Testing Prospective Memory Differences for Self versus Automation in a Driving Task

BUILD CSULB
CALIFORNIA STATE UNIVERSITY LONG BEACH

Martina Hollearn & James Miles, Ph.D., Department of Psychology

ABSTRACT

Partially-automated vehicles perform certain basic driving functions, such as steering or breaking. However, these changes additional challenges for the driver's prospective memory (PM). Partially-automated cars require the driver to remember upcoming driving events for both the automation and self. In addition, some trial blocks include implementation intention instructions for self and automated PM tasks, which may improve PM by verbalizing the specifics of the future situation and the conditional response. Results will determine the relation between concurrently performed self and automated PM tasks, whether both types of PM benefit from implementation intention instructions, and whether PM for automated tasks are influenced by the driver's trust in automation.

INTRODUCTION

Prospective Memory (PM) Task [1]

- Remembering to perform a planned action or recall a planned intention at some future point in time
- Common in daily life in wide range of tasks and types
- Very little research on vicarious PM (remembering for some or something else)
- Examples of our study
  - Self PM (i.e.: respond when you see 'T4')
  - Auto PM (i.e.: ensure automation responds to 'Z9')

Implementation Intentions [2]

- Verbalizing the specifics of an expected response
- Execution of a plan, idea by repetition of the result
- If___, then ___ fashion statements, for example, in our study: ***If*** *I see 'T4',* ***then*** *I will press the left button."*

Driving Task

- Manual driving on a two-lane road, avoiding crashes with oncoming traffic, which aims to increase the work load for the PM task.

OBJECTIVES

1. PM performance will be worse for automation than for self, similar to how PM has been shown to be less detailed for autobiographical events learned from other humans.
2. Trust in automation will decrease monitoring of automation's tasks, leading participants to not notice automation errors.
3. We investigate whether II can be both used for self PM whether that also benefits PM for monitoring automation.

METHODS

Subjects

At least 40 subjects will be recruited from CSULB.

Design and stimuli

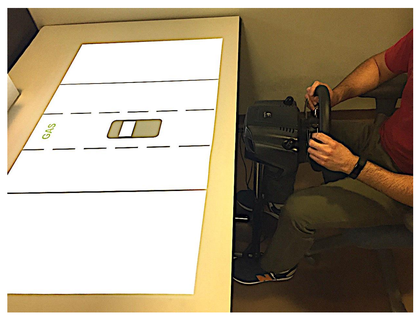
- PM stimuli: letter-number combinations (T4, R2, Z9, etc.)
- 2 x 2 within subjects design (4 conditions total)
- Instruction types:
  - no implementation: only written (no verbal repetition)
  - implementation instructions: verbal & written (must repeat aloud twice)
  - self or auto implementation

Trials

- 2 blocks/condition (total 8 blocks/ subject)
- 9 PM targets/block = 3 self, 6 auto (3 missed by auto)
- 2 sec target response window & 4 sec SOA

Equipment

- Driving simulator that includes a steering wheel mounted to the end of a table and a simplified roadway on a computer screen.



EXPERIMENTAL CONDITIONS

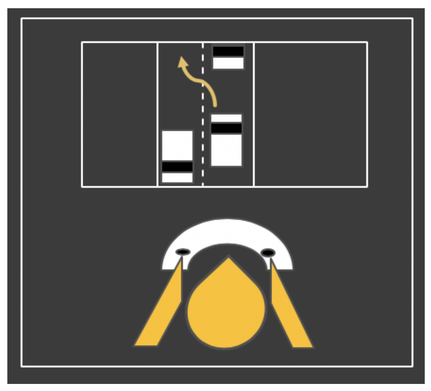
Two tasks will be concurrently performed (conditions in randomized order).

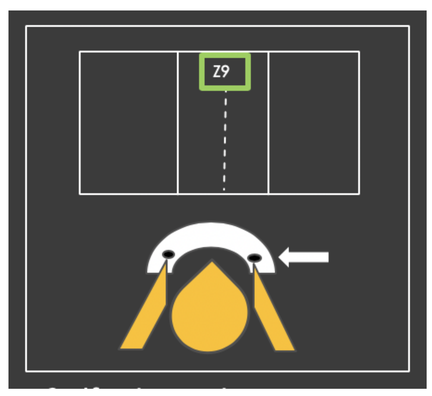
Task 1: Driving

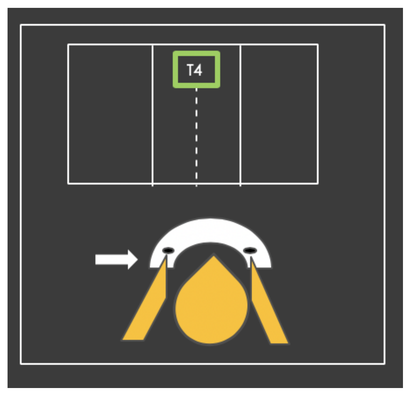
On a two-lane road participants will have to maneuver between cars and avoid a crash while mainly staying in the left lane.

Task 2: Prospective Memory

At the top of the screen subjects will see letter-number combinations and have to respond to the designated combination encoded during instructions.







Implementation Intentions

Some conditions include implementation intention in the instructions section, so when given initial instructions, participants will be asked to repeat aloud instructions or just read it on the screen.

*"**If** I see 'T4', **then** I will press the left button."*

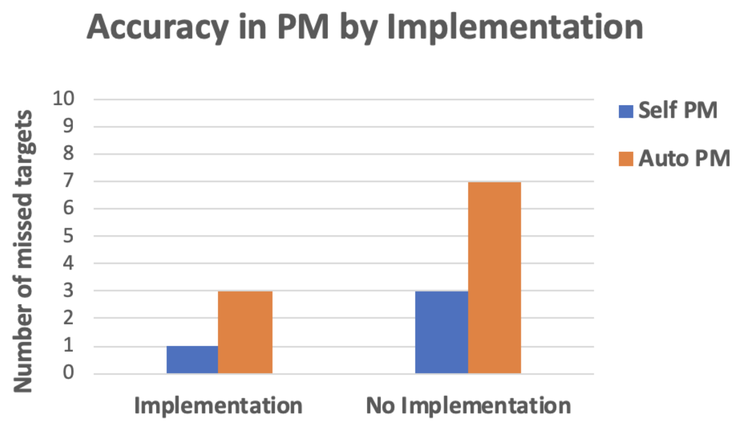
*"**If** the automation has not responded to its own target, 'Z9', **then** I will press the left button."*

Trust Survey

12 question Likert-scale questionnaire about participants' experience with the automation [5].

"*I am confident in the system."* and *"The system is deceptive."*

PROPOSED RESULTS

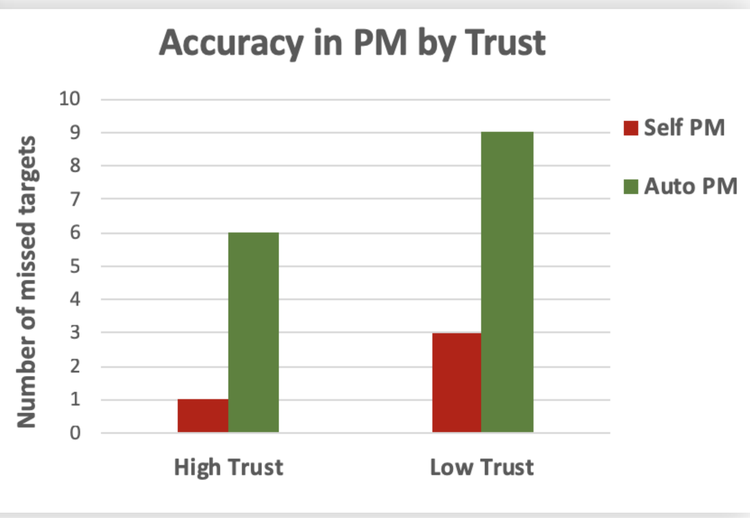


PM by Implementation

- Main effect for PM task, main effect for Implementations and an PM by Implementations interaction.
- General decrease in accuracy when implementation is included in the instruction for both groups.
- Will measure accuracy as number of missed PM targets (errors).
- Implementation intention instructions will not improve prospective memory for automation to the accuracy level for self.

PM by Trust

- Main effect of trust and a main effect of PM task In the automation prospective memory condition.
- High trust in automation will have a higher accuracy rate when the participant has to fill in the absent response from the automation, compared to low trust in automation.
- Mean difference between the self and the automated prospective memory condition, where the self-prospective memory condition includes higher accuracy.
- We think it is easier to remember future events for ourselves than for others.



DISCUSSION

- Factors such as driver workload, trust in automation, and system monitoring may make it more difficult to maintain prospective memories [3,4].
- Implementation intention memory strategies may help to improve recognizing driving events in the absence of an automated response [2].
- Future directions will include symbol recognition, communicational strategies, and varying mental workload levels.

REFERENCES

[1] McDaniel, M. A., & Einstein, G. O. (1993) The importance of cue familiarity and cue distinctiveness in prospective memory. *Memory*, 1, 23-41.
[2] Gollwitzer, P.M. (1999). Implementation intentions: Strong effects of simple plans. *American Psychologist,* 54, 493–503.
[3] Lee, J. D., & Moray, N. (1992) Trust, self-confidence, and operators' adaptation to automation. *International Journal of Human-Computer Studies*, 40, 50-80.
[4] Parasuman, R., Sheridan, T. B., Wickens, C. D. (2008) Situation awareness, mental workload, and trust in automation: viable, empirically supported cognitive engineering constructs. *Journal of Cognitive Engineering and Decision Making,* 2, 140-160.
[5] Jian, J. Y., Bisantz, A. M., & Drury, C. G. (2000). Foundations for an empirically determined scale of trust in automated systems. *International Journal of Cognitive Ergonomics*, 4(1), 53-71.

ACKNOWLEDGEMENTS

This project would not be possible without Dr. James Miles and his laboratory. This research was supported by the National Institute of General Medical Sciences of the National Institutes of Health under Award Numbers; 8UL1GM118979-02. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.