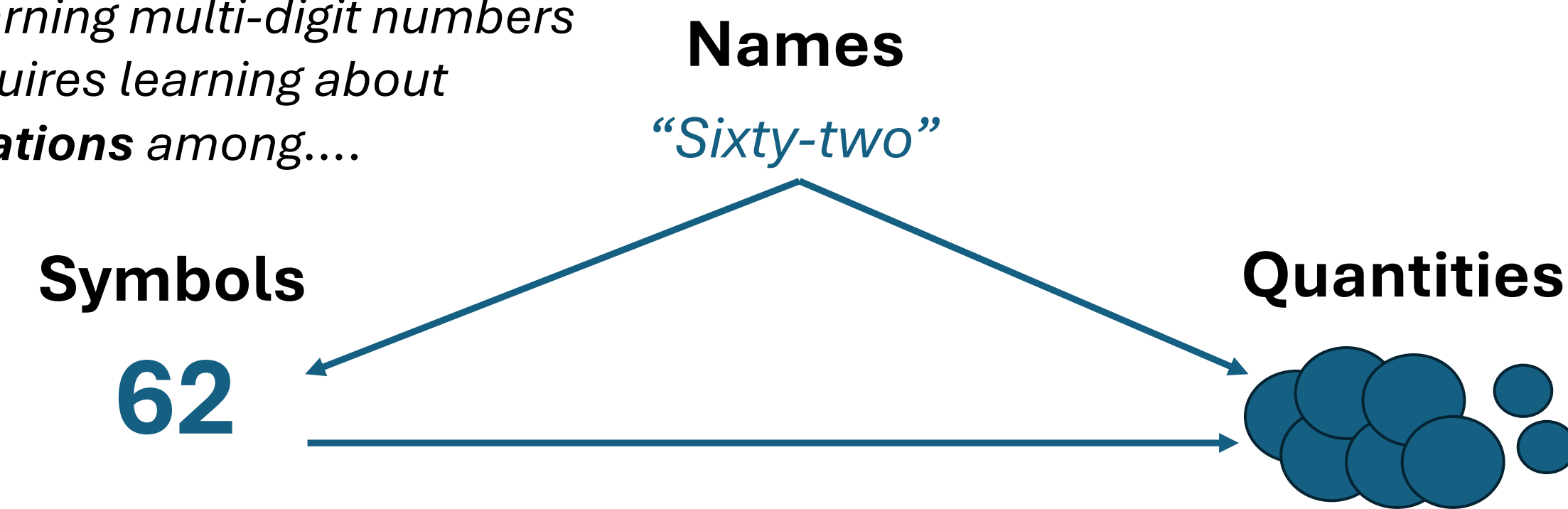


Background

Learning multi-digit numbers requires learning about **relations** among....



This learning process starts informally and unfolds distinctly for every child—shaping how they each learn & interact with formal instruction.

Research Question:

How does a child's early knowledge about multidigit numbers influence where they look and how they interact with learning materials during instruction?

Methods

4 Day Summer Camp Study at DEL Lab, CU Boulder in 2024

Participants: N = 27, 4- to 6-year-olds (mean age = 5.34, N of males = 20)

Pretest (and post-test) (3 tasks)

Which-is-N

89 79 98

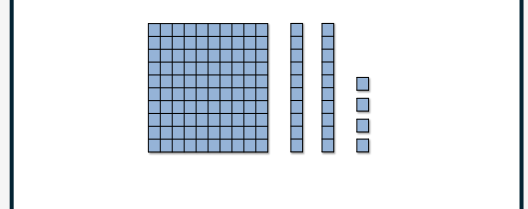
Which number is eighty-nine?

Which-N-has

5 52 525

Which number has five tens?

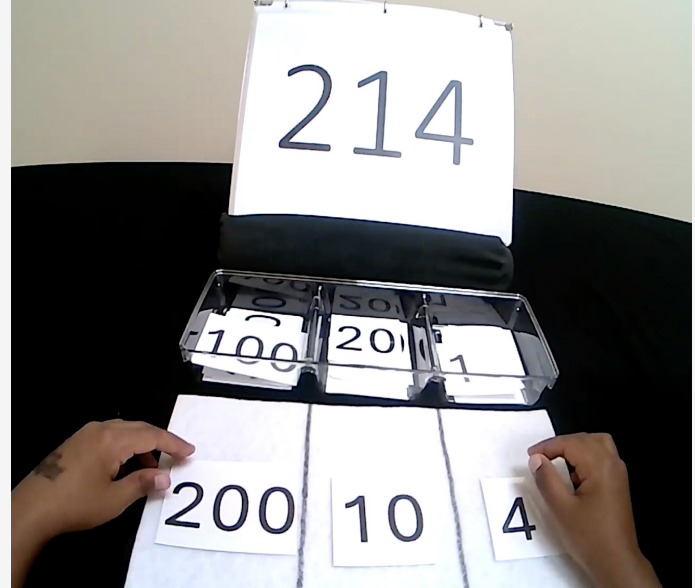
Base-10 Counting



How many small squares are on this page?

Instruction Phase (2 tasks)

Expanded Number Cards



Counting Across Units

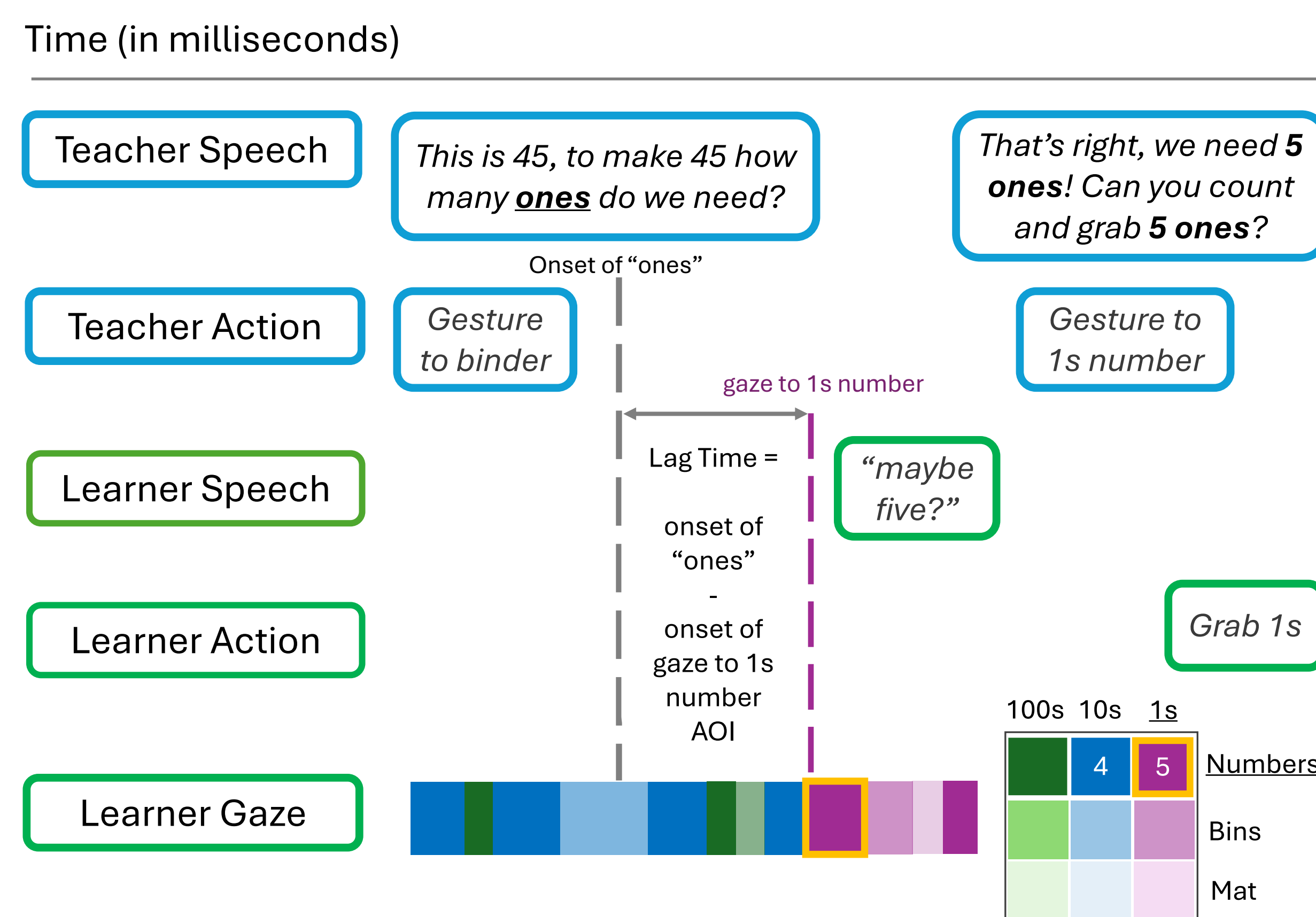


Areas of Interest (3x3):

100s	10s	1s
	4	5

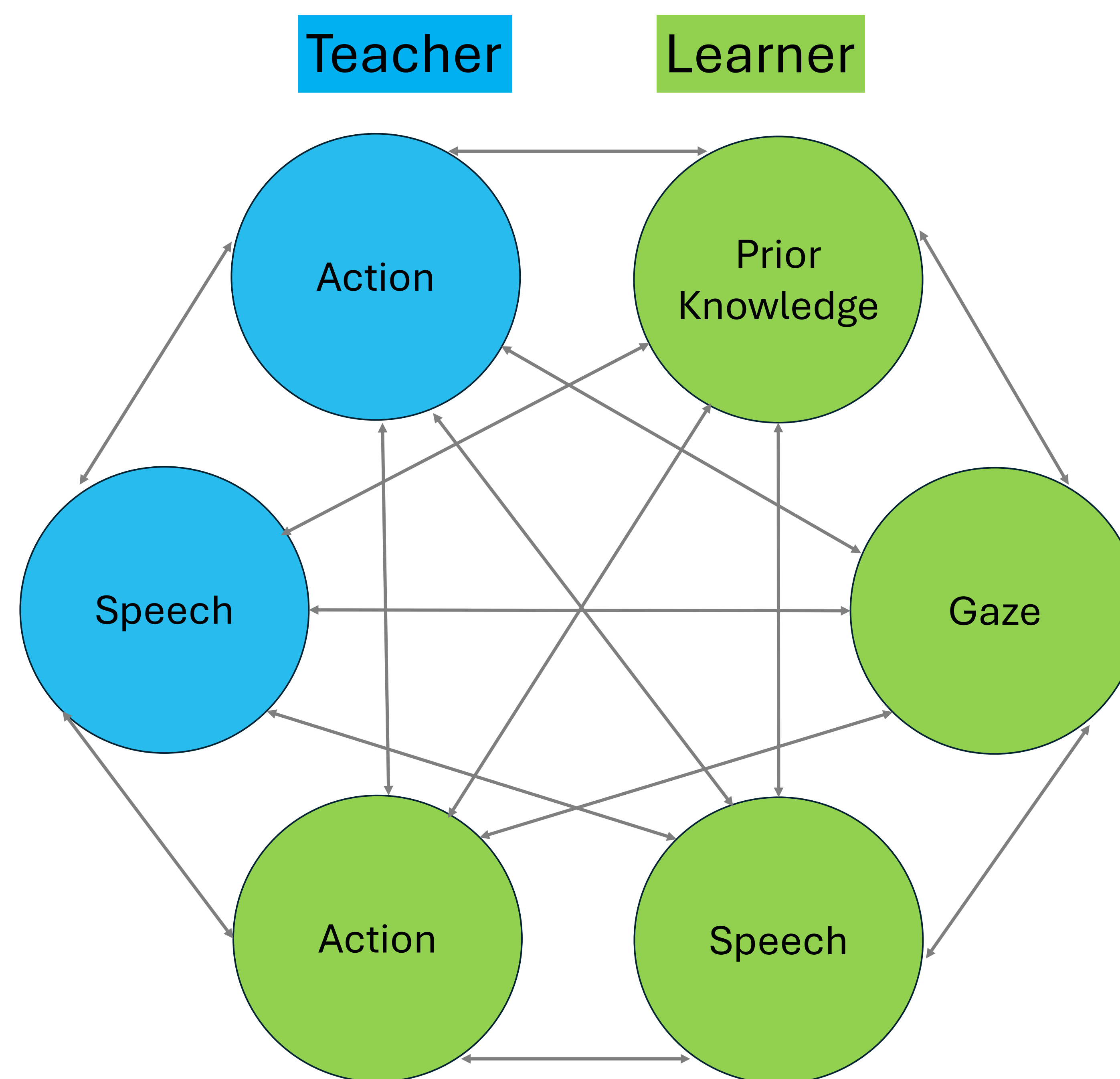
Numbers
Bins
Mat

Analyzing child-teacher interactions during instruction:



Lag Time → How long each child takes to look at a target # (100s, 10s, 1s)

Identifying individual differences in early learning involves measuring a dynamic system of interactions between teacher & child

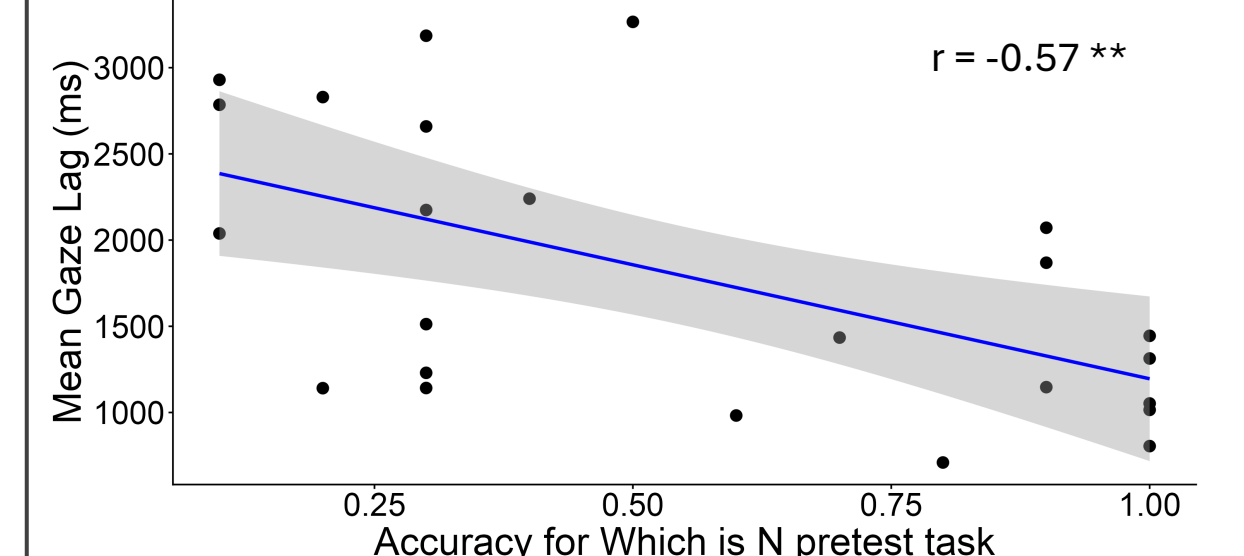


Children's eye movements can reflect their progress in learning about multi-digit numbers

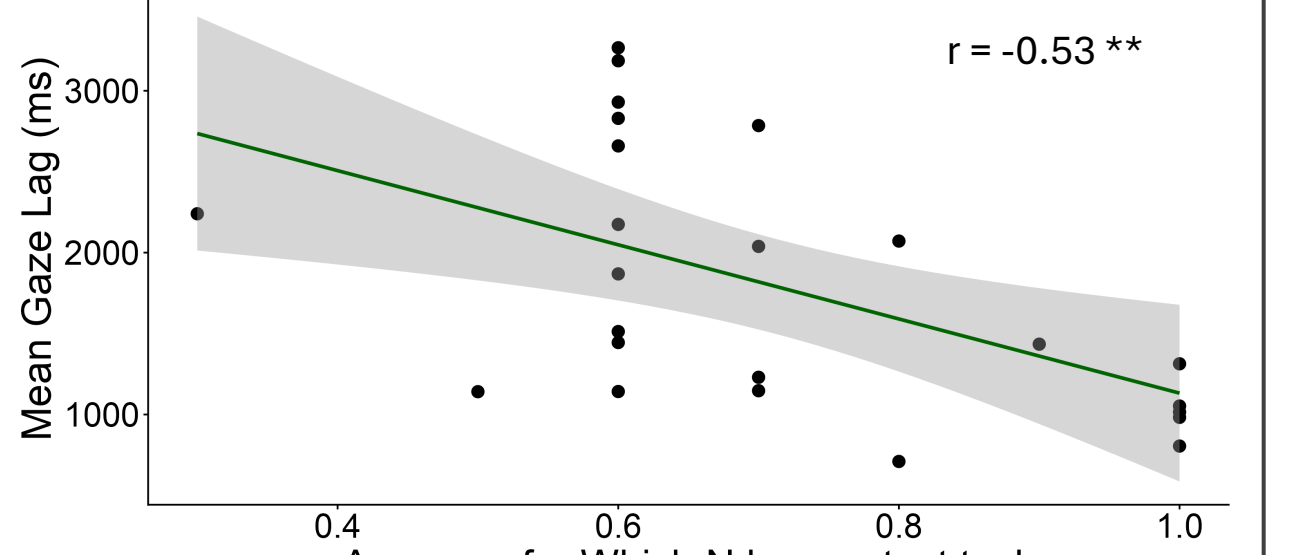
Preliminary Results

Greater prior knowledge at pretest → more efficient gaze to target number positions (100s, 10s, 1s) during instruction

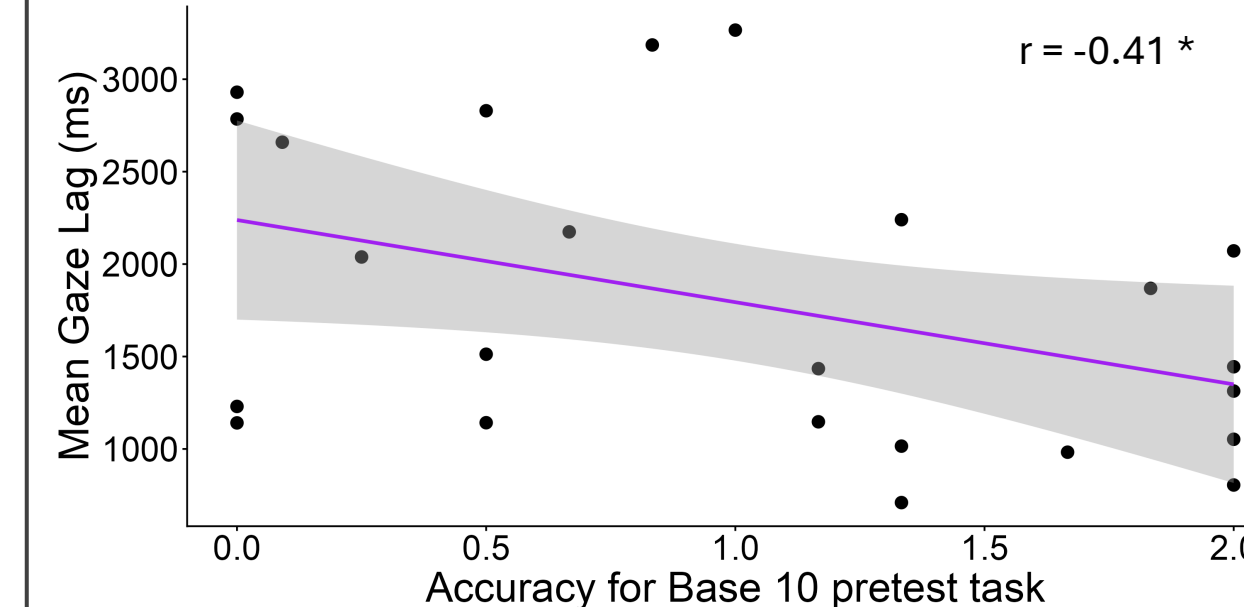
Which-is-N Accuracy by Lag Time



Which-N-has Accuracy by Lag Time



Base-10 Accuracy by Lag Time



Implications for STEM Learning



Children's early place value understanding predicts later calculation success in school (Mix et al., 2023).

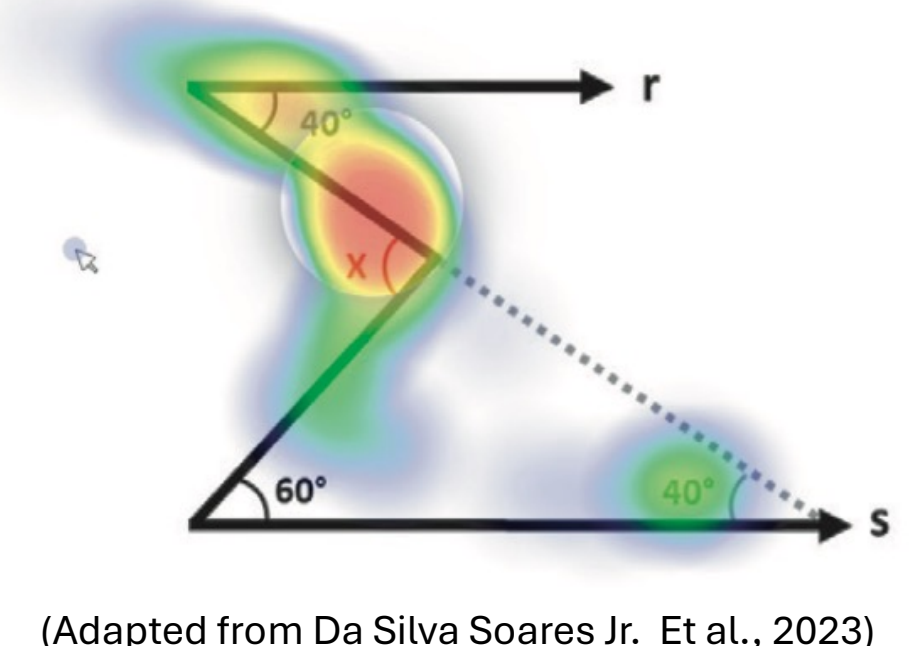
Measuring how **individual differences** emerge in early multi-digit number learning can inform how we design effective educational materials and instruction

& help us understand how these differences continue to shape learning across the lifespan in STEM fields like:

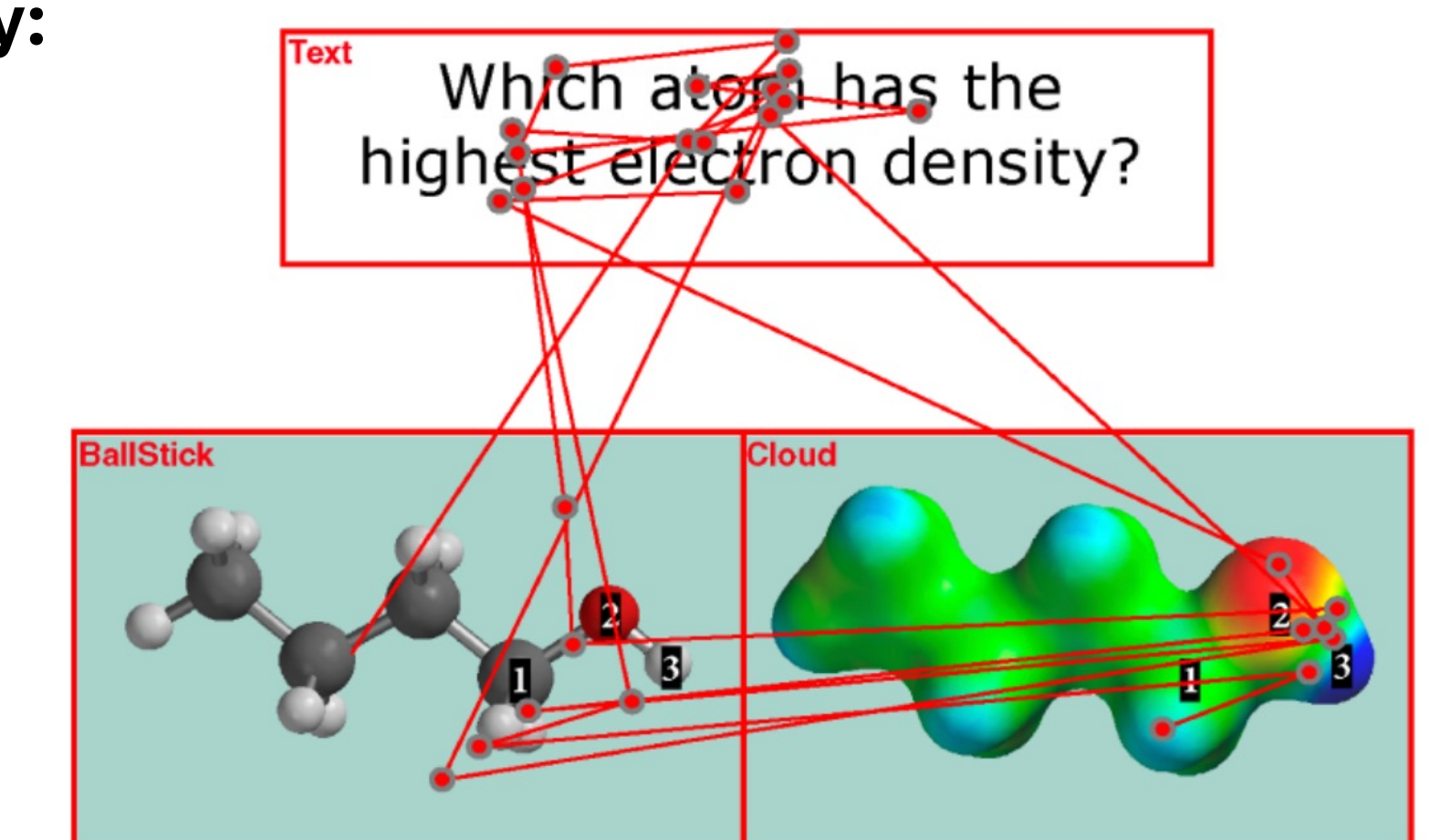
Mathematics:

You must calculate the value of x and say out loud which is the correct alternative:

- x = 40°
- x = 80°
- x = 90°
- x = 100°



Chemistry:



References: [1] Da Silva Soares Jr., R., Barreto, C., & Sato, J. R. (2023). Perspectives in eye-tracking technology for applications in education. *South African Journal of Childhood Education*, 13(1), a1204. [2] Mix, K. S., Bower, C. A., Yuan, L., Hancock, G. R., & Smith, L. B. (2023). Predictive relations between early place value understanding and multidigit calculation: Approximate versus syntactic measures. *Educational Psychology*, 43(7), 795–813. [3] Williamson, V. M., Hegarty, M., Destongchamps, G., Williamson, K. C. III, & Shultz, M. J. (2013). Identifying student use of ball-and-stick images versus electrostatic potential map images via eye tracking. *Journal of Chemical Education*, 90(2), 159–164.