The Relationship between Cognition and Visual Statistical Learning

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Introduction

- Visual statistical learning (VSL) is a domain general cognitive mechanism that allows humans to extract patterns from their environment for implicit learning (Monroy et al., 2022; Fiser & Aslin 2002).
- VSL has been demonstrated in both adults and infants (Kirkham et al., 2010) with adults more efficiently extracting patterns from input (Bertels et al., 2015).
- The literature seeks to better understand VSL by identifying the contributions of language skills or nonlinguistic abilities but rarely both.
  - Some literature suggests that language skills predict VSL (Daltrozzo et al., 2017; Monroy et al., 2022).
  - While others suggest that general nonlinguistic abilities account for variance in learning and extracting patterns (Siegelman & Frost, 2015).
- This study seeks to fill in this gap by evaluating the relationship between VSL and both nonverbal and linguistic abilities.

Objective

- This study evaluates the relationship between measures of nonverbal and verbal ability and visual statistical learning in a small group of adults.

Methods

Participants

- Undergraduate and graduate students enrolled at Sacred Heart University (N = 21).
- Mean age = 20 years (SD = 1 year).
- All monolingual English speakers.

Cognitive and Language task

- Wechsler Abbreviated Scale of Intelligence, 2nd Edition (WASI-II, Wechsler, 2011) was completed with each participant.
- Yielded raw scores across four subtests .
  - Nonverbal: Block Design, Matrix Reasoning (see Figure 1).
  - Verbal: Vocabulary, Similarities.

References

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Methods (cont.)

Visual statistical learning (VSL) Experiment

Materials

- 12 creatures adapted from Van Witteloostuijn and colleagues (2019) were normalized for size and luminance.
- Creatures were grouped into four base triplets.
- Create two lists of creatures to counterbalance base triplets and order of triplet presentation.

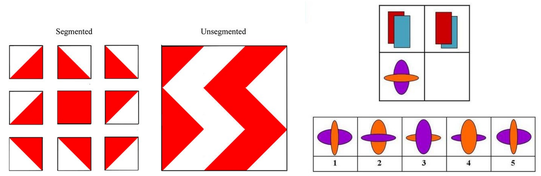

Figure 1. *WASI-II Block Design & Matrix Reasoning*

Phases

- Presented using Qualtrics
- **Exposure phase**: 20 triplets per block x 4 blocks presentations (240 creatures).
  - Presented individually for 1,000 ms with an ISI of 2,000 ms.
  - Base triplets always occurred in temporal order.
  - Order of base triplets varied.
  - See Figure 2a.
- **Test phase:** 16 test trials (4 base triplets x 4 presentations) using 2AF choice.
  - Base triplet and impossible triplet (three creatures that never temporally occurred in the base triplet) were presented on each side of the computer screen.
  - Participants were instructed to click on the group of creatures that occurred in order.
  - See Figure 2b.

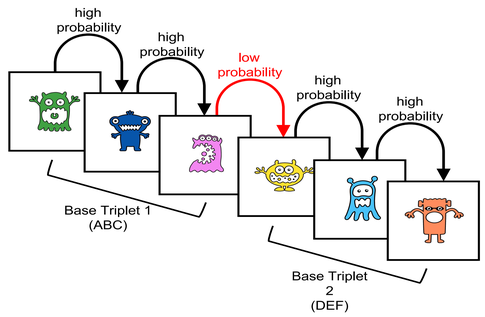

Figure 2a. *Exposure phase*

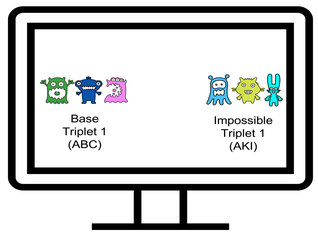

Figure 2b. *Test phase*

Data analysis

- A VSL experiment accuracy score was computed for each participant: total number of correct trials/16 *100.
- Pearson correlations were used to evaluate the relationship between WASI-II subtest raw scores & accuracy score.
- Analyses were completed in R Studio Version 4.0.2 (RStudio Team, 2020).

Results

- Experiment accuracy was above chance with most of the participants learning the patterns (19/21 participants scored >50%; Table 1).
- Significant positive correlation between WASI-II Block Design subtest and VSL experiment accuracy, all other correlations were NS (Figure 3).

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- Scan the QR code to learn more about our work.

Table 1. *Participant results*

	Mean (SD)	Range
WASI-II		
Nonverbal subtests		
Block Design	45 (13)	11 - 64
Matrix Reasoning	21 (4)	13 - 30
Verbal subtests		
Vocabulary	39 (5)	24 - 48
Similarities	32 (4)	21 - 38
VSL Experiment Accuracy	76.46% (19.15%)	43.75%-100%

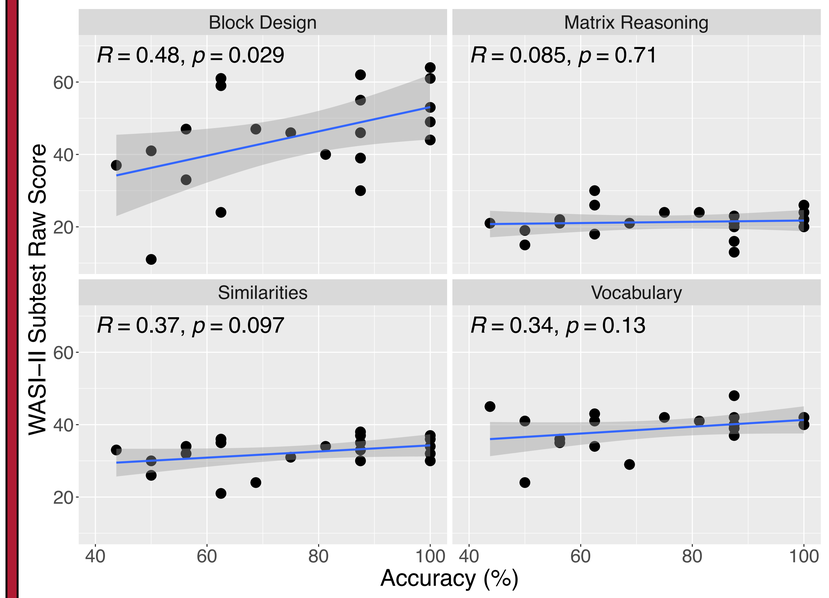

Figure 3. *Pearson correlations between WASI-II & VSL accuracy*

Discussion

- Consistent with other studies of visual statistical learning most of our participants were able to extract the patterns at above chance levels.
- There was no relationship between VSL and verbal skills, unlike other studies of pattern detection (Daltrozzo et al., 2017).
- There was a positive relationship between VSL and the nonlinguistic block design task likely due to the learning and procedural memory components of both.
  - The block design task was the only subtest that required participant learning. Previously learned knowledge about the blocks could be applied to successive trials.

Next Steps

- To collect data on a larger, more representative population to see if the effects generalize to a more diverse group of people.