Statement of Research Interests

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My research interest is changes in children's knowledge and how children learn both across developmental time and on a moment-by-moment time scale. I believe that understanding cognitive development at these levels requires also understanding the interaction between children's previous experiences and the particulars of the task in which children's knowledge is assessed in a experiment. Young children encounter many situations in which they must learn quickly and make good guesses about what other people are talking about or about how to meaningfully categorize an object. For example, imagine a toddler at the zoo. His mother points into a habitat and exclaims "Look, a penguin!" How does the child know what the novel word "penguin" refers to? It might refer to the penguin, the fish the zookeeper is feeding the penguin, the color black, the animal's beak or the white belly. Two things he can use solve this problem are his previous experience with language and categories and the information present in the moment. Thus, he can infer that his mother is probably naming a single, whole object, and the penguin rather than the fish because if she wanted to direct his attention to that animal she would have used the name he already knows, "fish". On this view, *knowledge* is not limited to something that a child "has" or "possesses," but rather can be viewed as something much more dynamic and fluid that is created in the moment based on the child's developmental history (or previous experience) and the specifics of the task (the information available in the moment).

My research focuses on how smart behavior emerges from the interaction of such previous experience and the specifics of the task at hand. Under this framework, I have studied young children's knowledge in two domains: word learning and categorization. In my view, these two domains are intimately coupled. Nouns name categories of things (e.g., fish and penguins) and categories can help one know which objects can be called by the same name. I study infants and toddlers who are just beginning to learn how to name objects. I use both empirical studies and, more recently, neural network modeling techniques, to understand how children learn about categories and acquire language.

Language Acquisition

Fast Mapping and Novel Name Retention.

My dissertation research explores how children learn novel names from two directions: empirical experiments and neural network simulations. Specifically, I am investigating how young children determine the referent of a novel name and how the specifics of the task context influence their ability to retain novel name-object mappings. In this series of studies I introduce children to novel name-object pairs in a typical fast mapping task in which they are presented with three objects simultaneously: two for which they already know names (e.g., a car and a dog) and one that is completely novel (e.g., a hand back massager). On each trial an experimenter asks for an object by name—either a known name (e.g., *car*) or a novel name (e.g., *fode*). Children are very good at correctly picking the novel object in response to the novel name. Five minutes after this initial task, I test children's retention of the novel name-object mappings. In an initial series of studies I conducted with Larissa Samuelson (Horst & Samuelson, under revision), we found that children are unable to retain name-object mappings learned in the typical fast mapping task. However, when we provided support in the form of ostensive definition and multiple naming instances, children did remember the name after a delay. These results are important because they demonstrate that the names a child already knows and the specifics of how the objects are named during the task play critical roles in the child's ability to learn a new name.

Neural Network Modeling.

My current research extends my fast-mapping work by examining the processes underlying these effects. In particular, I am investigating under what conditions the presence of known names and objects in the fast-mapping task facilitate children's ability to infer the referent of the novel names, but also compete with the formation of the strong name-object mapping needed for later retention. I have captured the Horst and Samuelson empirical data (see Horst, McMurray and Samuelson, 2006) using a dynamic neural network. Using this network I have shown that the fast mapping task can be solved using probabilistic constraint satisfaction– that is, the most probable referent can be determined using the regularities presented in the input (e.g., the name

car often occurs when there is a car present). Importantly, analyses of changes to the network's weights enabled me to demonstrate that learning does occur on each fast mapping trial, however, that amount of learning is insufficient to create a strong enough name-object link thus that the network also cannot "retain" the name-object mapping. Most recently, I have begun implementing competition between the names and objects into this network and will soon test predictions from these implementations empirically.

Novel Name Generalization Studies.

The general theme of how prior experience and the task interact to create children's knowledge is also evident in my work on children's novel noun generalizations, conducted in collaboration with Larissa Samuelson. We examine children's novel noun generalizations using a task in which an experimenter shows the child a novel object and gives it a novel name. The child is then asked whether new objects that are similar to the original object in particular ways (e.g., having the same shape, being made from the same material), can also be called by the novel name. Using this task, we have examined how children's previous naming experiences and the particular information present in the moment influence children's generalization of the novel name to new objects by testing children with varying levels of vocabulary knowledge and by manipulating how much children know about the objects via demonstrations of their functional properties.

We used this approach to examine possible causes for a set of apparently conflicting results in the literature (Samuelson & Horst, in press). Soja, Carey and Spelke (1991) found that 24-month-old children generalized novel names for novel solid objects to test objects that were the same shape as named exemplars, but generalized novel names for nonsolid substances to test objects that matched exemplars in material. In contrast, Samuelson and Smith (2000) found that children generalized names for solid objects based on shape similarity but did not show any systematic biases when generalizing names for nonsolid substances. Importantly, the tasks used by Soja et al. and Samuelson and Smith differed in 1) the training used to teach children the task, 2) whether or not stimuli were presented in pieces on some trials, and 3) whether test objects that matched nonsolid exemplars in material also matched in color. In our study, we systematically examined the effect of each of these differences on children's noun generalizations with solid and nonsolid stimuli. We found that 24-month-old children generalized names for whole solid objects on the basis of shape—replicating the findings from the previous studies. However, as we systematically manipulated training children received and whether the named exemplars were presented whole or in pieces, we found that children's bias to name by shape was dramatically reduced. Further, children only demonstrated a systematic material bias when material-matching test objects also matched exemplars in color. This suggests that the specifics of the task and stimuli were instrumental in shaping children's naming behavior in the moment. Importantly, we also found that the features of the objects that children experienced on pervious trials influenced their name extensions for solid objects on later trials. That is, children's previous experience in the task influenced their present behavior. Subsequent studies in this line of research have examined vocabulary effects on these naming biases in 16- and 18-month-old children and how children manually explore solid objects and nonsolid substances. Two papers based on this research are currently in preparation (Horst & Samuelson, in prep; Samuelson & Horst, in prep).

We also examined how using forced choice versus yes/no versions of the task influenced children's naming biases (Samuelson, Horst, Dobbertin & Schutte, 2006). Critically, we found that groups of 30-month-old children matched for vocabulary size and shown the same stimuli generalized novel names for deformable things (e.g. made from sponge) by similarity in shape when required to respond "yes" or "no" when asked whether each object individually can be called by the same name (e.g., "is this a dax?"). At the same age, children generalized novel names by similarity in material when presented with two deformable objects at once and forced to choose one of the items as a referent of the novel name (e.g., "which one is a dax?"). We have developed a Dynamic Field Model that captures differences in the decision processes that underlie behavior in these tasks and further demonstrates the importance of the specific question children are asked in determining how their knowledge of nominal categories is brought to bear in individual moments of behavior.

Categorization

Before children become proficient language users, they form categorical groups of objects based on the same sorts of similarity judgments required for determining the referents for novel names. I have studied the early influence of previous knowledge and the specifics of the task using three different methodologies with infants and young toddlers: habituation to visually presented items from a completely novel category (Horst, Oakes & Madole, 2005), familiarization with visually presented pictures from a familiar category (Kovack-Lesh, Horst & Oakes, under revision), touching and manipulation in a sequential touching task of objects that can be categorized based on their appearance or their function (Horst et al., under revision). With Lisa Oakes and Kelly Madole, I tested two theoretical ideas about category learning. Specifically, I tested the idea that we first learn individual exemplars (e.g., individual dogs we encounter), then form a general prototype of the category and finally, remember both the category prototype and the individuals (Quinn, 2000). I compared this to another view, which is not mutually exclusive, that we first learn category prototypes and then remember exemplars (Smith & Minda, 1998). My results supported both models and showed than *when* infants are tested influences whether they remember category exemplars or form prototype representations (Horst, Oakes & Madole, 2005).

More directly relevant to my work on novel noun generalization, in a collaborative project at the University of Iowa and Grinnell College, I explored flexibility in toddlers' categorization (Horst et al., under revision). Flexible categorization requires being able to switch from categorizing something in one way in one situation and in another way in another situation. For example, my stapler can be used to staple pages together when I am collating tests or used as a paperweight when I open the office window. I tested this type of flexibility in toddlers' categorization. In a sequential touching paradigm, I gave them sets of objects that could be categorized in two ways to explore freely. After two minutes I demonstrated that some of the objects were squishable for toddlers in the experimental group and just held up the objects for toddlers in the control group. I found evidence that toddlers who were the most advanced in terms of vocabulary were more likely to switch what they attended to when categorizing the objects. That is, they showed flexibility in this task. This study also highlights the dynamic interaction of children's previous experience (vocabulary) and the specifics of the task (the demonstration), but in the domain of object categorization.

Conclusions and Future Directions

As a researcher of cognitive development, I am interested in investigating changes both across developmental time and on a moment-by-moment time scale, which is why I view the interaction between previous experience and the task so important—as each of these components characterizes one of these time scales. I intend to continue researching how young children learn names for object categories from this perspective. For example, I would like to explore how experience with multiple exemplars from a category helps young children learn new words. I also plan to continue using neural network modeling to explore the time scales of word learning and investigate how this time scale changes depending on the number of words the child is learning at a time