



Investigating Effects of Manipulating Play Materials and Game Contexts on Parent-Child Math Talk

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Background

- Number-related activities at home contribute to variability in preschoolers' numerical knowledge. (Ramani et al., 2015)
 - Both direct math activities and indirect activities predict math outcomes, even when controlling for SES.
- Different types of parental number talk have different impacts on child's later cardinal number knowledge (Gunderson, 2011; Elliott et al., 2017)



Ways to Increase Parental Math Talk

- Explicitly direct parents’ attention to the opportunities for discussing math (e.g., Braham et al., 2018) and to scaffold their interactions with prompts or guidance (e.g., Hanner et al., 2019);
- Training parents to support early math learning (e.g., Berkowitz et al., 2015; He et al., 2022; Hojnoski et al., 2014)

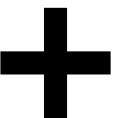
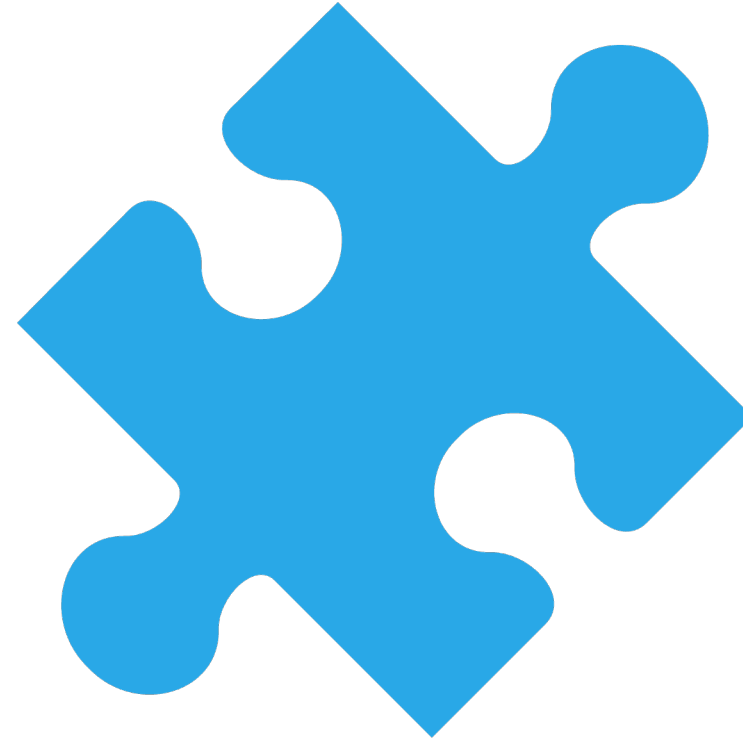
However...


- labor- and time-intensive;
- limits the generalizability and potential to scale up;
- did not look into the impact on children’s math talk.



Research Question

Can features of play materials and game contexts implicitly influence the type and amount of numerical input parent-child dyads generate during play?





Cognitive Alignment
Framework
(Laski & Siegler, 2014)

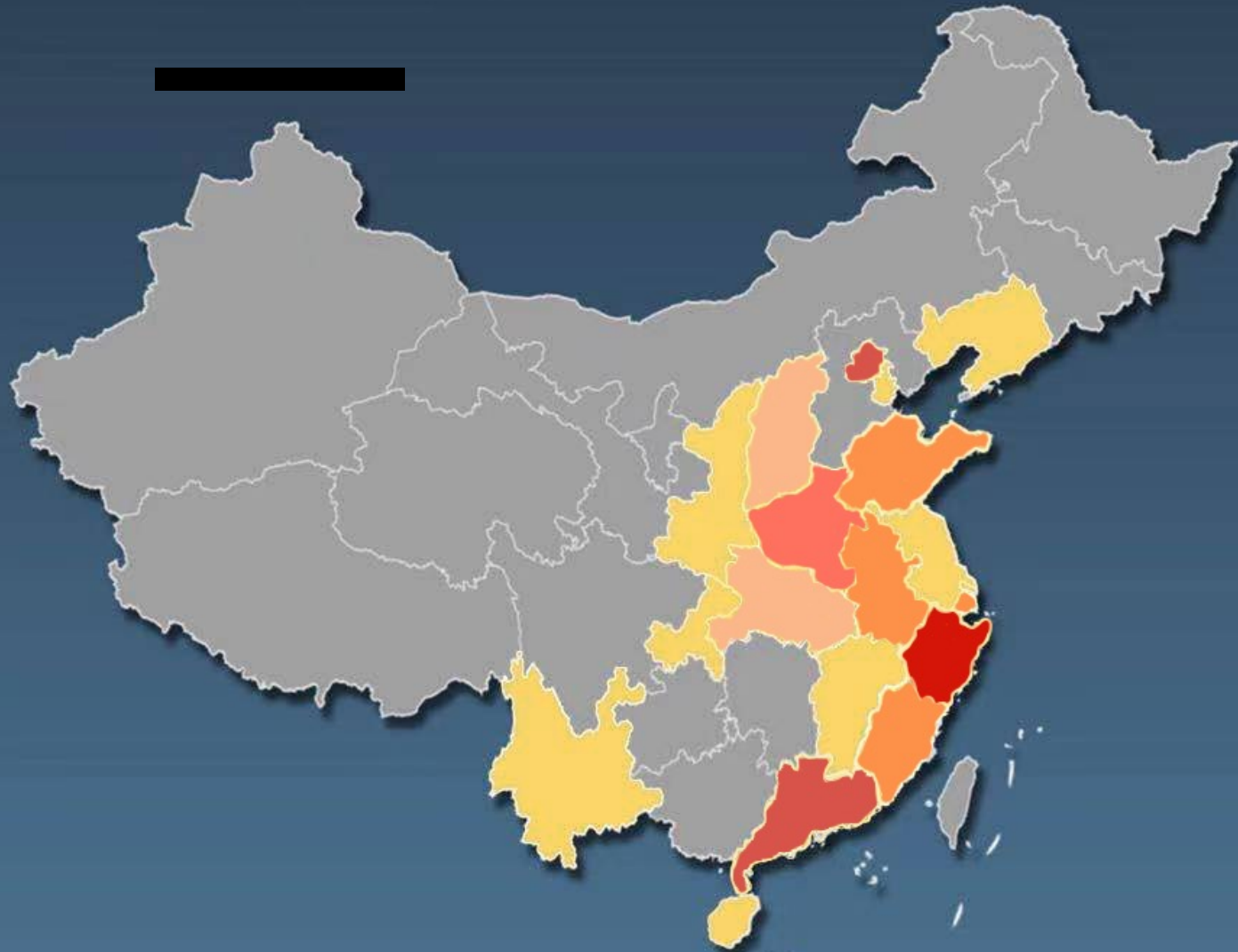
Highlight the importance of
aligning the features of
materials to desired learning
outcomes to enhance learning.



Hypotheses

- Identical, as opposed to perceptually distinct objects, may elicit the discussion of *absolute magnitude* (i.e., unique quantities of a given number);
- Presenting quantities within a bounded range may elicit the discussion of *relative magnitude* (i.e., relations among numbers);
- Contexts commonly associated with math talk (e.g., grocery shopping) would elicit a greater amount and diversity of number talk.





Participants

- 75 parent-child dyads (36 girls, 38 boys; $M_{age}=5.1$ years) from different regions of China (18 provinces, 35 cities);
- Parents (59 mothers, 15 fathers) varied in the amount of education from 12 years (high school diploma) to 20 years (graduate degree) ($M=16$ years).

北京 上海 天津 重庆 无锡 杭州 宁波 湖州 绍兴 金华







Procedure

- 3(between-subject conditions)*2(within-subject games) factorial design;
- Participants were randomly assigned to one of the three conditions, which varied in the characteristics of play materials;

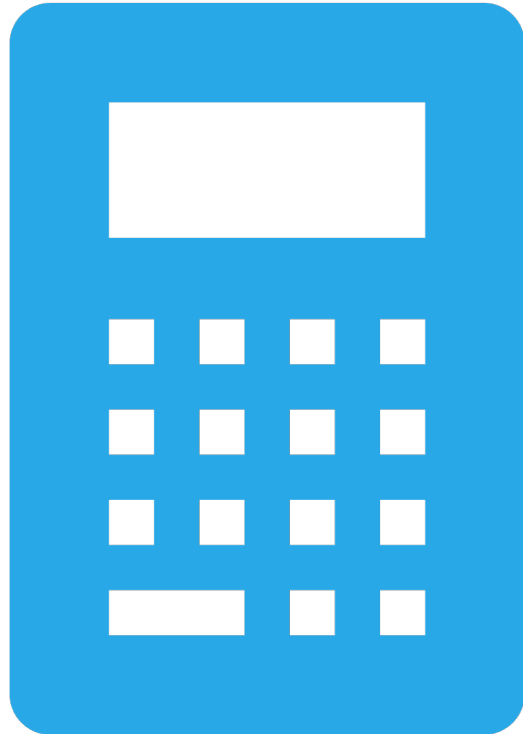


Game Context

Condition

	Unique Objects/ Unbounded Range	Homogeneous Sets/ Unbounded Range	Homogeneous Sets/ Bounded Range
Party Preparation	 <p>Prepare a food platter using 15 unique items and no constraint on how many items can be used</p>	 <p>Prepare a food platter using 5 sets of identical items and no constraint on how many items can be used</p>	 <p>Prepare a food platter using 5 sets of identical items <u>but</u> with the constraint that only up to 10 items can be used</p>
Grocery Shopping	 <p>Purchase food for a party selecting from among 15 unique items and no constraint on how many items can be used</p>	 <p>Purchase food for a party selecting from among 5 sets of identical items and no constraint on how many items can be used</p>	 <p>Purchase food for a party selecting from among 5 sets of identical items <u>but</u> with the constraint that only up to 10 items can be purchased</p>





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Amount of Math Talk

Diversity of Math Talk

Absolute Magnitude

Relative Magnitude

Results: Numeric Tokens

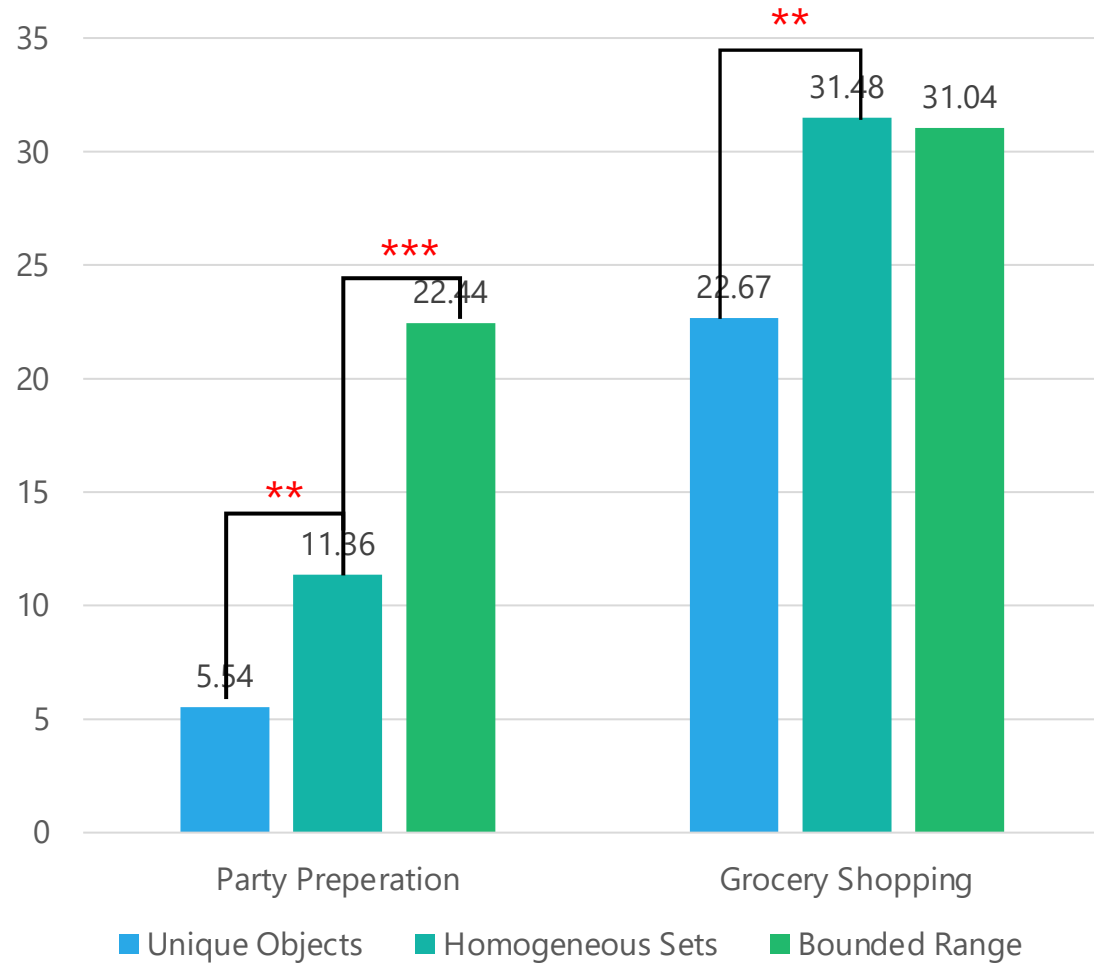


Figure 1a. Mean Number of Math-Related Utterances (Parents)

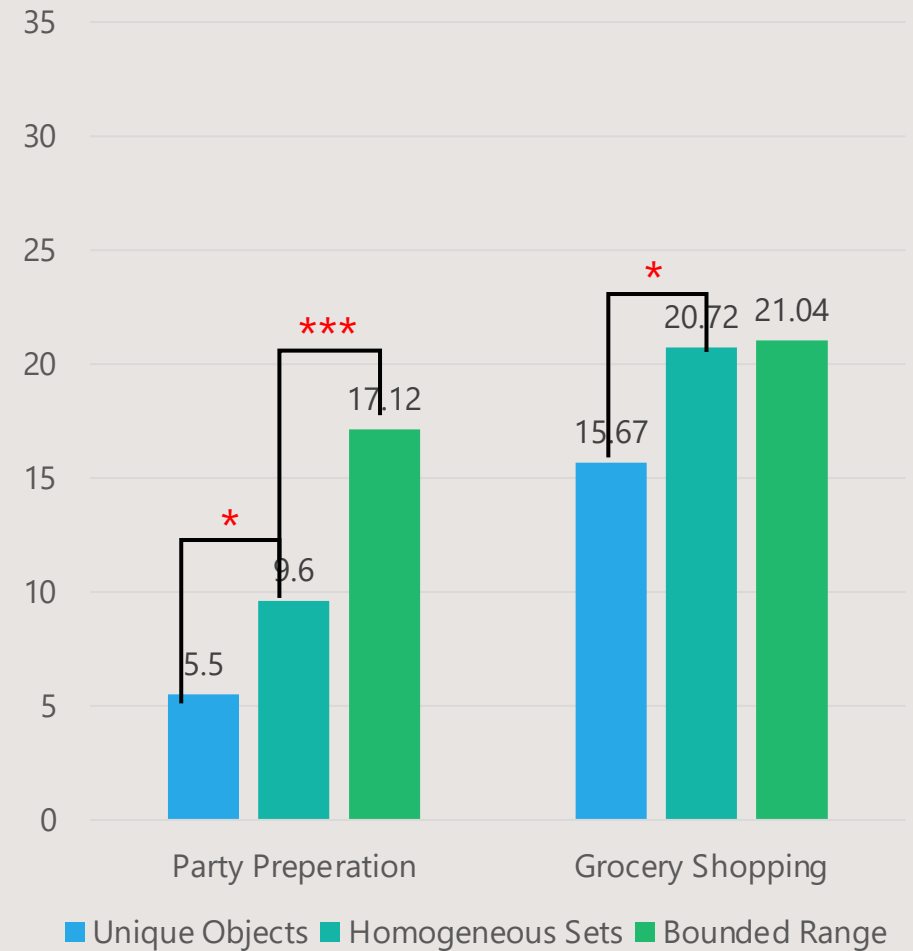


Figure 1b. Mean Number of Math-Related Utterances (Children)



Results: Numeric Types

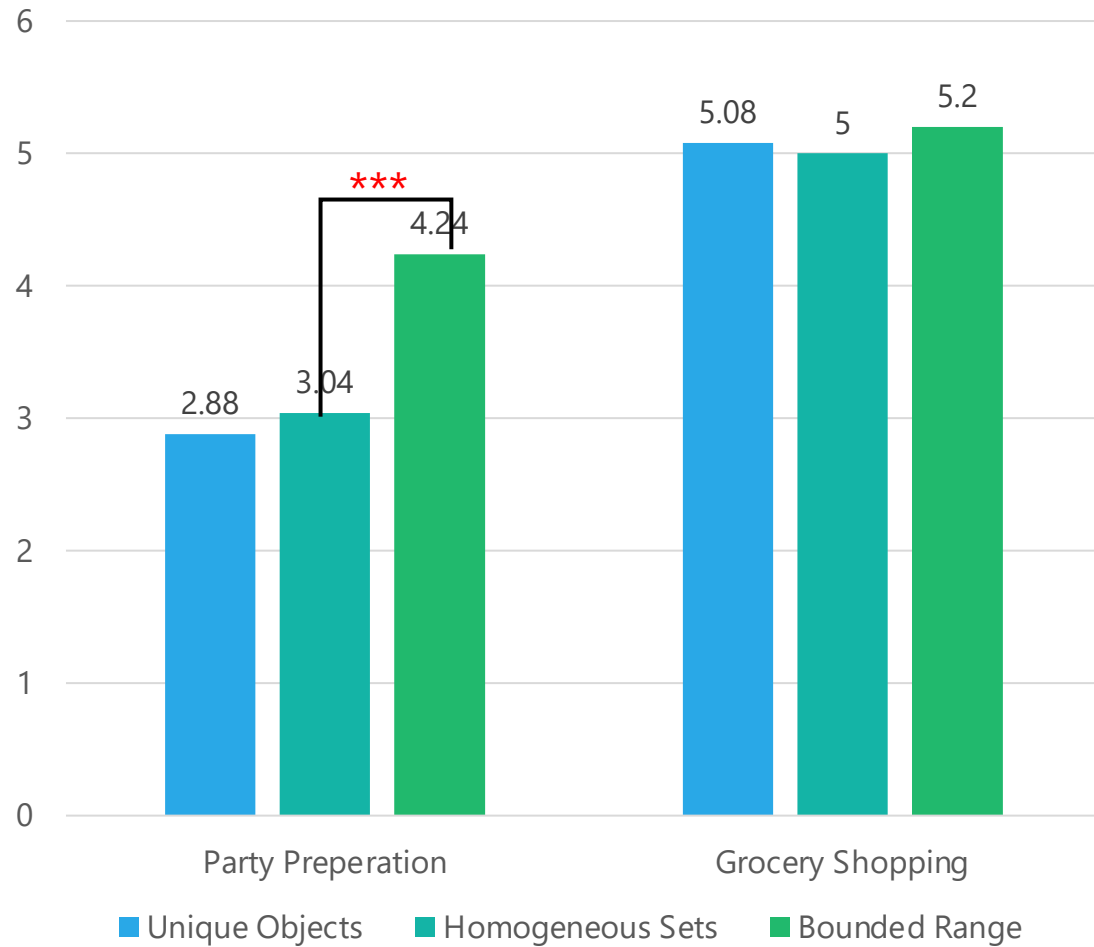


Figure 2a. Mean Number of Different Types of Math Talk (Parents)

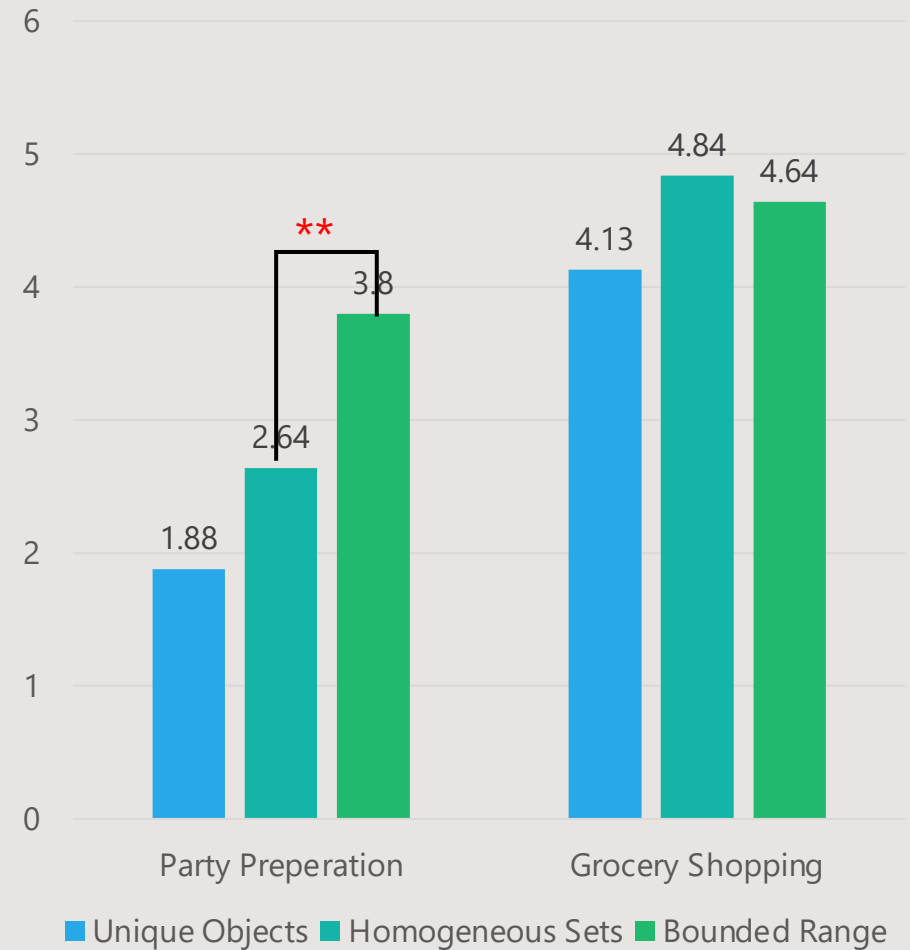


Figure 2b. Mean Number of Different Types of Math Talk (Children)



Results: Absolute Magnitude

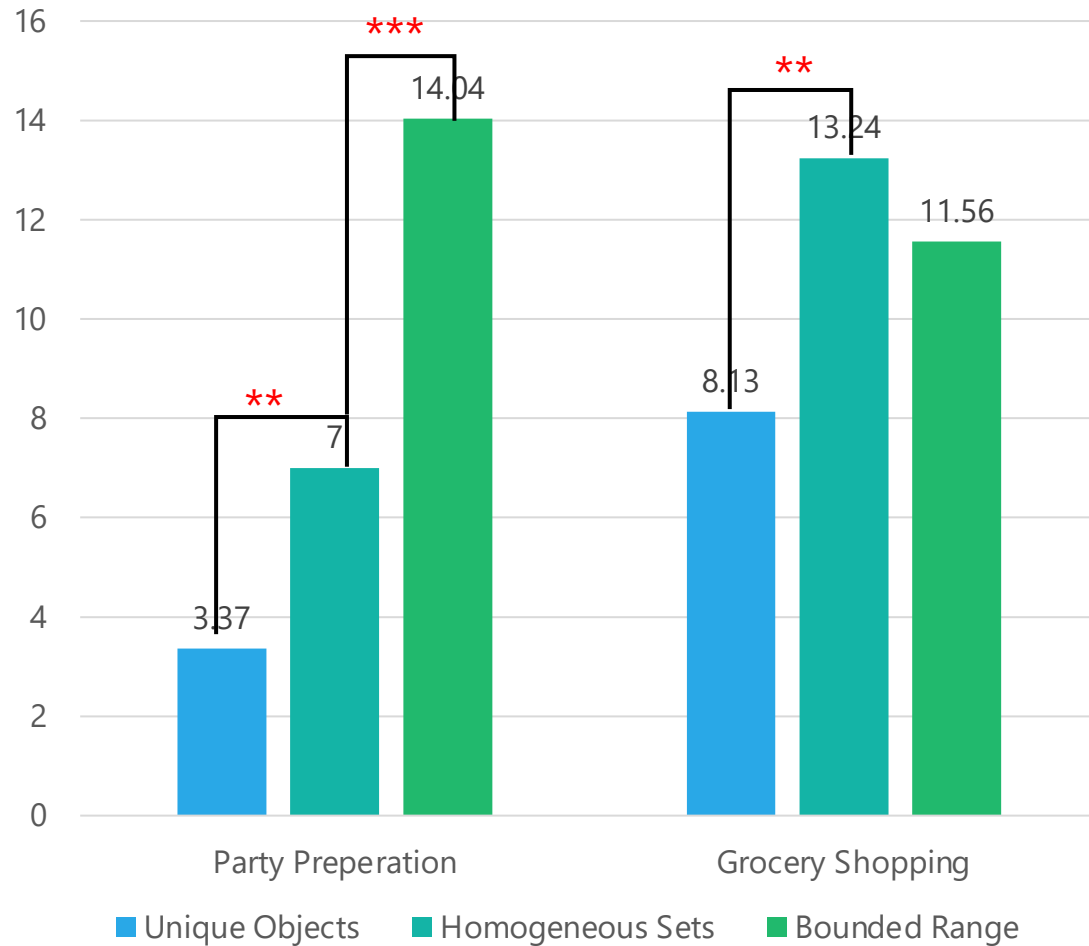


Figure 3a. Mean Number of Absolute Magnitude Talk (Parents)

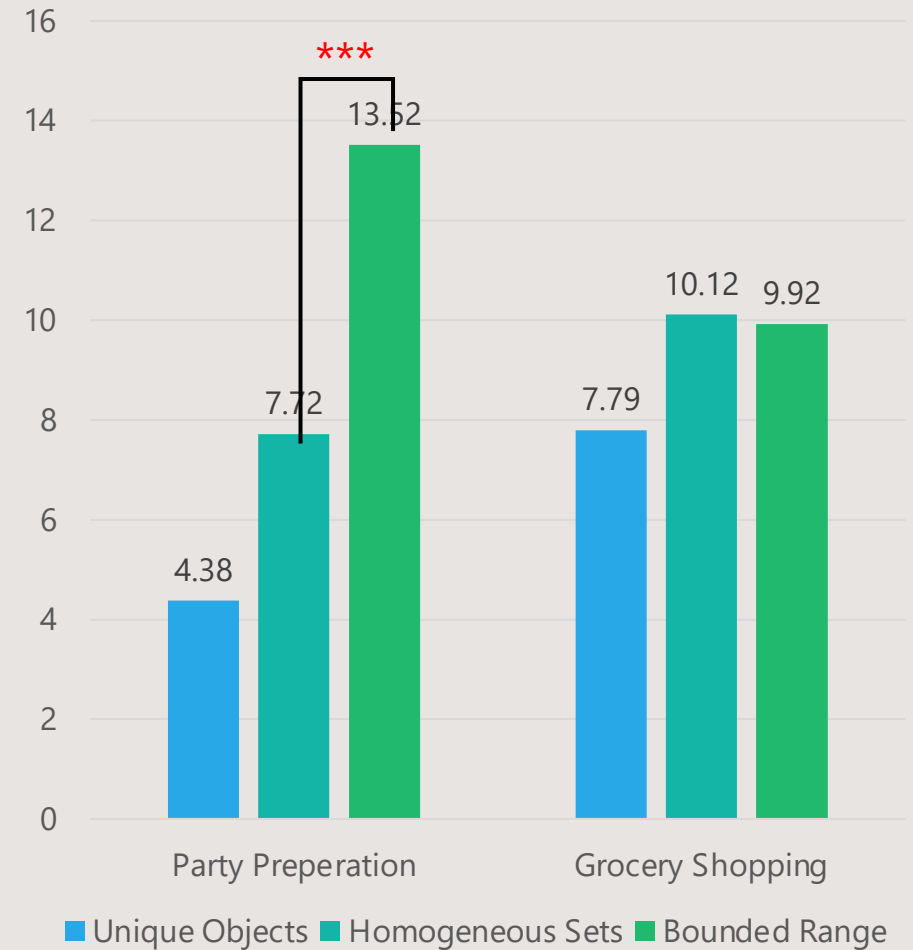


Figure 3b. Mean Number of Absolute Magnitude Talk (Children)



Results: Relative Magnitude

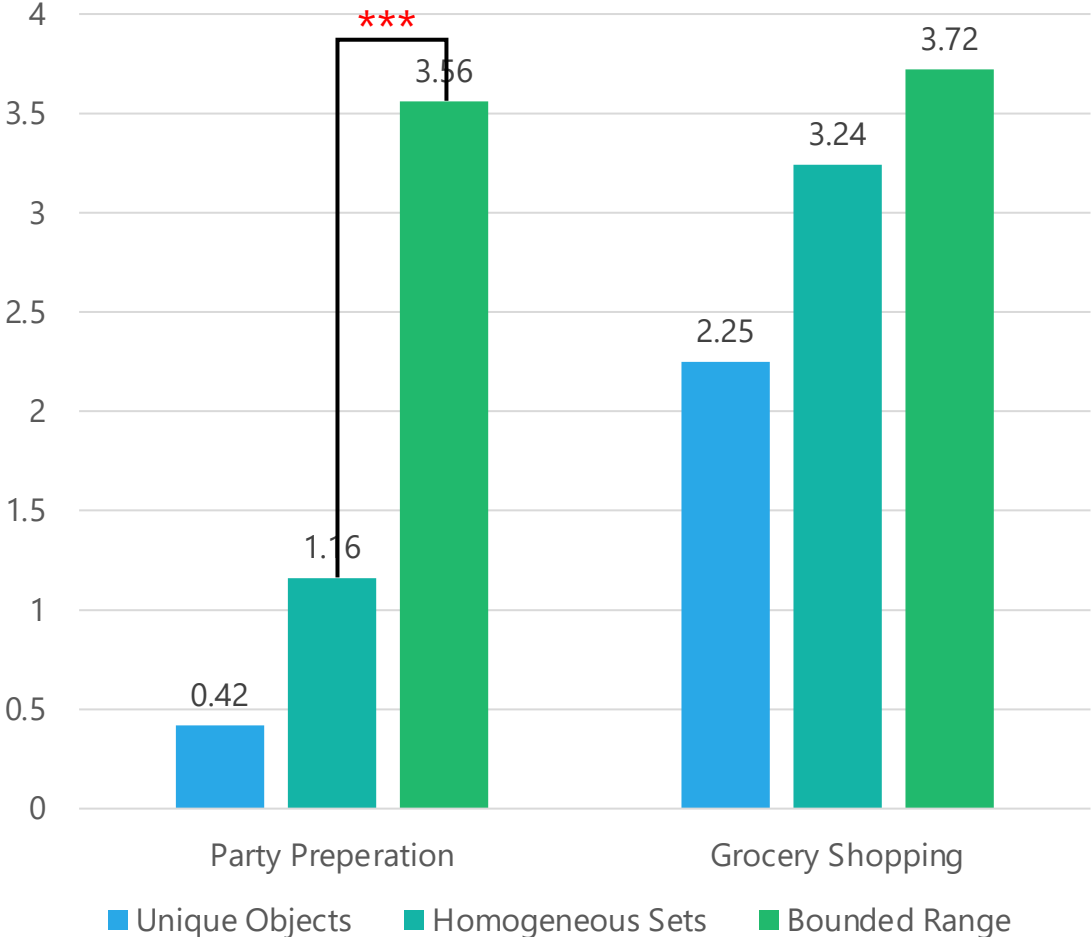


Figure 4a. Mean Number of Relative Magnitude Talk (Parents)

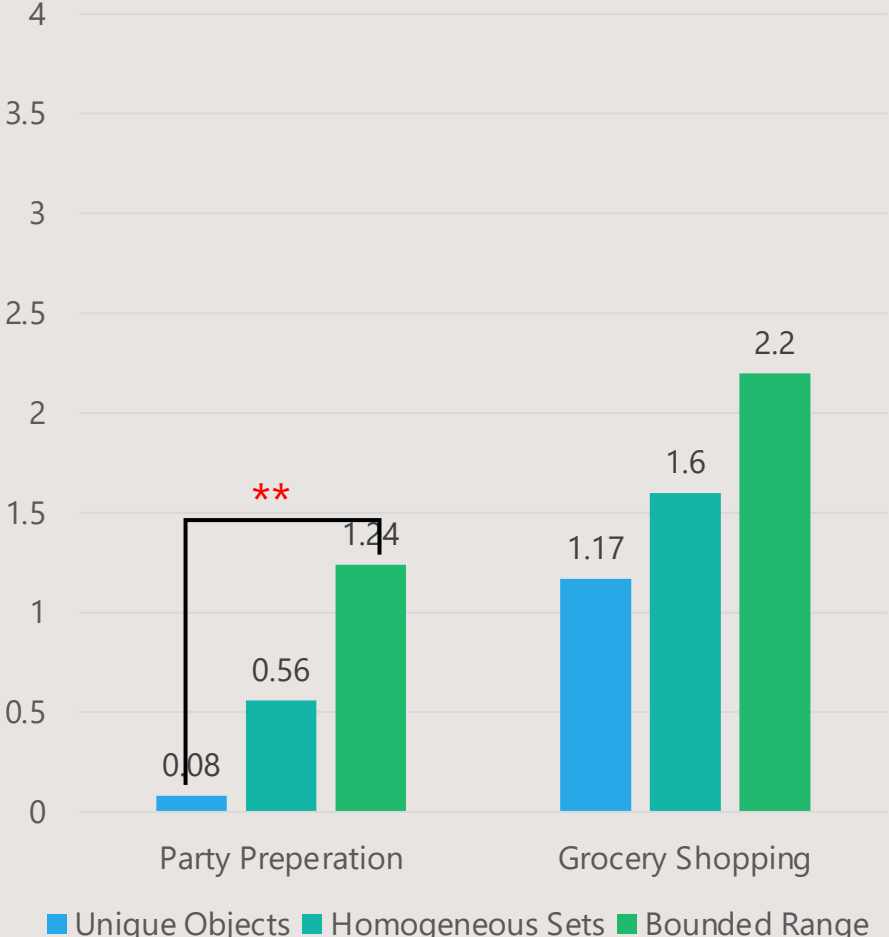


Figure 4. Mean Number of Relative Magnitude Talk (Children)



Summary

Relation Between Parent-Child Math Talk

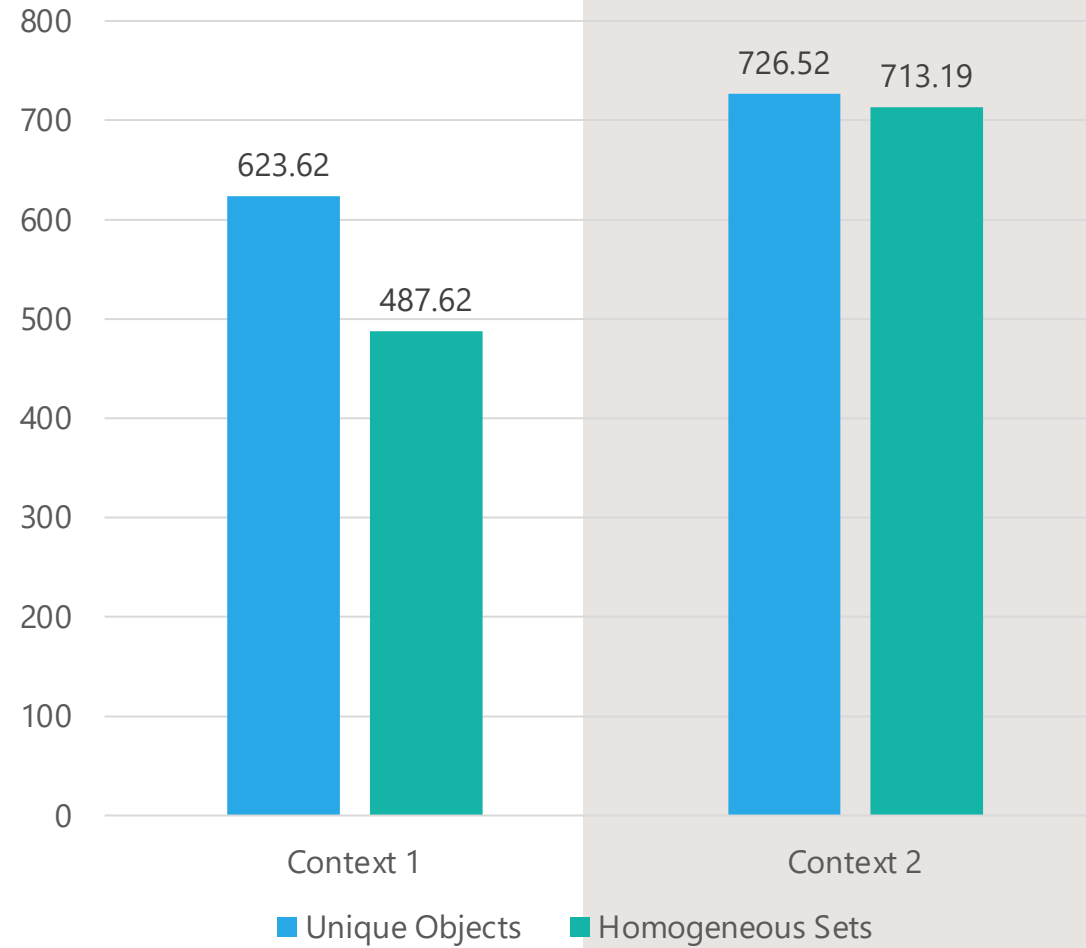


*Does the impact of materials persist
one month later?*

- Dyads played two games using the same materials;
- No restrictions on the context and duration of the games.



Duration of the Games (in seconds)



*Figure 5. Duration of the game (seconds) in session 2
N=42 (Unique Objects & Homogeneous Sets conditions);*



Results: Total Math Talk (Session 2)

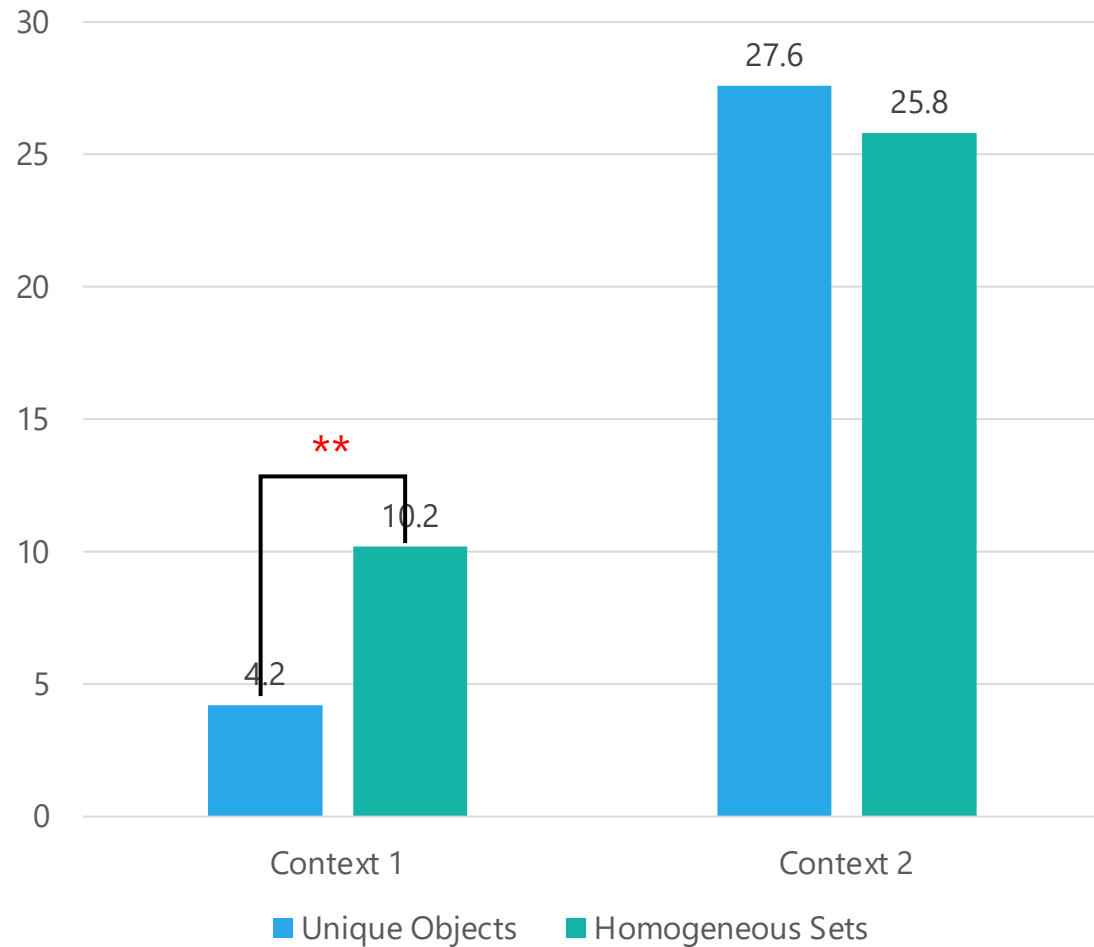


Figure 6a. Mean Number of Total Math Talk (Parent)

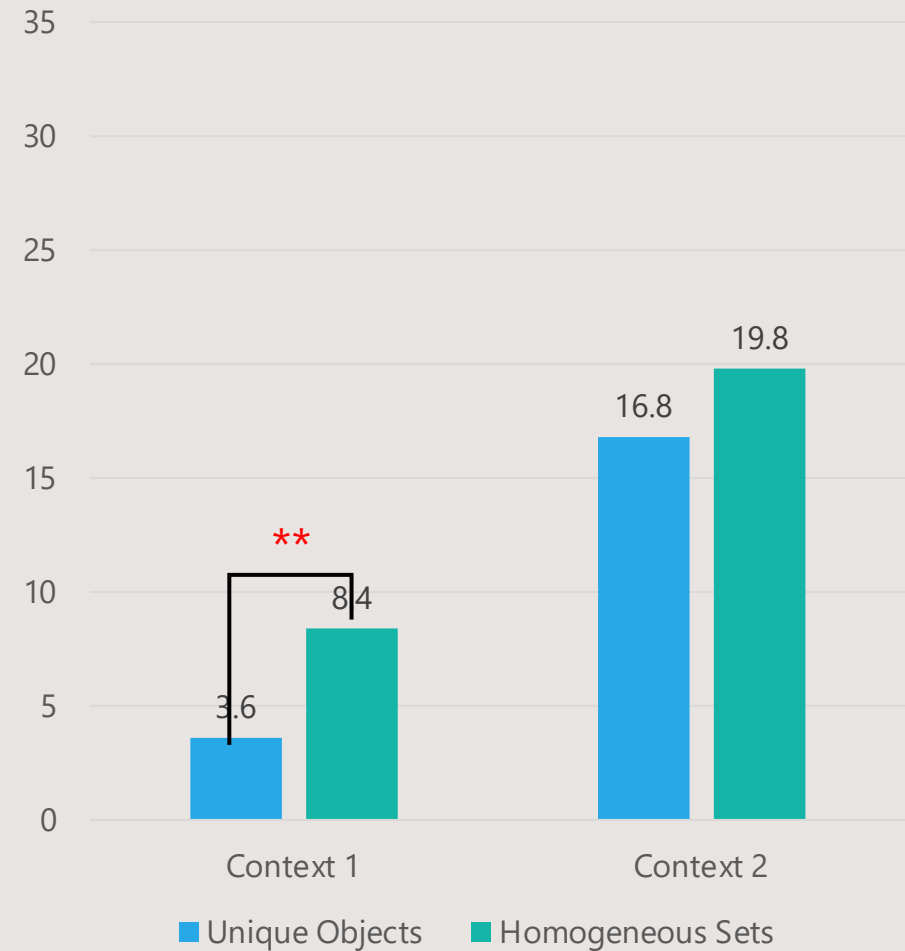


Figure 6b. Mean Number of Absolute Magnitude Talk (Children)

Results: Absolute Math Talk (Session 2)

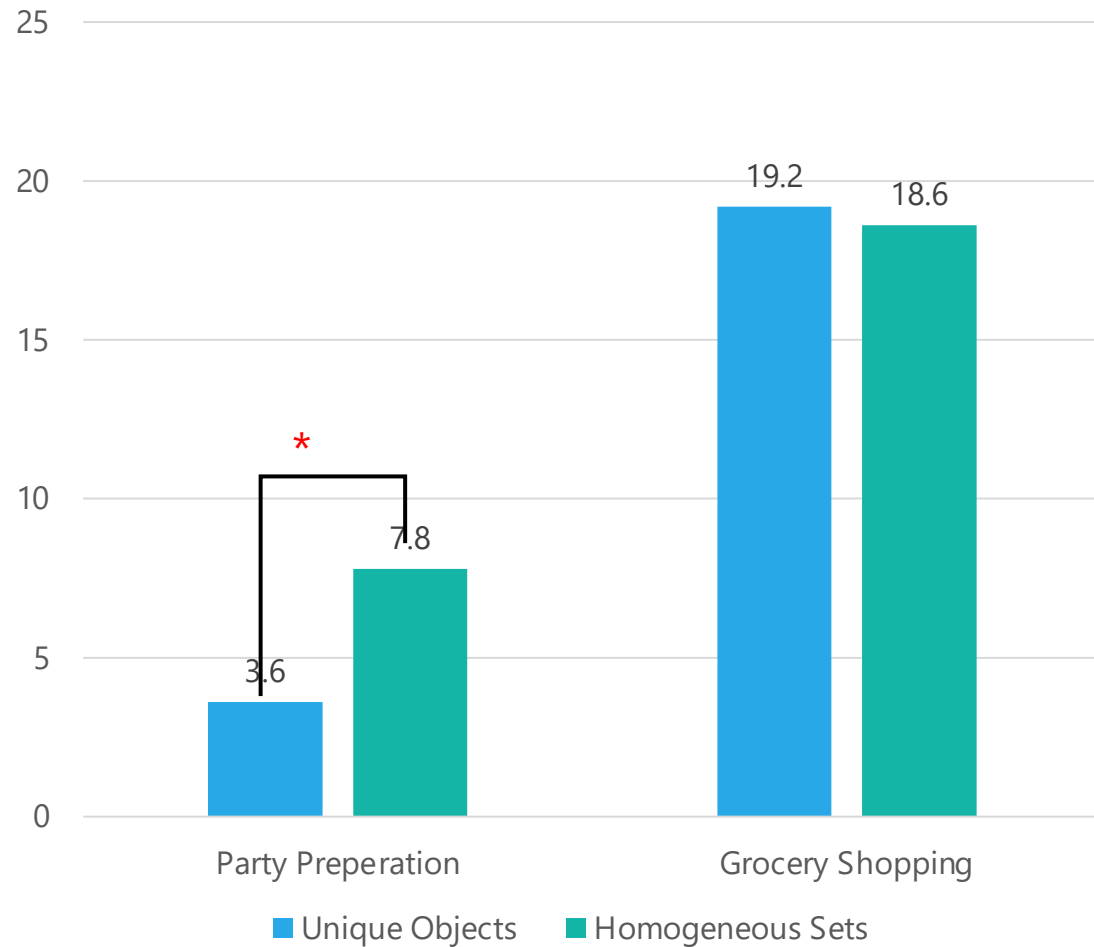


Figure 7a. Mean Number of Total Math Talk (Parents)

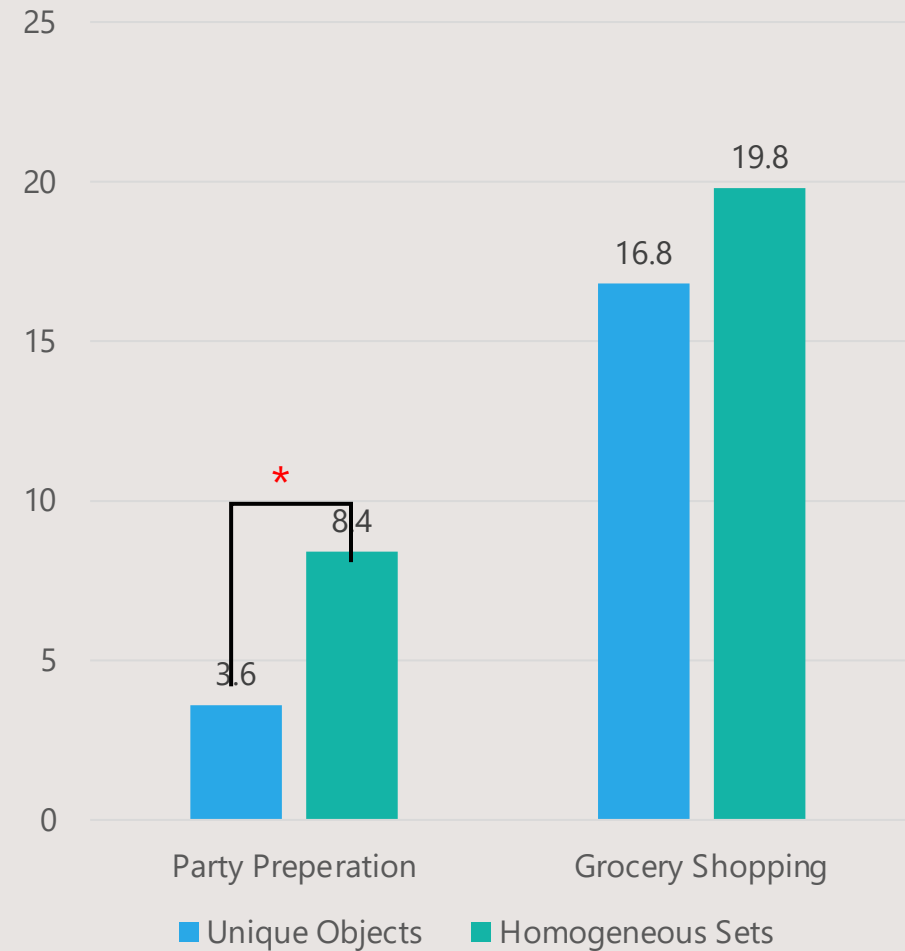


Figure 7b. Mean Number of Absolute Magnitude Talk (Children)

Summary

Features of Play Materials

