Comparing Passive and Active Learning Conditions via Cognitive Modeling



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Rationale

Address the limited quantitative research on the cognitive processes involved in active (AL) versus passive learning (PL) strategies

Hypothesis

Active learning (Bonwell and Eison, 1991), with more opportunities to interact with the learning material than passive learning, will generally increase learner's performance.

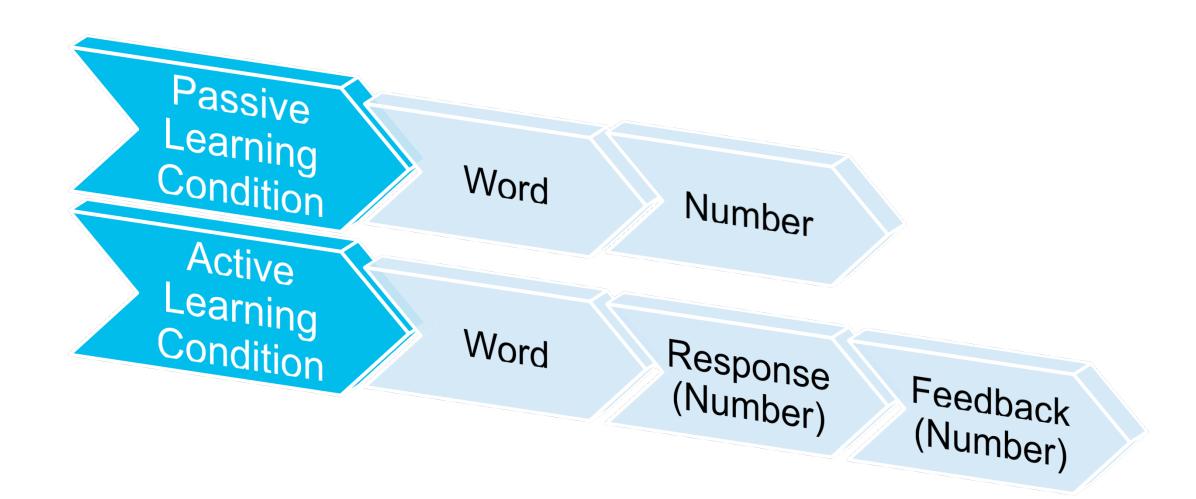
Experiment Overview

- Investigate the merits of implementing active versus passive learning teaching methods by employing a computational cognitive model
- Cognitive model created in the ACT-R cognitive architecture (Anderson, 2007)
- Paired-Associate task (Anderson, 1981): learning of association between a word and number (e.g. DART 9)
- Stimuli administered by an external software
- ACT-R computational cognitive architecture:
 - Interacting modules supports the implementation of a theory of human cognition
 - declarative memory (know what) and procedural memory (know how)
 - Working Memory a module that holds and processes new and already stored information

Passive and Active Learning Conditions



Passive vs. Active Learning Condition (ST)



Cognitive Model Model Stimuli read the word encode the word and store an incomplete associate in working memory YES Final **Active learning** attempt Generate answer YES Home time attempts to retrieve an association between the displayed word and a number in declarative memory NO Was an YES association learning retrieved in condition declarative can not recall the memory? association NO retrieval of a complete association which leads to reinforcement of the association in declarative generate a memory response detect a visual item (number) Display correct read number associate the correct number to the word item in the working memory clear of the working memory which leads to reinforcement of the association in declarative memory 1: Word is displayed DART 2: Correct answer (number) is displayed Working memory Visual DART

Acknowledgements

DART

DART

NECK

Response

The work presented here was supported by The Air Force Office of Scientific Research grant number FA9550-14-1-0206 to Ion Juvina.

Declarative memory

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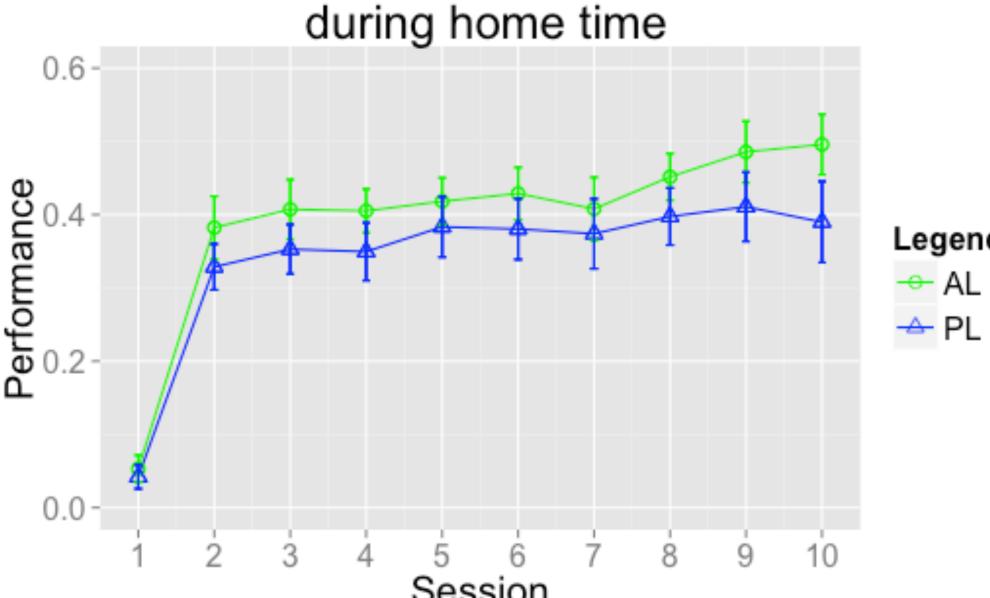
DART

Results

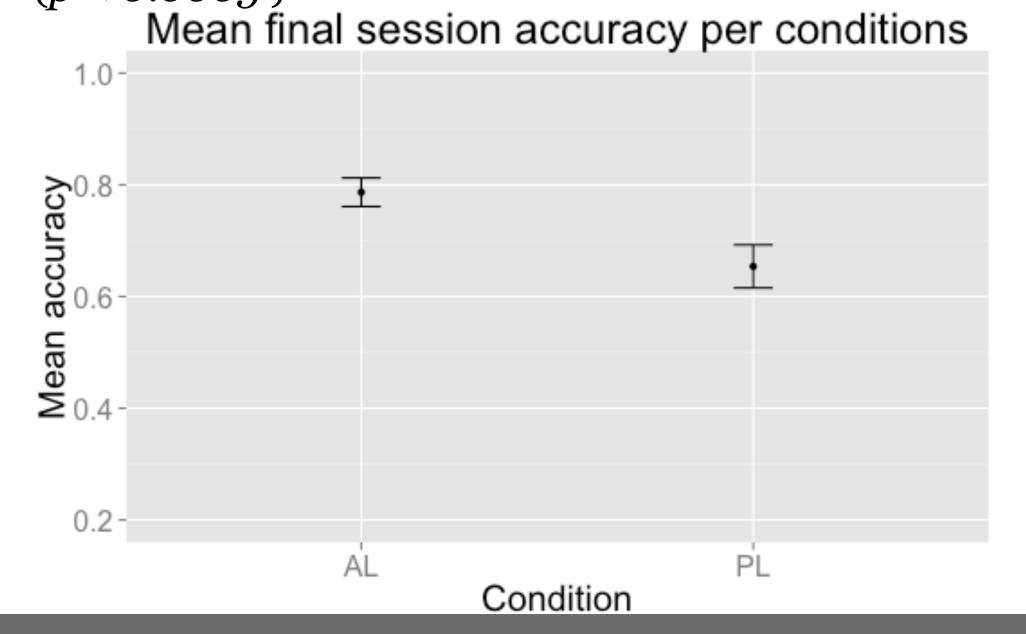
Simulation parameters:

Parameter	Value
Home time	300 s
Number of words per session	12
Word increment per session	4
Number of sessions	10
AL: Answer duration time	10 s
AL: Correct answer duration time	10 s
PL: Word duration time	10 s
PL: Correct answer duration time	10 s
Final session answer duration time:	10 s

AL > PL during home time (10 sessions)
 Performance in AL and PL conditions



Session AL > PL in final session – difference significant (p < 0.0005)



Conclusions

- Hypothesis confirmed
- A priori prediction for human participants: generating a response before the correct answer is displayed improves performance
- Future work: compare these simulation data with data from human participants

References

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