# Comparing Measures of Cognitive Performance: A Factor Analysis Approach

**Sarah V. Park**[1,2], B. Marius 't Hart[1], Ji Yeh Choi[2], Denise Y.P. Henriques[1]

[1]*Centre for Vision Research &* [2]*Department of Psychology, York University, Toronto*

33rd Annual Meeting of the Canadian Society for Brain, Behaviour, and Cognitive Sciences

University of Guelph, ON

Tuesday July 17th, 2023

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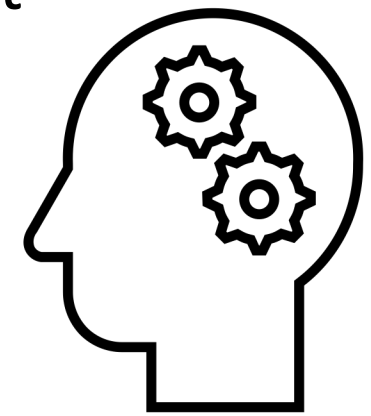
# “Cognition” is Complex

- “Cognition” is an umbrella term encompassing many processes
- External influences on cognitive performance
- Measuring and quantifying cognitive processes is difficult
- Analysis methods affect the inferences drawn



# Dimensionality Reduction

- Dimensionality reduction: computational process to remove redundancy in data

- Theory-driven and data-driven approaches
  - Theory-driven: using existing knowledge and conceptual framework to reduce data
  - Data-driven: rely on the data and certain algorithms

# Research Goals

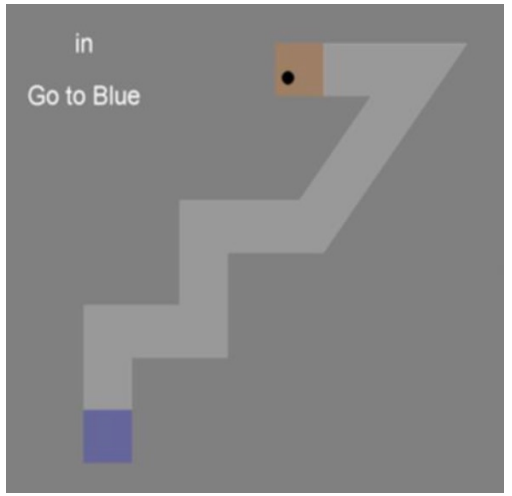
- Compare two data dimensionality reduction techniques on cognitive performance data
  - (M1) Theory-driven
  - (M2) Data-driven

- Evaluate cognitive model performance with the addition of lifestyle and demographic measures

# Participants & Procedure

- Battery of cognitive tasks and lifestyle and demographic questionnaires administered online
  - N-back, Task switching, go/no-go, visual search, trail making, tunneling
  - age, sex, stress, fitness, sleep (PSQI), affect (I-PANAS-SF), cannabis use, method of birth

- 1141 undergraduate students
  - $n_{female}$ = 781
  - $M_{age}$ = 23.13yrs, $SD_{age}$ = 7.38yrs

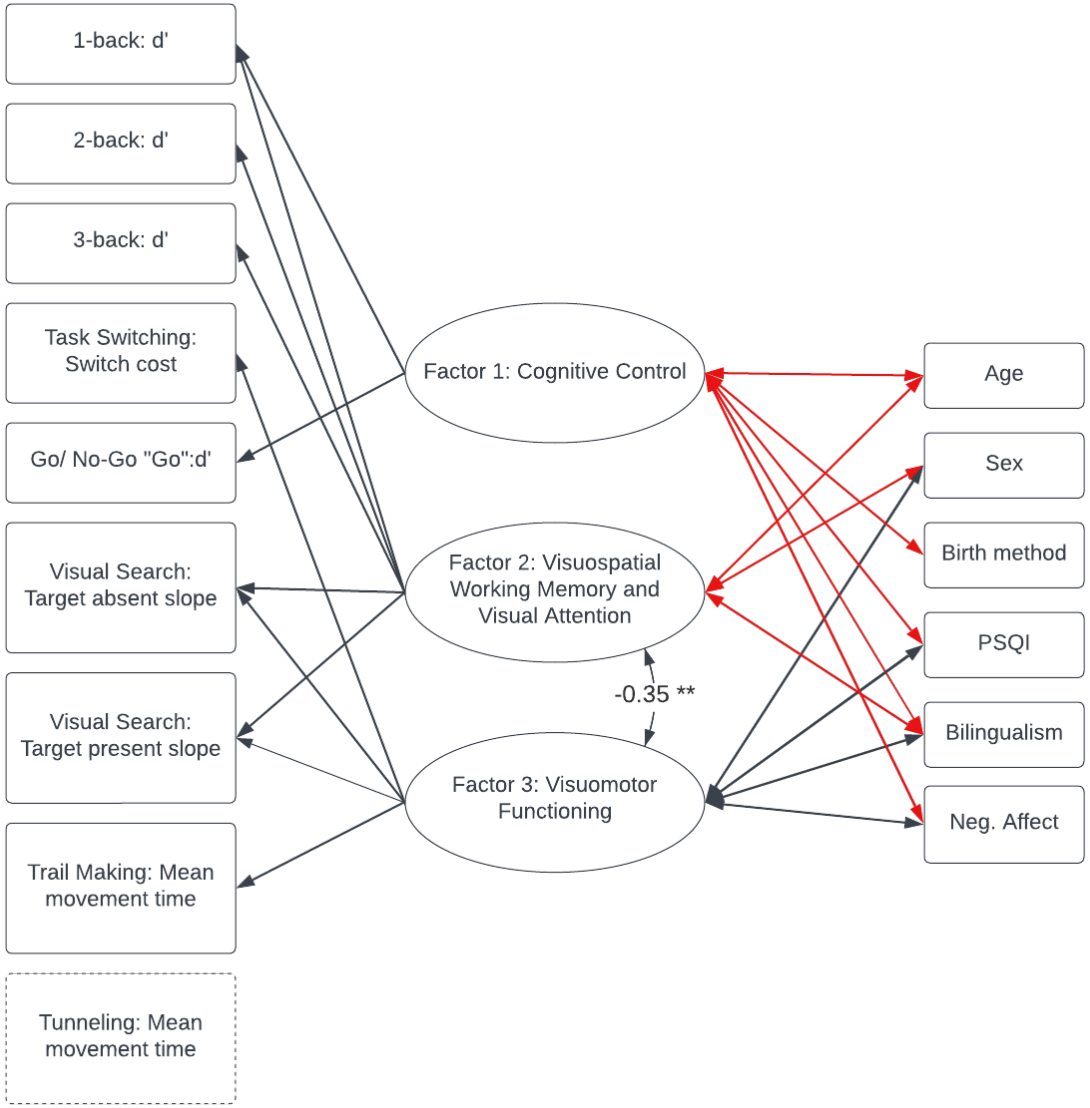


# Analysis Methods: SEM and PCA

- Structural Equation Modelling (SEM)
  - Framework that handles many relationships with measured and latent variables

- Principal Components Analysis (PCA)
  - Data-driven dimensionality reduction method that relies on covariance structures

# (M1) Theory-driven Model




- RMSEA = .099, 90% CI[.094, .104]
- $\chi^2(120) = 1461.62$, $p < .001$
- GFI = .827, CFI = .535, TLI = .338
- SRMR = .095
- BIC = 45244.096

# (M2) Data-driven Model

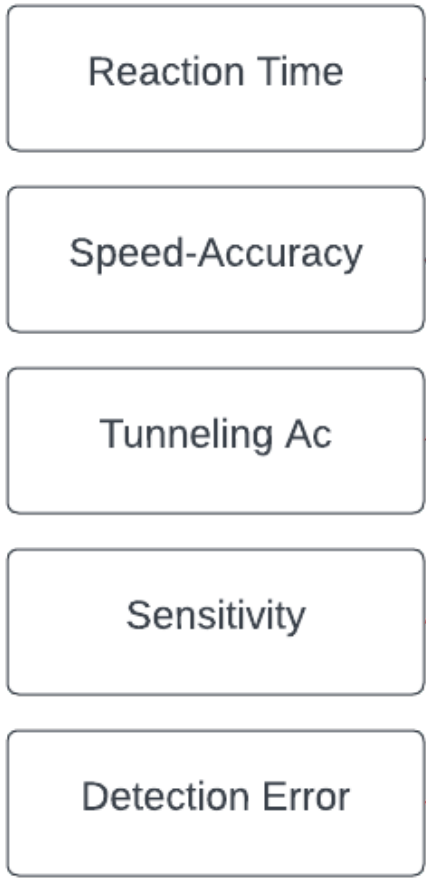
PCA conducted on the RT and Ac measures

- Missing data: imputed with an algorithm (regularized)

5 PCs

(1) Reaction Time (21.33%)
(2) Speed-accuracy trade-off (16.70%)
(3) Tunneling Accuracy (10.73%)
(4) Sensitivity (8.68%)
(5) Detection Error (6.21%)

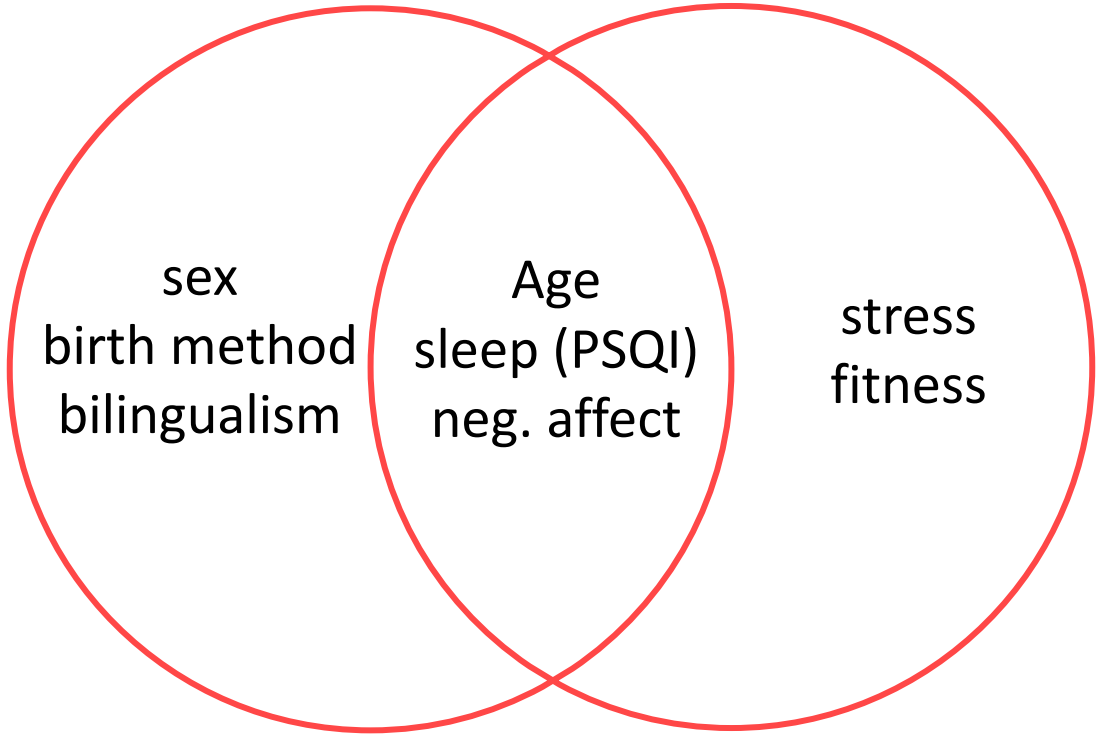
# (M2) Data-driven Model



# Model Comparison

**(M1) Theory-Driven**

Reduced data based on theoretical constructs




**(M2) Data-Driven**

Reduced data based psychophysical response patterns

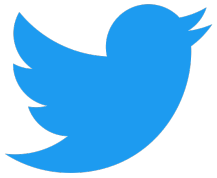
Cannabis use, pos. affect

# Conclusions & Next Steps

- “Cognition” and cognitive performance remains complex
- Analysis methods & data/dimensionality reduction techniques should be critically evaluated
- Assess and probe different relationships

# Questions?

Connect with me!



@SarahVPark_

svpark@yorku.ca

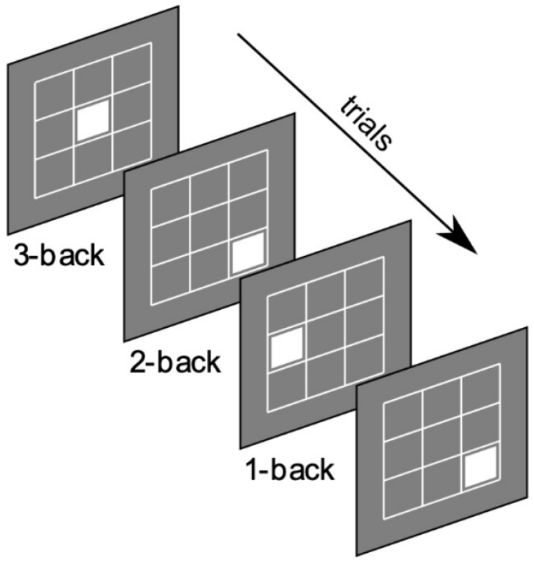
# Data Used: M1

| | |
|---|---|
| **N-back** (3) | d’[N1, N2, N3] |
| **Task switching** (1) | switch cost |
| **Go/no-go** (1) | d’[go] |
| **Visual search** (3) | slope[target absent, target present] |
| **Trail making** (1) | $M_{MT}$ |
| **Tunneling** (1) | $M_{MT}$ |

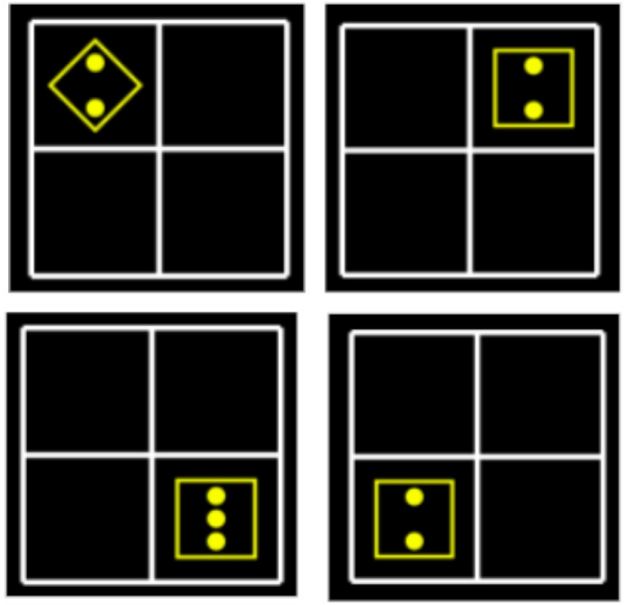
# Data Used: M2

| | | |
|---|---|---|
| **N-back** (6) | RT | hits[N1, N2, N3],<br>false alarms[N1, N2, N3] |
| **Task switching** (12) | RT | switch, non-switch, congruent,<br>non-congruent, Block1, Block2 |
| | Ac | switch, non-switch, congruent,<br>non-congruent, Block1, Block2 |
| **Go/no-go** (2) | RT | Go, no-go |
| **Visual search** (12) | RT | target absent[6, 12, 18],<br>target present[6, 12, 18] |
| **Trail making** (5) | MT | T1, T2, T3, T4, T5 |
| **Tunneling** (8) | MT | 40%, 60%, 80%, 100% |
| | Ac (in-trac) | 40%, 60%, 80%, 100% |

## N-Back

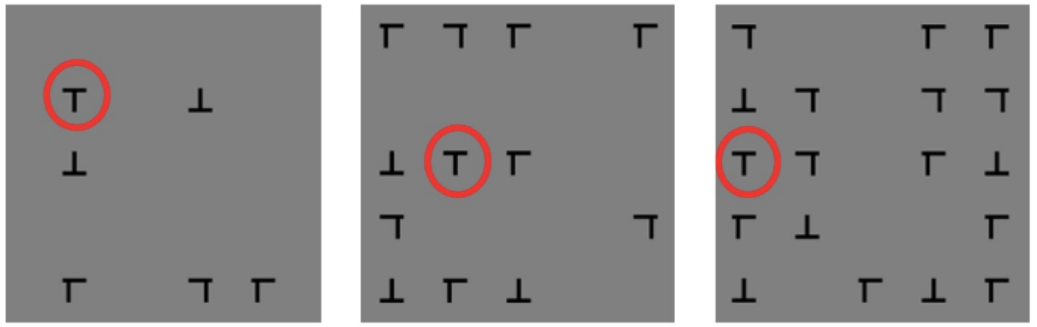



## Task Switching



## Go/No-go


## Visual Search



## Tunneling


## Trail Making Test (B)