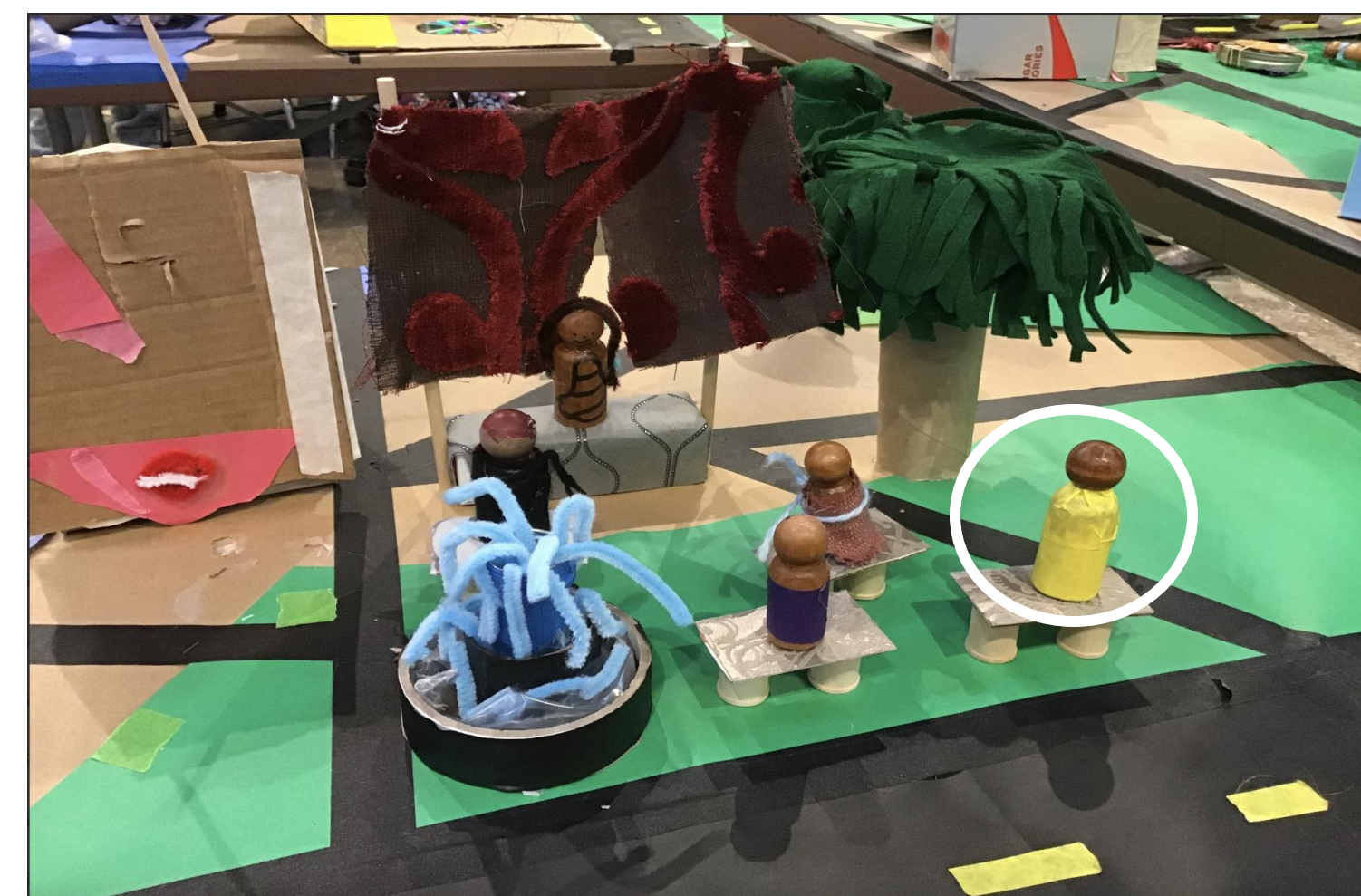




Introduction

- Spatial thinking is an important skill for children to develop, as it relates to other STEM skills and many everyday practices (Uttal et al., 2013).
- Encouraging storytelling through prompts and toy characters can support families' STEM engagement when tinkering and reflecting on their experiences (Acosta & Haden, 2023).
- Storytelling may also support families' sense of belonging during STEM activities, which is important for driving children's interest in STEM (Belanger et al., 2020; Goodenow, 1993).
- We explored how incorporating toy characters into a spatial-focus tinkering program supported families' engagement in spatial talk and storytelling while building and reflecting on the activity.
- We also were interested in how children's STEM belonging moderated the relation between storytelling and spatial talk.



Participants & Method

- **Tinkering Activity:** 23 families with children between 4-10-years-old ($M = 7.22$) were invited to create a structure they imagined as missing from a cardboard neighborhood in the exhibit.
 - 65% male, 35% female children
 - 43% White, 17% Asian, 13% Latine, 13% More than one, 13% Unreported
- **Toy Characters:** Some families ($n = 12$) chose to incorporate wooden peg characters into their creation whereas others ($n = 11$) chose not to.
- **Post-Tinkering Reflections:** After tinkering, a researcher invited children's reflections about their creation (e.g., Why did you decide the neighborhood needed this?).
- Families' tinkering conversations and reflections were transcribed and coded for spatial language, storytelling, and STEM belonging talk (see Table 1).

Results

Figure 1. Children's Storytelling While Tinkering and Reflecting

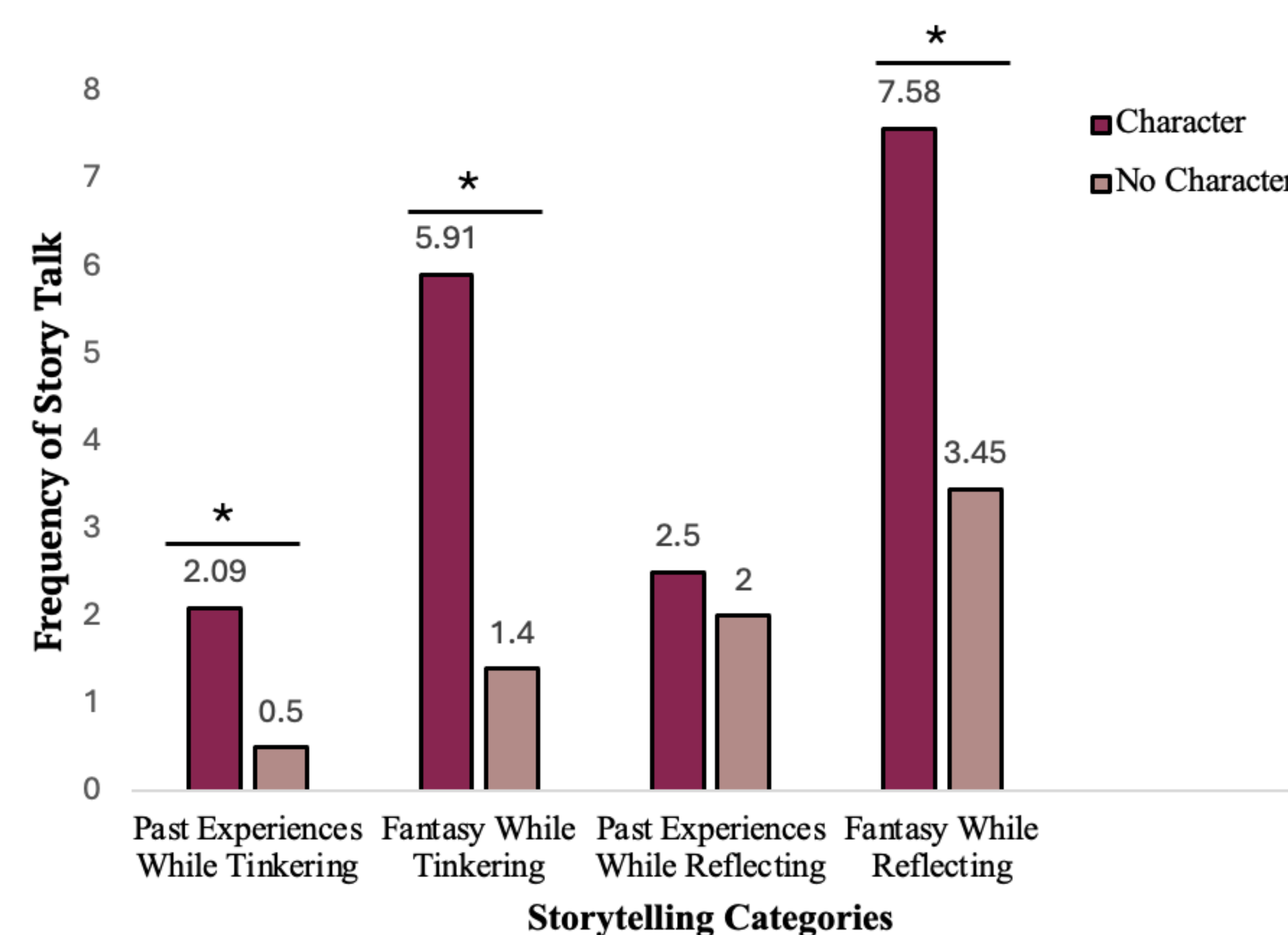


Figure 2. Children's Belonging by Storytelling and Spatial Talk

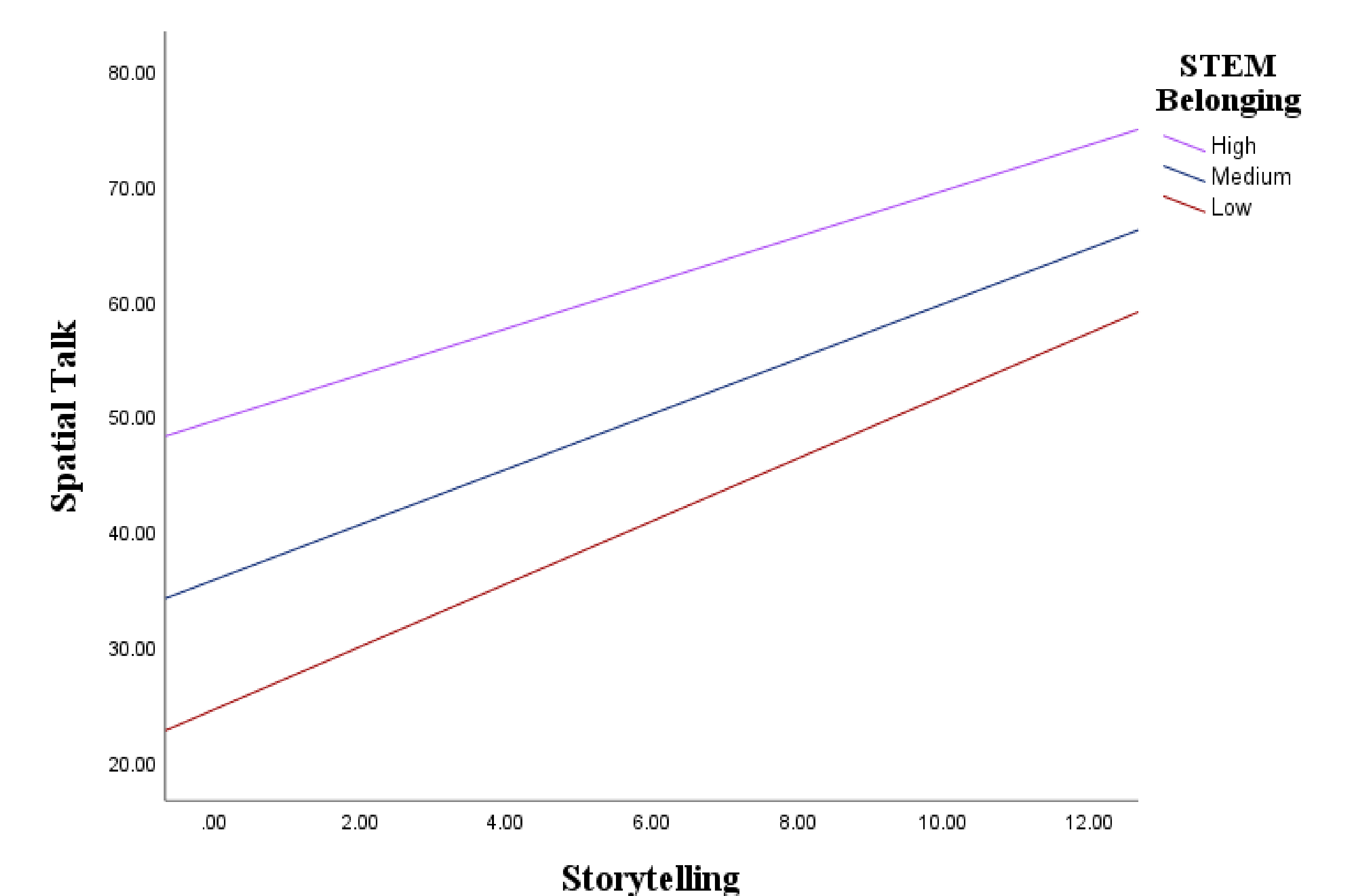


Table 1. Coding Schemes

Category	Codes	
Spatial Talk Codes & Examples (Cannon et al., 2007)	Spatial Dimensions: big, little, height Shapes: circle, shape, cone Locations/Directions: on, above, next to Orientations/Transformations: turn, rotate Continuous Amounts: a little, less, inch, space Deictics: here, there, wherever Spatial Features: side, even, angle Patterns: order, next, before	
	Frequency of talk framing the task through: <ul style="list-style-type: none"> • Fantasy/fiction storytelling • Real-life past experiences/activities 	
STEM Belonging	STEM Belonging Supports	STEM Belonging Indicators
	Helpful to Others Persistence Confidence Encouragement Motivation	Interest Enjoyment Comfortability Connection STEM Identity

- Although we did not find differences in spatial talk during *tinkering*, children who used characters engaged in more spatial talk at *reflection* compared with those who did not use characters, $F(1, 18) = 8.27, p = 0.01$.
- As seen in Figure 1, children engaged in more storytelling during tinkering when they used characters when making their creation compared to those who did not use characters, $F(1, 18) = 7.14, p = 0.02$. Compared to children who did not use characters, those who did also engaged in more fantasy storytelling in their reflections, $F(1, 21) = 5.01, p = 0.04$.
- Children's spatial talk correlated with storytelling during tinkering, $r(19) = .525, p = .015$, and reflection, $r(23) = .83, p < .001$.
- As seen in Figure 2, the overall regression model, which included children's storytelling and STEM belonging, explained 45% of the variance in children's spatial talk while tinkering, $R^2 = 0.45, F(3, 17) = 4.61, p = 0.02$. The relation between children's storytelling and spatial talk is consistent across different levels of STEM belonging (high, medium, low), $t = -.47, p = .64$.

Discussion

- This project expands our understanding of how to support children's spatial thinking through storytelling, specifically by incorporating story characters during tinkering activities.
- Our work also suggests that fostering children's sense of belonging during STEM activities can advance storytelling-spatial thinking relations.