Volume 1, Issue 4, February 2019

Dear Parents,

We greatly appreciate your participation as well as that of your child in our current research projects. Over the past few months, the Language and Learning Lab has completed several new projects and we could not have done it without your dedication and commitment. In this newsletter, we would like to share what we discovered in the studies you and your child participated in and share new studies that may be of interest to you.

If you would like to update your contact information with us or tell us about any new additions to the family, please visit our website (languageandlearninglab.com) and fill out the form linked under 'For Parents' or send us an e-mail (languageandlearninglab@gmail.com).

If you know of any friends or families that you think might be interested in participating, we would greatly appreciate your help in passing our information on to them. We are always looking for new 'child scientists' to help us with our studies, and we could not do our work without the generous support of parents like you.

Sincerely,

Language and Learning Lab Team

The University of Toronto

Language & Learning Lab
UNIVERSITY OF TORONTO

Volume 1, Issue 4, February 2019

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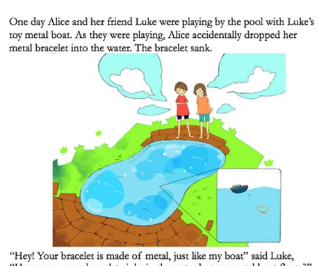
Order of Instruction Matters when Teaching Young Children Science

Here in Ontario, the new Kindergarten Curriculum has embraced play-based learning and exploration. In the area of science, this curriculum promotes engaging children through play to promote their exploration and investigation. Along with these goals of promoting inquiry skills, children also need to be taught correct scientific information. This is important because children commonly develop misconceptions in the domain of science. Picture books are a great tool that can be used to teach information to children. Given these two distinct areas, play and picture books, the question becomes when we should engage children in each area.

To examine this question we developed books and activities aimed at engaging children in learning about why objects sink and float. The most common misconception children have in this area is that heavy objects sink and light objects float. We tested 96 5-year-old children, and had 48 of them complete the play-based activity first and then read the book. The remaining 48 had the opposite order, they read the book first and then participated in the play-based activity. To measure children's learning, they completed a pre-test (before they did either the book or the activity), a mid-test (in-between their completion of either the book or the activity) and a post-test (after they finished both the book and the activity)!

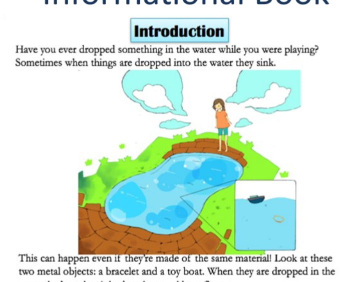
Narrative Book



One day Alice and her friend Luke were playing by the pool with Luke's toy metal boat. As they were playing, Alice accidentally dropped her metal bracelet into the water. The bracelet sank.

"Hey! Your bracelet is made of metal, just like my boat" said Luke, "How come your bracelet sinks in the water but my metal boat floats?"

Informational Book



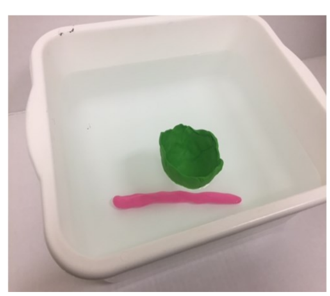
Introduction

Have you ever dropped something in the water while you were playing? Sometimes when things are dropped into the water they sink.

This can happen even if they're made of the same material! Look at these two metal objects: a bracelet and a toy boat. When they are dropped in the water the bracelet sinks, but the metal boat floats.

Near Transfer Activity

Far Transfer Activity



Order of Instruction Matters when Teaching Young Children Science

In this study 96 five-year olds were randomly assigned to one of two conditions:

1. **Book reading-activity group (book reading first)**
2. **Activity-book reading group (activity first)**

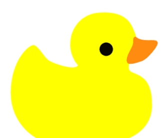
Children in both groups had low pre-test scores indicating that most children think that heavier objects sink and lighter ones float. We found that children who read the book first and then completed the activity scored higher on mid-test and post-test, compared to children who did the activity first and then read the book. This study suggests that providing children with correct scientific explanations before completing a related play-based activity is more effective for revising misconceptions than the other way around.

	Book reading—Activity	**Activity—Book reading**
Pre-test	Low scores	Low scores
Mid-test (after first delivery)	Higher scores compared to Activity-Book reading group	Scores similar to pre-test
Post-test (after second delivery)	Higher scores compared to Activity-Book reading group	Scores better than mid-test but lower than Book reading-Activity group mid-test scores

Can young children make inferences about another person's desire?

In everyday life, children and adults have to infer the meanings of ambiguous statements such as "Can you give it to me?". To solve what "it" refers to, we have to think back to previously shared conversations or actions that point to what this person must be asking for. For example, this person might have said "There's the ball!" right before "Can you give it to me?" thus providing context.

In this study, we explore whether 2- and 3-year-old children are able to make these types of inferences to answer an ambiguous question, "Can you give one to me?". Children entered a room to find a toy "slide" and were told that they could play with the slide using animal toys (ducks and turtles) that were hidden in the room. As the child and experimenter searched for the toys, the experimenter expressed either a like or dislike of a certain animal. Once located, the experimenter asked the ambiguous question, "I want to put one of these animals down my slide. Can you give one to me?" at which point the child was required to infer which animal she might want.



We found that three-year-old children were able to make appropriate inferences based on positive information they had heard, i.e. "I like turtles!". If they heard "I do not like turtles" they had more difficulty inferring that the experimenter might prefer to receive the other toy, the duck.

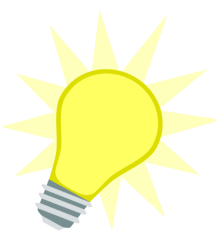
Two-year-old children generally have more difficulty with this task for both types of language information. Their difficulty with this task is not related to their comprehension of the words "no" or "not". Further research will explore why this task is difficult for children under age 3, however one speculation is that they may choose to give whichever animal they themselves prefer.

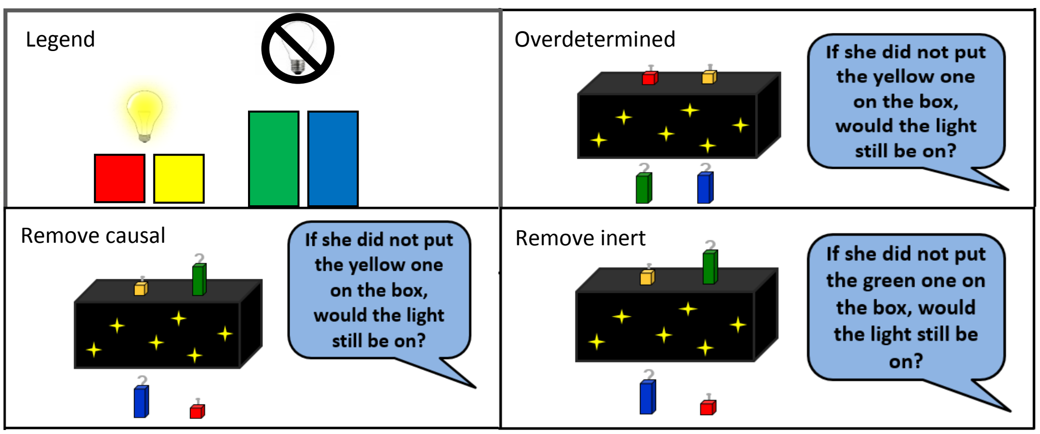
Research has shown that providing young children with lots of affective information (e.g. exaggerated facial expressions, gestures) to supplement desire language information is helpful for their comprehension. In addition, using language such as "I want", "I like", "I think" with your child from an early age can foster the development of these skills earlier on!

Can young children reason about "what-ifs"?

Counterfactual reasoning is the ability to think about alternatives to events that have occurred, and often involves thinking about how an outcome would change if a preceding event had occurred differently. The last time you were late for an appointment ("If I'd taken a different route, I would have arrived on time"), you may have used counterfactual reasoning. We wondered the earliest age at which children can succeed in this type of reasoning so we designed a study where the events are clearly causally connected to one another.

We set up a video demonstration for children ages 3.5 to 5 years old in which a box would light up when some blocks were placed on it (causal blocks), but not when others were placed on it (inert blocks). The video then showed 2 blocks being placed on the box at the same time, and asked about the removal of one of the blocks:





Four- and five-year olds answered correctly more than we would expect if they were guessing on all trial types, while 3-year-olds answered at chance levels on all trial types. In fact, 5-year-olds' performance was nearly perfect.

Children were successful even in a follow-up study where there was a delay and children did not see images in front of them. This means that children were not using simpler reasoning strategies by looking at the image in front of them.

In summary, our results suggest that mature counterfactual reasoning develops as young as 4 years old, in contrast to previous research suggesting it develops around age 12. The early success may be due to the fact that children clearly understood the events presented to them in these studies.

How do children think about alternative outcomes?

In this study, we were interested in whether young children would reason counterfactually and causally in the same way adults do, or if these reasoning processes develop over time. To track this development we studied children ages 3.5 to 8 years of age. Children heard 4 different stories in which a minor mishap occurred due to a force of nature, but was enabled by the character's action. For example:

> *"Harry is playing in the sand at the beach. He builds a sandcastle right beside the water and goes to get his bucket. A big wave comes along and knocks over the sandcastle. Harry's sandcastle is ruined now."*

In this story, the wave *caused* the sandcastle to be ruined, but this was *enabled* by the fact that Harry built the sandcastle beside the water. When asked why the sandcastle was ruined, preschool-age children (3.5 to 5 years old) and school-age children (6 to 8 years old) were more likely to reference the true cause (e.g., "Because a big wave came") than the enabling event (e.g., "Because he built it by the water"). However, when asked the counter-factual question: "What should have happened so that the sandcastle would not be ruined?", preschool-age children were more likely to reference the true cause (e.g., "the wave shouldn't have come") and school age-children were more likely to reference the enabling event (e.g., "he should have built it further from the water").

In summary, school-age children reason causally and counterfactually in the same way as adults, but preschool-age children reason differently in comparison to older children. They put greater focus on the true cause of events when thinking about how the event could have happened differently. This implies that there are developmental changes in the focus of children's counterfactual thoughts between the ages of 3.5 to 8 years old.

Can children infer the meaning behind implied messages?

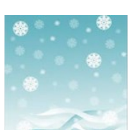
When we hear that our friend ate *some* of the cookies, we can easily infer that there are more cookies still left over. In this study, we were interested in whether 5– and 7-year-old children can make similar inferences in situations where the critical piece of information is implied rather than explicitly conveyed.

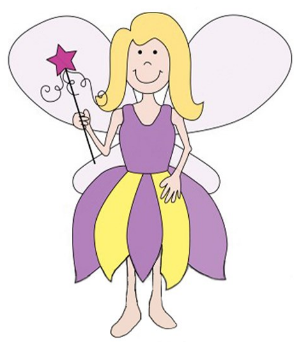
Children watched short vignettes about a target activity (e.g., blowing up the balloons) on the computer. At the end of each vignette, children heard a critical statement, e.g., "I blew up *some* of the balloons". In some trials, they were asked whether they thought all the balloons were blown up, or if they couldn't tell. In other trials, children saw that all the balloons were blown up by two people. Then they saw a third person, who did not know the outcome, hear the critical statement. Children were asked whether the third person would think all the balloons were blown up or if she wouldn't know.

We found that children in both age groups were able to make inferences when they were asked about their own perspective. However, only 7-year-old children were able to understand the perspective of a third party, recognizing other people's ability to make similar inferences when given implied rather than explicit information about a situation. Overall, the study showed that children's ability to take into account different perspectives during a communicative interaction is still developing between 5 and 7 years of age.

How do children interpret stories as they unfold in real time?

Most children have a lot of experience with fantastical stories. By the time they are 4 or 5 they know that in a story world, things can happen that would never happen in the real world. For instance, once children know that Peter Pan can fly, they are not surprised when it happens again. But are children good at using these rules to interpret what they hear in real time, as the story unfolds?





We invited adults and 7-year-olds - who are veteran story readers - to the lab. They listened to some narrated short stories about fantastical characters like monsters and fairies, while looking at a picture of the character on the screen. For example:

'Chloe the fairy doesn't have cake for her snack. She has snow for her snack! And she doesn't wear shoes on her feet. She wears boxes on her feet!' Then the fairy picture disappeared and in its place, children saw pictures of the four items from the story: a cake, some snow, a pair of shoes, and a box. After a few seconds, the narrator said 'Chloe is eating up the snow!

We were interested in how children *expected* the final sentence to end once they had heard the start of the word 'eating', but before they heard 'snow'. We used where they looked on the screen during this period as a guide to what they thought would happen. They looked to the story-related pictures (e.g. snow) and the pictures that matched their real world knowledge (e.g., cake) for a similar amount of time, suggesting that they were not clear about what to expect. Unlike the 7-year-olds, adults were able to 'override' what they knew about the world and about language, and looked to the story-related pictures (e.g. snow) at a rate above chance level.

We also wanted to check that children and adults were able to use their knowledge of the world when there was no story involved, and so only one likely way of interpreting the sentence. This time with new participants, we first introduced the character ('e.g., This is Chloe the fairy!') and then skipped to the last sentence. As expected, both children and adults now looked more to the picture that was a good fit for the verb (such as 'cake' after hearing 'eating') than to the other pictures.

CURRENT STUDIES

Learning from Videos

28 months to 31.9 months & 34 months to 37.9 months

Can children use information from videos in real life with repetition and adult support? Your child will watch three short video clips of a person hiding a toy and then will be asked to find it in real life. This will involve one 20 minute visit to our lab.

Science Misconceptions

5-year-olds

How do children learn a physics concept from hands on activities? We will do an activity with your child and then ask them some questions before and after to see what they've learned. The study involves 2 visits to our lab (scheduled approximately one week apart) that will take about 30 minutes each.

Understanding Storytellers

6-year-olds to 8-year-olds

How do children understand storytellers' intentions? Children will watch a story on the computer and be asked questions about the end of the story. This will involve one 20 minute visit to our lab.

Promoting Honesty Through Stories

4-year-olds to 6-year-olds

We will ask you to fill out some questionnaires about your child's behaviors while your child plays some language games and listens to a story with a graduate student in an adjacent room. We are interested in observing developmental differences in children's truth and lie-telling behaviors in different situations. For instance, will children peak at a toy when they are asked by the researcher not to look. In order to accurately record children's responses and behaviors, we have hidden cameras set up in the room. At the end of the session, we will also provide children with a full debriefing of the study, its purpose, the activities that were performed, and also allow them to go on a hidden camera hunt. This will involve one 30 minute visit to our lab.

Understanding Stories from Verbal Prompts

5-year-olds to 6-year-olds

We are interested in how 5 and 6-year-old children watch stories on video. You will be invited to watch as we show children some stories on the screen, and track their eye movements as they watch and listen. (Eye-trackers use harmless near-infrared light, similar to the light that surrounds us every day). Children get to see where their eyes were looking at the end of the session, which is usually fun for them! We will also ask your child about some vocabulary words.

Learning Science Concepts

6-year-olds to 8-year-olds

How do children learn science concepts from picture books and hands-on activities? We will read a book and perform an activity designed to inform your child about a science concept and then ask them some questions. Your child's language skills will also be informally assessed. This will involve one 40 minute visit to our lab.

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