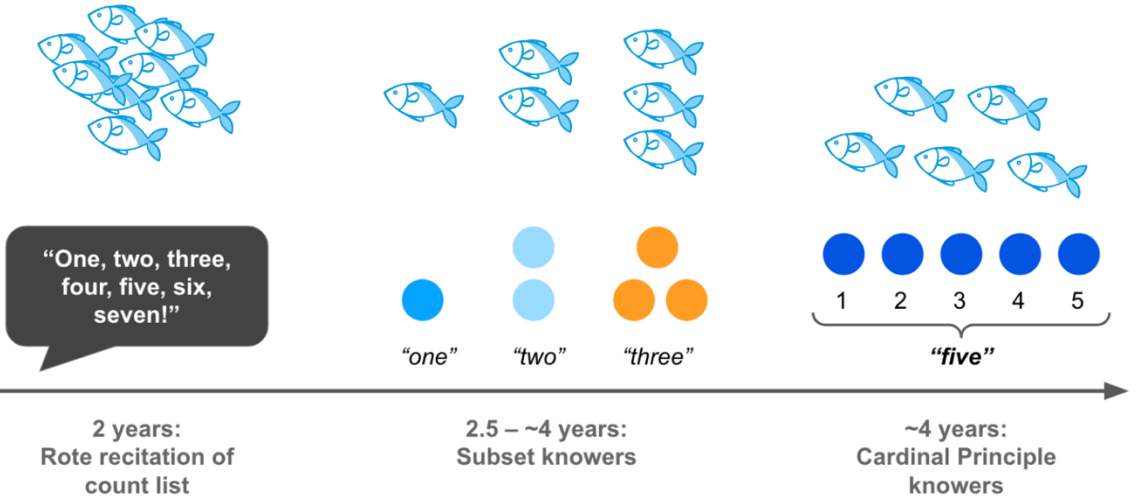


# ‘Five’ is the Number of Bunnies and Hats: Children’s Understanding of Cardinal Extension and Exact Number

Khuyen N. Le, David Barner  
University of California, San Diego

## Background

- Children understand numbers through a developmental trajectory:



- Need to integrate reasoning about sets and number words.
- Cardinal Extension (CE)** investigates this understanding.

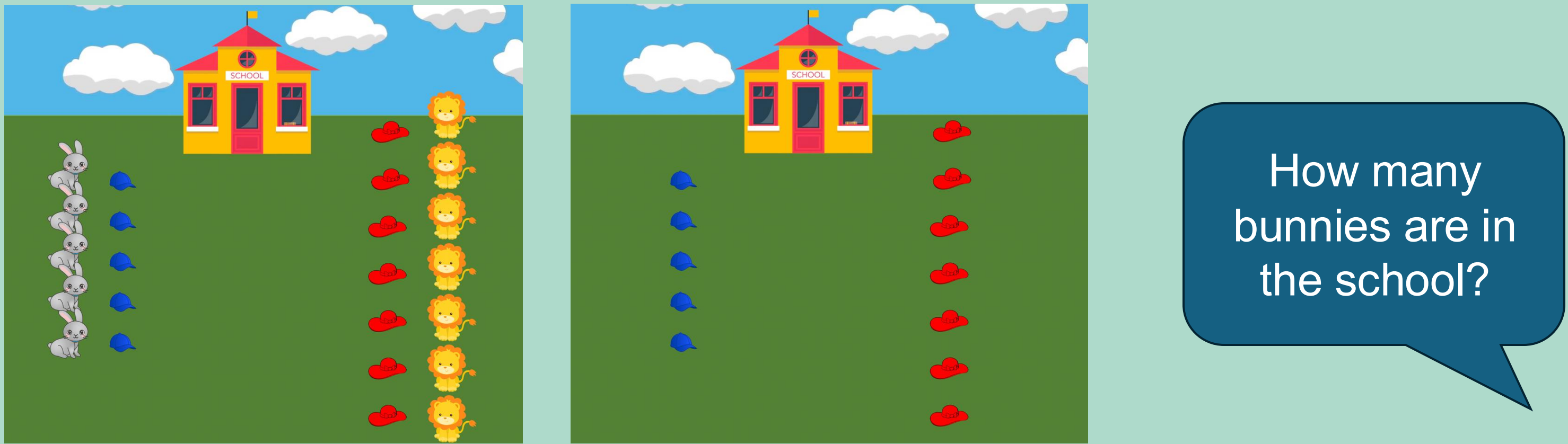
## Research Questions

- When do children acquire CE?
  - As they learn their first number words (as subset-knowers)<sup>1</sup>
  - At, or after learning the Cardinal Principle (as CP-knowers)<sup>2 3</sup>
- How do children extend number words between sets?
  - By reasoning about approximate quantities of sets.
  - By noticing that sets in one-to-one correspondence are equinumerous.

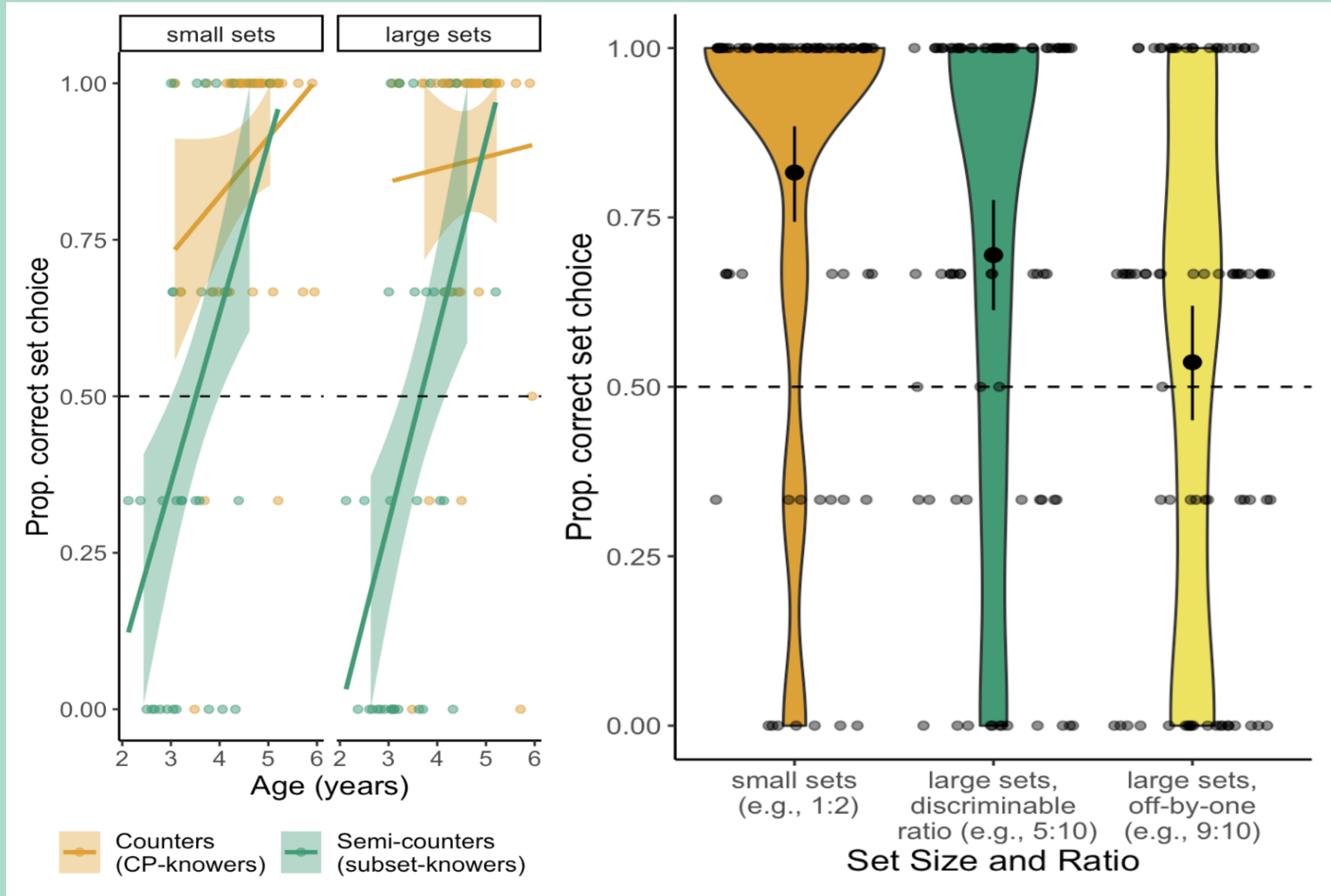
## Contact Information

Khuyen N. Le ([khuyenle@ucsd.edu](mailto:khuyenle@ucsd.edu))  
**UC San Diego** Language and Development Lab

**Cardinal Extension (CE):** the same number word can be used to label **equinumerous** sets.



Children acquire CE **after understanding counting** (becoming Cardinal Principle-knowers), but extend number words based on **approximate, not exact** equality.



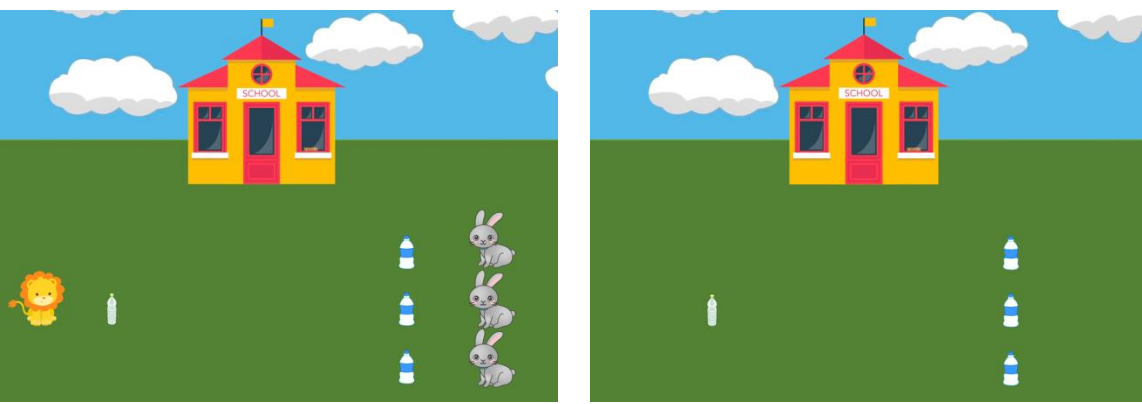
## Methods

- English-speaking 2;0 – 5;11 yos
- Study 1: n = 82 (38 subset-knowers, 44 CP-knowers).
  - Study 2: n = 78 CP-knowers.

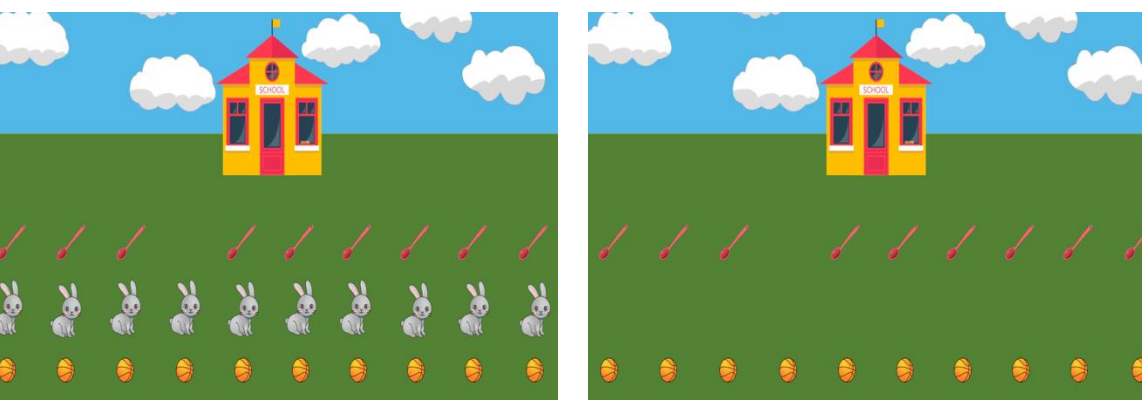
**Give-A-Number:** measure largest set children can construct, classify children into subset- and CP-knowers (CP-knowers can construct sets of 5/6).

**Highest Count:** measure highest number children count to, general proxy of counting experience.

**Cardinal Extension:**  
Study 1:



Study 2:



## Other Results

- Variability in children who understand counting (CP-knowers), not explained by **age** or **highest count**.
- Children might attempt to count the correct set but fail to give accurate numerical response → consideration for future studies.

## Future Directions

- When do children **compare sets** and **extend number words** based on exact equality?
- What factors explain **variability** in CP-knowers?

## References

<sup>1</sup>Sarnecka, B. W., & Gelman, S. A. (2004). Six does not just mean a lot: Preschoolers see number words as specific. *Cognition*, 92(3), 329-352.  
<sup>2</sup>Carey, S. (2009). Where our number concepts come from. *The Journal of philosophy*, 106(4), 220  
<sup>3</sup>Davidson, K., Eng, K., & Barner, D. (2012). Does learning to count involve a semantic induction?. *Cognition*, 123(1), 162-173.