An Evolving Perspective on Driver Attention

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UTC Program Office Visit

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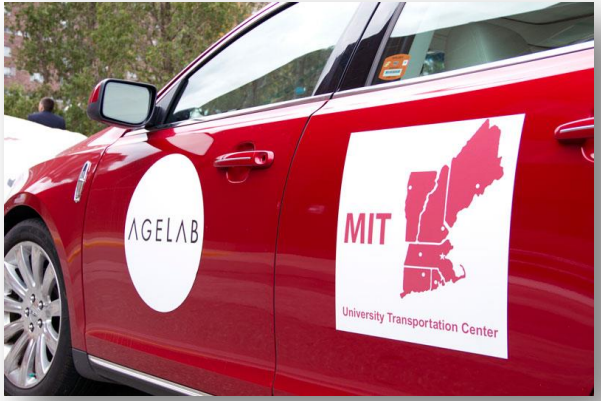

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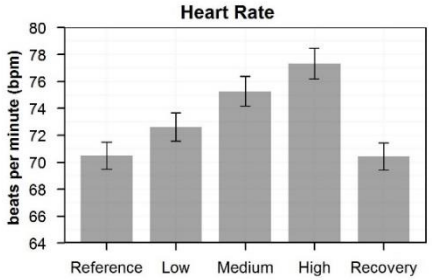
The MIT n-back

An internationally used method for inducing graded cognitive demand for scaling comparisons of other tasks

- Series of 10 single digit numbers (0-9) presented in random order aurally at 2.25 sec intervals
- Subject instructed to respond with n^{th} digit back
- Across levels
  - Auditory demands constant
  - Vocal demands "relatively" constant
- Aims to manipulate secondary cognitive demand

Stimulus	**6 9 1 7 0 8 4**
0-back Response	6 9 1 7 0 8 4
1-back Response	- 6 9 1 7 0 8
2-back Response	- - 6 9 1 7 0



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Technologies that Vie for Driver Attention

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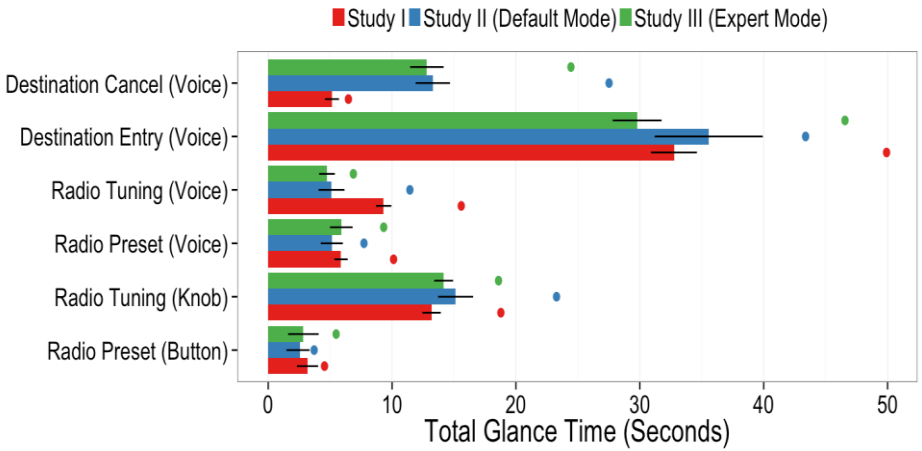
We Looked for High Cognitive Demand in Real World "Voice" Interfaces

But what routinely stands out is a **significant visual component** to "voice" tasks – indicating that these are best considered multi-modal interfaces



Bars represent the mean visual demand with standard error (line). Dots show the 85% point in the sample distribution for each task.

Findings across multiple studies show:

- Total eyes off road time for auditory-vocal (AV) tasks (assumed to be cognitive in nature) often lower than visual manual (VM) equivalent
- Temporal characteristics of AV vs VM tasks differ
- Remote DRT performance (as a proxy for awareness of what is happening on the road) does not robustly differentiate AV tasks
- DRT performance does consistently suggest slower reactions to VM tasks over AV tasks with all reactions during secondary tasks slower than just driving

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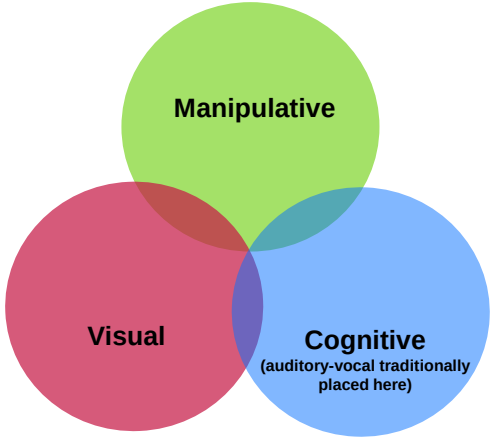
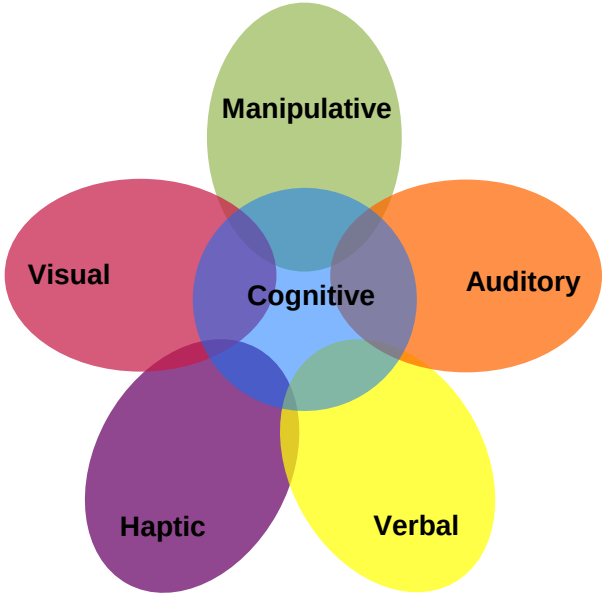
Re-envisioning the Demands of Driver Vehicle Interfaces

"Traditional View Point" of Visual-Auditory-Cognitive-Psychomotor Dimensions of Demand



A Visualization of Attentional Demands in Today's Multi-Modal Systems



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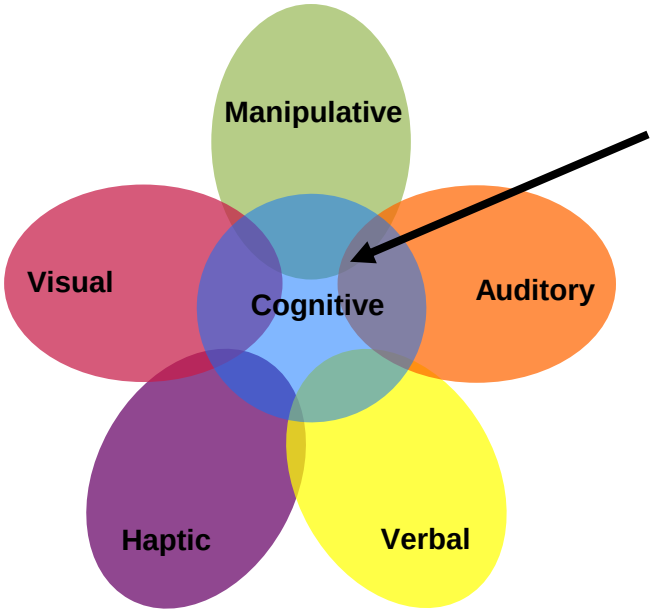
Understanding Demand

We can observe and often reasonably quantify the input and output modalities:

- We know cognition plays a role in everything but it is not clear where it may be separable
- Classically visual demand is tightly cupped with risk. How this relates to the future of automotive safety (automation) is unknown.



We are frequently limited to inferring cognition through rather indirect measures, often we don't know:

- If it is internal in nature
- Driven by an external activity related to the primary operational task or a secondary activity
- Involves other factors (for example mind wandering)

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Splitting Hairs

Cognitive demand, workload, and stress are highly overlapping constructs.
Are they realistically separable in an engineering / applied context?

- Workload is difficult to define and can have different meanings in different contexts
- Workload can be modulated through compensatory behaviors and may be best evaluated in the construct of all operational and secondary activities
- Cognitive demand rarely occurs in isolation from other demands on driver attention

Separable?
Probably not easy to do today in an engineering context.

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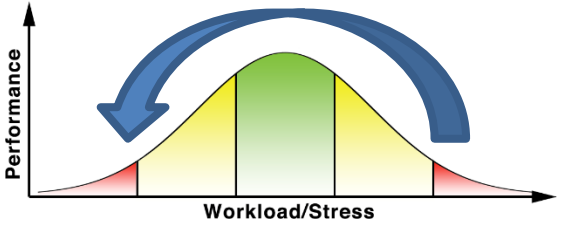
Vehicle Automation: A Need for a Deeper Human Centered Consideration of Attention Management?

What we once considered a distraction may become a key element to safety

More Information

A need for a holistic view?

Partial Automation



Today's conversations are focused on a difficult construct or redline to theoretically or practically define what we call "distraction". However, we may more appropriately need to consider a functional view of driver attention that focuses on a holistic view of the **net impact of all sources of demand (secondary and operational, including all automation levels) on safety**.

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