Visual information sampling at the zebra crossing: Gaze behaviour in speed and time-to-arrival judgements

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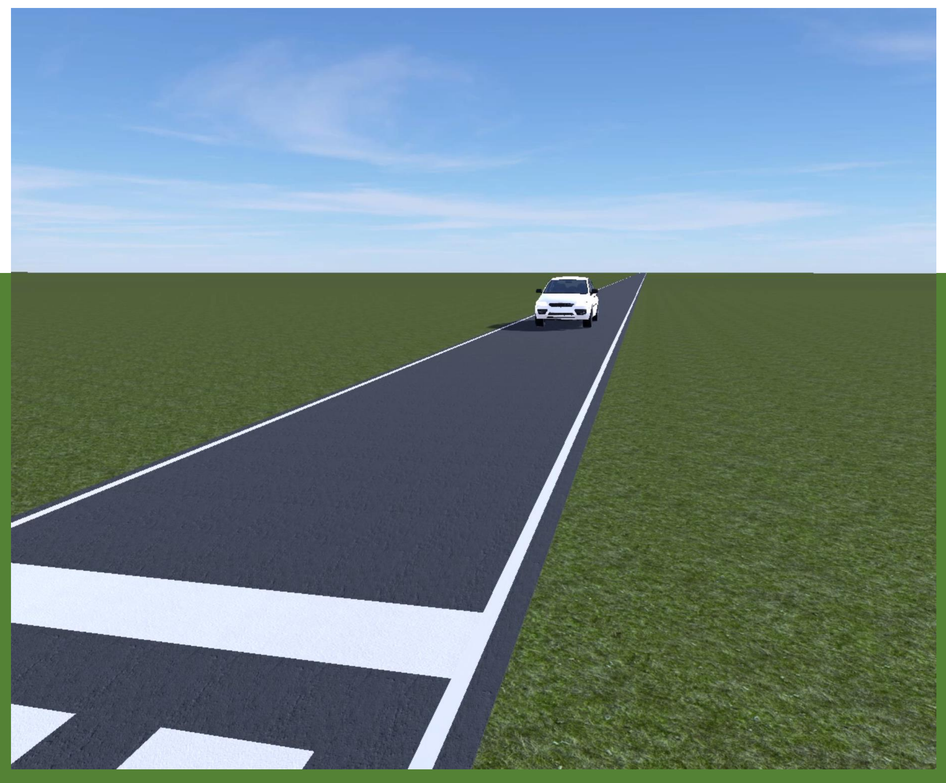


METHODS. In two separately performed 2IFC tasks, participants (N = 15) judged the speed ("Which vehicle is faster?") and time-to-arrival ("Which vehicle will arrive first?") of a simulated vehicle. Vehicle speed ranged from 10 to 90 km/h, time-to-arrival after vehicle disappearance (3 s after onset) ranged from 1.44 to 4.64 s. Eye movements were recorded while participants performed the tasks.

CONCLUSIONS

Sensitivity is higher towards time-to-arrival differences compared to speed differences.

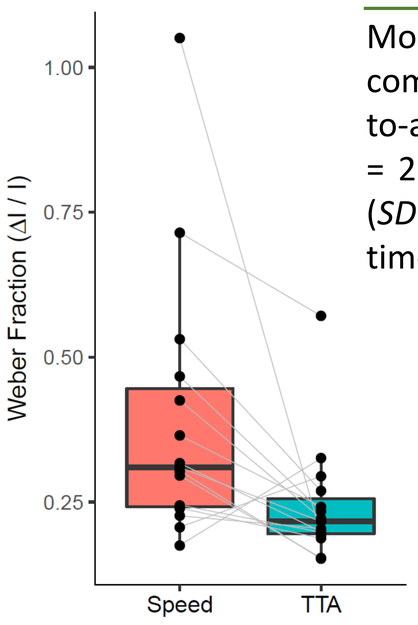
Eye movements are idiosyncratic rather than task dependent.

The influence of gaze on discrimination performance depends on the task.

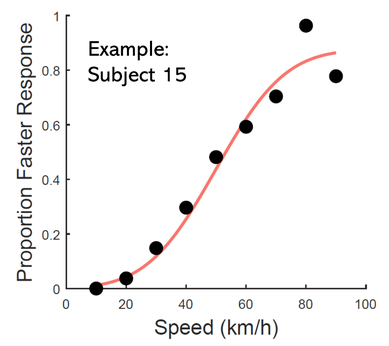
BACKGROUND. Gaze location within a vehicle has been shown to influence its perceived speed[1]. Little is known how observers spontaneously sample visual information when evaluating the time-to-arrival of approaching vehicles. This study investigates whether gaze behaviour differs between speed and time-to-arrival judgements. It constitutes the first step in the investigation of pedestrians' perception and should help gaining an understanding of the perceptual processes preceding road crossing decisions.

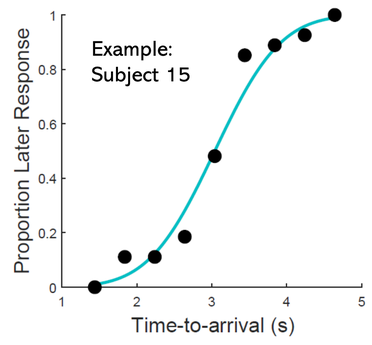
RESULTS

DISCRIMINATION PERFORMANCE



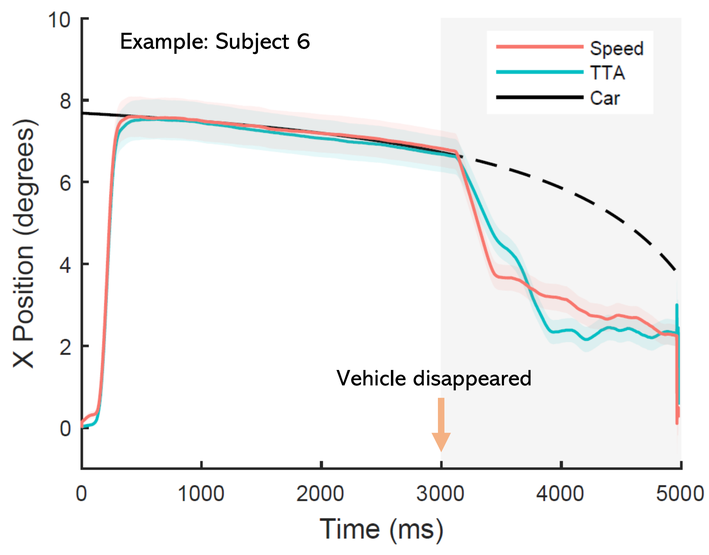
Most participants performed better at discriminating time-to-arrival compared to speed differences. Lower Weber Fractions in the time-to-arrival task were observed in 12 out of 15 participants (Sign test, $z = 2.58$, $p < .01$). The mean Just Noticeable Differences were 19.57 ($SD = 11.57$) km/h in the speed task and 0.74 ($SD = 0.31$) s in the time-to-arrival task.

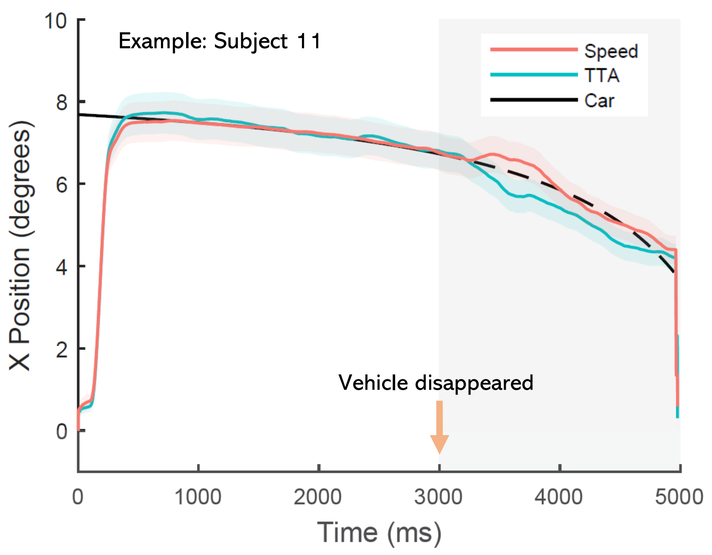




EYE MOVEMENTS

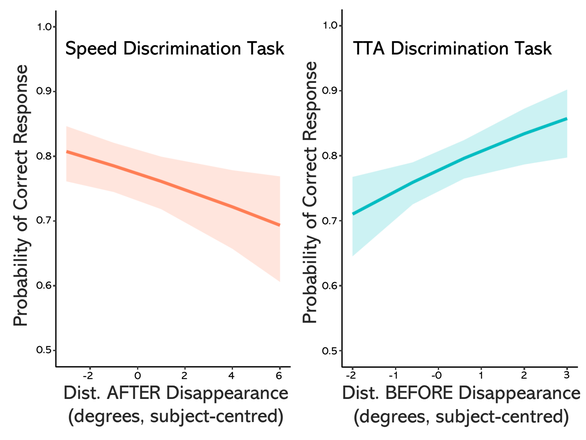
Participants employed different gaze strategies. After the vehicle disappeared half of the participants performed an increased number of saccades and visually explored the remaining road scene. The other participants continued pursuing the extrapolated trajectory of the vehicle. Most participants did not adapt their gaze strategy. Participants who continued or not continued pursuing the trajectory of the vehicle did so in both tasks. Only one participant alternated between the two gaze strategies.





INFLUENCE OF GAZE BEHAVIOUR ON DISCRIMINATION PERFORMANCE

Two binomial regression models (estimates shown in table) indicated that participants were more likely to successfully discriminate speed when gaze remained close to the extrapolated trajectory. In the time-to-arrival task, participants' probability of responding correctly decreased with decreasing gaze – vehicle distance before vehicle disappearance suggesting that pursuing the vehicle centre did not constitute an optimal gaze strategy. In both cases BIC-derived Bayes Factor indicated >100 more evidence in favour of the alternative hypothesis (full vs reduced model).



	Speed		TTA	
(Intercept)	1.23	(0.11) ***	1.26	(0.08) ***
Distance BEFORE disappearance	0.01	(0.08)	0.18	(0.07) **
Distance AFTER disappearance	- 0.07	(0.03) *	- 0.01	(0.03)

Fixed Covariates: RMS distance between gaze position and vehicle centre (before & after vehicle disappearance); **Random Factor**: Subject ID.
Standard errors in parantheses. * $p < .05$; ** $p < .01$ *** $p < .001$.

REFERENCE

[1] Clark, H. E., Perrone, J. A., Isler, R. B., & Charlton, S. G. (2016). The role of eye movements in the size-speed illusion of approaching trains. *Accident Analysis & Prevention*, *86*, 146-154.

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