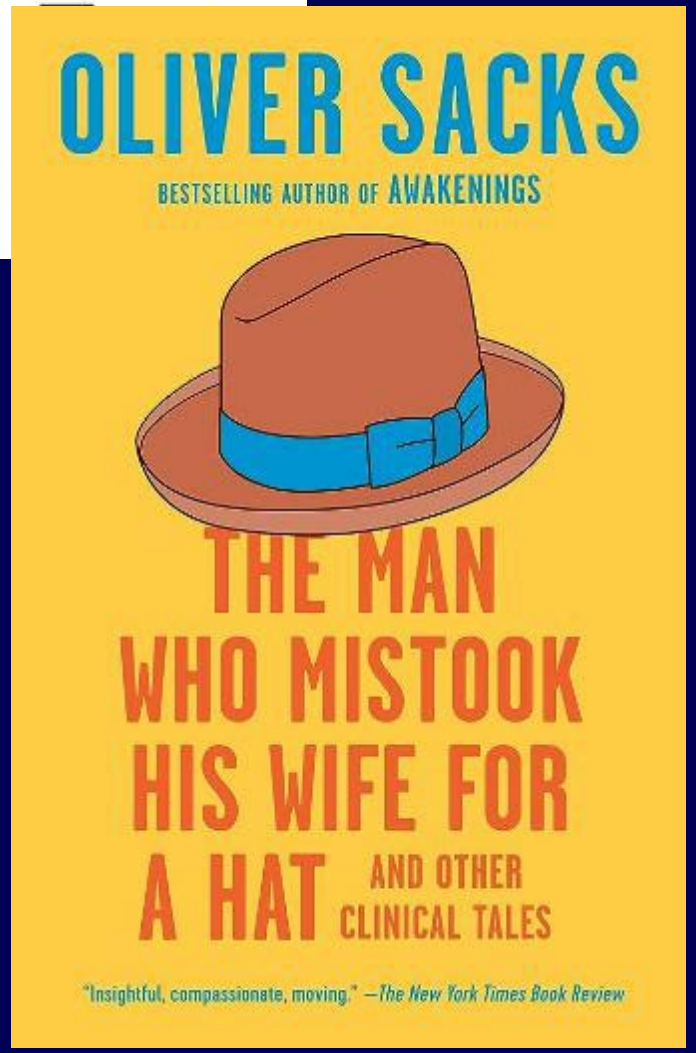


Susan G. Wardle et al. 2022. Illusory faces are more likely to be perceived as male than female. PNAS 119 (5): e2117413119; doi: 10.1073/pnas.2117413119
Ota, C., & Nakano, T. (2021). Self-face activates the dopamine reward pathway without awareness. *Cerebral Cortex*, *31*(10), 4420-4426.

2. People Priority

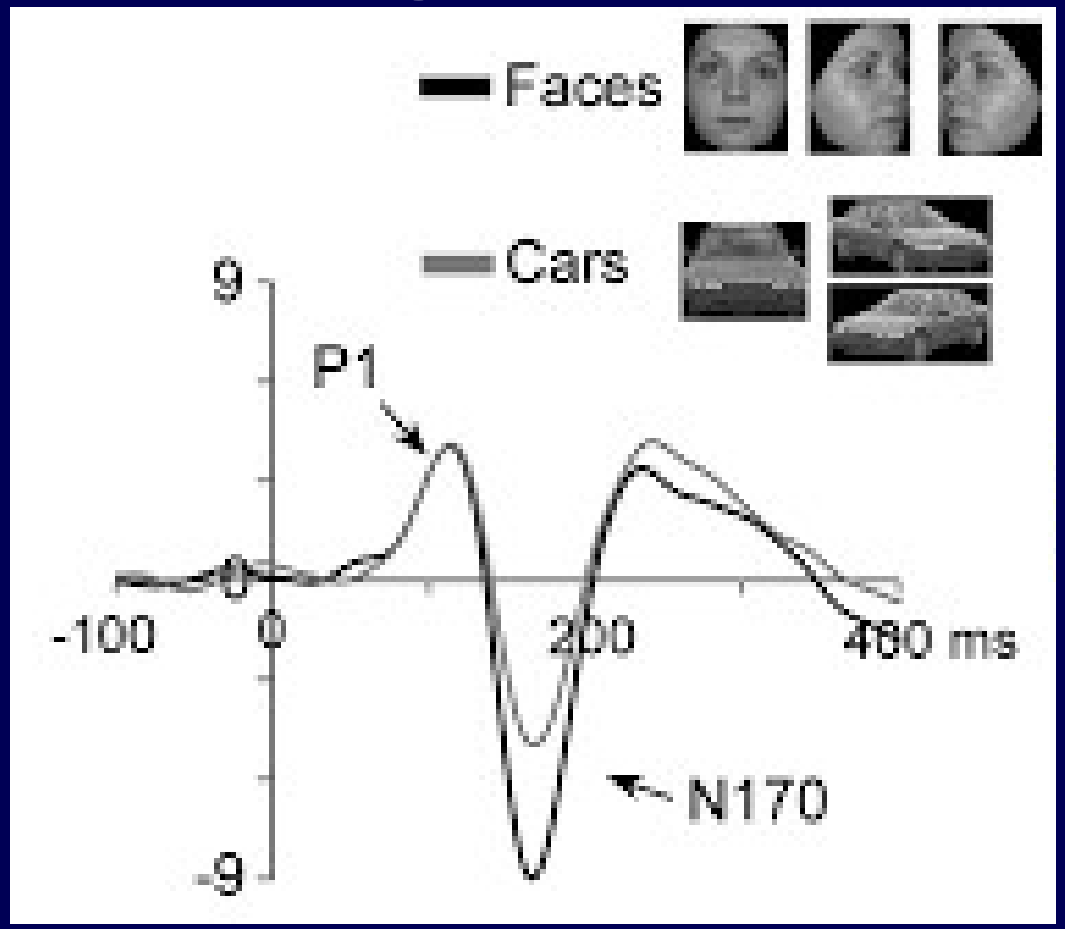
- Facial recognition is tied into the dopamine and oxytocin pathways
- Human Body Language accesses these as well as the amygdala and the adrenaline systems





Rypma, B., Fischer, H., Rieckmann, A., Hubbard, N. A., Nyberg, L., & Bäckman, L. (2015). Dopamine D1 binding potential predicts fusiform BOLD activity during face-recognition performance.
Journal of Neuroscience, *35*(44), 14702-14707. Lopatina, O. L., Komleva, Y. K., Gorina, Y. V., Higashida, H., & Salmina, A. B. (2018). Neurobiological aspects of face recognition: the role of oxytocin.
Frontiers in behavioral neuroscience, 195.

You have specific brain wave patterns and structures for seeing faces and bodies



- The height of the wave is directly related to the intensity of the emotion you are seeing.
- You don't need to directly look at a face to get this response

Blau, V. C., Maurer, U., Tottenham, N., & McCandliss, B. D. (2007). The face-specific N170 component is modulated by emotional facial expression. *Behavioral and brain functions, 3(1), 1-13.*
Cauquil, A. S., Edmonds, G. E., & Taylor, M. J. (2000). Is the face-sensitive N170 the only ERP not affected by selective attention? Neuroreport, 11(10), 2167-2171.

3. Perceptual Limits

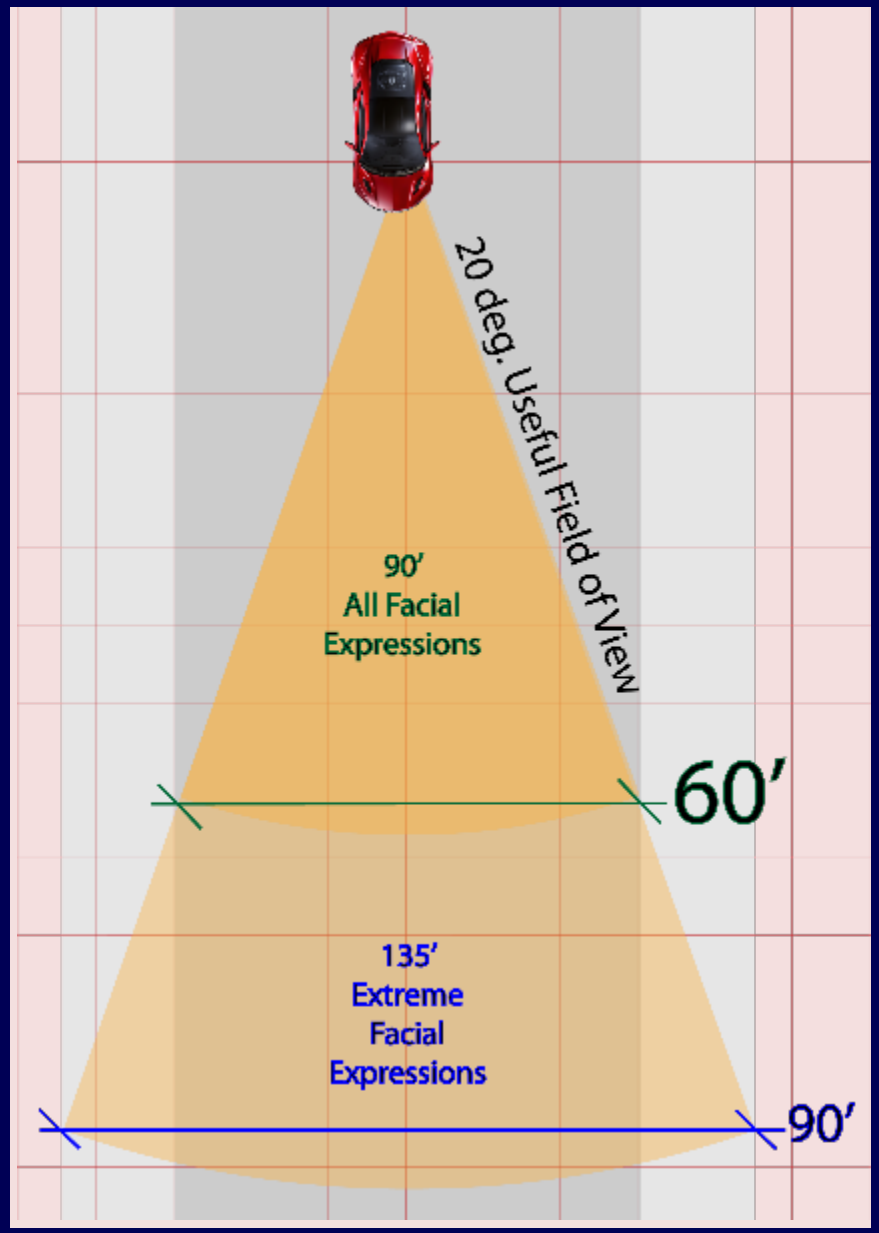
There are concrete limitations on perceiving people in time and space

Limitations:

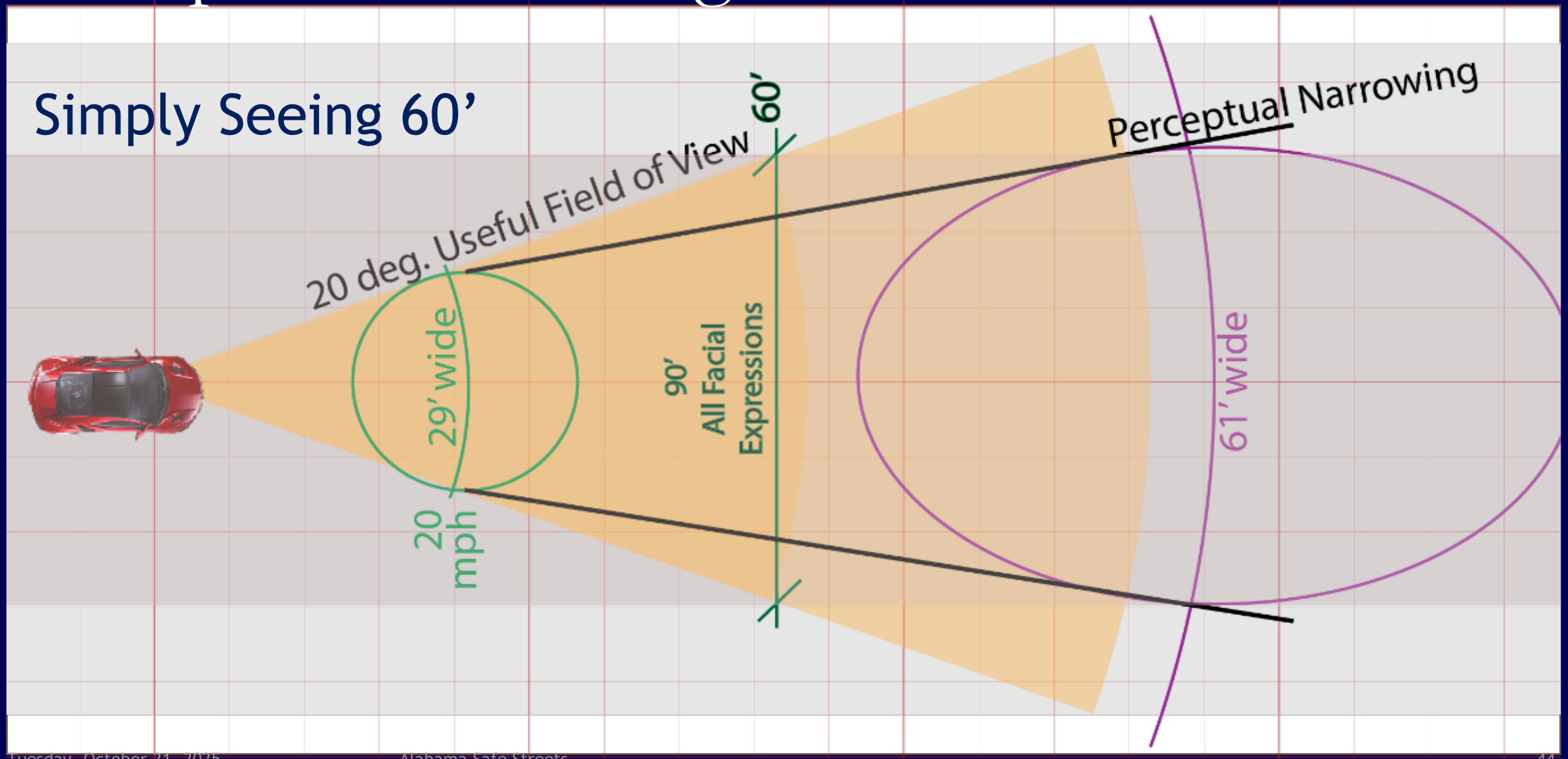
Plan view:

- Interaction Possibilities:
  - 90-135 feet
- Driver uses a 20 degree view

➢**Yields a 60-90’ wide corridor**



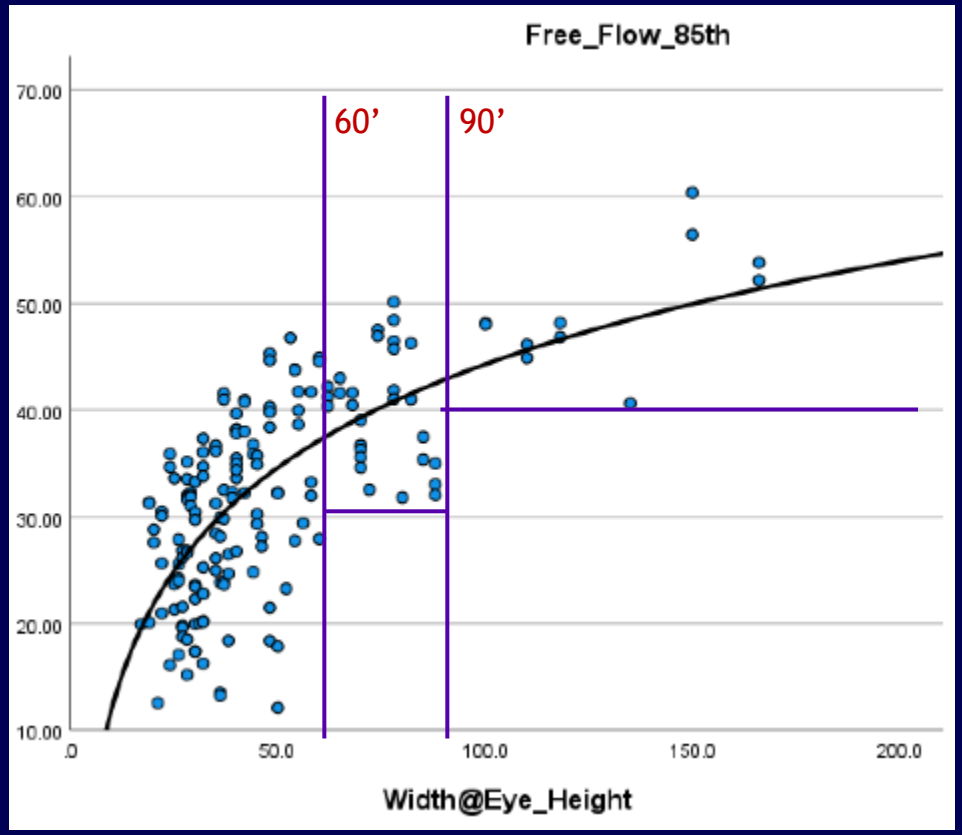
Perceptual Narrowing



That's why width matters:

- The visual tunnel that the driver navigates
  - Wider than 60', speeds below 30 mph disappear
  - Wider than 90', speeds below 40-45 mph disappear

You may not be able to guarantee a slow speed but you can put yourself out of the game.

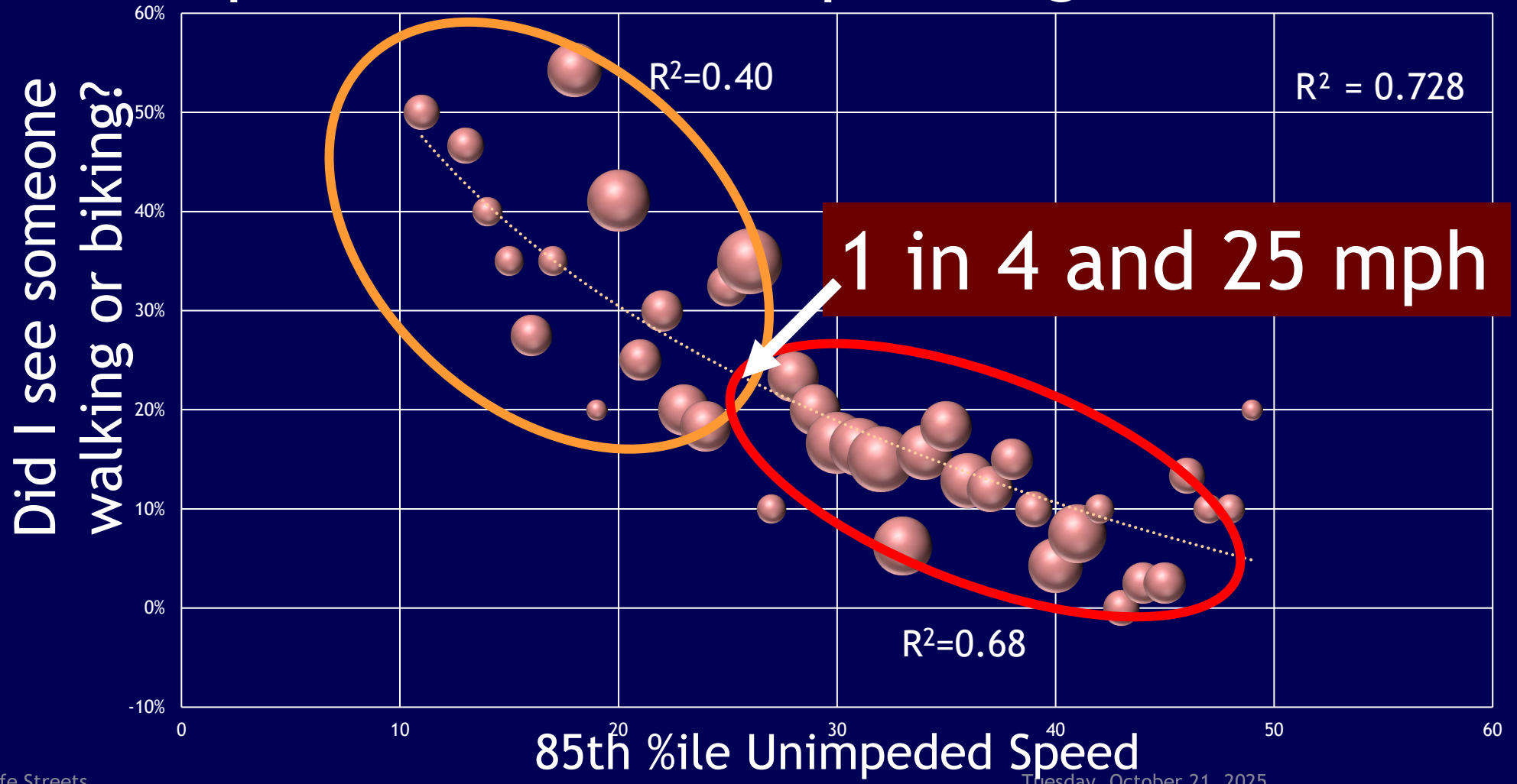


4. Expectations

We see what we expect to see

This hints at two different types of driving

Expectations Drive Speeding Behavior



4. Salient Novelty

Brains look for the New

8 second attention spans

Close your eyes

Think of your favorite trip

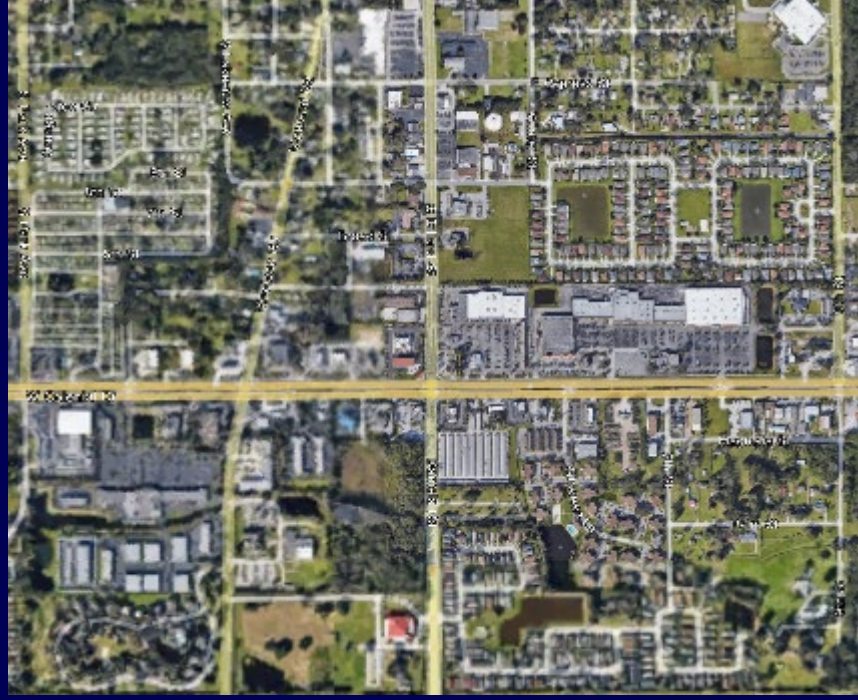
What do you remember?

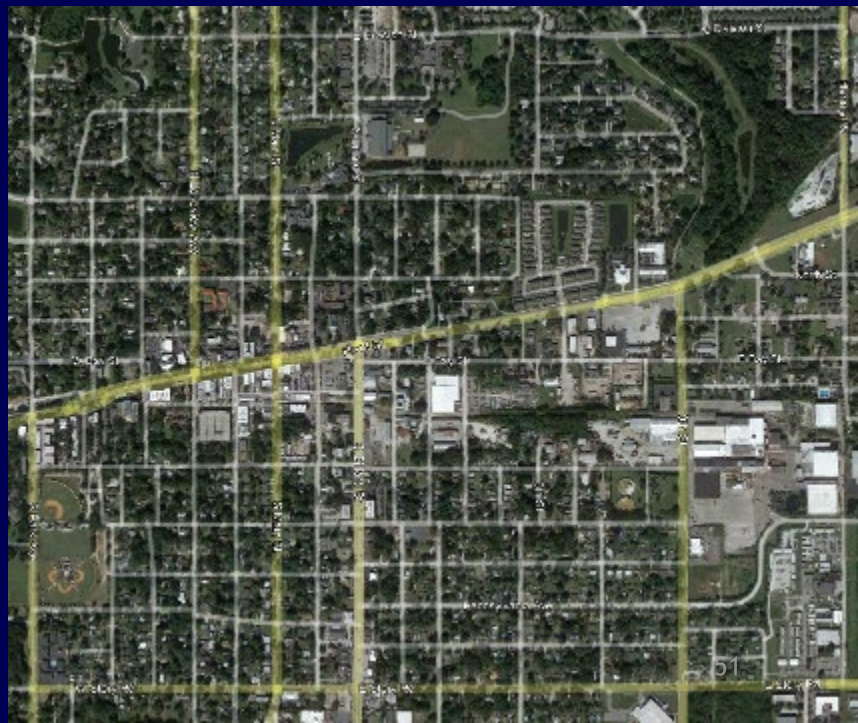
Stills, Shorts, or Video?


Each trip is a story
Think of the path in terms of story beats

Access Management

- Great for suburban highways
  - It will increase your speed 5-10 mph
  - Move people away from an access managed corridor
- Not so great for urban streets
  - The interruptions keep drivers engaged





Are your kids this sweet in city traffic?

Mine weren’t

How does that make you feel?

6. Speed and Workload

Drivers manage the workload demands with their speed

To get speed down you need to get their attention and keep it

3 Factors:

1. People
2. Close enough
3. Frequent change

$$\text{Speed} = -5.26 - 1.58\ \text{Doors/100'}\ \text{of block face} + 9.9\ \ln(\text{Visual Tunnel Width}) + 0.0068\ \text{Block Length}$$

Mid block, free flow 85th percentile speed

7. Event Horizons

Memory Structures

Ever walked through a door and forgotten everything?

Memory is stored spatially like a string of pearls

Your mental model of the space creates the bucket that the memory is stored in

Spatial Transitions create a reset

Each major transition is like going into a new room

You have to recreate a new mental model of the space

At transitions

Scanning takes precedence over focus

Right when you need to see people

You will be looking everywhere else

How does all this translate into crashes and design?

Why are the failures happening?

Are we just too squirrel prone?

Mismatched Expectations Kill People

Around 22-43 mph operational

Trouble Zone

	Operational Speed	10	15	20	25	30	35	40	45	50	55
Drivers	Can see ped/bike	80%	60%	55%	50/50	50 / 50			Depends on clutter		
	Expect to see	50/50	4 of 10	1 of 3	1 of 4	1 of 5	1 of 6	1 of 10	1 of 15	1 of 20	
Active Users	Expect to be seen										
	Can walk away	95%	88%	80%	68%	55%	38%	25%	15%	8%	5%
	Facilities provided										

Hit by a vehicle at
12 mph
9/10 walk away

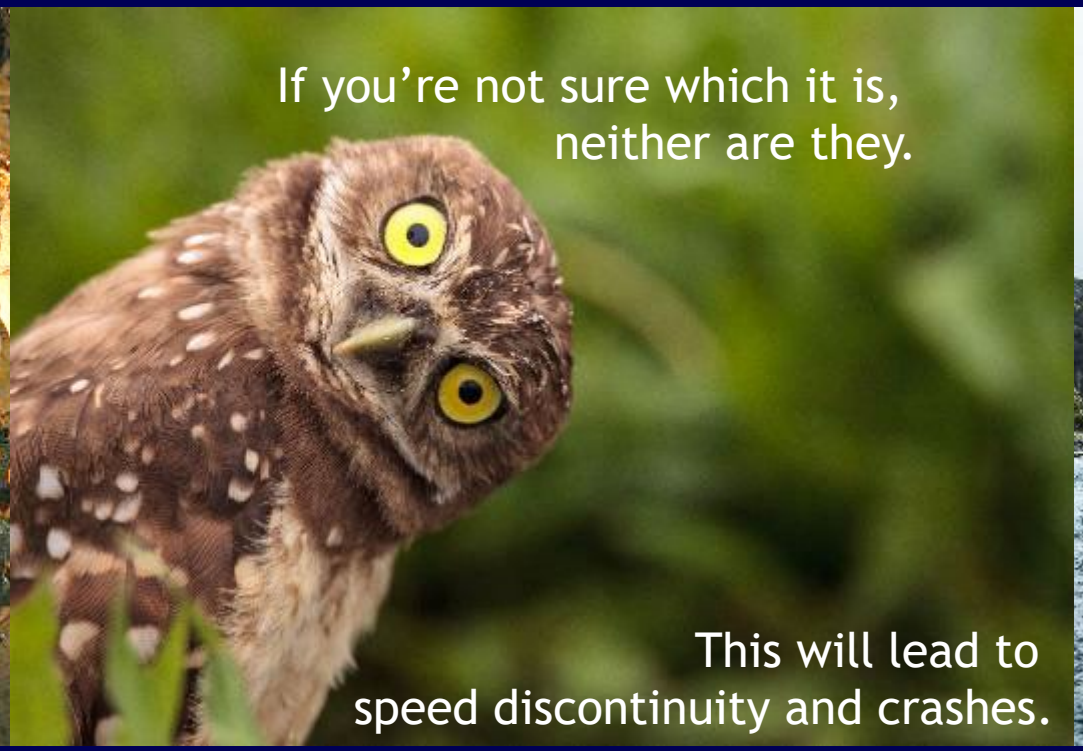
Hit by a vehicle at
32 mph
5/10 walk away

Hit by a vehicle at
49 mph
1/10 walk away

So how do we think about this?

Two design concepts:

STREETS: IT'S A DANCE, NOT A DRIVE



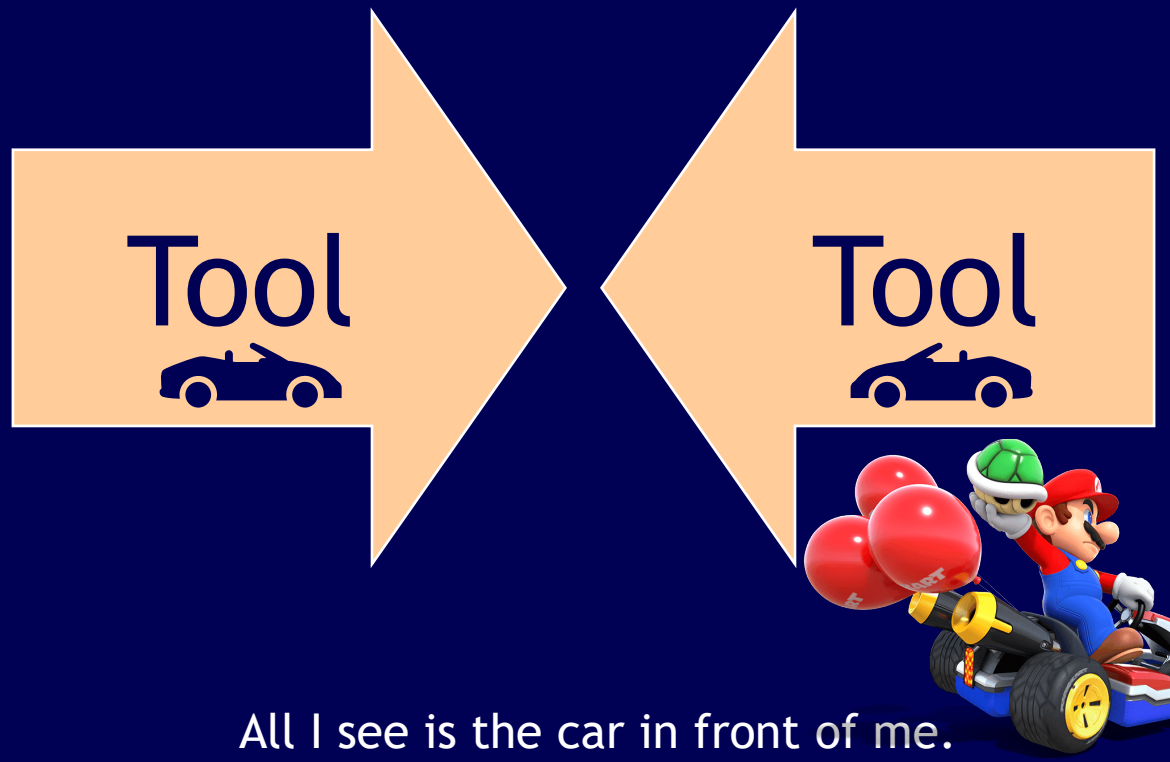
ROADS: IT'S A RIVER, NOT A ROUTE

Interactive=Street

Face to face, eye to eye
So you know you can trust this guy.

We are human here

Manipulative=Road



All I see is the car in front of me.
So don't trust me to see anybody.

We're just playing a video game here

Street Prerequisites

Street facing land use

3 lanes or less

Blocks <600 feet

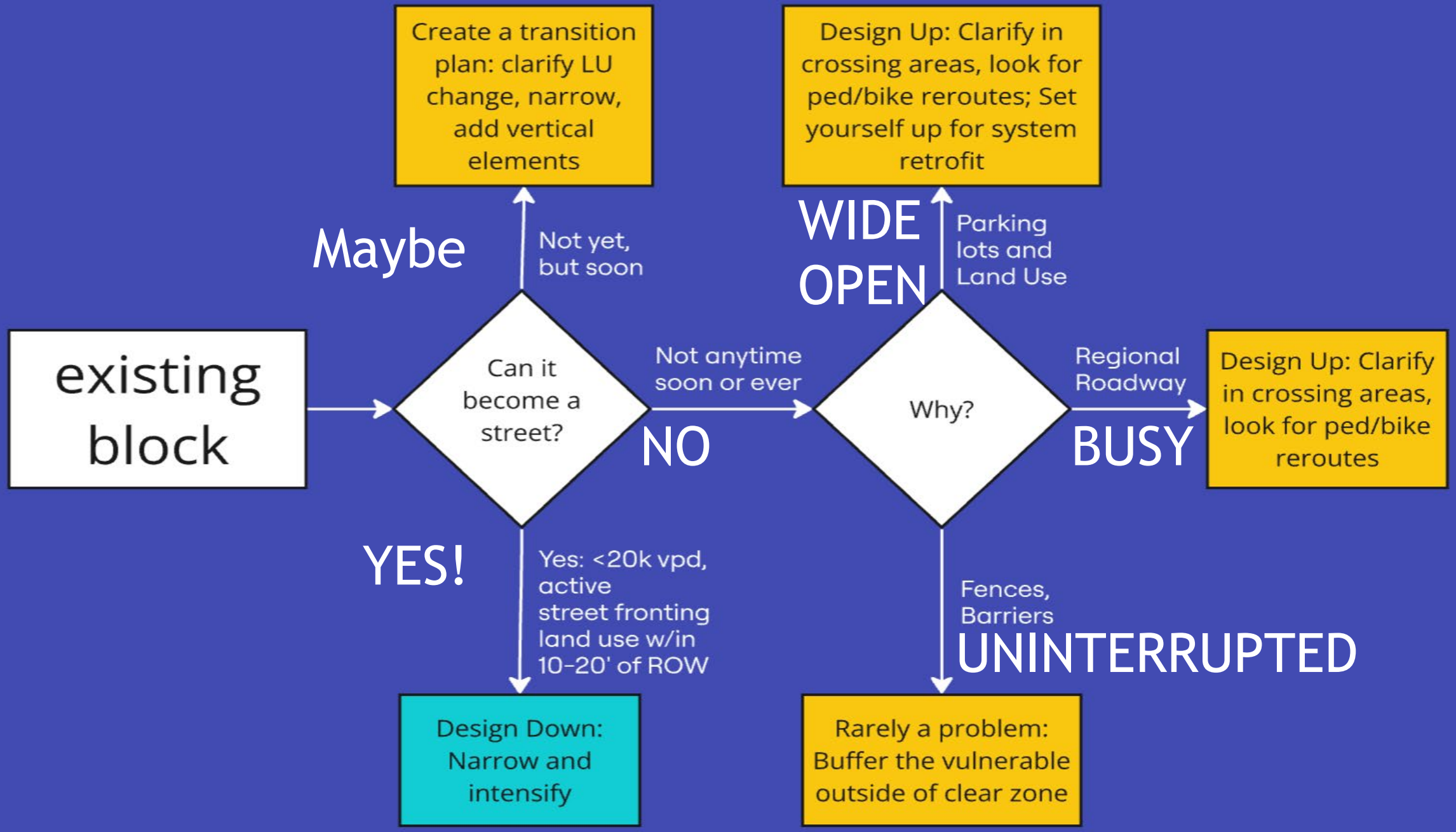
Transition Strategy

Goal: Avoid a 25-40 mph target speed

Choose whether you need a street or a road in the long term

We need both in the system, just not necessarily in the same right of way

Parallel systems are ideal


existing block
Can it become a street?
Maybe
Not yet, but soon
Create a transition plan: clarify LU change, narrow, add vertical elements
YES!
Yes: <20k vpd, active street fronting land use w/in 10-20' of ROW
Design Down: Narrow and intensify
NO
Not anytime soon or ever
Why?
WIDE OPEN
Parking lots and Land Use
Design Up: Clarify in crossing areas, look for ped/bike reroutes; Set yourself up for system retrofit
BUSY
Regional Roadway
Design Up: Clarify in crossing areas, look for ped/bike reroutes
UNINTERRUPTED
Fences, Barriers
Rarely a problem: Buffer the vulnerable outside of clear zone

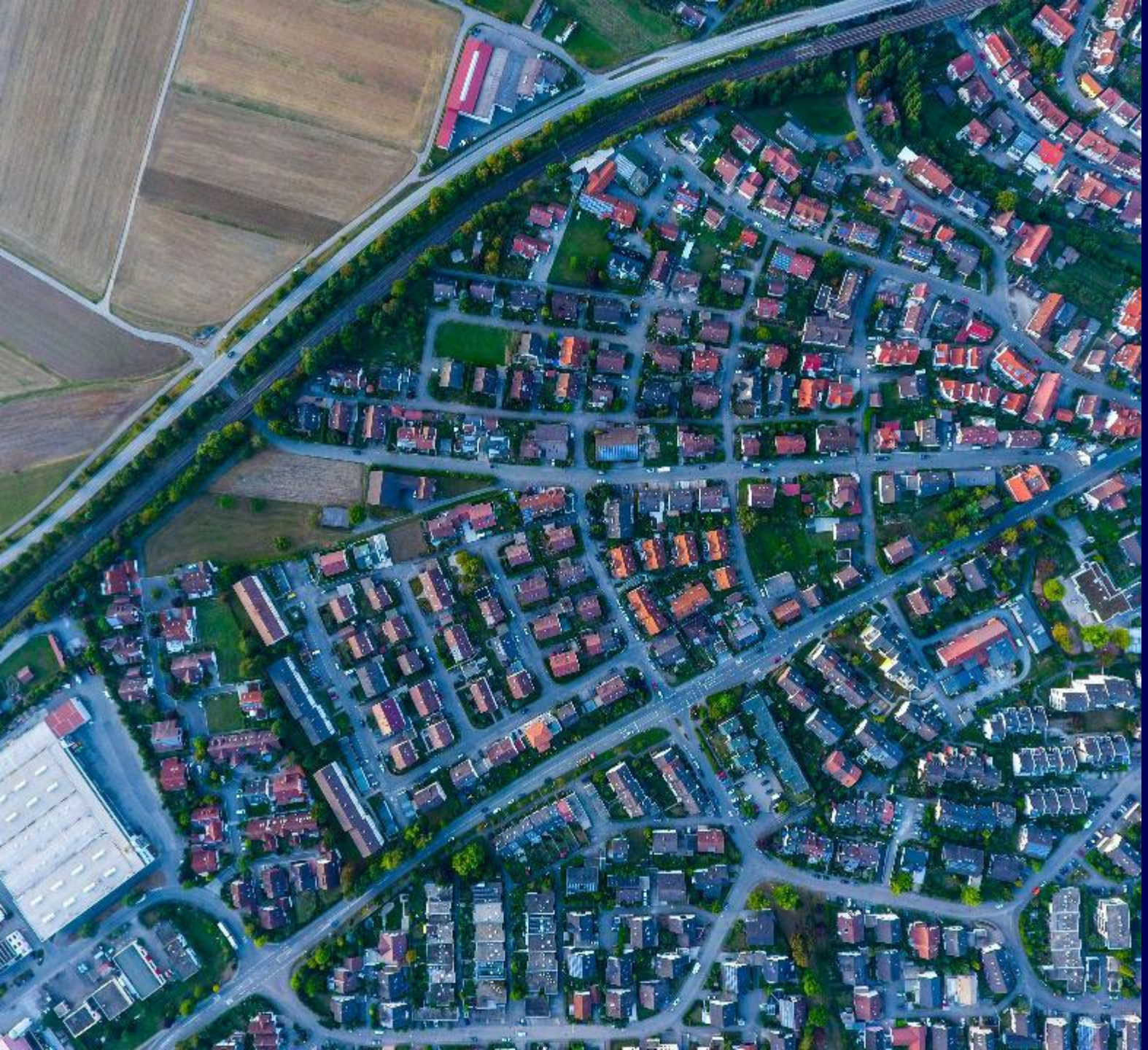
Try it out:

Jersey City's Example: Tactical Urbanism as an Infrastructure strategy

Tactical urbanism is not a silver bullet for overcoming opposition by any means. However, **it puts the debate out into the public realm,** where it's not theoretical; it's something physical everyone can see and debate, and **it's reversible** and therefore low risk politically.

--Mike Lydon

Final takeaways



Big picture:

We cannot build our way out of congestion

Widening only adds to fatalities

Time to think in systems

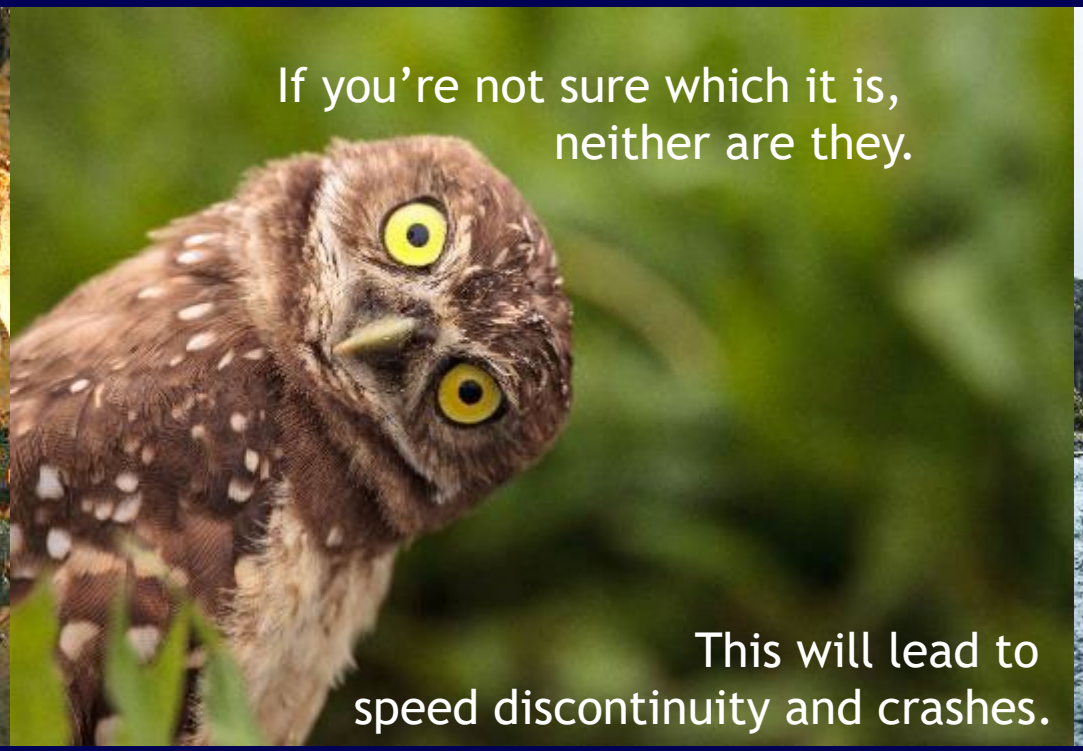
Congestion trap

- Without the supporting network, the state systems needs continual roadway widening until the road way consumes the adjacent land use
- Up to 4-lanes, historic land use can survive; not past it

Two design concepts:

STREETS: IT'S A DANCE, NOT A DRIVE

ROADS: IT'S A RIVER, NOT A ROUTE



Treat your pavement like gold and you'll get heavenly places.

Not an inch more or less than you need.

Move the curbs. Put something vertical there.

Shaping the space shapes the response

- Drivers may not be seeing individual targets at intersections—they need to get the big picture.
- Make those targets as obvious as you can.
  - Steer your drivers
  - Pull pedestrians into view

“But that’s not in my box”

Remember, the Eisenhower system shifted the development pattern for the whole country, not by fiat, but by accident

Inputs

You control the rate things come in.

Outputs

You can control direction quantity, and character of what comes out.

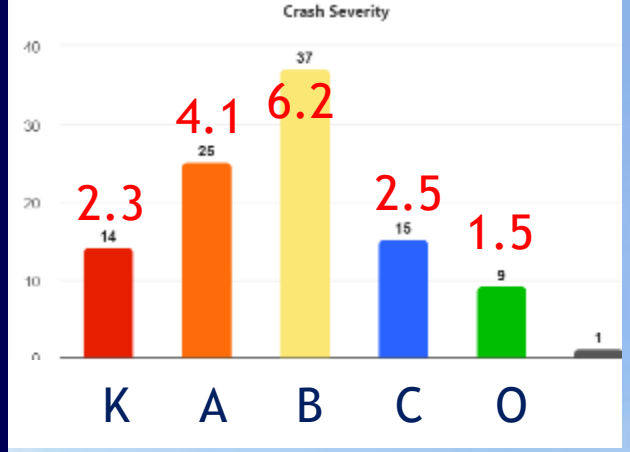
Dr. Patricia Tice
ProFound Insights, Inc.
PTice@ProFoundInsights.net

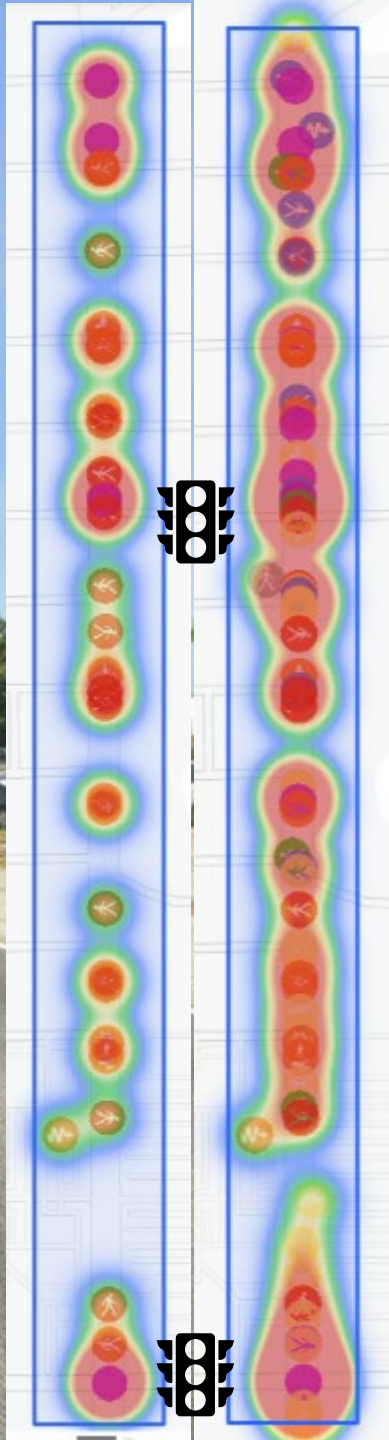
https://profoundinsights.substack.com/

Bonus Material!!!

Case Study: OBT, south of I-4

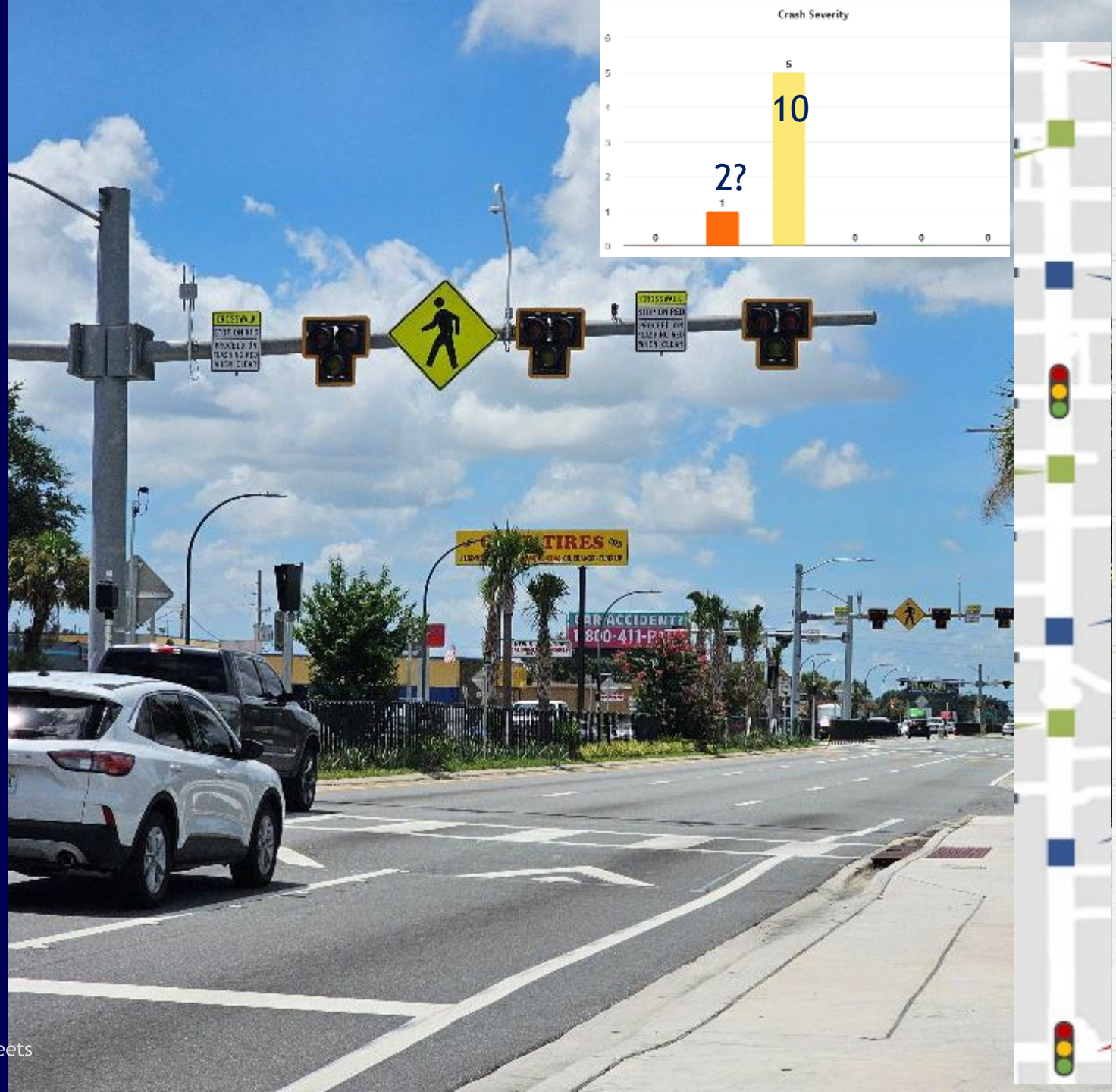
- Low income neighborhood, Transit Corridor
- Had already tried:
  - Reduced speed limit, mid-block crosswalks, raised median
  - 7 Ped/bike Serious/Fatal per year despite the changes



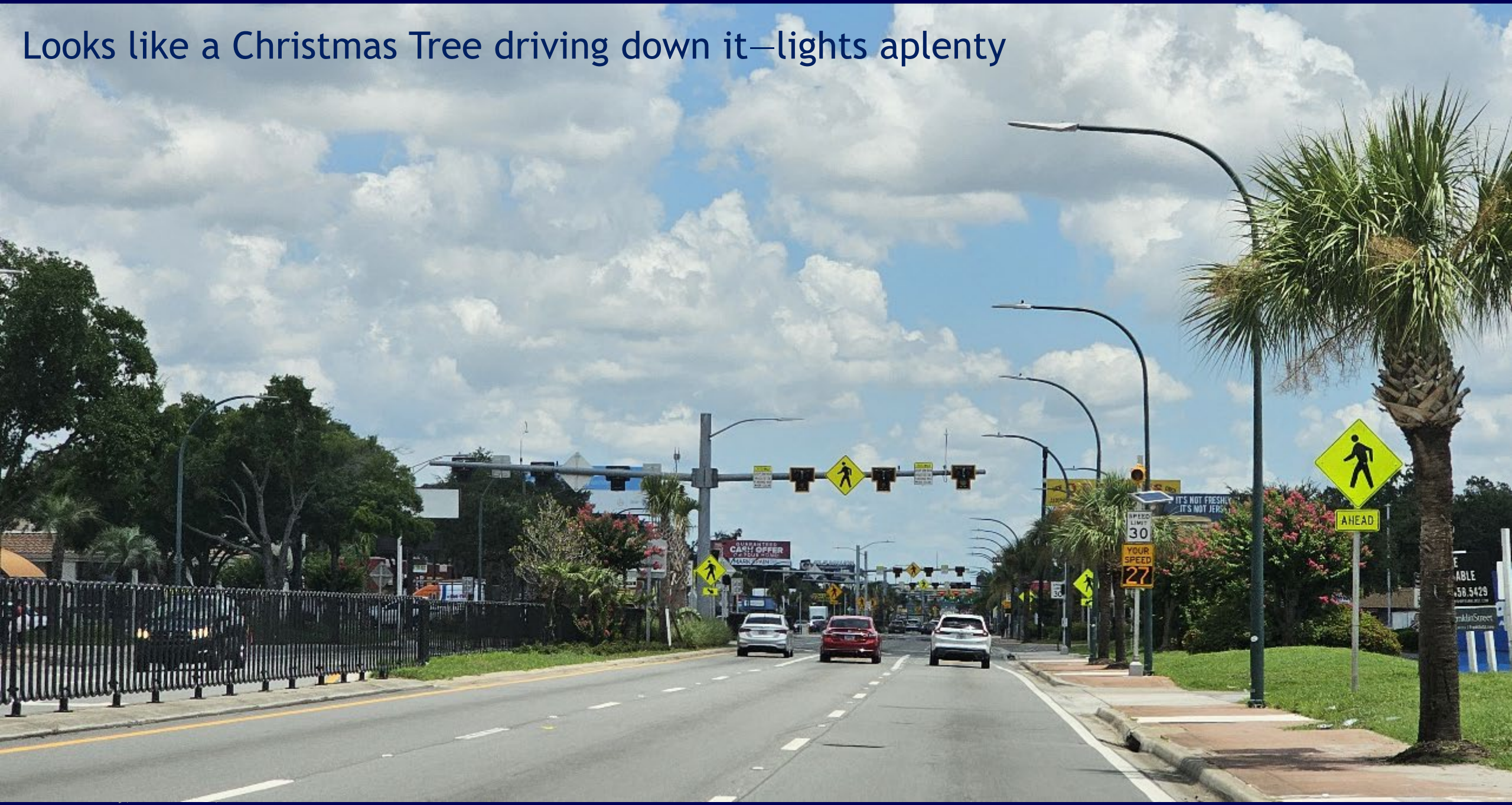


Case Study: OBT, south of I-4

- After:
  - Midblock PHB's
  - raised crosswalk,
  - narrowed lanes
- Outcomes:
  - 18 months to the first fatality

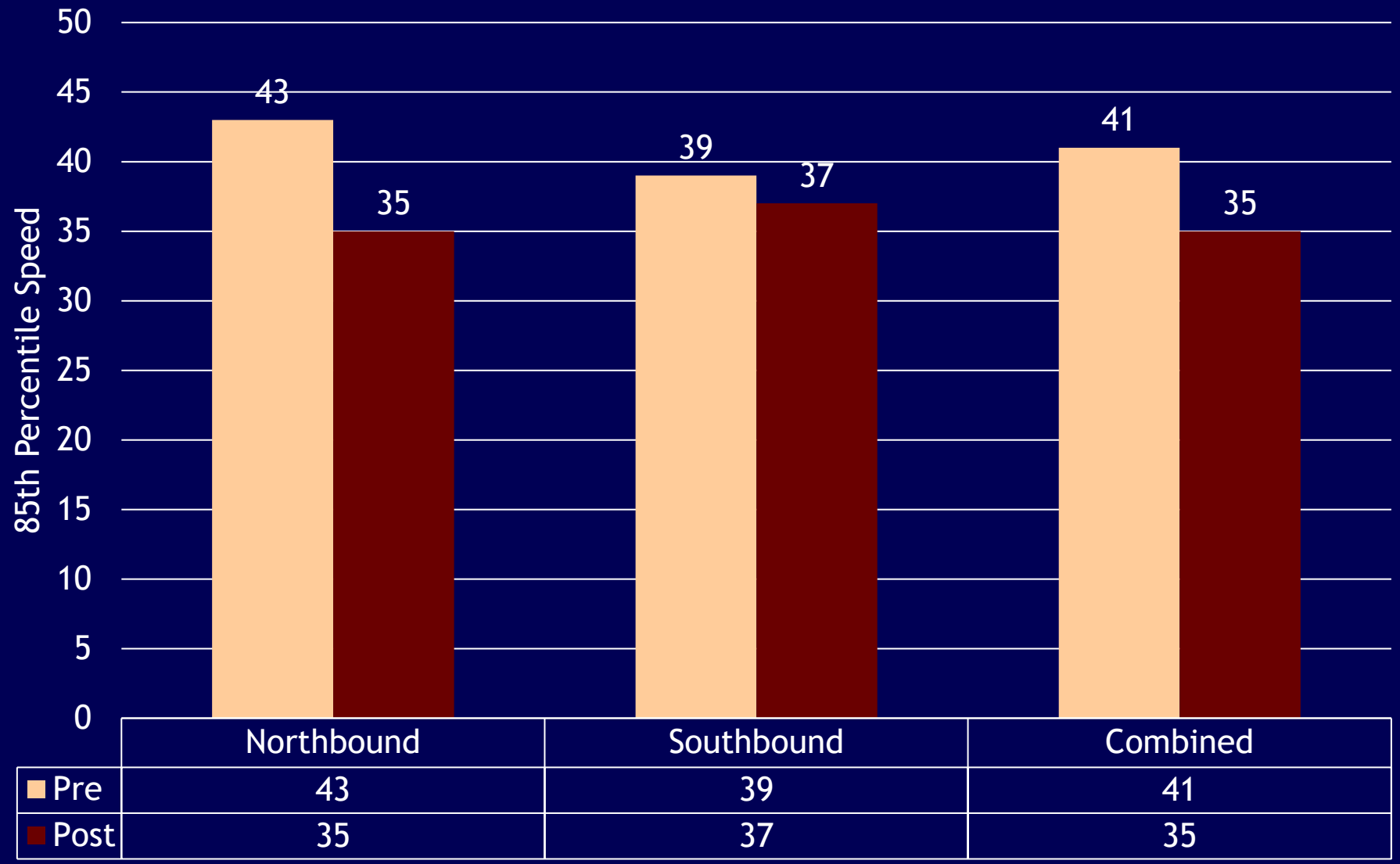


Looks like a Christmas Tree driving down it—lights aplenty



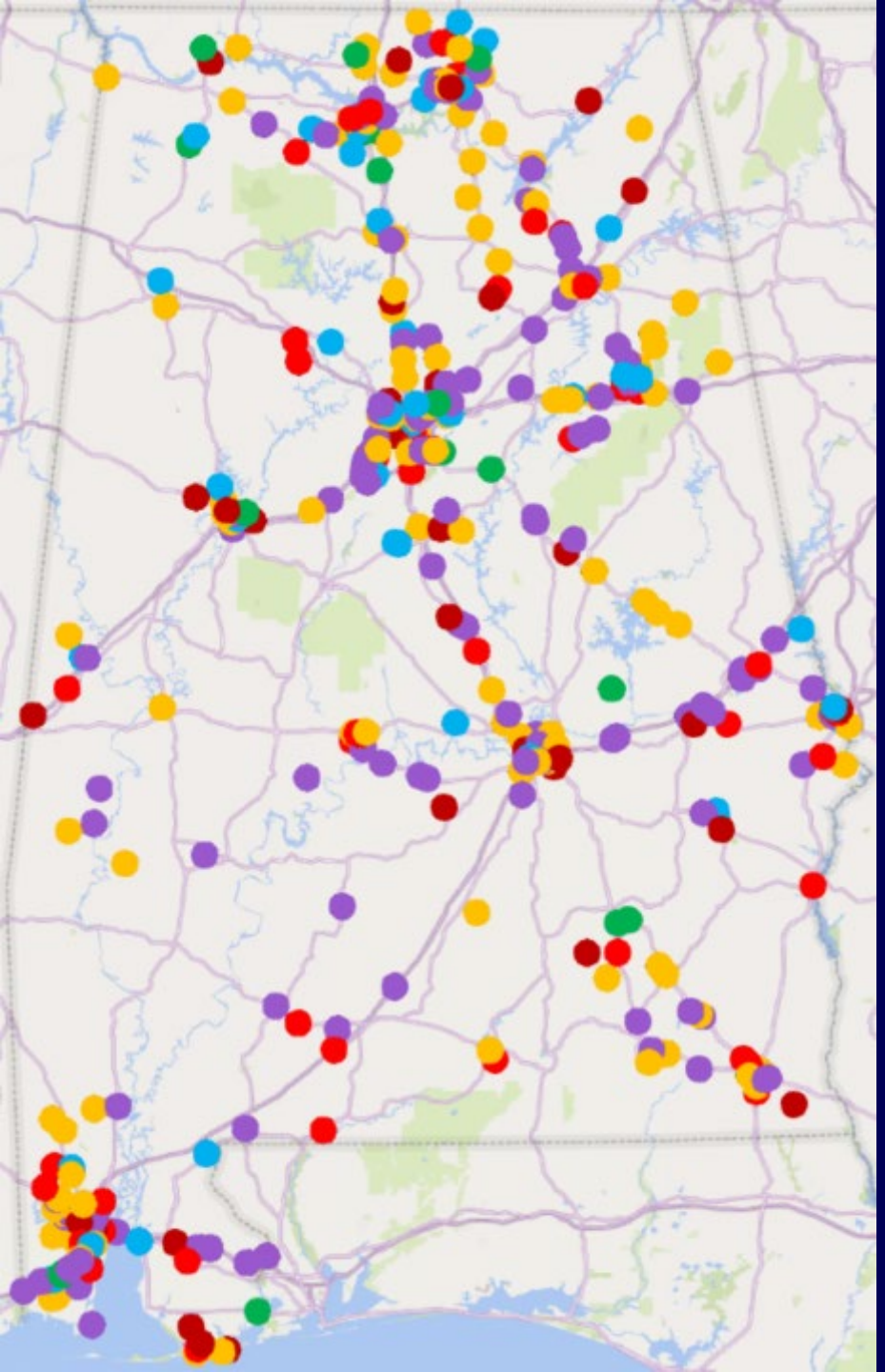
Doesn’t stop people from crossing where they want
It does slow things down so it’s not as big a deal when they do

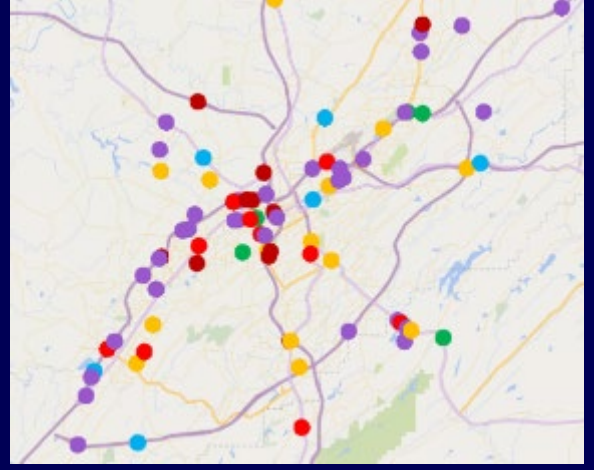
Near Orange Blossom Center
85 Percentiles Speed by Direction

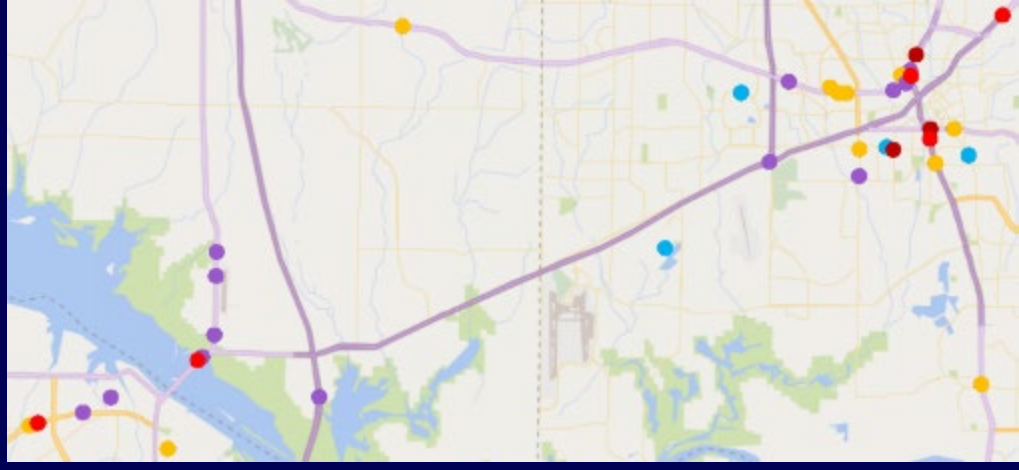


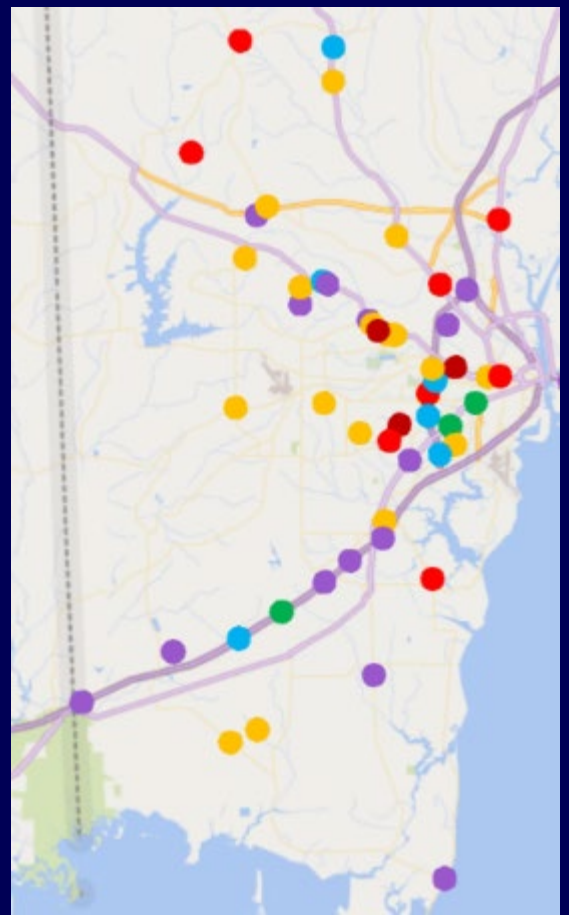
	Northbound	Southbound	Combined
Pre	43	39	41
Post	35	37	35

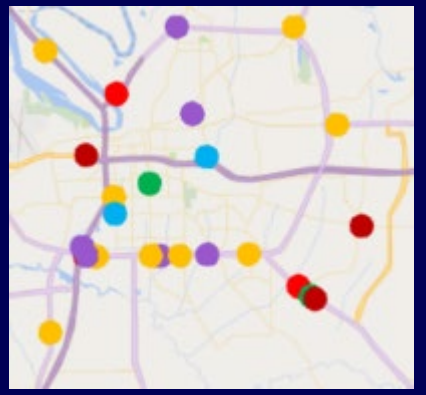
It's acting a lot slower than this…









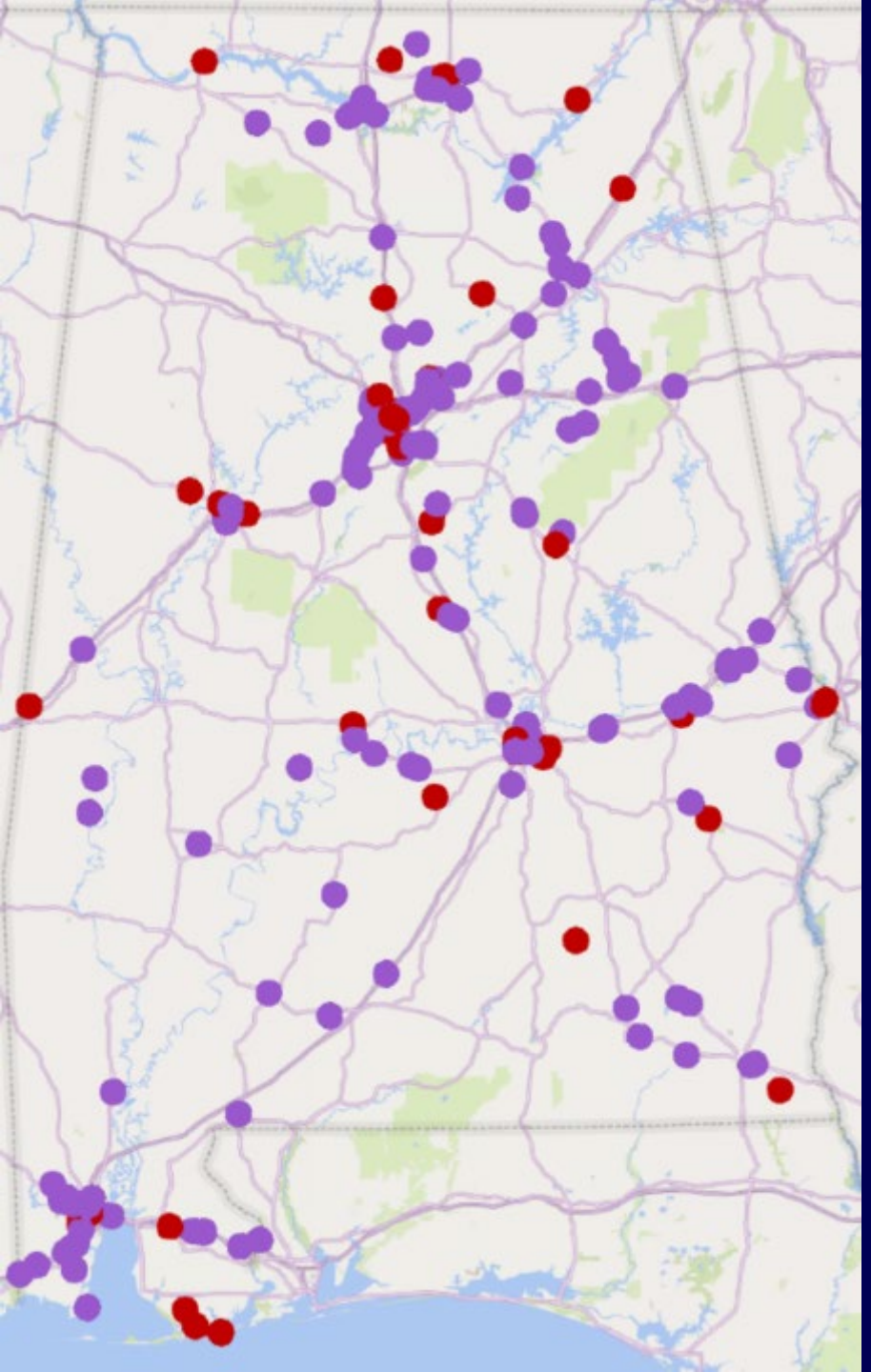


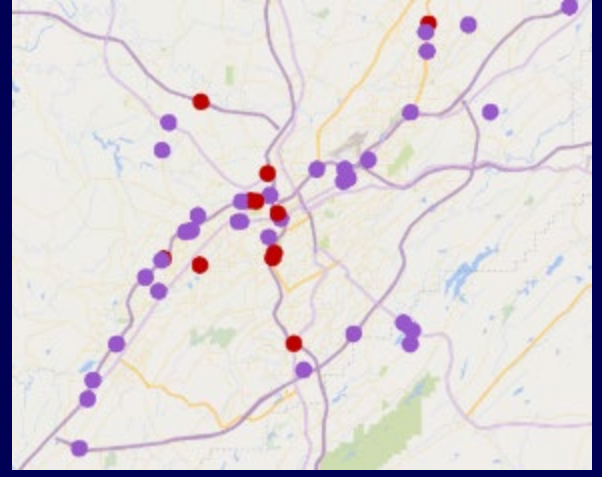
Alabama's night-time pedestrian fatalities

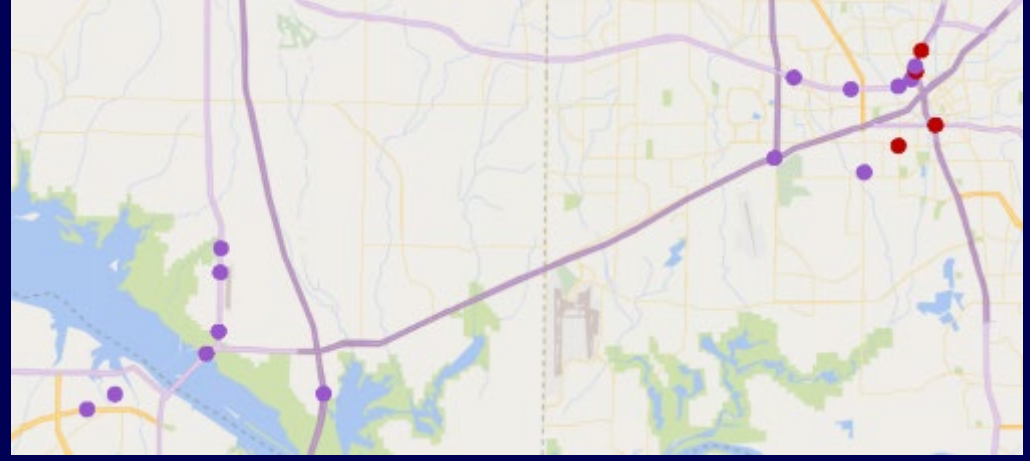
Notice Anything?

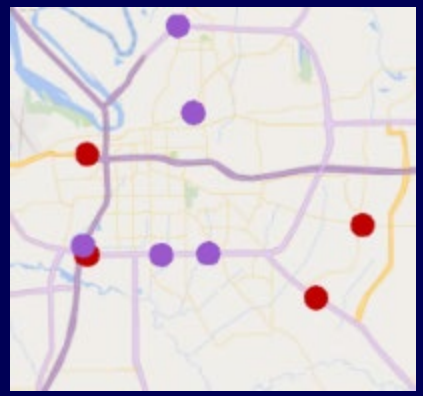
Morning
PM peak
6-9 pm
9-10 pm
10-11pm
11pm-5 am

2017-2021









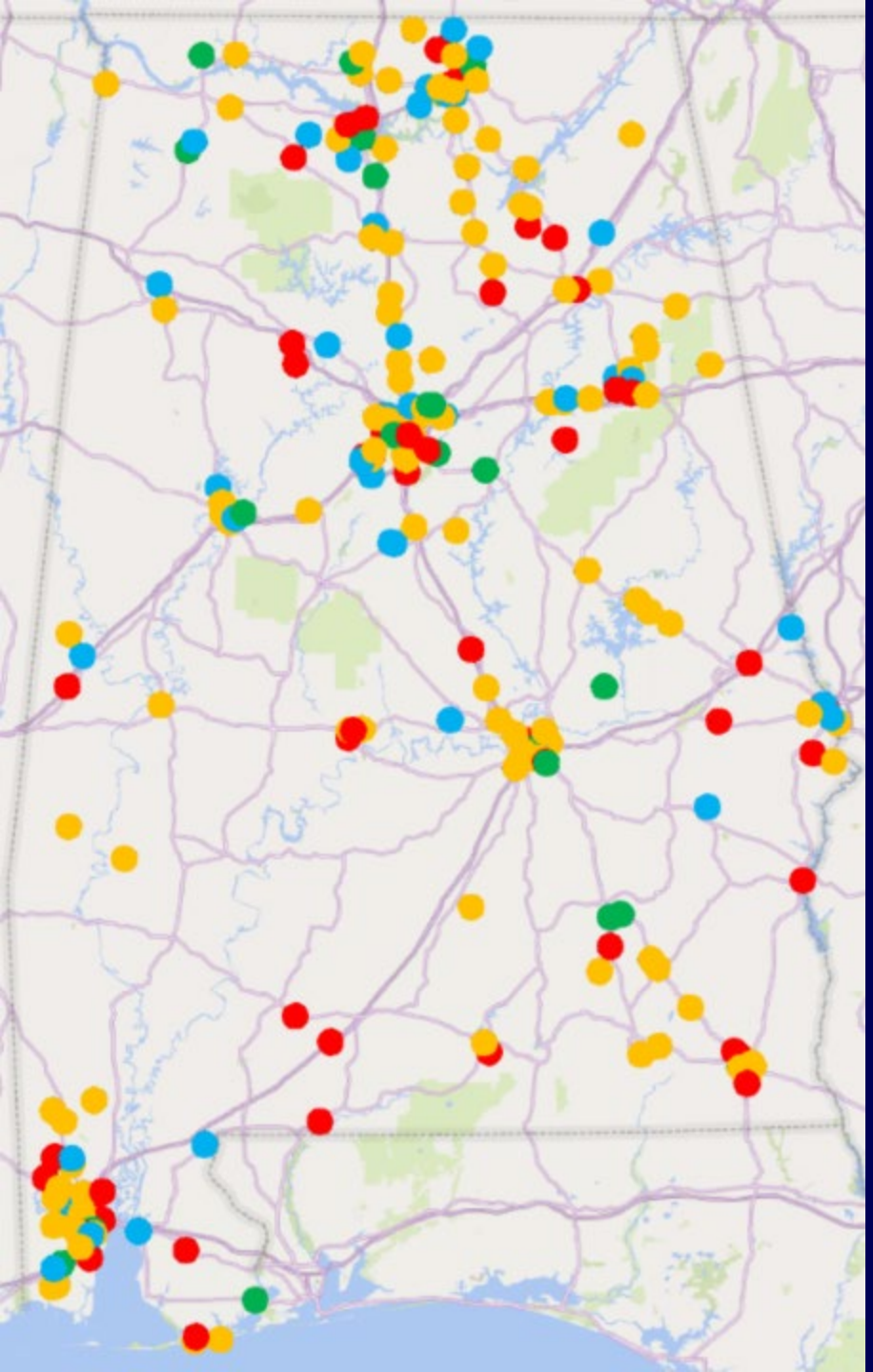
We could chalk this up to mischief

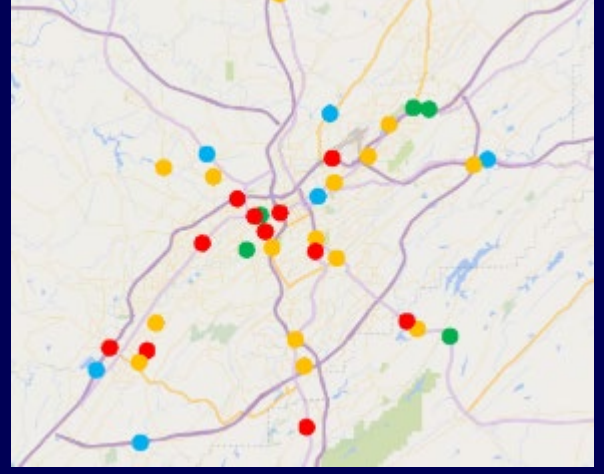
Often impaired pedestrians get hit near bars, strip clubs, liquor stores

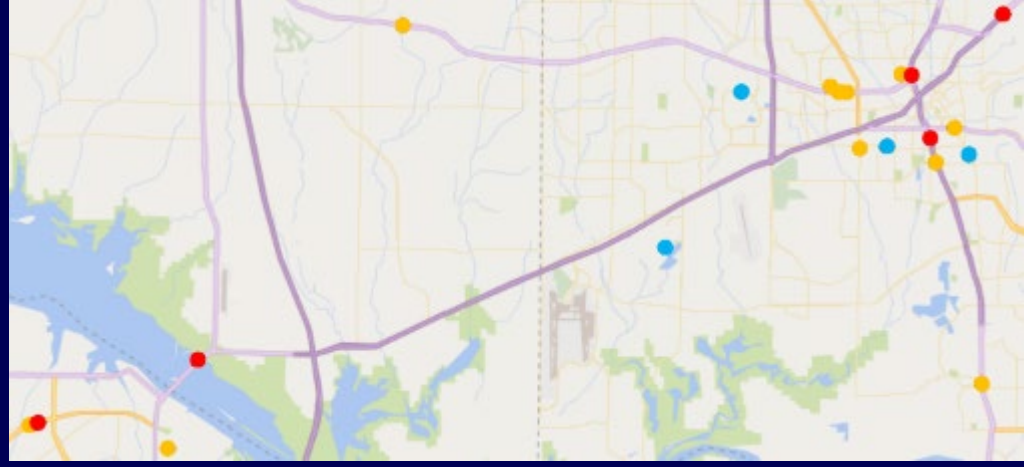
May need stronger controls there (fencing helps)

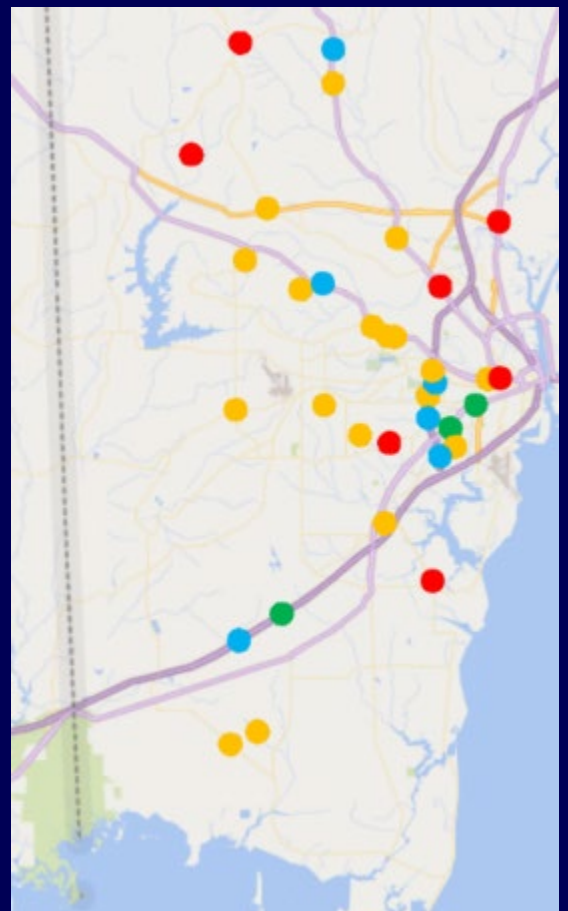
2017-2021

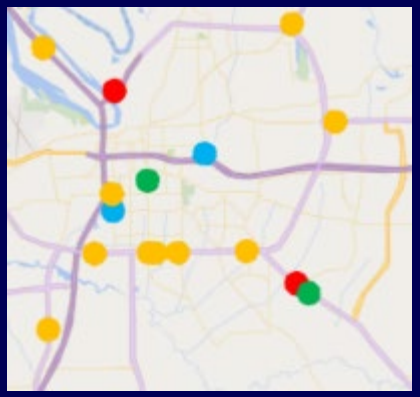
- 10-11pm
- 11pm-5 am











These are Functional mode shift trips

Lots of them on highways and surface street arterials

These are trips we want to happen but not deaths we want to have

Morning
PM peak
6-9 pm
9-10 pm