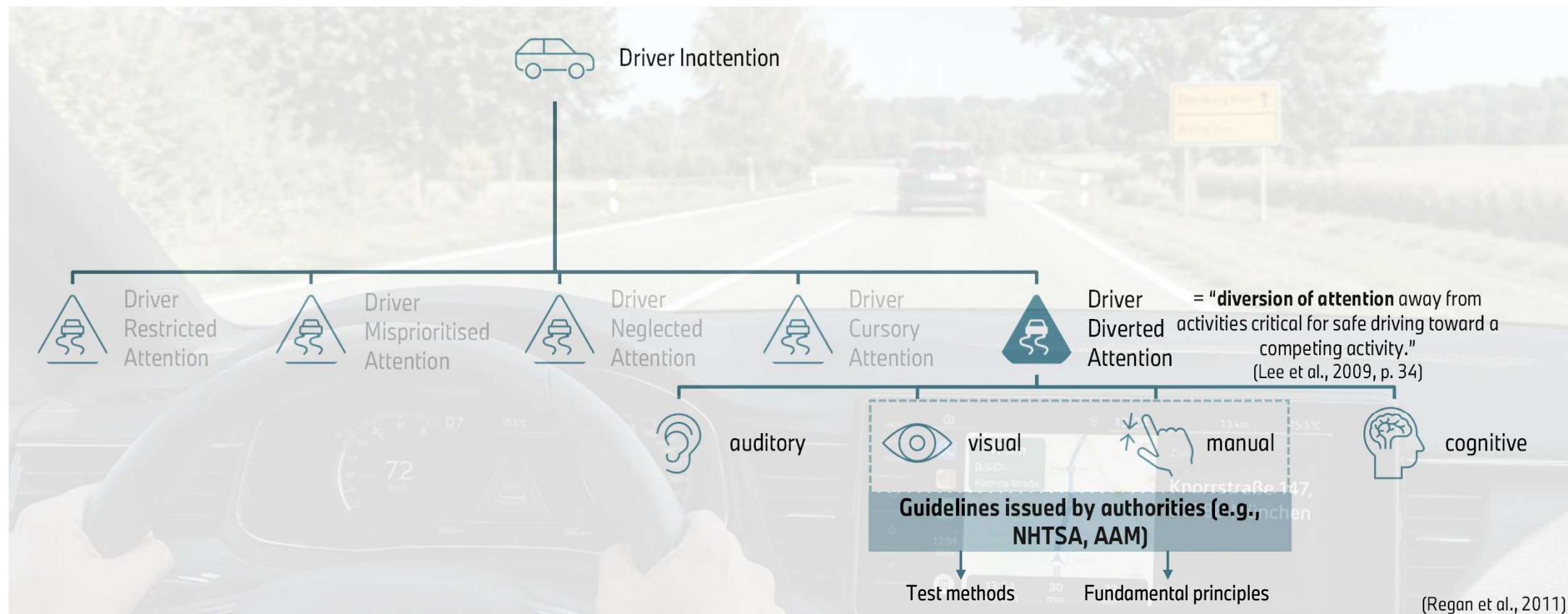


PARTIAL DRIVING AUTOMATION CAN IMPOSE ADDITIONAL DEMAND ON THE DRIVER WITHOUT IMPAIRING DRIVING PERFORMANCE IN A CAR-FOLLOWING SCENARIO.

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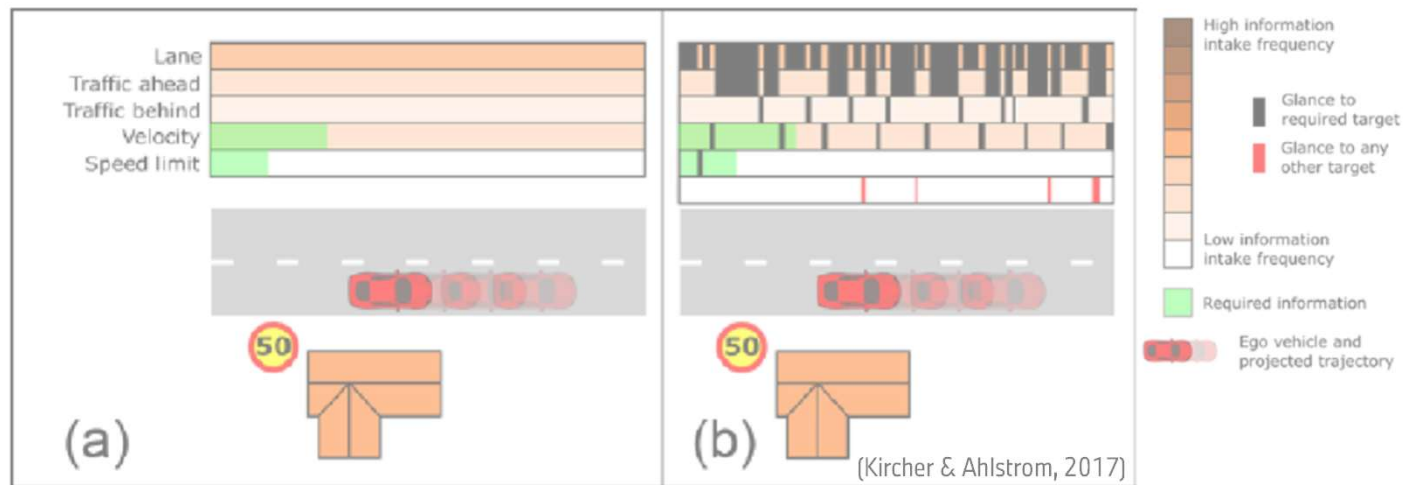
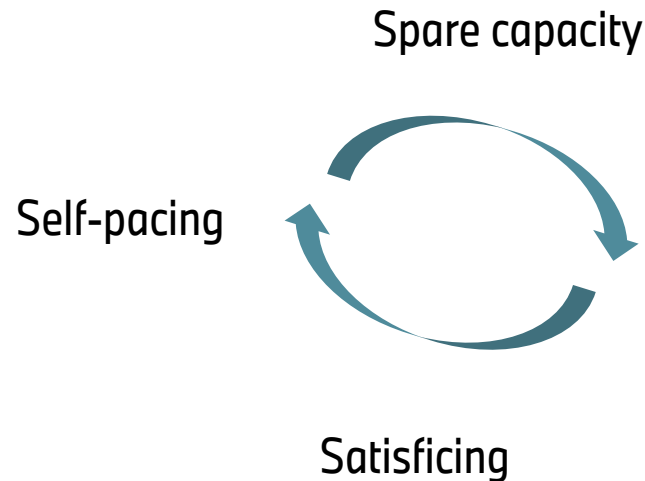
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DISTRACTION IS A MAJOR CAUSE OF CRASHES.



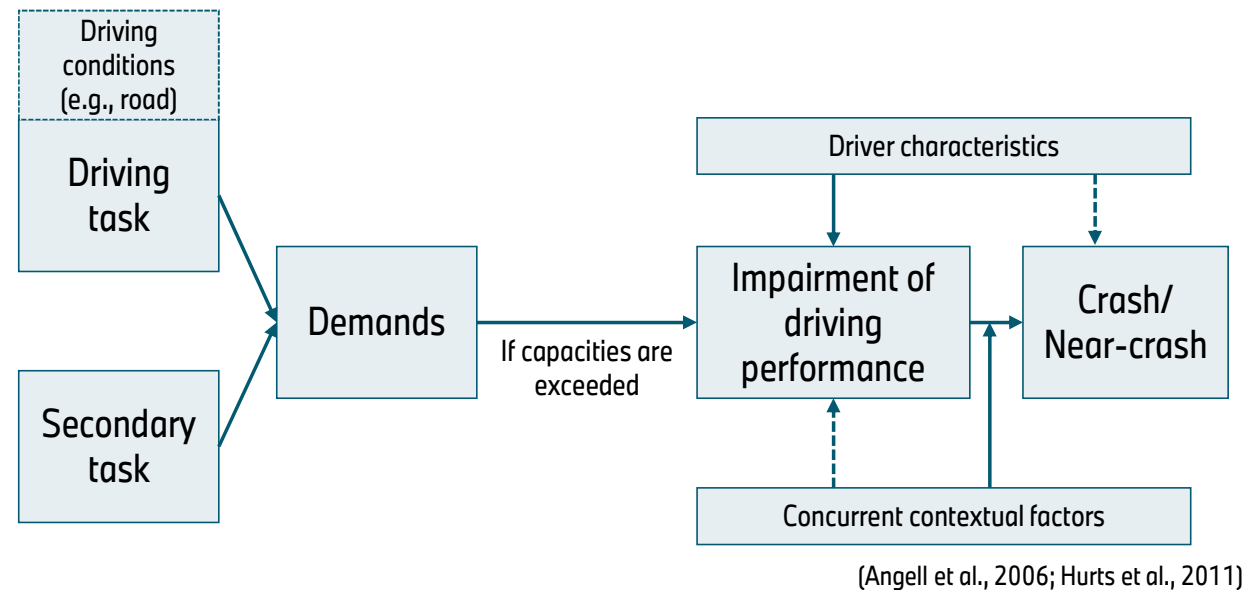
We need not only to prevent driver distraction but also to understand how drivers successfully avoid crashes when distracted.

SELF-PACING AND SATISFICING ENABLE DRIVERS TO ADJUST TASK DEMANDS AND PRESERVE SPARE CAPACITY.



Task-acceptance testing typically evaluates off-road glances during a car-following task in a driving simulator. Compensation strategies or changing driving conditions are not considered. The MiRA theory (Kircher & Ahlstrom, 2017) could provide a basis for improving methods used to assess driver distraction.

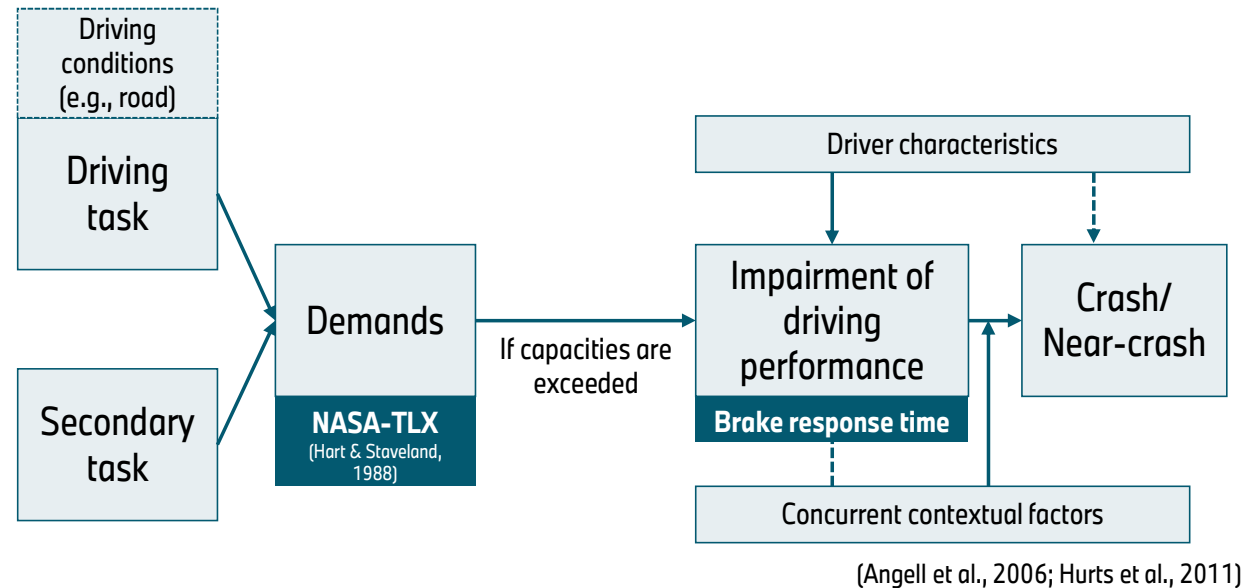
WHEN DO TASK DEMANDS EXCEED DRIVERS' AVAILABLE CAPACITIES AND THEREBY IMPAIR DRIVING PERFORMANCE?



The Driver Workload Metrics model links demand to interference with driving performance, whereas the MiRA theory proposes that drivers adapt to higher demand through self-pacing and satisficing.

WHEN DO TASK DEMANDS EXCEED DRIVERS' AVAILABLE CAPACITIES AND THEREBY IMPAIR DRIVING PERFORMANCE?

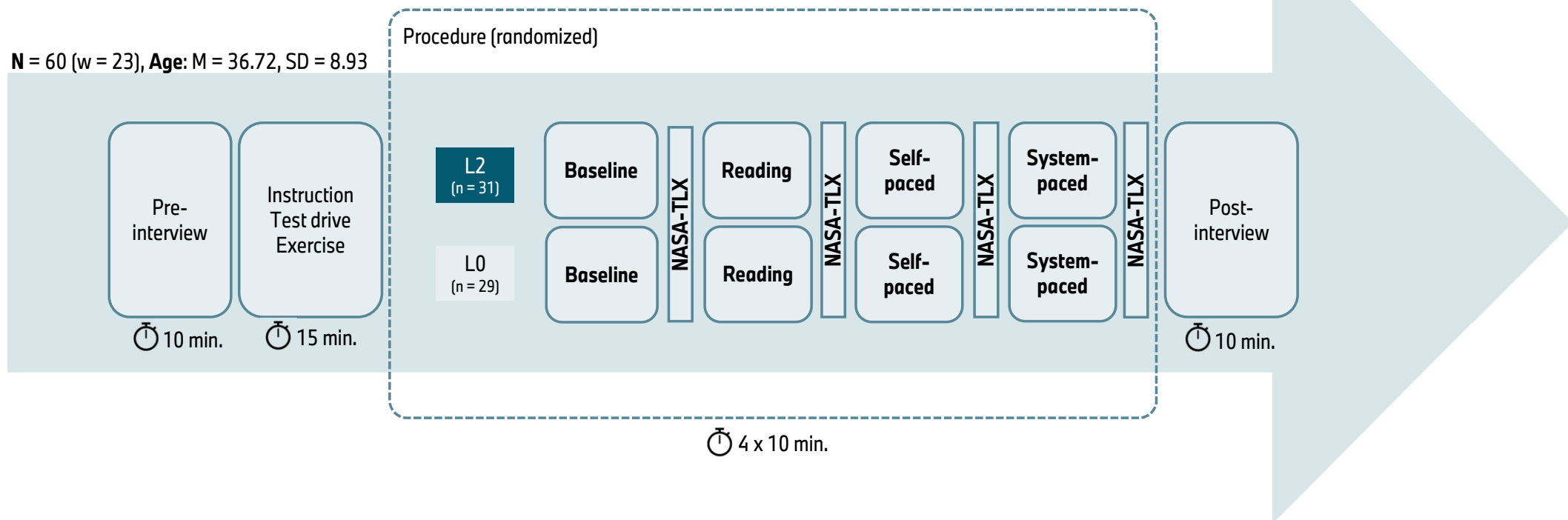
- H1:** The use of an L2 system reduces self-reported demand on the driver.
- H2:** Secondary tasks increase demand, especially when they are not self-paced.
- H3:** Increased demand leads to impairments in driving performance.



We examined the theoretical causal chain linking factors that increase demand to the effects of demand exceeding available capacity.

WE CONDUCTED A DRIVING SIMULATOR STUDY.

N = 60 (**w** = 23), **Age**: **M** = 36.72, **SD** = 8.93



Sixty participants completed a car-following scenario. The lead vehicle braked unexpectedly at randomized time points, shortly after a secondary-task prompt. In the L2 group, a simultaneous longitudinal system failure created a crash risk with the lead vehicle.

PARTICIPANTS COMPLETED SELF-PACED AND SYSTEM-PACED SECONDARY TASKS, AS WELL AS A REFERENCE READING TASK.

Self-paced



4-s prompt

System-paced



4-s timer + time limit

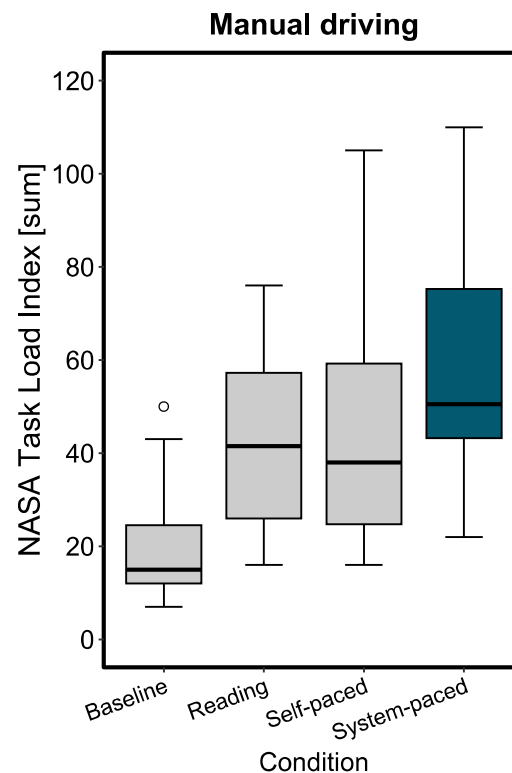
Reference reading task



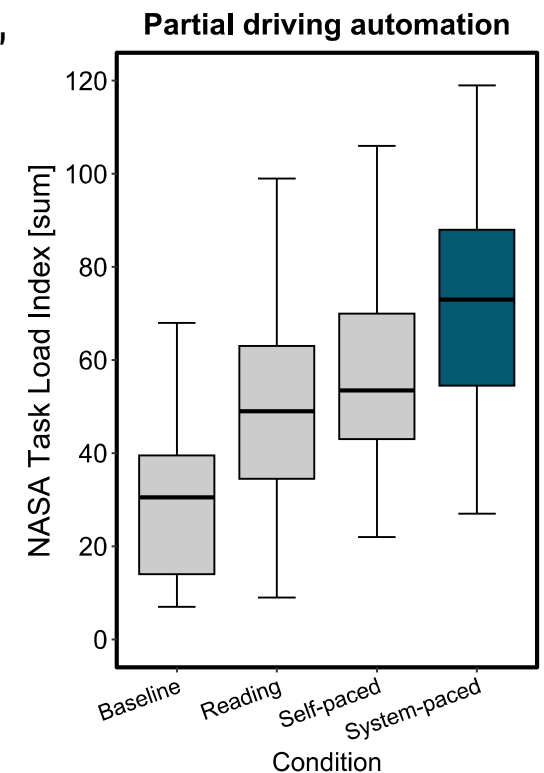
In the self-paced and system-paced tasks, participants searched for a triangle among geometric elements. In the reading task, they read a short text about animals and dismissed it.

RESULTS SUPPORT A CAUSAL LINK BETWEEN SECONDARY TASKS, THE DRIVING TASK, AND INCREASED SELF-REPORTED DEMAND.

Self-reported demand was highest for the system-paced condition in both L0 (M = 58.3, SD = 23.6, n = 22) ...



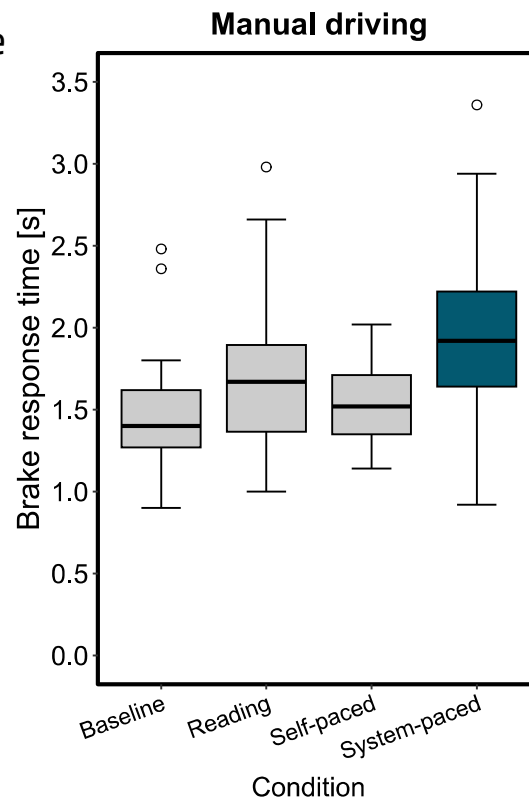
... and L2 (M = 72.4, SD = 23.2, n = 27).



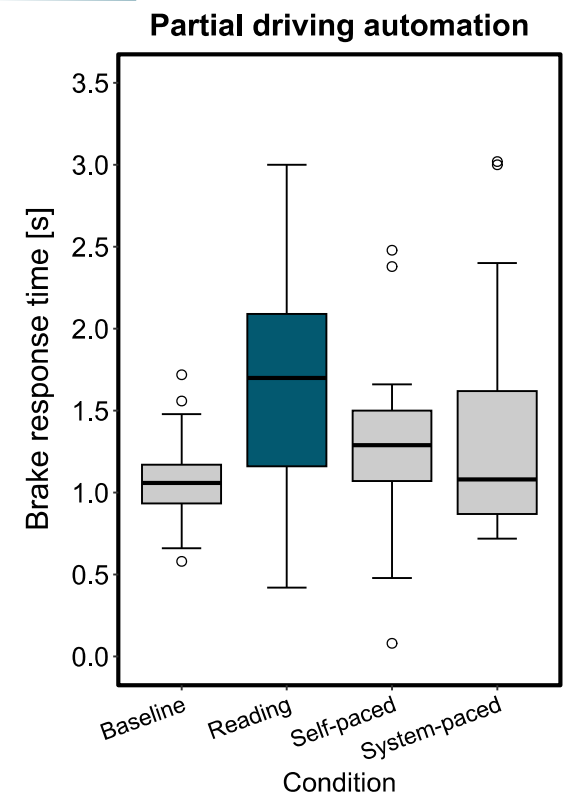
Linear mixed models showed increased self-reported demand, especially for system-paced tasks, $b = 39.80$, $\beta = 1.58$, $p < .001$ (**H2**), and for L2 driving, $b = 12.22$, $\beta = 0.49$, $p = .01$ (contrary to **H1**), $\sigma^2 = 245.0$, adj. ICC = 0.60.

HIGHER SELF-REPORTED DEMAND WAS GENERALLY ASSOCIATED WITH LONGER BRAKE RESPONSE TIMES, BUT EFFECTS OF COVARIATES VARIED.

During L0 driving, brake response time was highest in the system-paced condition ($M = 1.93$, $SD = 0.57$, $n = 25$).



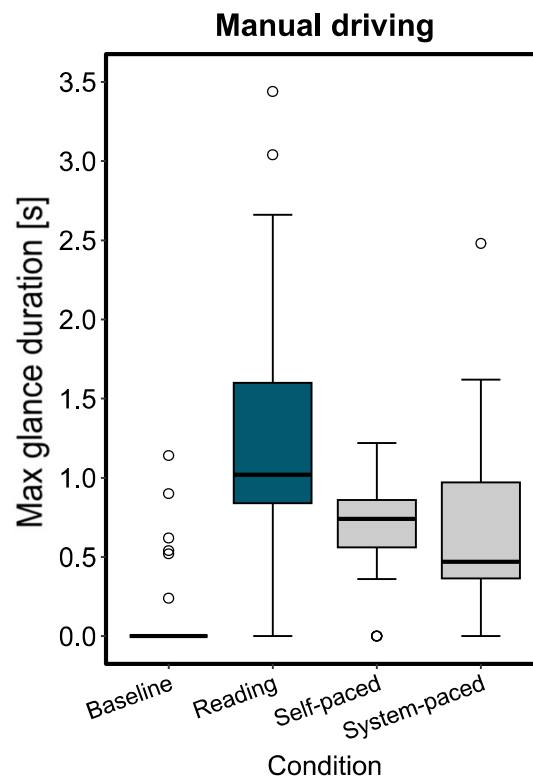
During L2 driving, the reading task led to the longest brake response times ($M = 1.67$, $SD = 0.65$, $n = 31$).



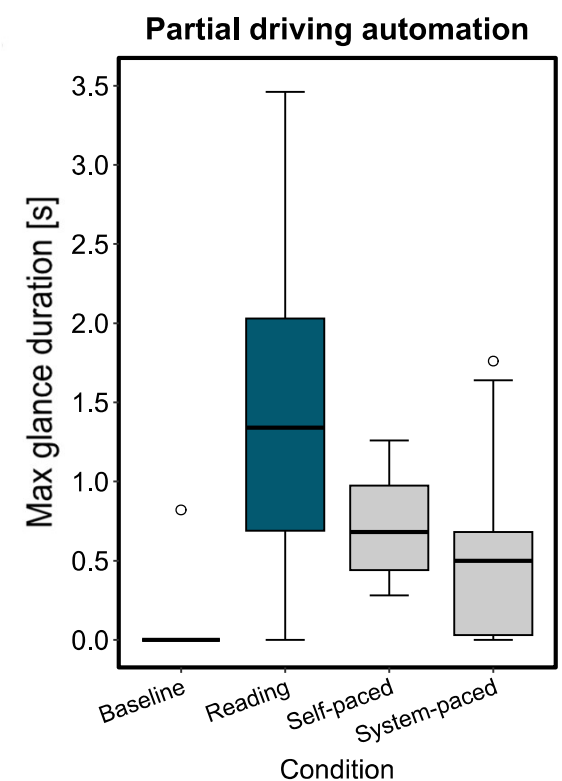
Self-reported demand was positively associated with brake response time, $b = 0.01$, $\beta = 0.25$, $p = .007$ (**H3**), while L2 driving was negatively, $b = -0.40$, $\beta = -0.71$, $p < .001$, and the reading task positively associated with it, $b = 0.36$, $\beta = 0.64$, $p < .001$, $\sigma^2 = 0.05$, $\text{adj. ICC} = 0.20$.

FURTHER ANALYSIS OF MAXIMUM GLANCE DURATION REVEALED THAT THE READING TASK PLACED THE GREATEST DEMAND ON ATTENTION.

Maximum glance duration was longest for the reading task condition in both L0 (M = 1.30, SD = 0.83, n = 29) ...



... and L2 (M = 1.34, SD = 0.90 n = 31).



The reading task produced the longest maximum glance durations despite lower self-reported demand.

HOW DOES THIS RESEARCH CONTRIBUTE TO THE DEVELOPMENT OF A CONTEXT-DEPENDENT TEST METHOD FOR DRIVER DISTRACTION AND INATTENTION?

Takeaways



Capacity exceedance is context-dependent.

L2 driving may impose additional demand – potentially because supervising the system requires resources – without necessarily delaying braking.



Self-reported demand and driving performance reflect different aspects of capacity exceedance.

Some secondary tasks can place high demands on visual attention and impair driving performance without being perceived as highly demanding.

Consistent with the MiRA theory, higher demand does not necessarily impair driving performance as long as attention is sufficiently maintained. Distraction testing should therefore determine when compensatory mechanisms fail and which gaze and driving performance metrics indicate this.

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THANK YOU FOR YOUR ATTENTION.



NASA-TLX (HART & STAVELAND, 1988).

	1 = low/bad	20 = high/good
How visually demanding was the task?		
How much mental effort did the task require?		
How much physical activity did the task require?		
How much time pressure did you feel regarding the frequency or pace at which the tasks occurred?		
In your opinion, how successfully did you achieve the goals set by the experimenter?		
How hard did you have to work to achieve your level of task completion?		
How uncertain, discouraged, irritated, stressed, and annoyed did you feel during the task?		