



UNIVERSITY OF LEEDS

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Perceptual Errors in Road-traffic Situations

My career

- University of Leeds (2012-Present)
 - Teaching aspects of perceptual neuroscience and research into why human make perceptual errors.
- Post-doctoral Research Fellow (2007-2012) – Royal Holloway, University of London
 - Neural underpinnings of human self-motion (“how do we drive” / “how do we manage not to fall over”)

Today, I'll talk about...

- Errors under “perfect” conditions (cognitively speaking).

“The second most common contributory factor allocated to fatalities was driver/rider failed to look properly, allocated to 26% of reported fatalities and 11% of pedestrian fatalities in 2013. Failed to look properly was most common factor for serious and slight injury casualties, 35 and 43% respectively”.

This is commonly known as the looked but failed to see in road safety literature.

Department for Transport datasheet (June, 2015)

Today, I'll talk about...

- Errors under “perfect” conditions (cognitively speaking).

In the last 10 years, between 68-74% of accidents involving a motorcycle have been at a junction (Dept for Transport, 2023).

Helman et al. (2012) outlined ‘looked but failed to see’ accidents comprised of:

- Drivers look, but not in correct place or for long enough
- Driver looks, but just fails to detect motorcycle
- Driver detects the motorcycle, but fails to make an accurate speed judgement.



“Low level” perception

- I’m interested in the limits of the human visual and attentional system.
- We have a limited neural capacity for information
 - Visual acuity
 - Limits to processing speed
 - Tendency to focus attention
 - How much we can hold “on line”
- Expert witness case examples



Awareness Test

MORE VIDEOS

Source:
MACLEOD, D. 2008. *Do The Test with Transport For London* [Online].
<http://theinspirationroom.com/daily/2008/do-the-test-with-transport-for-london/>.
[Accessed 30th April 2018].

[Click here to find on
you tube](#)

Driver looks, but just fails to detect motorcycle

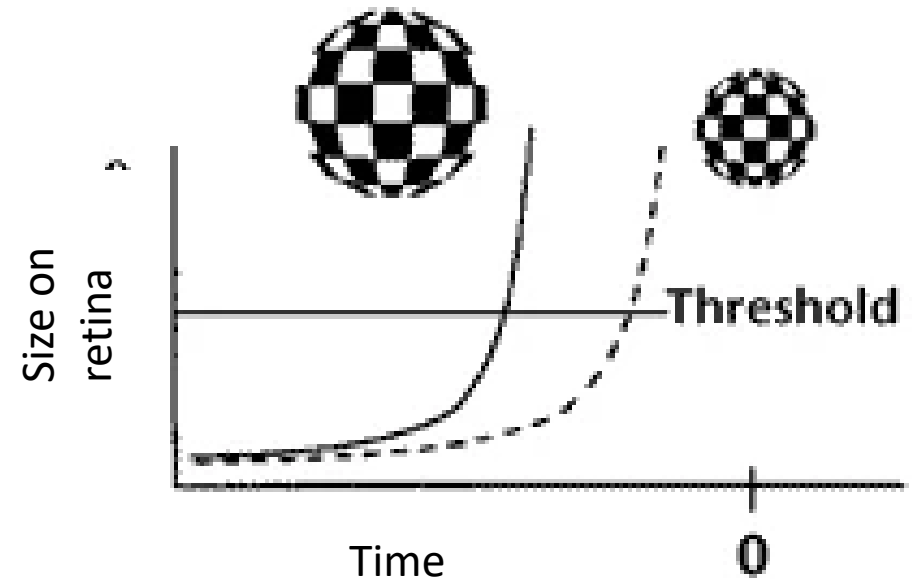
- Inattention blindness

- Mack and Rock (1998) – Driver may not “process” objects they are looking at directly
- In part because their attention is engaged in something else or on another object.
- Can occur with diligent driving, particularly if something is unexpected.
- May be more likely to occur during dual tasking (using phone, even hands free!).

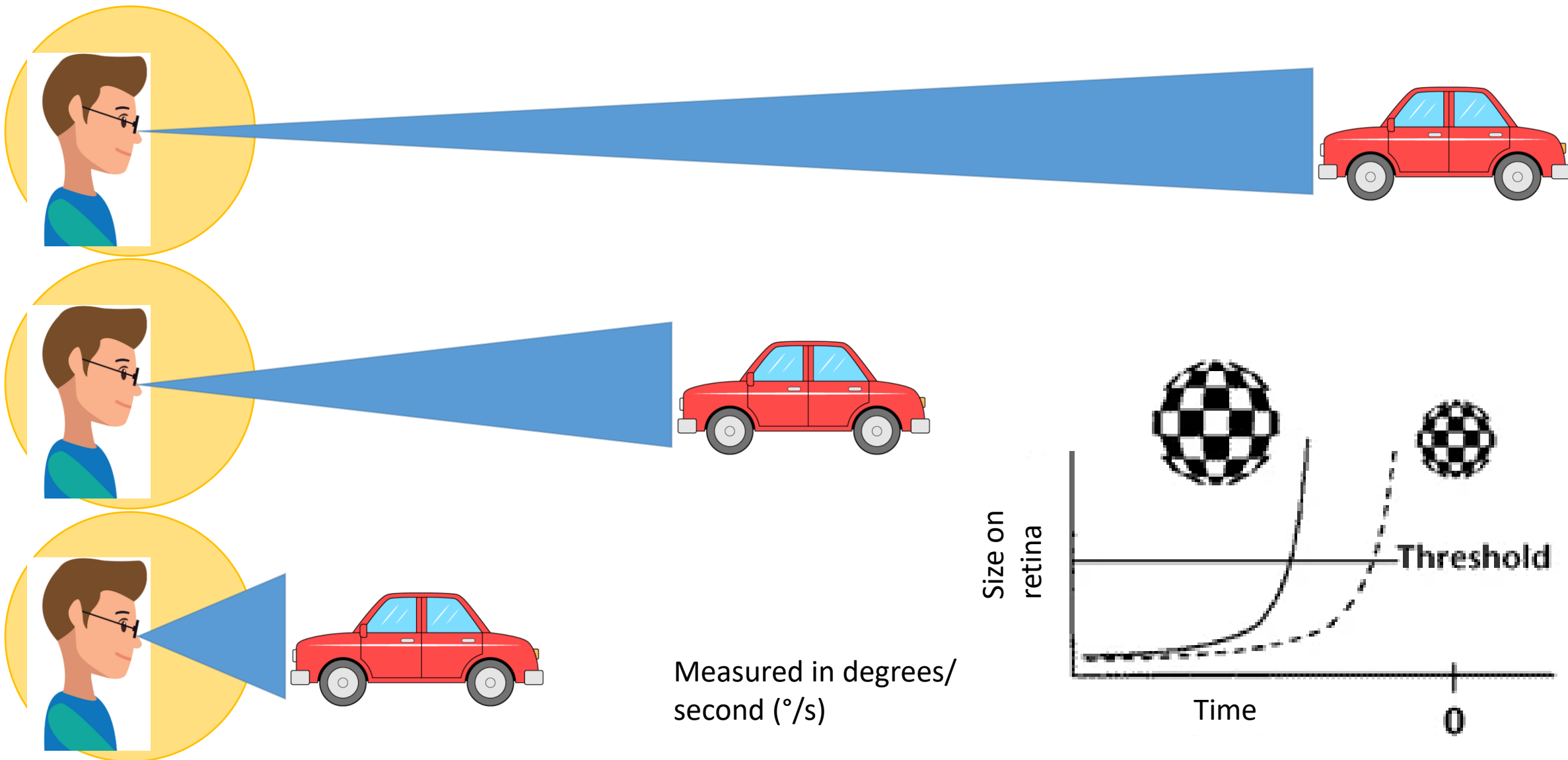


Driver detects the motorcycle, but fails to make an accurate speed judgement....

Looming



Visual looming



Why is it important?

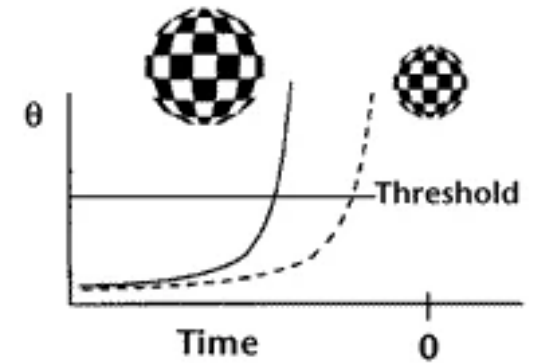
- Time for vehicle to reach you = Distance/ Speed
- Looming! – rate of expansion of the vehicle gives you a pretty good estimation of the vehicles time to arrival.
- Ancient brain area
- This rate of expansion gets larger as the vehicle gets closer.
 - You moving towards something- it moving towards you. Same thing



But....we have perceptual limits!

$$\dot{\theta}(t) = \frac{sv(t)}{D^2(t)}$$

- Looming has to reach a particular rate before you can detect it.
 - If an object is:
 - smaller
 - moving quite slowly
 - is quite far away
 - You will probably fail to be able to detect it is moving towards you (as opposed to maybe moving to the side or reversing).
 - **Looming Threshold:** $\sim 0.34^\circ/\text{s}$ are realistically required before a driver perceives an immediate hazard requiring a brake response (Lamble et al., 1999, Muttart et al., 2005).



VS



Applying this to real life

- Expert witness testimony
- Road-traffic situations where accidents could be a result of unavoidable perception error or attentional misses.
- Unintuitive!

Case 1

- Mr P was driving on the motorway when he hit a stationary vehicle in the fast lane. Civil case brought against Mr P for driving without due care.
 - Mr P claims he was not distracted, not tired, had not been driving for long period of time.
 - But, crash forensics state he was driving at around 81mph at time of collision.
- Is there cause to believe that Mr P would have been incapable of seeing the parked was looming and (crucially) this would have been the case at 70mph.

Details...

$$\dot{\theta}(t) = \frac{sv(t)}{D^2(t)}$$

- Speed of Mr P – 81mph (36.21 m/sec)
- Size (width) of parked car (VW Passat) – 1.83m
- Parked car came into view 526m prior to collision (according to crash forensics)...

Way below threshold ($\sim 0.34^\circ/\text{s}$)

Looming about
 $\sim 0.014^\circ/\text{s}$.



Mr P's car.

Perceptible if –
doing nothing else

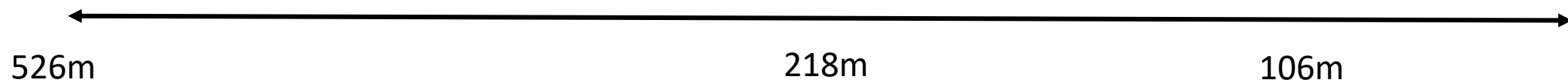
Looming about
 $\sim 0.08^\circ/\text{s}$.

Perceptible looming

Looming about
 $\sim 0.34^\circ/\text{s}$



Parked car.



Way below threshold

Looming about
 $\sim 0.014^\circ/\text{s}$.



Mr P's car.

Perceptible if –
doing nothing else

Looming about
 $\sim 0.08^\circ/\text{s}$.



Perceptible looming

Looming about
 $\sim 0.36^\circ/\text{s}$



Parked car.



526m

218m

106m



2.93 sec to collision

1 sec response time

= under 2 seconds for
vehicle to stop.



70m
Apply
brakes
(80mph)

97m braking distance

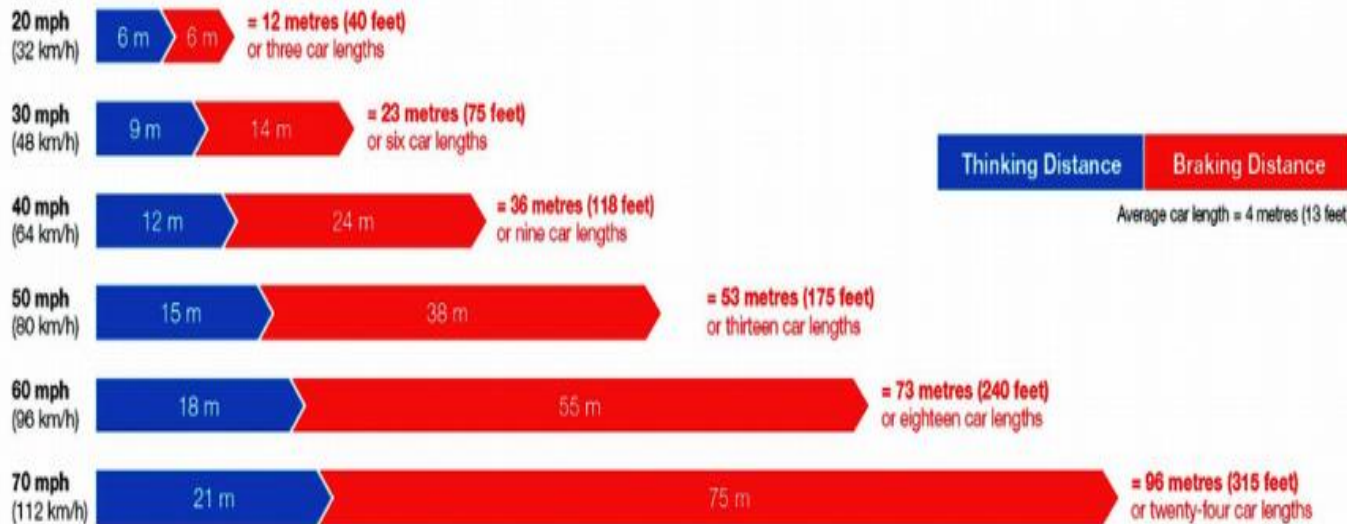
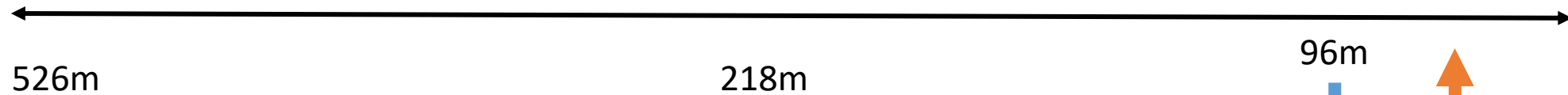
But, Mr P should have been driving at 70mph...

Perceptible looming

Looming about
 $\sim 0.34^\circ/\text{s}$



Parked car.



3.06 sec to collision

1 sec response time

= 2 seconds for
vehicle to stop.

65m
Apply
brakes
(70mph)

75m braking distance

But (again)

- Hazard lights!!

Lack of certainty at to whether these were on.

In attentional blindness:- Amongst other driving tasks....

- lane changing checks
- unexpected hazard

Outcome

- Mr P was driving with due care.
- If Mr P had been driving at 70mph, he would have been unlikely to be able to stop in time.
- Mr P would have to have been driving at 60mph or less to feasibly detect vehicle was stationary and brake on time.

Motorcycles...

- Overrepresented in accident statistics – 21% of fatalities in 2022 (DfT, 2022)
 - Motorcyclists less than 1% of road users
- Evidence to suggest that there are perceptual reasons for making errors of judgement regarding motorcycles...
 - “Size arrival illusion”

$$\dot{\theta}(t) = \frac{sv(t)}{D^2(t)}$$

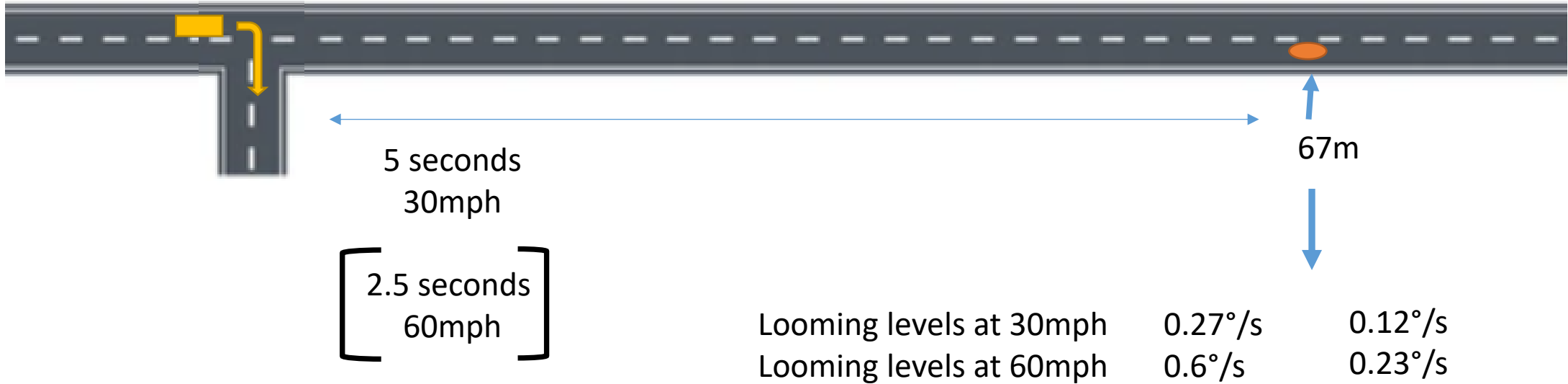

Smaller size, = lower looming levels = may seem to be moving slower or less apparent it is moving towards you

(Horswill, Helman, Ardiles, & Wann, 2005)

Case 2

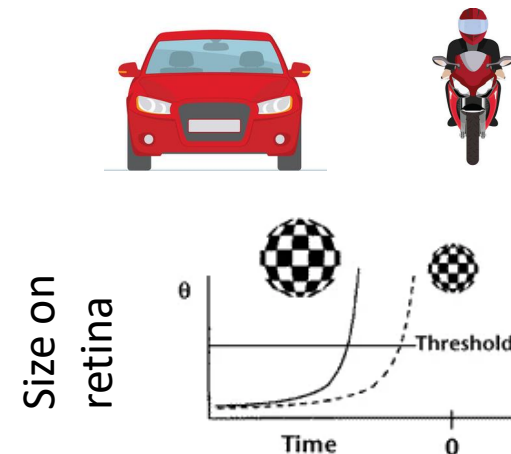
- Mr K (car driver) was on the main road making a right hand turn into a side road when he collided with Mr J (motorcycle rider) coming in the opposite direction on the main road.
- Mr K was stationary before turning
- Mr J was traveling at 50-60mph (in a 30mph zone)
- Was Mr K driving with due care?

Lower looming?



Whilst Mr K may have estimated the distance of the motorcycle- looming levels would have been less alerting of a shorter time to collision.

Other factors: Movement relative to other objects
30mph expectation



Riding at night?

- 50% of all fatal accidents occur between the hours of 6 pm and 6 am (ERSO, 2008).
- In lower light - less accurate when judging the speed of smaller vehicles, such as motorcycles, compared with larger vehicles (Pai, 2011).

Lighting levels and tri-headlight configuration



Single



Tri



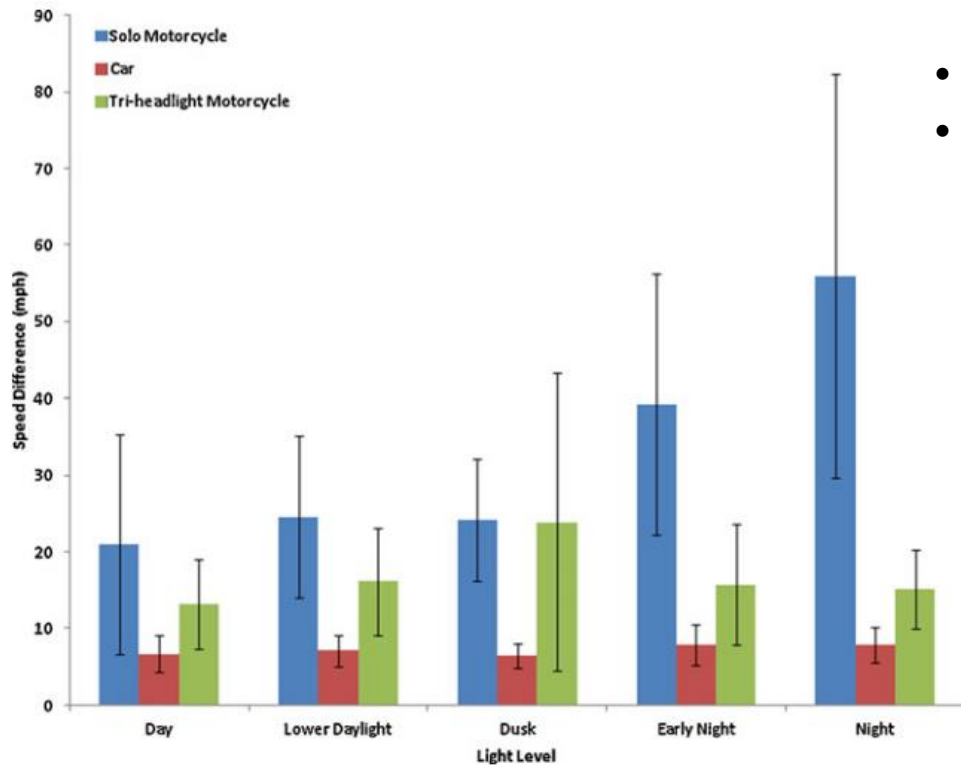
Car

Asked people to judge was fastest of two short clips played in sequence (0.5s each)

The experimental difference in speed of the two vehicles could be up to 180mph

Lighting levels and tri-headlight configuration

- Cars – best speed judgments
- Cars – judgements not affected by light levels.
- Motorcycles – Judgements worse than for cars
- Motorcycles – Judgements worse as light levels get lower.



“observers’ judgments for the solo headlight motorcycle declined from a 21 mph speed difference in the daylight condition, to a 39 mph and 56 mph speed difference in the early night and night-time conditions respectively. This means that a motorcycle travelling at over 70 mph at night-time would be perceived as travelling at the same speed as a car travelling at 30 mph”



Single

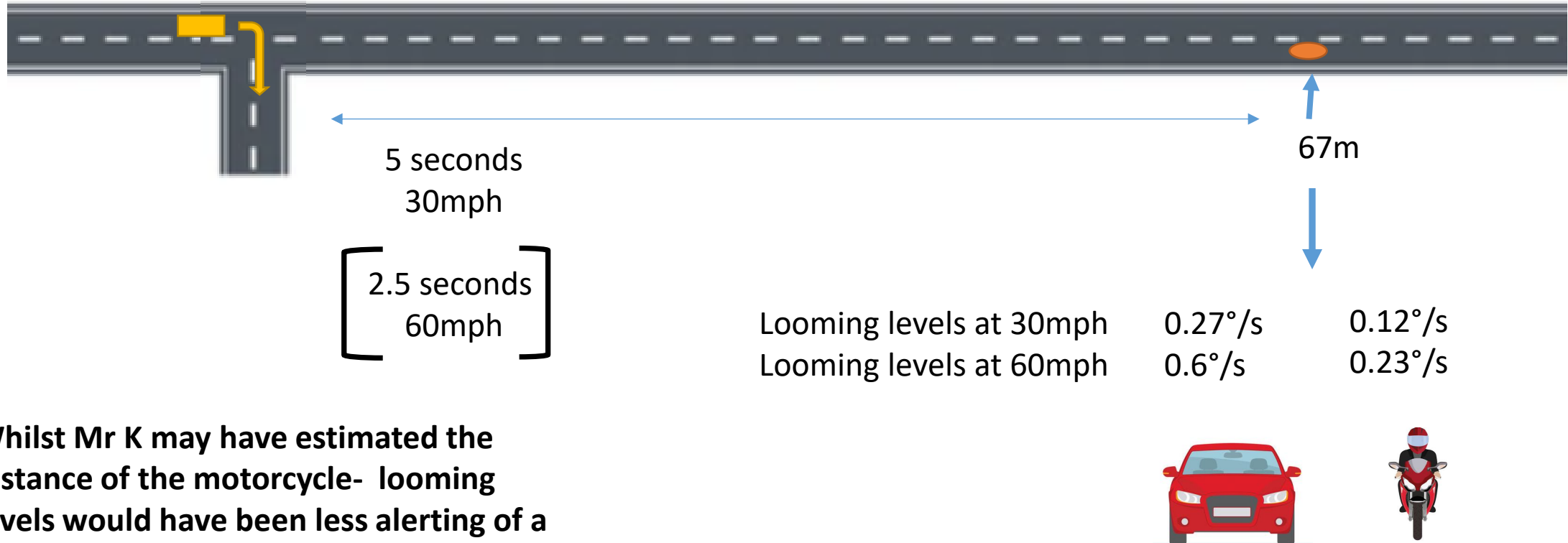


Tri



Car

Lower looming?



Whilst Mr K may have estimated the distance of the motorcycle- looming levels would have been less alerting of a shorter time to collision.

Other factors: Movement relative to other objects
30mph expectation

Safety implications

- Improve your visibility at night!
- Make yourself bigger – especially in darker conditions.
 - Tri-headlights provide more surface area to judge
 - Clothing – think about your whole outline, not just smaller stripes and points of fluorescents.

Thank you

Questions?

