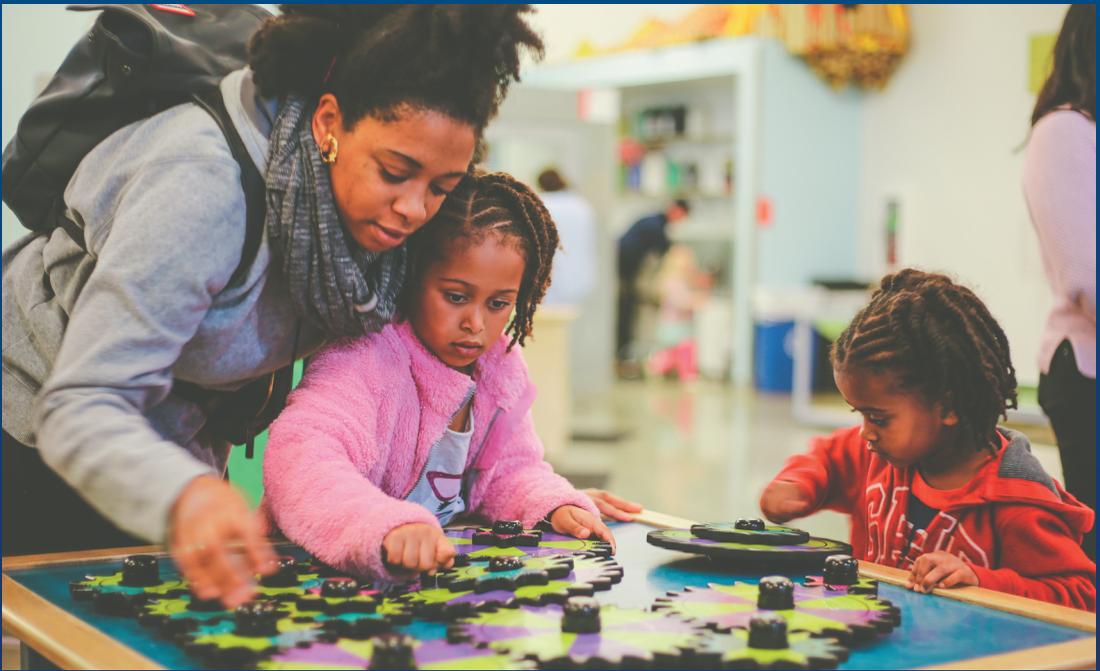


Exploration, Explanation, and Parent–Child Interaction in Museums

Maureen A. Callanan, Cristine H. Legare,
David M. Sobel, Garrett J. Jaeger,
Susan Letourneau, Sam R. McHugh,
Aiyana Willard et al.



Monographs of the Society for Research in Child Development
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Abstract Young children develop causal knowledge through everyday family conversations and activities. Children's museums are an informative setting for studying the social context of causal learning because family members engage together in everyday scientific thinking as they play in museums. In this multisite collaborative project, we investigate children's developing causal thinking in the context of family interaction at museum exhibits. We focus on *explaining* and *exploring* as two fundamental collaborative processes in parent–child interaction, investigating how families explain and explore in open-ended collaboration at gear exhibits in three children's museums in Providence, RI, San Jose, CA, and Austin, TX. Our main research questions examined (a) how open-ended family exploration and explanation relate to one another to form a dynamic for children's learning; (b) how that dynamic differs for families using different interaction styles, and relates to contextual factors such as families' science background, and (c) how that dynamic predicts children's independent causal thinking when given more structured tasks. We summarize findings on exploring, explaining, and parent–child interaction (PCI) styles. We then present findings on how these measures related to one another, and finally how that dynamic predicts children's causal thinking.

In studying children's exploring we described two types of behaviors of importance for causal thinking: (a) *Systematic Exploration*: Connecting gears to

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form a gear machine followed by spinning the gear machine. (b) *Resolute Behavior*: Problem-solving behaviors, in which children attempted to connect or spin a particular set of gears, hit an obstacle, and then persisted to succeed (as opposed to moving on to another behavior). Older children engaged in both behaviors more than younger children, and the proportion of these behaviors were correlated with one another.

Parents and children talked to each other while interacting with the exhibits. We coded causal language, as well as other types of utterances. Parents' causal language predicted children's causal language, independent of age. The proportion of parents' causal language also predicted the proportion of children's systematic exploration. Resolute behavior on the part of children did not correlate with parents' causal language, but did correlate with children's own talk about actions and the exhibit.

We next considered who set goals for the play in a more holistic measure of parent–child interaction style, identifying dyads as parent-directed, child-directed, or jointly-directed in their interaction with one another. Children in different parent–child interaction styles engaged in different amounts of systematic exploration and had parents who engaged in different amounts of causal language. Resolute behavior and the language related to children engaging in such troubleshooting, seemed more consistent across the three parent–child interaction styles.

Using general linear mixed modeling, we considered relations within sequences of action and talk. We found that the timing of parents' causal language was crucial to whether children engaged in systematic exploration. Parents' causal talk was a predictor of children's systematic exploration only if it occurred prior to the act of spinning the gears (while children were building gear machines). We did not observe an effect of causal language when it occurred concurrently with or after children's spinning. Similarly, children's talk about their actions and the exhibit predicted their resolute behavior, but only when the talk occurred while the child was encountering the problem. No effects were found for models where the talk happened concurrently or after resolving the problem.

Finally, we considered how explaining and exploring related to children's causal thinking. We analyzed measures of children's causal thinking about gears and a free play measure with a novel set of gears. Principal component analysis revealed a latent factor of causal thinking in these measures. Structural equation modeling examined how parents' background in science related to children's systematic exploration, parents' causal language, and parent–child interaction style, and then how those factors predicted children's causal thinking. In a full model, with children's age and gender included, children's systematic exploration related to children's causal thinking.

Overall, these data demonstrate that children's systematic exploration and parents' causal explanation are best studied in relation to one another,

because both contributed to children's learning while playing at a museum exhibit. Children engaged in systematic exploration, which supported their causal thinking. Parents' causal talk supported children's exploration when it was presented at certain times during the interaction. In contrast, children's persistence in problem solving was less sensitive to parents' talk or interaction style, and more related to children's own language, which may act as a form of self-explanation. We discuss the findings in light of ongoing approaches to promote the benefit of parent-child interaction during play for children's learning and problem solving. We also examine the implications of these findings for formal and informal learning settings, and for theoretical integration of constructivist and sociocultural approaches in the study of children's causal thinking.

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Young children learn about causality through everyday family conversations and activities. In this multi-site project, Callahan and colleagues investigated children's developing causal thinking through family interaction at gear exhibits in three US children's museums. The investigators documented children's exploring, parents' explanations, how these behaviors unfolded in time, and how they related to follow-up measures of children's causal thinking about gears. Children's systematic exploration predicted their causal thinking. Parents' causal language, when well-timed with children's actions, predicted children's systematic exploring. The coordination between exploration and explanation differed across interaction styles between parents and children, based on who set goals for the play at the exhibit. The authors use an integration of constructivist and sociocultural approaches to development as a framework for interpreting their data, and discuss practices for supporting parent-child interaction in museums.