Left Digit Effect in Atypical Number Line Estimation

Leah Vaidya, Sierra Eisen, Lauren Barragan, Selena Delgado, Sarah Hammond, Courtney Litts, Carolina Montano, Emily Newman, Sarah Aduke Ohiomah, Abby Wolk, Andrea Patalano, Hilary Barth

INTRODUCTION

Number line estimation (NLE) task focuses on magnitudes of targets, recent studies show that the leftmost digits influence estimates.[1]

left digit effect: numbers with similar magnitudes but different leftmost digits are placed too far apart on the number line. *E.g., Numbers like "698" are systematically placed too far to the left of numbers like "701" on a 0-1000 number line.*

We investigated these findings with a web-based task that includes both typical (0-1000) and atypical (238-1238) ranges, in both adults and children.

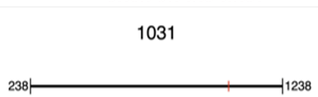
RESEARCH QUESTIONS

1) For a web-based version of the task, do estimates for a typical NLE range (0-1000) continue to exhibit a left digit effect (LDE)?
2) Does the LDE exist for an atypical (238-1238) range?
3) Is there a difference in the LDEs observed for typical vs. Atypical?

METHODS

Participants completed a number line estimation task either on an iPad (experiment 1a) or online (experiment 1b and 2):

"We're going to play a game with number lines. This number line goes from [0/238] on the left to [1000/1238] on the right. You will see a number and your job is to click where you think each number should go. A red mark will appear where you click on the line."



In order to measure the **LDE,** we calculated the average difference score for hundreds pair in each number line. The equation is the following:

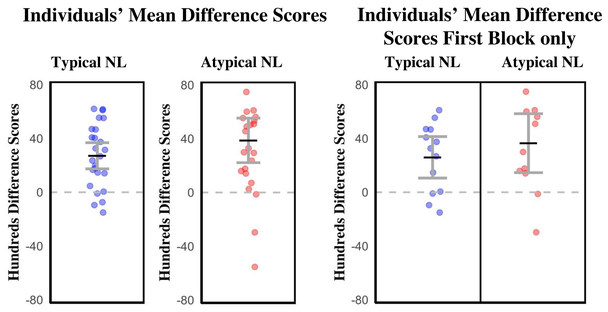
Difference score: ***(larger number placement - smaller numeral placement)***
Difference scores > 0 indicate a left digit effect

All analyses were preregistered.

RESULTS

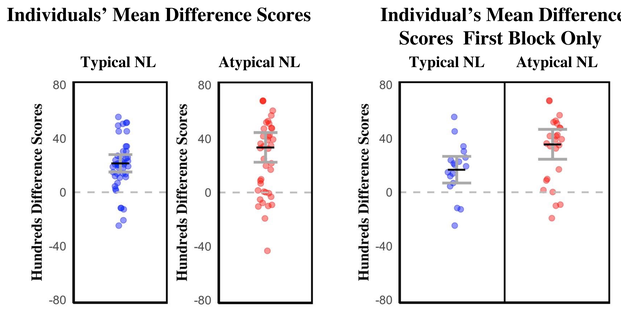
Difference scores greater than 0 indicate a significant left digit effect.

Experiment 1a:
Participants: 25 undergraduates



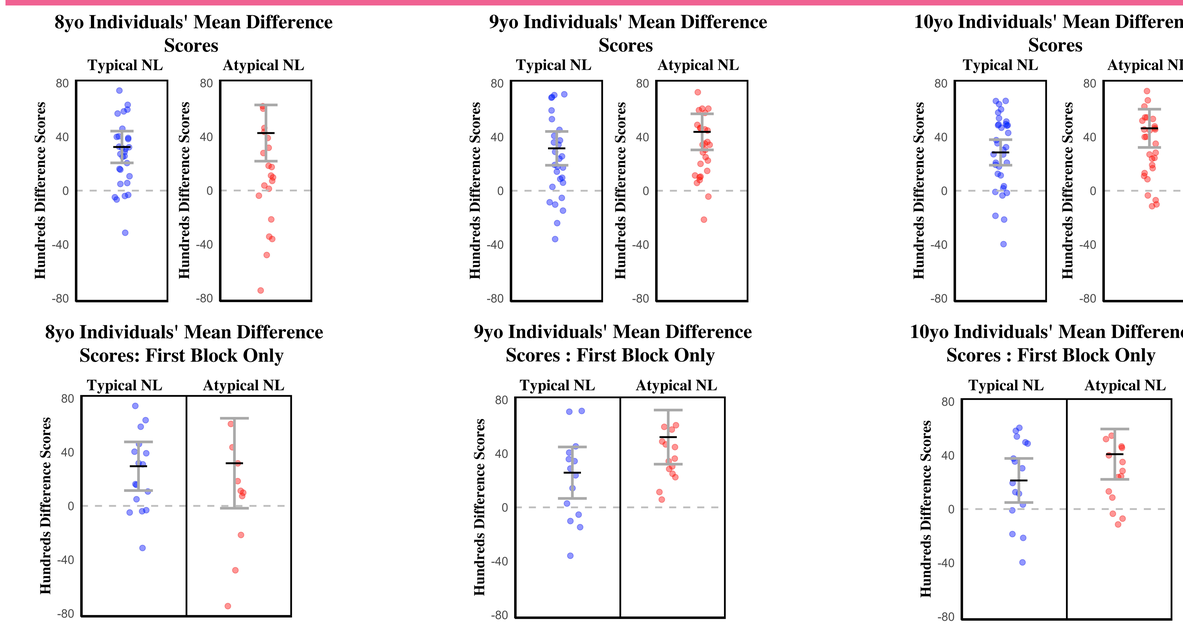
- Significant LDE for typical and atypical ($d = 0.965$)
- No significant difference in LDE between typical and atypical - Effect size was small

Experiment 1b:
Participants: 45 undergraduates



- Significant LDE for typical and atypical ($d = 0.999$)
- Significant difference in LDE between typical and atypical ($d = 0.913$)

Experiment 2:
Participants: 31 8-year-olds, 32 9-year-olds, and 34 10-year-olds



- Significant LDE for online version of typical across all ages (8-year-olds, $d = 0.750$; 9-year-olds, $d = 1.176$; 10-year-olds, $d = 1.139$)
- Significant LDE for online version of and atypical across all ages (8-year-olds, $d = 1.008$; 9-year-olds, $d = 0.904$; 10-year-olds, $d = 1.047$)
- No significant difference in LDE between typical and atypical across all ages

SUMMARY

- Findings from a web-based number line estimation task were consistent with findings from prior in-person studies, in both children and adults. Left digit effects do arise in a typical range (0-1000) number line estimation task in an online task format as they do for in-person task formats, with large effect sizes at all ages tested.
- Both adults and children ages 8-10 years old show left digit effects in atypical (238-1238) number line estimation tasks in online format. Adults also show left digit effects in atypical (238-1238) number line estimation tasks in an iPad task format.
- Adults show a greater left digit effect for the atypical range than a typical range in an online task.
- Children show no difference in left digit effect between the typical and atypical range in an online format.
- Our results suggest that left digit effect comes from individuals orienting themselves to a typical range and can be extended to the generality of left digit effect across task format (online vs. iPad) and number line range type (typical vs. atypical)

FUTURE DIRECTIONS

- What is/are the source(s) of the left digit effect in number line estimation?
- Does the left digit effect exist for atypical ranges with different scales?
- Is the left digit effect in number line estimation reduced or eliminated with feedback or motivational intervention?

REFERENCES

1) Lai, M., Zax, A., & Barth, H. (2018). Digit identity influences numerical estimation in children and adults. Developmental science, 21, e12657.