

# Family knowledge-building: How designed learning environments can support conversations around complex topics like manufacturing

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## Introduction

As designed informal environments, museums mediate opportunities for families to talk and interact around a set of ideas that help parents and children construct ways of thinking about the world together (Ash, 2003; Crowley, Schunn, & Okada, 2001; Schauble & Bartlett, 1997).

So, how can museums support family knowledge-building? One approach is to provide families with access to objects that they cannot see anywhere else. Collections-based museums use this approach to display one-of-a-kind or unusual artifacts that are meant to provoke visitors' curiosity (Gurian, 1999). In contrast, audience-focused venues like children's museums and science centers use ordinary objects to demonstrate unfamiliar principles or to challenge visitors' expectations (Wellington, 1990).

This ordinary object approach not only mediates rich experiences around objects that are familiar to families in the museum, it also has potential to activate parents to engage in conversations with their children when they come across similar objects at home.

## Research Questions

- Does a shared family experience in a museum exhibition involving ordinary objects affect parents' and children's understanding of and conversations about everyday objects immediately after their visit?

## Methods

### Participants

Family groups comprised of at least one parent and one child 21 families in Omaha; 59 families in Pittsburgh (Child age range = 6 to 12 years; Mean child age = 7 years)

### Location:

How People Make Things traveling exhibition at the Omaha Children's Museum and the Children's Museum of Pittsburgh

### Procedure

Parents and children were individually interviewed before and after they visited the exhibition. During the interviews, participants were shown a series of pictures of objects and asked to identify whether those objects were made in a similar way or a different way. Families wore wireless microphones and were videotaped during the visit itself.

### Coding

Participants' pre and post interview explanations and during-visit talk were coded for mentions of one of four specific manufacturing processes highlighted in the exhibition.

1.) *Cutting*: Parent or child uses words like cut, chip, carve, shave, scrape, remove, chop, rip, trim, etc.

"Probably if you consider the removal of materials as they start out as a larger object and then are made into a detailed smaller one. Again, just because you have a larger mass that starts out as a key, and then you cut the notches in it."

*Pre-Visit Omaha Adult #22, referring to keys*

## Methods, cont.

### Coding, cont.

2.) *Molding*: Parent or child uses words like mold, inject, fill, melt, getting colder, getting warmer, harden into a solid, etc.

"The rubber bath tub toy is made from plastic, and it should have seams like I have on my rubber duck....The bathroom toy is rubber [The bath toy was] probably [made in] like a mold with two parts."

*Post-Visit Omaha Child #23, referring to frog bath toy*

3.) *Deforming*: Parent or child uses words like deform, vacuum, bash, bend, suck, twist, straighten, press, flatten, force, stamp, crush, smash, etc.

Example: "Because it looks like it was made by vacuum forming... when you use heat and vacuum to make something. I know because I just made the bowl, and they use vacuum and heat to make it."

*Post-Visit Pitt Child #50, referring to packaging*

4.) *Assembly*: Parent or child uses words like assemble, sew it together, put together, put into, put on, put onto, put the pieces, take it apart, take off, screw on, build, etc.

Example: "Because [the spoon] is a single part, whereas the other items have several parts put together."

*Post-Visit Pitt Adult #33, referring to scissors*

## Findings

### Changes in Understanding of Everyday Objects

Children in both Omaha and Pittsburgh became significantly better at recognizing objects made through the specific manufacturing processes of Cutting, Molding, Deforming, and Assembly after their museum visit.

Percent Change in Adult and Child Specific Process Mentions by Location *				
	Molding	Cutting	Deforming	Assembly
Adult				
Omaha	31%*	27%*	34%*	19%
Pittsburgh	6%	65%*	44%*	67%*
Child				
Omaha	19%*	43%*	19%*	19%*
Pittsburgh	47%*	34%*	29%*	35%*

\* Indicates a significant difference at the .05 level

Parents in Omaha and Pittsburgh showed significant increases in their ability to talk about objects made by Cutting and Deforming. Parents in Omaha discussed Molding significantly more after their visit. Parents in Pittsburgh talked about Assembly significantly more after their visit.

Adults in Pittsburgh already knew a lot about Molding before their visit, so their Molding talk was equally high after their visit. Adults in Omaha increased their Assembly talk, but not significantly.

56% of the variability in family's total after-visit specific process talk can be explained by the amount of specific process conversations they engaged in during their visit. Time spent in the exhibition and pre-visit specific process knowledge were not significant factors.

## Findings, cont.

### Conversations About Objects During the Visit

We added the average number of Cutting, Molding, Deforming, and Assembly mentions from parents and children together, and found that families discussed specific manufacturing processes an average of 39 conversational turns per visit (n =20). These family conversations involved how everyday objects are made an average of 27 times per visit. This means that families had several opportunities to link ordinary objects to unfamiliar manufacturing processes.

Most of these co-occurrences happened while families were in the Molding Area (F(1,4) = 9.652, p < .05). Interestingly, the Molding Area also contains the most everyday objects compared to other process areas in the exhibition. In the following example, a mother uses a sequence of activities featuring everyday objects like combs, LEGOS, and footballs to talk to her 8-year old son, "Anthony", about molding:



Picture 1: Girl pulling a lever to reveal a flyswatter at Fill-a-Mold

Picture 2: Girl exploring a football at Mold Matching

<b>Anthony's mother walks over to Fill-a-Mold and pulls one of the levers.</b>
<i>Mother:</i> Oh, look! Do you see that?
<b>Anthony pulls down on another lever.</b>
<i>Mother:</i> It's filling it up.
<i>Anthony:</i> I'm doing another one. That rectangle thing.
<i>Mother:</i> Which one?
<i>Anthony:</i> That. I've done that.
<b>The family pulls various levers.</b>
<i>Mother:</i> Oh, look! I've made a flyswatter. You made a coat hanger. That's a model airplane wing.
<i>Anthony:</i> I'm going to try...have you already pushed this?
<i>Mother:</i> I don't think so.
<b>Anthony pulls a lever.</b>
<i>Mother:</i> That's a comb. Do you see how the liquid fills it up? Watch. Pretend this is melted liquid. Pretend it's melted plastic and when you push it - and when you push that melted plastic, it fills up the item. See how it fills it up? That's a LEGO block, and then when it gets hard...Boom! You have a Lego block. The plastic gets hard, and then you can play with it. That's like a comb that I comb your hair with. You just made a plastic roller.
<b>The family leaves the display and walks over to Mold Matching. Anthony sees a football.</b>
<i>Anthony:</i> Oh, look it!
<i>Mother:</i> You know what they do? They take that same liquid and they pour it in there. And then they put the mold on, and then when it gets hard, you have a football.

Anthony's mother uses the familiar object of the comb, which is similar to a comb the family has at home, to explain the molding process to her son. She mentions the material used, and even describes the state change that molded objects have to go through when talking about the LEGO block.

His mother then connects what the family just experienced at Fill-a-Mold to explain how footballs are made. She again walks her son through the process of molding and state change using a familiar object. This example illustrates how parents use ordinary objects to connect to larger ideas in manufacturing.

## Conclusions

Families' conversations within the exhibition reflect a rehearsal of the language of manufacturing that supports a view of objects in a process context. Parents and children are able to use what they talk about together in the exhibition to transform how they talk about everyday objects after their visit.