Title: Evaluating Information-Based vs. Modeling Media Parental Support on Parent-Child Interactions During a Preschool Engineering Activity

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1. Evaluation Goals

The goal of this evaluation was to assess the impact of different media resources on parent-child interaction during an engineering activity. We considered this a formative evaluation to inform the direction of family engagement program resources for parents of young children. Specifically, we were evaluating and improving the design of one component within a larger set of family resources that were originally developed for families with children in their first years of schooling (i.e., 4- and 5-year-olds) that were being adapted for families with younger toddlers and early preschoolers (i.e., 2.5- and 3-year-olds) due to increasing demand for museum outreach with the younger "early preschooler" age group. Parent-child interactions were observed during a naturalistic play session at the Children's Museum Houston, where families engaged in a ramp-building activity following exposure to different media resources appropriate for parent-child co-viewing. The study aimed to examine how theoretically distinct co-viewing media content influences the types of questions and conversation between parents and children during exploratory play.

Families often use educational media (e.g. PBS videos and video games) that provides information that is designed to promote young children's learning (e.g., Rideout et al., 2014). Common formats of educational media that are designed to provide information in developmentally appropriate ways include educational puppetry and animated characters such as those in Sesame Street. Young children may learn more when co-viewing these types of *information-only media* with a caregiver who can support their attention or scaffold learning (e.g., Neuman et al., 2020; Samurda et al., 2019). Recently, a second kind of educational media is designed to provide developmentally appropriate models of caregiver-child interactions that include play or ways to infuse learning in everyday activities (e.g., Radesky et al., 2016; Zucker et al., 2021). From these types *modeling media,* young children and parents may learn new vocabulary and concepts as well as ways to interact with each other. To inform the design of the museum's early preschool educational resources, this study experimentally contrasted these two types of educational media resources to observed how this related to parent-child conversations during an engineering-related play activity.

Research Questions:

(1) *Parent Questions:* How do different types of media resources (informational vs. modeling) influence the frequency and type of questions parents ask to support their child's learning during an engineering activity?

(2) *Child Talk:* How do the different media resources influence the frequency and type of questions children ask and basic engineering functions (i.e., testing and redesigning) during an engineering activity?

(3) *Child Knowledge:* Do children in both conditions and age groups demonstrate adequate knowledge of ramps in a proximal ramp knowledge measure?

2. Methods

Participants

Parents and their toddlers were recruited to participate in a study on parent-child interaction and exploratory play. We recruited caregivers broadly, including fathers, mothers, and grandparents; however, as most participants were mothers and fathers, we will refer to the adult participant as "parent" from this point forward. One parent and one child from each family were randomly assigned to either the Information Only or Modeling condition. Passive consent was used, allowing parents to receive information about the study and opt out if they chose not to participate. The study protocol was approved by UTHealth Committee for the Protection of Human Subjects prior to data collection. Families who completed the session received a $20 gift card and a small toy as a token of appreciation for their time.

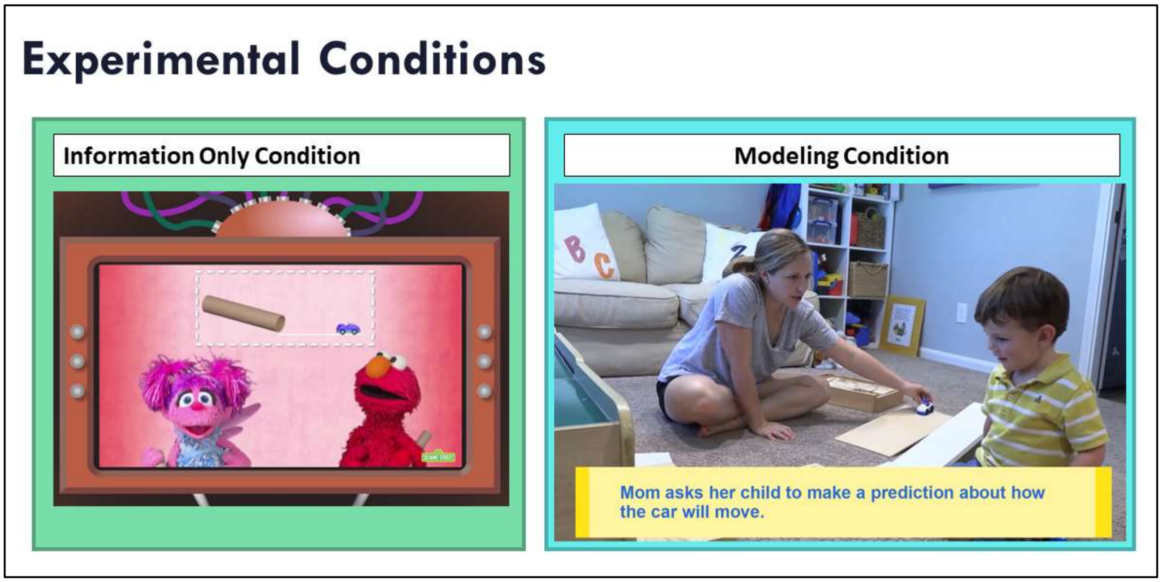
Procedure

The study was conducted as part of a collaboration between a research team from the Children's Learning Institute (CLI), which is part of the University of Texas Health Science Center at Houston (UTHealth), and museum educators from Children's Museum Houston. Data collection took place at the Children's Museum Houston, where museum visitors with children aged 2-5 years were invited to participate. Data were collected in a small room located near the museum galleries. A total of 69 families agreed to participate, with 64 families providing usable data for at least one component of the study (early preschoolers age group of 2.5 to<4.0 years: $n = 38$; pre-kindergarten/kindergarten age group of $\geq$4.0 to 5.5 years: $n = 24$).

Immediate after consent, research staff randomly assigned parent-child dyads to one of two conditions -- Information Only vs. Modeling (see Figure 1) – which included short videos that the parent and child were asked to co-viewed on a computer device. In the Information Only condition, parents and children co-viewed an informational video from Sesame Street featuring Elmo explaining how ramps work (lasting 1min and 17s). This informational video provided basic scientific concepts about ramps but did not offer specific guidance on parent-child interaction or scaffolding strategies. In the Modeling condition parents and children co-viewed a video that included content about ramps but also modeled parent behavior during a naturalistic play session (lasting 2min and 44s). In the modeling video, a mother and her 3-year-old child built and tested ramps together from a collection of family activities at the University website (https://cliengagefamily.org/). The modeling video provided text boxes, that were designed for parents, with explicit instructions on how to ask questions and scaffold learning through play, demonstrating ways to engage children in exploratory behavior and problem-solving.

Figure 1. Examples of videos provided in each condition. Left: Information Only Condition, featuring a child-appropriate explanation of the science of ramps. Right: Modeling Condition, showing a mother and child building a ramp together, discussing how ramps work, with modeled parental behaviors that scaffold learning and encourage exploration. An example of explicit

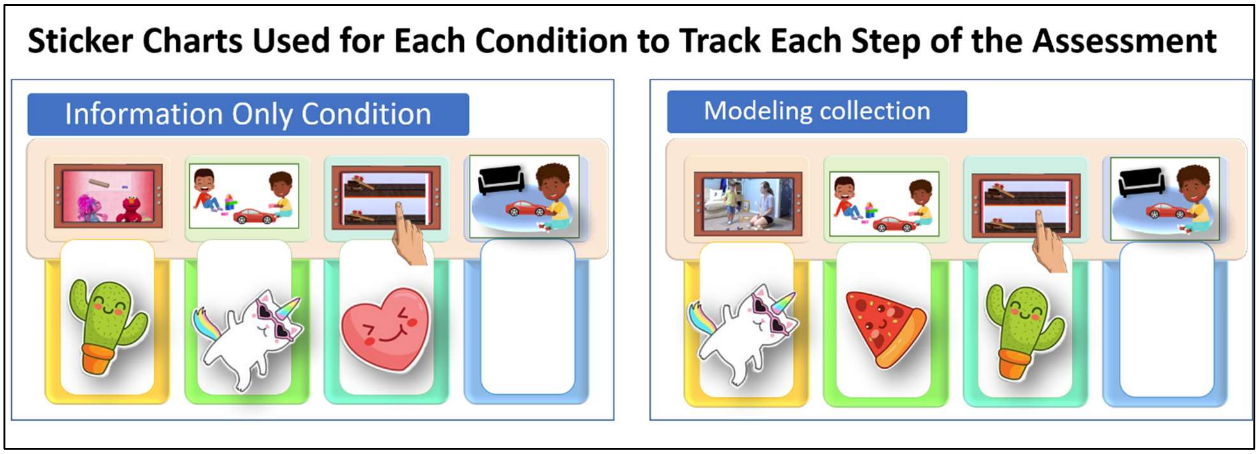
instruction in parental scaffolding behaviors is highlighted in yellow.



After watching their assigned video, both groups of parents and children were given ramp-building materials and instructed to explore how objects such as balls and cars moved on different types of ramps. The activity was open-ended to encourage free play and experimentation during 5-minutes of activity play. The parent-child ramp-building free play was followed by a brief computerized assessment of ramp knowledge.

To help young children understand and complete each step of the study, we provided a sticker chart (See Figure 2). After finishing each stage of the study (i.e., co-viewing the video, building a ramp, completing the computerized assessment, and taking home the car used in the activity), children could select a sticker to add to their chart. This visual aid was particularly helpful in easing the transition from building ramps with their parents to the computerized assessment, as it reminded participants that they would get to keep the car, allowing them to continue building ramps at home.

Figure 2. Sticker chart shows each step of the study session from left to right: co-viewing the video, building a ramp, completing the computerized assessment, and taking home the car used in the activity.



Observations and Data Collection

A trained member of the research team observed and videotaped each parent-child dyad during the exploration phase, documenting interactions and guiding play behaviors using a standardized protocol. The focus was on how parents scaffolded their child's learning, engaged with the materials, and supported the child's problem-solving and exploration. After the ramp-building activity, children were asked to answer 5-7 questions on a computer to assess their understanding of how ramps work. Parents were instructed not to assist their child in answering these questions to ensure the child's independent performance was measured.

Materials

For both media conditions, the video was shown to families on a Dell Laptop Computer. Both groups were provided with the same set of materials for the ramp-building activity, which included various types of ramps and objects like balls and a car to test how different surfaces and inclines affected motion.

Live Talk Coding System

This coding system was designed to capture parent-child interactions live or in real-time during a ramp-building activity, focusing specifically on questions as a key way for parents to scaffold learning. Adapted from prior coding frameworks used in activities like book reading and a bridge-building challenge (i.e., Bambha et al., 2024; Pentimonti et al., 2021), the researcher tracked the types and frequency of questions asked by parents and children. By analyzing questions during the activity, the coding highlights how parents facilitate problem-solving and guide their child's learning through exploratory play. The focus is on conversational engagement, not task success, with an emphasis on testing and redesign behaviors. Live coding began when the researcher finished instructions and started the task timer. It ended when the examiner signaled that one minute remained, at the 4-minute mark of the session. During the final minute of the task, parents and children completed the ramp-building activity while the researcher prepared the computerized ramp assessment, helping to support the transition from ramp building to the computer assessment. All adult and child questions were categorized into one of four types. In cases where a sentence contains multiple question words, only the main clause is coded.

Four question types: (1) **Wh- questions** begin with or contain interrogative words such as "who," "what," "when," "where," or "which," and are designed to elicit information. These questions can have the interrogative word at any point in the sentence, as long as they are structured to prompt a response. Example: "What will you do next?". (2) **Why Questions** are specifically interrogative sentences that start with or contain the word "why." They tend to elicit more detailed, explanatory responses. Example: "Why did the car go faster?". (3) **How Many** questions involve quantity and begin with "how" to inquire about numbers or amounts. Example: "How blocks do you need?" **How Questions** were also procedural, for example, “How can we make it taller?”. (4) **Yes/No Questions** include questions that can be answered with "yes" or "no," as well as those that prompt a simple one-word response. Auxiliary verbs (e.g., "do," "will," "can"; “Can we make it longer?”) or forced-choice options often signal these types of questions. Informal yes/no prompts (e.g., "Do you want to test it?", “Do we need to fix that part?”) are also coded here.

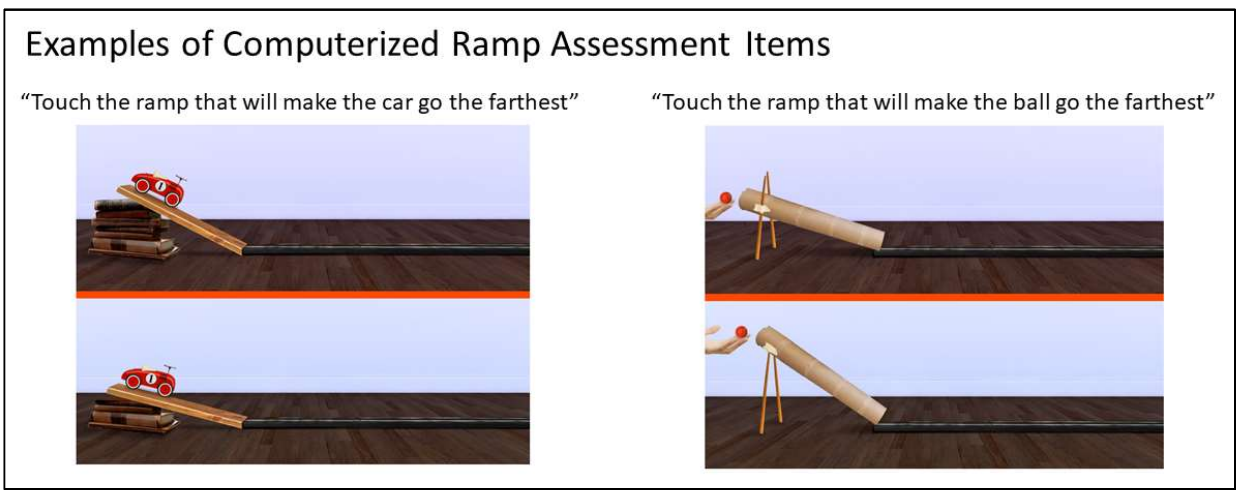
Child talk. We applied the same question codes to parent and child utterances. However, given the young age of the children, we anticipated that children might show limited talk about engineering processes in the form of questions. To more fully capture engineering utterances from children, research staff also live-coded child utterances related to testing or redesign during the ramp-building activity. These utterances included comments or questions about how their ramps functioned, attempts to modify their designs, or observations about the materials used. For example, child *testing* utterances included explicit reference to trying the ramp: “I gonna try it” and “That one goes better.” Sample child *redesign* utterances included references to changing or fixing the design: “I make it bigger” or “I think it’s gonna go slow because I’m going to make it really tiny.” By coding these utterances, we aimed to understand how children engaged with and articulated their understanding of the engineering process through exploration and problem-solving.

Observer reliability. Before starting data collection, all research staff gathering data were trained to by the first author to code with >85% agreement a set of four videos of parent-child conversations.

Computerized Assessment of Ramp Knowledge

The computerized formative assessment (see Figure 3) used in this study was adapted from the Children's Learning Institute STEMLabs, which includes 20 modules covering science, math, and engineering for preschool-aged children (See CLI STEM Lab). STEMLabs employs a multimedia format, featuring a PBS video followed by online guided practice trials with immediate feedback. After the parent-child ramp-building play session, the Ramp STEMLab module was used as the formative assessment, consisting of 2 guided practice trials with feedback on accuracy and scaffolding, followed by 6 independent trials with no feedback. Parents were asked not to help children during the assessment; however, 2.5 to 3-year-olds often completed the assessment with some parental supports to redirect their attention. Child performance was scored immediately, with total scores and accuracy provided for each item. All items had one correct response and three foils such that the chance or guessing rate is 25%.

Figure 3. STEMLab Computerized Assessment.

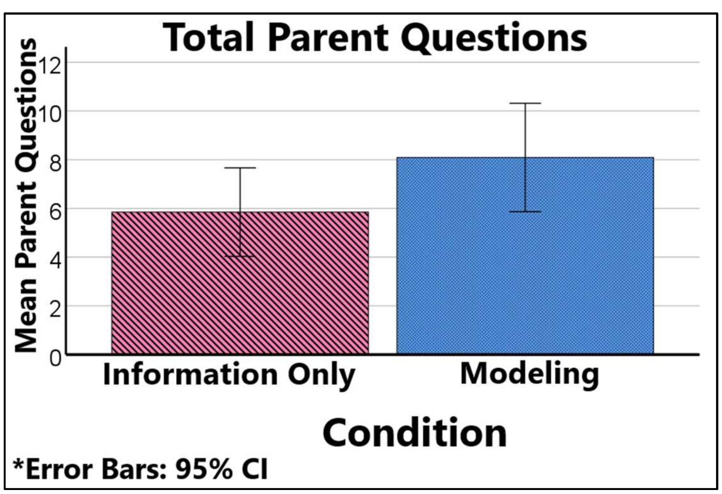


3. Results

Parent Questions During Engineering Play

There was a non-significant trend suggesting the possibility that parents assigned to the Modeling condition (Condition 2) asked more questions overall compared to those in the Information Only condition (Condition 1) ($F_{2,54} = 2.43$, $p = .121$). Specifically, a univariate ANOVA testing main effects of condition (Information Only vs. Modeling) and age (2.5-3.9 years vs. 4.0-5.5 years) indicated that parents in the Modeling condition demonstrated higher frequencies of question asking relative to parents in the Information Only condition. Age of the child did not impact the frequency of parental question asking. On average, in this 5-min play session, parents asked 7 questions. Parents asked various types of questions and tended to ask several “Yes/No” questions ($M = 4.13$, $SD = 3.27$) but parents, on average also asked a single “how”- question and a single “wh” question. Parents rarely asked “why” questions, with this occurring only three times across the whole sample of parents.

Figure 4. Effect of media condition (Information Only vs. Modeling), showing non-significant trend for increased parental question asking for parents assigned to the Modeling media condition.



Child Talk During Engineering Play

As expected, children asked very few questions overall, such that across all participants only 31% ask a question during the play session. Specifically, only one child asked a "why" question and one child asked a "how" question. For "wh-" questions, three children asked a single question, and one child asked two questions. Although still relatively low, five children asked a single Yes/No question, two children asked two Yes/No questions, and one child asked three Yes/No questions. These low frequencies suggest that while the activity encouraged parent question asking, young children were unlikely to engage in asking questions themselves during the ramp-building task.

In addition to coding the frequency of child questions, researchers also examined children's talk related to testing and redesigning the ramp. Over 84% of children had utterances coded in these categories. While there were no significant effects of condition for child utterances, an ANOVA that included the frequency of total adult questions with age included as a covariate indicated significant effects, such that children whose parents asked more questions were more likely to engage in utterances associated with testing the ramp ($F_{2,52} = 15.25$, $p < .001$) or redesigning the ramp ($F_{2,52} = 18.43$, $p < .001$). Notably, the frequency of total adult questions significantly predicted how often children talked about testing and redesigning the ramp. This suggests that parent questioning plays a key role in promoting children's engagement in both testing and redesign processes during engineering play.

Child Knowledge of Ramps

No significant effect of condition was indicated for the computerized assessment of ramp knowledge where the average score was 84% correct with a range of 50% - 100% correct. There was a nonsignificant trend suggesting that older children had higher scores on the assessment ($p = .061$).

4. Preliminary Conclusions

This study was a small formative evaluation of parent-child conversations following co-viewing one of two distinct versions of educational media. We evaluated how caregivers and children's talk during play was influenced by a short video to inform future design of family engagement resources used by museum educators and researchers who support two age groups toddlers/early preschoolers (ages 2.5 to 3.9 years) as well as children in pre-k/kindergarten (ages 4.0 to 5.5 years). In both media conditions and age groups, children scored above chance on the proximal knowledge check and anecdotally all age groups appeared to understand the science and engineering concepts presented about ramps. In both media conditions, parents asked several questions to scaffold their child's learning while playing the with cars, balls and ramp materials. However, parents asked slightly more questions in the Modeling media conditions; although non-significant, this trend might highlight the potential of media that models key parent behaviors, such as question-asking, to support parent-child conversation and learning from engineering-related play. Importantly, when parents asked more questions, their child used more engineering-related utterances about testing and redesigning their ramp.

These findings are preliminary due to the small sample size within each age group but suggest that families with children as young as toddlers can be supported to explore engineering concepts. Co-viewing a model of a parent and child playing together appears helpful to supporting conversations. Future research could contrast this type of modeling with in-person modeling from an expert, such as a museum educator or could examine impacts of interleaving both widely available information-focused educational media (e.g., PBS) with media that models how to extending that learning to parent-child play.

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