Developmental changes in the serial position function for different visual elements.

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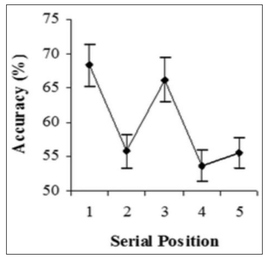
Background

- Previous research has relied on the multi-element processing task to examine how various elements (i.e., letters, numbers, and other symbols) are visually processed within a string[1,2].

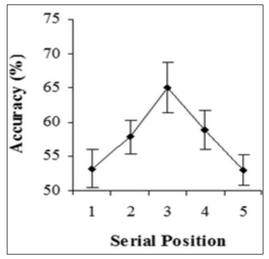
Multi-Letter Processing Task

The serial position function (SPF) displays how the position with a string can affect one's ability to accurately identify an element[3,4]. The SPF for letters and numbers is W-shaped[1,5], while the SPF for other symbols is inverted U-shaped[5].

Letters: SPF
(Tydgat & Grainger, 2009)



Symbols: SPF
(Tydgat & Grainger, 2009)



- The shape of the SPFs for letters/numbers may be due to a combination of visual crowding from surrounding elements and decreased visual acuity due to increased distance from fixation[6]. However, this explanation does not explain the difference between the SPFs for letters and other symbols.
- Conversely, the reliance on iconic memory and the increased attentional load necessary to complete the multi-element processing task could explain the difference between the SPFs for letters and symbols[7].

1. **Does the serial position function vary across different visual categories as reported in previous literature?**
2. **Do the shapes of these functions change with age and reading ability?**

Methods

	Age	Gender F:M:Other	WJ Basic Reading Score*	TOWRE Index**	CTOPP Rapid Symbol Naming***
Adults (n=14)	25.4 (4.96)	7:6:1	101.3 (12.5)	107.2 (13.7)	—
Children (n=48)	10.0 (1.59)	24:24:0	99.6 (15.9)	94.2 (17.5)	85.2 (10.7)

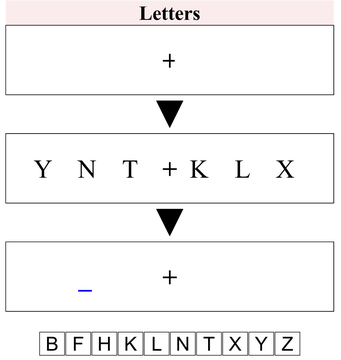
*Composite word and nonword reading scores
**Composite timed word and nonword reading scores
***Composite timed letter and digit naming scores

Participants completed a set of standardized reading assessments.

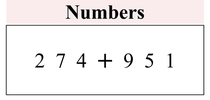
- Woodcock-Johnson IV (WJ)
- Test of Word Reading Efficiency (TOWRE)
- Wechsler Abbreviated Scale of Intelligence (WASI-II)
- Comprehensive Test of Phonological Processing (CTOPP-2)

Multi-Element Processing Task

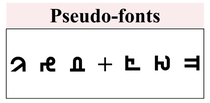
Letters



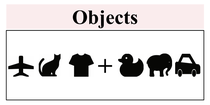
Numbers



Pseudo-fonts



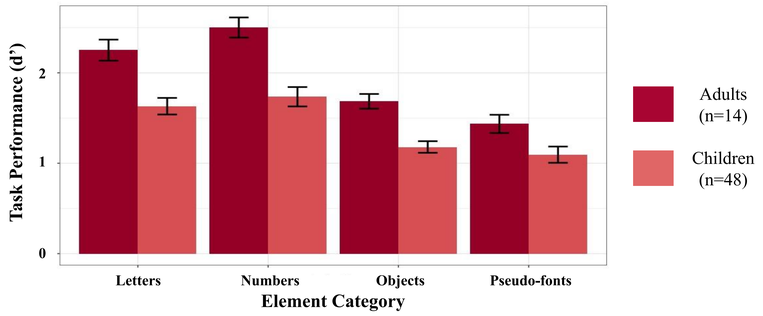
Objects



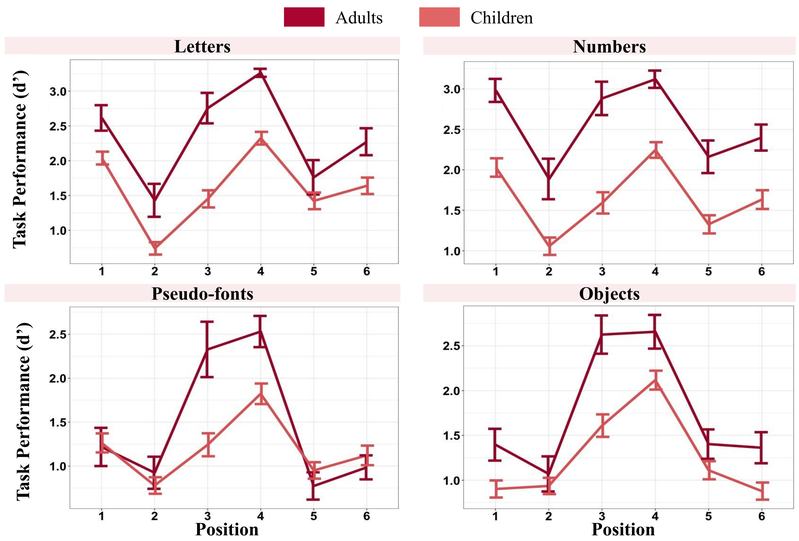
- A string of 6 elements flashed for 240ms.
- Participants were required to report the element in the post-cued position from a set of 10 choices.
- Eyes were tracked to ensure fixation while elements were present.
- Trials ended and were repeated after a fixation break.
- Target elements span +/-1.74° on either side of fixation.

Results

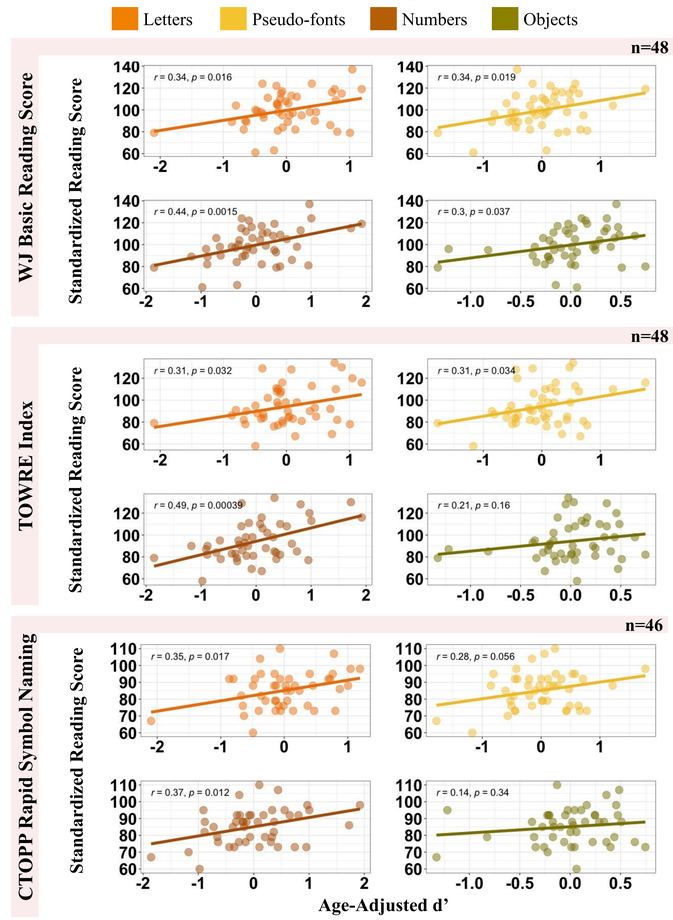
Task performance is highest for numbers, followed by letters, objects, and then pseudo-fonts.



For letters and numbers, the SPF is W-shaped; for objects, it is inverted U-shaped; and for pseudo-fonts, it is a shape in between.



There is a moderate but significant correlation between task performance across different elements and WJ basic reading scores for children.



Discussion and Conclusion

- While task performance does significantly increase with age, the shapes of each SPF remain the same for both adults and children.
- Similar to Tydgat and Grainger (2009), we observe that the SPF for objects (namable symbols) is inverted U-shaped. In addition, we observe that the SPF for pseudo-fonts (non-namable symbols) is a shape between that of letters and objects.
- Children show a moderate but significant correlation between task performance and reading ability (WJ) across all visual elements, suggesting that the processing of different visual elements may be related to reading ability. Notably, performance in the multi-object processing task showed no correlation with TOWRE and CTOPP while performance in the multi-pseudo-font processing task did correlate with TOWRE.
- We hypothesize that children (beginning readers) should process pseudo-fonts similarly to letters, whereas adults (skilled readers) should show no correlation between reading ability and task performance for objects and pseudo-fonts. A larger sample size of adult participants is necessary to report correlations.

Next Steps

1. Our goal is to administer this task to 180 children.
2. We aim to recruit more children with dyslexia to begin examining the impact that reading deficits may have on the ability to process all visual elements.

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References

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