SHIFTING BETWEEN COGNITIVE AND VISUAL DISTRACTION:
THE IMPACT OF COGNITIVE ABILITY ON DISTRACTION CAUSED BY SECONDARY TASKS

Sachi Mizobuchi, Mark Chignell (Vocalage Inc./ University of Toronto)

Junko Suzuki, Ko Koga, Kazunari Nawa (Toyota InfoTechnology Center Co., Ltd.)

sachi@vocalage.com

Introduction

Our view of cognitive workload

Central Executive (CE) functions

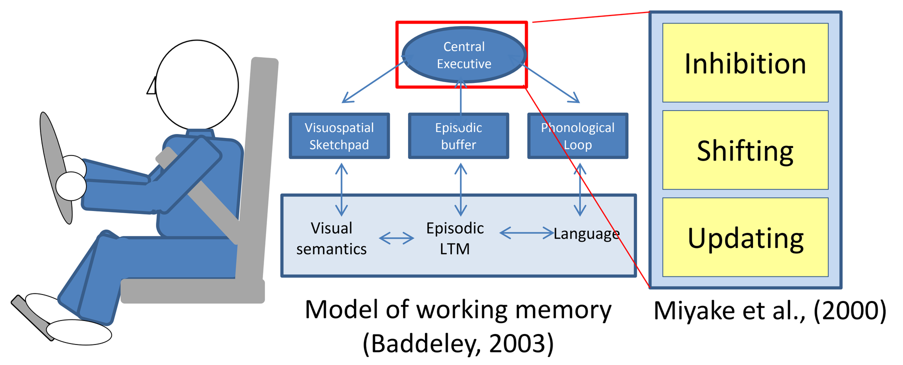

Figure 1. Working memory and fractionated central executive model

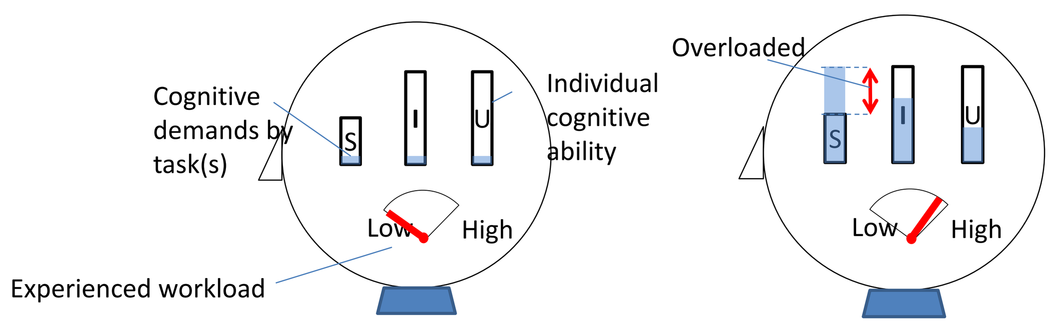

Figure 2. Individual cognitive ability and experienced workload

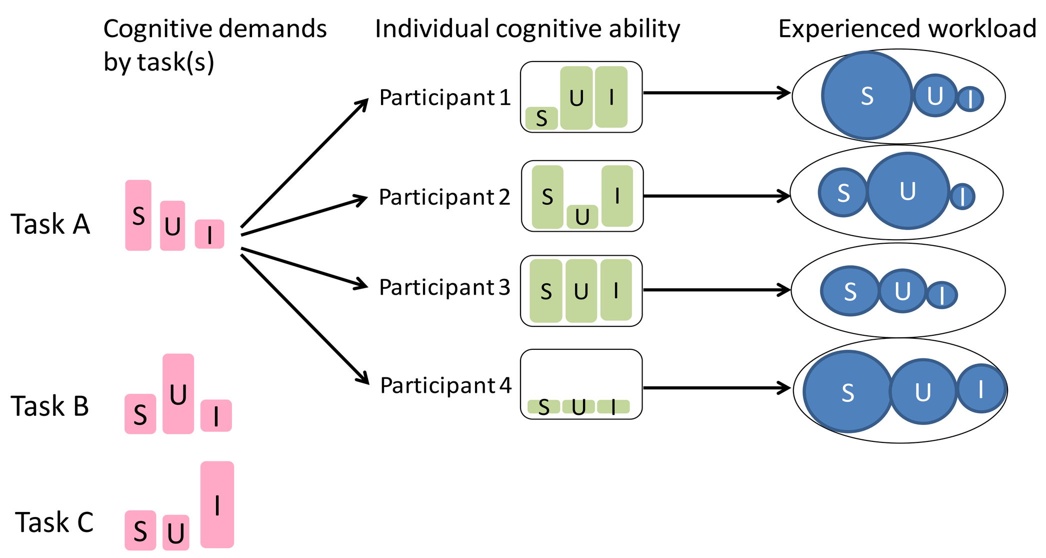

Figure 3. Models of cognitive workload based on the individual differences and different task requirements

Motivation: Shortfalls in cognitive ability may generate increased cognitive workload in the face of cognitively demanding tasks

Research questions

1. Do individual differences in CE functions moderate the impacts of distraction?
2. Do the impacts differ depending on the modality of secondary tasks?

Method

Screening test

measured the 3 central executive (CE) abilities with 102 people
-> selected 34 people

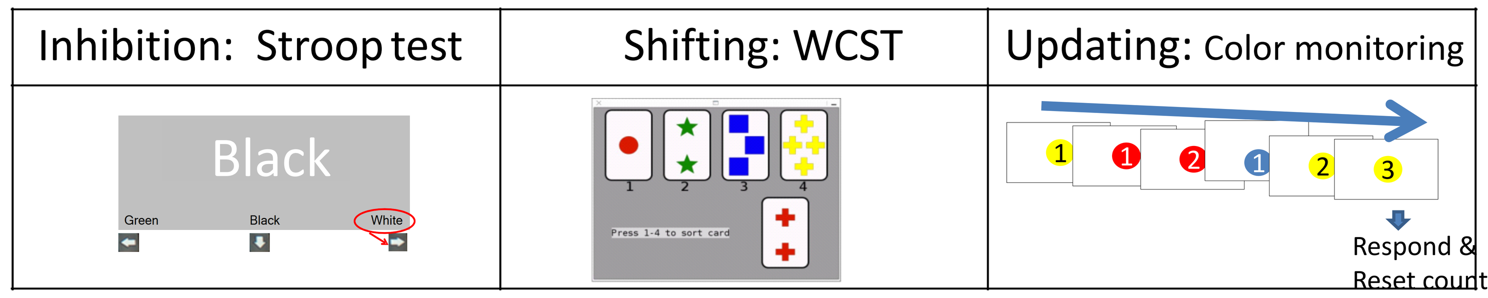

Figure 4. CE ability tests

Experiment

•34 participants (20M & 14F, 17 to 64 years old, *M*=42.9, *SD*=13.2)
•Dual tasks (1D tracking task with a foot pedal & 6 secondary cognitive tasks)
•Within-participant, repeated measures design

Primary task : 1D pedal tracking task (abstracted car following task)

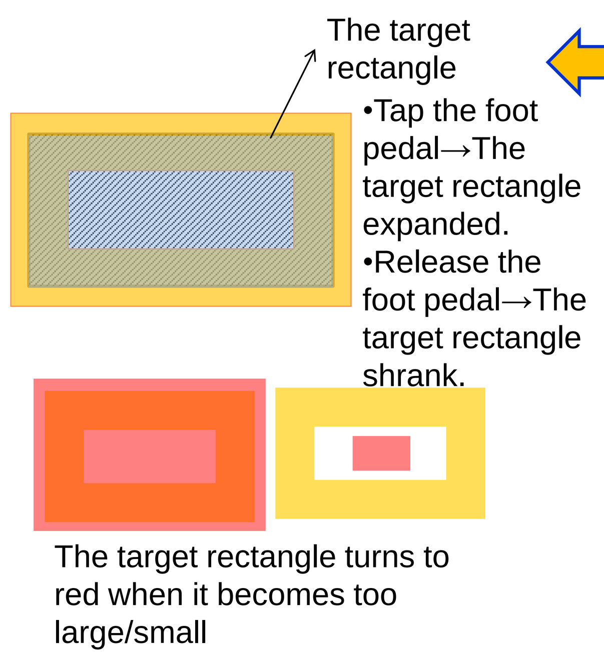

Figure 5. 1D pedal tracking task

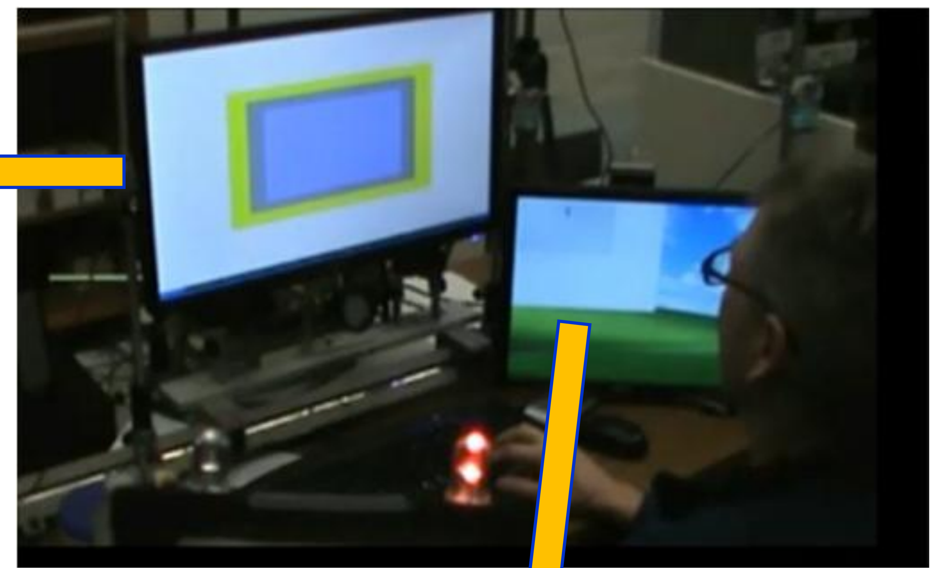

Figure 6. Experimental Setting

Secondary task: 3 CE tasks x 2 modalities

Table 1. Secondary tasks

	Inhibition	Shifting	Updating
Visual	(VI) Stroop task	(VS) Number calculation rule task	(VU) Color monitoring task
Auditory	(AI) Auditory stroop task	(AS) Auditory number calculation rule task	(VU) Tone monitoring task

Results

Primary task performance by cognitive ability

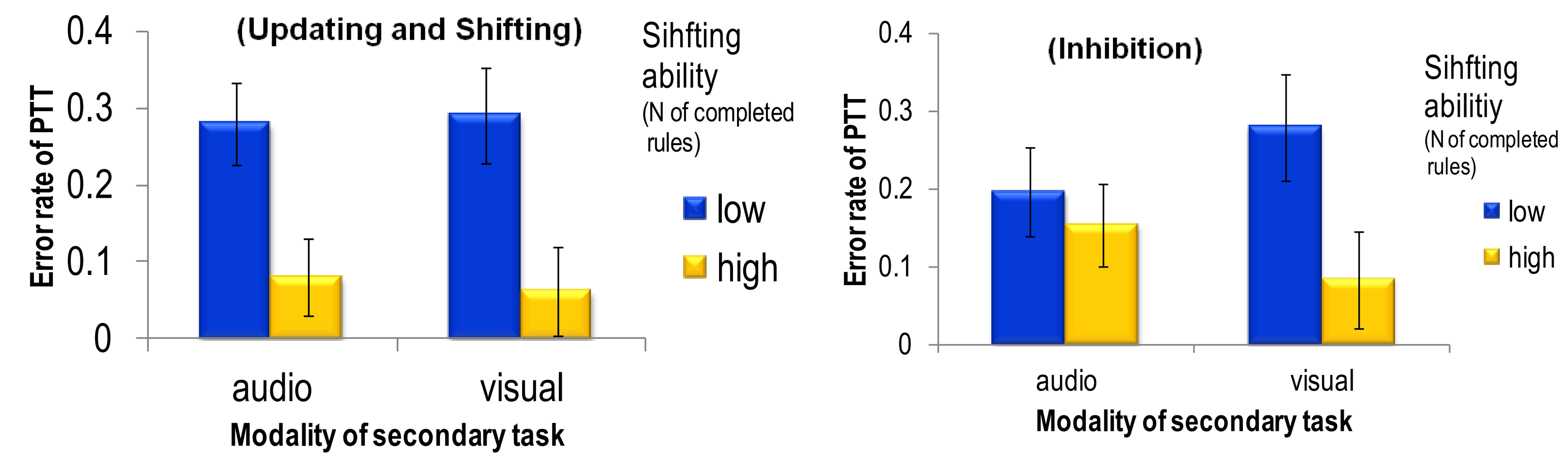

Figure 6. Mean Error rate and standard error bars in pedal tracking task by secondary task modality and shifting ability (left: for Updating and Shifting tasks combined, right: for Inhibition task only)

-> People with high shifting ability made fewer errors in the primary task
An Interaction was found between modality and cognitive ability in the Inhibition task

Eye gaze control by cognitive ability

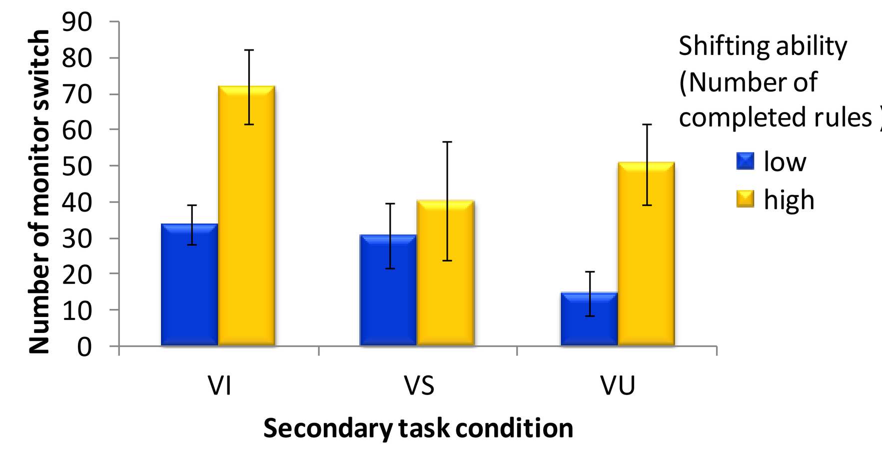

Figure 7. Mean number of switches (with standard error bars) in gaze between monitors, by shifting ability and secondary condition task (visual only)

-> People with high shifting ability switched their gaze between the primary and secondary monitor more frequently.

Conclusion

- Shifting ability was particularly important in determining whether primary task performance was better in the presence of the secondary task
- This effect was greater when the secondary task was presented visually .

Vocalage
TOYOTA InfoTechnology Center Co., Ltd.
InteractiveMediaLab
University of Toronto