

Golinkoff, R. M., & Hirsh-Pasek, K. (2006). The emergentist coalition model of word learning in children has implications for language in aging. In E. Bialystok, & F. Craik (Eds.), Lifespan cognition: Mechanisms of change (pp. 207-222). New York, NY: Oxford University Press.

Chapter 14

The Emergentist Coalition Model of Word Learning in Children Has Implications for Language in Aging¹

Roberta Michnick Golinkoff and Kathy Hirsh-Pasek

...there are no single effective pushes to the developing system, but rather a combination of influences that lead to observable change (Nelson 1996, p. 85).

In this quotation, Katherine Nelson (1996) captured the spirit of this volume – and of this chapter. We live in a multifactorial world. If we are to understand the complex behaviors characteristic of humans, we will have to embrace systems-based models that offer a more comprehensive and integrative account of development than single-factor explanations. As Bronfenbrenner and Morris (1998) argued, systems operate at many levels, from the multiple proximal inputs that directly affect the child to the more distal effects including the time and context in which these inputs are encountered and evaluated by the child. Much of the current research in language development that does not rely on language production suffers from a more limited perspective on development, from what Bronfenbrenner (1974) suggested is the “science of the behavior of children in strange situations with strange adults” (p. 3). Indeed, much of our research is also conducted at a single point in time as opposed to longitudinally and on a single

variable as opposed to multiple variables. Thus, we rarely ask how a child might coordinate various strands of input towards the goal of constructing language nor do we ask how these strands might begin to pull apart with aging.

In this chapter, we begin to ask empirically how a combination of influences can lead to observable changes in language comprehension. We speculate about how such an integrated model could help us see atypical development as part of the continuum of typical development and how aging might affect the more normative processes of language learning. Throughout, we use one aspect of language development, word learning, as our test case. Words are the bedrock of language, the building blocks around which sentences are formed.

The chapter is organized in four parts. First, we review the families of theories that have been posited to account for word learning. We then describe a theoretical alternative that incorporates the best of the theories in an integrative framework and allows for testable hypotheses about word learning. Third, we examine the impact of an integrated theory for approaching questions in language development for both normal and atypical children. Such a study forces us not only to consider how the combination of influences might interact, but also how they are interpreted by children with different cognitive starting points. Finally, we ask how attention to a broader proximal system that includes person characteristics as well as proximal influences from the perceptual, social, and linguistic contexts might explain breakdowns in language with age. Empirically testable theories of development that embrace more complex and over-arching models of word learning might allow us to find alternative pathways to development and degradation that would not surface in the drive towards more parsimonious single factor explanations.

Three Theories of Word Learning

The problem space: On its face, word learning seems like a simple problem. The child need only attach the word to an object in plain view. On closer inspection, however, word learning proves to be a difficult task. To learn a word, infants must first segment the sound stream, finding the carving joints in the continuous stream of speech around them. Second, they must discover a world of objects, actions, and events, and figure out how those are divided into meaningful units. Finally, they must map words they have uncovered from the sound stream (or visual stream in sign languages) onto some referent in the world. Quine's (1960) oft cited story highlights the inherent difficulty of this so-called mapping problem: A linguist in a foreign land sees a rabbit scurrying by while hearing a native exclaim "gavagai!" Among an enormous number of other possibilities, the word "gavagai" could refer to the whole rabbit, the rabbit's ears, or to the rabbit's hopping. The world allows an infinite number of possible word-to-world mappings. This leads many to ask how the child ever learns how a word maps onto a referent.

Theories of word learning can be distinguished on the basis of whether they embrace the Quinean conundrum as a foundational assumption or whether they reject it. Theories that posit constraints or principles adopt Quine's view of the problem space. Theories that emphasize social input or associative learning consider Quine's example largely irrelevant to the problem of word learning. These theories form the landscape for the debate about the nature of early word learning.

Constraints or principles theories take Quine seriously. Because word-to-world mapping is under-determined, human minds must be equipped with constraints or principles that narrow the search space. Under this theory, children approach the word learning task biased to make certain assumptions over others for what a word might mean. Domain-specific constraints theories have been posited for a number of cognitive development domains. As Gelman and

Greeno (1989) wrote with respect to theories of number development:

If we grant learners some domain-specific principles, we provide them with a way to define the range of relevant inputs, the ones that support learning about that domain.

Because principles embody constraints on the kinds of input that can be processed as data that are relevant to that domain, they therefore can direct attention to those aspects of the environment that need to be selected and attended to (p. 130).

Similar statements have appeared in the literature on spatial development (Newcombe & Huttenlocher, 2001) and object perception (Spelke, 1990). The general thrust of the constraints or principles position is to make a daunting task manageable by restricting the number of hypotheses the learner need entertain to arrive at a representation of a domain.

A substantial body of evidence has accumulated to support the constraints position in word learning. Markman's (1989) principle of mutual exclusivity, for example, states that children assume that an object can have only one name. The consequence of this principle is that a novel name will not label an already named object but rather will label an unfamiliar object. Others have shown that 28-month-olds will assume that a novel label maps to an unnamed object when presented with a set of familiar and unfamiliar objects (Evey & Merriman, 1998; Golinkoff, Hirsh-Pasek, Bailey, & Wenger, 1992; Mervis & Bertrand, 1994). These findings not only support Markman's mutual exclusivity principle but also a more flexible principle ("novel name-nameless category" or N3C) posited by Golinkoff, Mervis, and Hirsh-Pasek (1994). Similarly, Clark (1983) suggested that children operate with a principle called "conventionality": Use the word that your linguistic community uses or you won't be understood. Mervis (see Golinkoff et al., 1994) provided numerous diary entries which showed that children abandon their idiosyncratic terms in favor of the standard terms (e.g., over time "pops" becomes

“pacifier”).

The principles/constraints theories have flourished. Indeed, over the last 15 years, there has been a proliferation of principles including Waxman and Kosowski’s (1990) “noun-category bias,” Markman’s (1989) “mutual exclusivity,” Markman and Hutchinson’s (1984) “taxonomic assumption,” and Clark’s (1983) pragmatic constraint of “contrast”. These principles were reviewed and placed in a developmental framework by Golinkoff et al. (1994) who posited a set of six principles (some new and some in the literature) that were necessary and sufficient to account both for how children get word learning “off the ground,” and for how they become “vacuum cleaners for words” (Pinker, 1994) at around 19 months of age.

The Golinkoff et al. framework offered a developmental model in which the principles of word learning were organized on two tiers that captured the changing character of word learning (see Figure 1). On the first tier, and appearing at around 12 months of age, were the principles of reference (that words map to objects, actions, and events); extendibility (that words do not uniquely refer to the original referent but rather to a category of objects, actions and events); and object scope (that words refer to whole objects rather than to object parts and to objects over actions). On the second tier, the principles of N3C (that novel names label novel categories); categorical scope (that words label taxonomic categories); and conventionality (Clark, 1983) (use socially agreed upon names for things) are born from the first tier principles and help children catapult into the mature word learning characterized by the vocabulary spurt. Fundamental to the principles framework is the idea that the *principles themselves undergo change with development and are an emergent product of the combination of word learning experience and some inborn biases*. Nested in the Golinkoff et al. (1994) framework is a powerful developmental solution to the Quinean dilemma.

Social-pragmatic theorists stand in stark contrast to the constraints position. Children, embedded in a social nexus, are guided by expert word learners as they embark upon the word learning task. As Nelson (1988) has written, Quine's problem becomes irrelevant:

The typical way children acquire words ... is almost completely opposite of the Quinean paradigm. Children do not try and guess what it is that the adult intends to refer to; rather...it is the adult who guesses what the child is focused on and then supplies the appropriate word (pp. 240-241).

Bloom (1993, 2000) similarly concludes that adults talk about objects, actions, and events that are *relevant* to children. Children don't have to wade through alternative interpretations for a word; the correct interpretation is already the focus of their attention.

There is considerable evidence that children are capable of utilizing social cues in the service of word learning. For example, various researchers have shown that 18- and 24-month-olds can use the intention of the experimenter to attach a label to a novel object or action (Akhtar & Tomasello, 2000; Baldwin & Tomasello, 1999; Carpenter & Tomasello, 1999; Disendruck, 2001; Tomasello & Barton, 1994; Tomasello, Strosberg, & Akhtar, 1996). If the experimenter indicates that she erred in using a label, children will not attach a novel label to the first object or action they see but to the second object. Akhtar and Tomasello (1996) showed that 24-month-old children mine the social context to attach a novel label to a hidden object instead of to novel objects that they are shown. Furthermore, Baldwin, Markman, Bill, Desjardins, Irwin, and Tidball (1996) showed that 18-month-olds can evaluate whether an adult uttering a label in great excitement ("It's a toma!") while on the telephone is intending to label the child's object or something else. Young children are not fooled into forming a link between a label uttered by a woman who is not addressing them just at the moment that they are focused on a novel toy. Nor

do 12-month-olds form mismappings between names and potential referents (Hollich et al., 2000).

Under the social-pragmatic view, children are seen as skilled apprentices to expert word learners participating in a structured social world. Children are also seen as able to read the social intent of their mentors (P. Bloom, 1999) in this world. By virtue of being a social animal, language comes for free. Under this interpretation, Quine's linguist differs from real children because children are immersed in rich social contexts that naturally delimit the possible mappings between words and their referents.

The constraints/principles and the social-pragmatic theories of word learning represent the most common positions in the literature. Recently, however, Smith (1995, 1999, 2000), Samuelson and Smith (1998), and Plunkett (1997) have offered a third perspective on the word learning problem. The domain-general view of word learning rejects Quine's conundrum, suggesting that word learning can be best accounted for through "dumb attentional mechanisms" like perceptual saliency, association, and frequency. In comparing the differences in constraints theories and her own systems-theory view, Smith (1995) wrote:

The empirical focus [of constraints theories] becomes not the processes that enable children to interpret words in context, but whether children's biased learning has the properties needed to 'solve the induction problem.' The present thesis is that the induction problem is irrelevant to developmentalists. Learning is not necessarily hypothesis testing. Development is not induction (p. 4).

Children do not need constraints or principles to forge word-to-world mappings. The process of mapping a word onto an object is straightforward. Children notice objects, actions, and events that are the most salient in their environment. They associate the most frequently used label with

the most salient candidate (Smith et al., 2002). In this way, ambiguity in the word-learning situation is removed. General cognitive mechanisms are sufficient not only to account for how young children first map words onto referents, but also to account for the complexity of more sophisticated word learning (Smith, 2000).

This synopsis of the theoretical debate in the area of word learning parallels that in the developmental literature. For any given developmental problem space, theories arise that represent the constraints, domain-specific alternative, a social-pragmatic or cultural alternative, and an associationistic alternative. As in the area of word learning, there is mounting data to support each of the positions. There are also reasons to reject each theory. By way of example, one could argue that despite many attempts to sweep away the Quinean problem in word learning, it refuses to disappear. Any single object, action, or event presents an array of possible referents to be named. Even something as simple as a “sippy cup” has a lid, an elevated portion on the lid (mouthpiece) and possibly pink flowers on its blue plastic base. All of the parts move together when the cup is lifted and some of these parts -- such as the mouthpiece -- may prove more salient than the whole object. Which of these parts is graced with the name, “cup?” Neither perceptually-based nor socially-based theories assist the child in reaching the final determination of what makes word-to-world mapping possible. Only the constraints or principles theories solve the Quinean problem. Yet, they do so by default. Either they assume that principles come in full-blown and are non-developmental (Markman, 1989) or they offer a developmental perspective with little emphasis on the mechanisms of change.

The debate presses on (Golinkoff, Hirsh-Pasek, Bloom, Smith, Woodward, Akhtar, Tomasello & Hollich, 2000) as scientists try to determine which theory best accounts for the data. Yet, science’s steadfast and historically rooted view that parsimony demands a *choice* of

one theoretical explanation over the other might lie at the root of the problem. Perhaps the issue should not be cast as *which* of the particular theories is “right.” Perhaps the issue should be recast as which components of which theories seem to govern children’s word learning at different points in the course of development. This reframing of the question requires the creation of a hybrid approach with clear hypotheses that make the theory empirically testable. The idea that we need to consider multiple perspectives to solve complex problems is not new (Bloom, 1978, 1993, 2000). It was from this idea that the emergentist coalition model was born.

The Emergentist Coalition Model of Word Learning

The emergentist coalition model (ECM) of word learning is a hybrid model that builds on the developmental lexical principles framework (Golinkoff et al., 1994). This model (Hollich et al., 1998; Golinkoff et al., 1999; Hollich, Hirsh-Pasek & Golinkoff, 2000) incorporates the impact of diverse factors on word learning because, as in the real world, it is likely that children avail themselves of social, attentional, cognitive, *and* linguistic cues to learn new words. The emergentist coalition model embraces this complexity. It allows for the full range of cues that contribute to word learning, rather than forcing artificial choices among them. Thus, the first defining tenet of the model is that children mine a coalition of cues on their way to word learning. Figure 2 graphically depicts the multiple inputs that are available for word learning.

Although a range of cues is always *available*, not all cues for word learning are equally *utilized* in the service of word learning. Younger children, just beginning to learn words, rely on only a subset of the cues in the coalition. Older, more experienced word learners rely on a wider subset of cues and on some cues more heavily than others. The model posits that social cues such as eye gaze that are subtle and may demand at least a primitive theory of mind, will be less utilized than a cue such as the salience of objects. Given a choice between attaching a novel

name to a boring object that an adult is looking at versus a colorful, exciting object, the child just beginning to learn words should rely on perceptual salience (consistent with the associationist) before relying on the subtle social cue of eye gaze (consistent with the social-pragmatic perspective). Thus, the second major tenet of the theory is that the cues for word learning change their weights over developmental time.

Because children make differential use of the available cues with development, this model holds that principles for word learning are emergent. They develop over the course of the second year of life as children gain word learning experience. Unlike other constraints posited in the literature, the emergentist coalition model states that not all of the principles are available from the start of word learning. Lexical principles are the products and not the engines of lexical development. Children do not start word learning, for example, with the novel name - novel category principle (N3C). Mervis and Bertrand (1994) have shown that the N3C principle is not in place until after the vocabulary spurt. The third tenet of this model, then, is that the principles for word learning are emergent and not given a priori.

The developmental cast of this model makes it imperative to study the origins of word learning as well as the transformation that takes place in the second year of life when the child becomes an expert word learner. Data need to be collected that demonstrate that children detect and utilize multiple cues for word learning; that their reliance on these cues changes over the course of development; and that principles for word learning emerge from word learning experience.

Our research has assessed these claims within the context of the first tier principles of reference (that words map onto the child's representation of objects, actions, and events) and extendibility (that words map onto more than one exemplar). First, we hypothesized that

children learning their first words (at 10- or 12-months of age) would be informed by multiple cues, of an attentional, social, and linguistic nature. Second, we hypothesized that perceptual salience would be more heavily weighted than social cues for the novice than for the expert word learner. Third, we hypothesized that the word learning principles themselves develop along a continuum from immature to mature such that children are first attracted by what is most salient to them, and only later note what is important to the speaker. As they break through the language barrier, children are guided (though not completely) by associationist laws. As they mature into veteran word learners, they are guided (though not completely) by social-pragmatic strategies. Both views are united under one theory.

Evidence for the Emergentist Coalition Model

Investigation of the hybrid model demanded experiments that could trace development of the principles of reference and extendibility from their immature to their mature states. To assess the principle of reference, we examined whether infants would attach a label to both interesting and boring objects. We reasoned that a child with an immature principle of reference might attach a novel label to the interesting object – regardless of which object an adult was labeling. The child with a mature principle, on the other hand, should overcome the salience of the object in favor of relying on the speaker's social cues to what is being labeled. To assess the principle of extendibility, we first asked whether infants would extend a label for a given object to one that differed only in color from the original exemplar. We then put infants in a very difficult task and asked whether they would use social information to extend that label to an object that bore no resemblance to the original object. After all, bean bag chairs and dining room chairs bear little resemblance to one another and yet they are both called, "chairs." Children who fail to extend a label or who will only extend the label to close perceptual relatives possess an immature

principle of extendibility. Alternatively, children who trust a social mentor extending a label in the face of contrasting perceptual cues are operating with a mature principle of extendibility (Maguire, Hennon, Hirsh-Pasek, & Golinkoff, 2003).

Examination of the emergentist coalition theory required a method that could be used equally effectively with children in the age range of interest (10 to 24 months) and one that would enable researchers to manipulate multiple cues (attentional, social, and linguistic) and their interactions. The Interactive Intermodal Preferential Looking Paradigm (IIPLP) provided this new method (e.g., Hollich et al., 2000). Based on the “Intermodal Preferential Looking Paradigm” (Golinkoff, Hirsh-Pasek, Cauley, & Gordon, 1987; Hirsh-Pasek & Golinkoff, 1996) used to study lexical and syntactic comprehension, Baldwin’s (1991, 1993) “bucket task,” and Fagan’s (1971; Fagan, Singer, Montic, & Shepard, 1986) infant intelligence test, the method allows for the study of multiple cues to word learning in the first two years of life. The physical set up is depicted in Figure 3.

Infants are seated on their blindfolded mother’s lap facing the experimenter and our testing apparatus. After pre-exposure to the toys -- familiar toys on some trials and novel toys on others -- the toys are fixed with velcro onto one side of a two-sided black board that can be rotated so that the toys can go in and out of view for a specified period of time. The experimenter hides behind the board while children are inspecting the toys and during test trials. Coding is done off-line from video taped records.

Using this apparatus, it is possible to examine word learning in a controlled setting. Familiar object trials allow us to ask whether the child can “play our game.” The use of unfamiliar, novel objects permits exploration of the cues and *combinations* of cues that children use to guide word learning across development. The logic of the design (Golinkoff et al., 1987;

Hirsh-Pasek & Golinkoff, 1996) is that children should look more at an object that “matches” the linguistic stimulus than at an object that does not match. Thus, the dependent variable is visual fixation time to the target (named) object versus to the unnamed object.

Validation of the method comes from the familiar trials. Children at three ages were tested: 12- to 13-month-olds just at the beginning of word learning; 19- to 20-month-olds who may or may not have yet experienced a vocabulary spurt; and 24- to 25-month-olds who typically have sizeable production vocabularies. In over 23 experiments children demonstrated the potency of the method by looking significantly more at the target item than at the non-target item in the familiar condition when an item was requested (Hollich, et al., 2000). Evaluation of the hypotheses comes from children’s responses to *novel* stimuli. Using this method, we were able to explore how infants move from immature to mature principles of reference and extendibility and to examine the hypotheses that form the foundation for the emergentist coalition model.

Evidence from the Studies on the Principle of Reference

Reference, or the assumption that words refer, is the most basic of the word learning principles. Do infants assume that a word refers to an object, action, or event? How do they decide which object, action or event should receive a label when one is offered? To investigate these questions, conditions were created in which multiple cues were available to children but were sometimes placed in conflict. In what we called the *coincident* condition, we labeled the novel toy that coincided with children’s preferences -- the interesting toy. In the *conflict* condition, we labeled the novel toy that did not coincide with the children’s preferences -- the boring toy. We reasoned that learning the word in the coincident case should be easy for children because all of the “cues” -- attentional, social, and linguistic -- were in alignment. In contrast, learning a novel word in the conflict condition should be more difficult because the

coalition of cues is not acting in concert.

The experiment was conducted in four phases. First, children were given the opportunity to explore both the interesting and boring toys. Second, children participated in a salience trial in which they saw both the interesting and boring toy mounted side by side on the black board. Third, in the labeling phase, the experimenter captured children's attention, displayed both toys and labeled the target five times with a novel word (e.g., danu). In the coincident condition, the experimenter looked at and labeled the interesting toy; in the conflict condition, she looked at and labeled the boring toy. Finally in the test trials, the experimenter, now hiding behind the board, asked for the object that was labeled during training, once again getting the child's attention first. For example, she might say, "Eve, where's the danu?" If children learned the name of the correct toy, they should look more to the target than at the non-target (see Hollich et al., 2000, for details).

Do children understand that words refer? What cues do they use to determine the referent of a word? The participants in this study were 32 children at each of 12, 19, and 24 months of age. At all three ages, there is evidence that children detected the range of cues available. For example, even the 12-month-olds detected the social cue of eye gaze although they could not use it when it was in conflict with perceptual salience. They learned the name of the object only in the coincident condition, as several further studies indicated (Hollich et al., 2000). The 19-month-olds learned the names of the objects in both conditions, but were still influenced heavily by perceptual salience. Even the oldest group who learned the names of the novel objects in both the conflict and the coincident conditions still showed the effects of perceptual salience by looking much longer at the target object in the coincident condition than in the conflict condition. This suggests that children were lured by the perceptual salience of the

interesting toy, but were able to overcome it when the boring toy was the focus of the experimenter's attention. In short, these data suggest that infants with an immature principle of reference are more dominated by perceptual salience than are their counterparts with a more mature principle of reference. Nineteen- and 24-month old children recruit the speaker's social intent when mapping word to object. In light of these data, we conducted studies with 10-month-old infants to see whether children who were just beginning to acquire a comprehension vocabulary operated like the 12-month-olds who were starting to produce language. Results from this age group suggest that 10-month-olds are even more bound to perceptual salience than the 12-month-olds. They demonstrated a clear preference for the interesting toy even in the conflict condition, suggesting these children ignore the presence of conflicting social cues. They apparently assume that labels "go with" interesting rather than boring objects, regardless of what the speaker is labeling (Hirsh-Pasek, Hennon, & Golinkoff, 2003)!

What we see in the data is a clear pattern that changes over time such that infants become less dependent on perceptual cues and more dependent on social cues to determine reference. Such data speak to both the associationist and the social-pragmatic theorist. The associationist position would predict that children *would* form a mismatching between the *interesting* object and the label in the conflict condition. If the 10-month-old data stand, then these data fit this prediction – but only for the very youngest children. Yet, by as early as 12 months of age, children with only 3 words in their productive vocabularies are already demonstrating some sensitivity to social information in a word learning task. These children, at the cusp of word learning, learned the novel labels only in the coincident condition. In the coincident condition, the experimenter labeled the object that the babies were most interested in. For these babies, learning took place when the cues coincided. However, when multiple cues failed to coincide in

the conflict condition, infants showed little evidence of word learning. They wanted to look at the interesting object despite the fact that the experimenter persisted in labeling the boring object. Though they looked at the interesting object much more than the boring object in the conflict condition, they did not falsely conclude that the novel label was attached to the interesting object. Even 12-month-olds were sensitive to the fact that the experimenter was looking elsewhere and *not* labeling the interesting object. Even 12-month-olds are able to use multiple cues for word learning, but for learning to occur, the cues had to *overlap*. While the 12-month-olds are not social pragmatists yet, they also defy the predictions made by the associationistic camp. Only a hybrid theory that talks about attention to multiple cues and differential attention to these cues over time, can account for the data.

Implications of Emergentist Coalition Model

If there are data to suggest that studies of word learning offer only incomplete snapshots of behavior, and if it is the case that we can find testable hypotheses in an integrated view, then it should be possible to apply the theory broadly and to gain new insights into language development. Two areas that might prove particularly fruitful are the study of language disabilities and the study of elder speech. In each area, questions that could be profitably explored are 1) whether the three systems of input (perceptual/attentional, social, and linguistic) are all accessible to older adults; 2) whether the systems have differential weighting both within certain populations and across time; and 3) whether children and adults can coordinate the cues in ways that optimize learning and processing.

Atypical language development. One of the breakthroughs afforded by a systems-based approach like the emergentist coalition model is that atypical development is considered to have the same sources as typical development (Hennon, 2001). In fact, researchers like Bates

(personal communication, 2000) have argued that atypical development is but the extreme end of the normal continuum and that when stressed, even a normally developing adult will show the same language patterns found in atypical populations. If we take the systems model seriously, it would mean that all atypical development should emerge by tweaking the weightings and the developmental timing of the available cues that children might use to learn language.

Traditionally, researchers who examine atypical development have not adopted a unified and integrated view of language development. This leads researchers to adopt a “pet” theory that helps to explain a particular aspect of atypical language but fails to provide an integrated view of what goes wrong. Constraint theories with a strong linguistic focus, for example, appeal to those who study disorders having known biological etiology (Levy, 1994; Pinker, 1994) like specific language impairment (SLI). What is impaired here is thought to be some fundamental aspects of the innate grammar (Rice, 1996). While such accounts do a reasonable job of explaining SLI, they have difficulties interpreting evidence of language disorder with no known neurological abnormalities. In stark contrast, socio-pragmatic theories offer excellent starting points for explaining language disorders like autism that are associated with impairments in social relationships (Hertzog & Shapiro, 1990; Howlin & Yule, 1990).

The ECM offers a more comprehensive theory that might allow the problems observed in various disordered populations to be explained within a single framework. Imagine, for example, that language impairment comes from a dampening of one of the input cues or from a delay in the accessibility of that cue. Is there any evidence in the literature that might support this speculation? Autism offers one test case. Autism has often been described as a primary impairment in interpreting the social intent of others. If we assume that social pragmatic cues are primary for language development, and that the autistic child has little access to these cues,

we are presented with a paradox: How can we explain the relative success of language development in some autistic children? If, however, we understand that their social impairment influences a language *system* that also includes perceptual, attentional, and grammatical elements, interventions may be developed that strengthen the contribution of each of these other aspects (e.g., perception or grammar) as a means of compensating for the “missing” social component. In the framework of the ECM model, children with autism might differentially rely on the perceptual and linguistic components of early word learning with relatively little sensitivity to the socio-pragmatic component. They might continue to use perceptual strategies for learning well into the second year when most children come to rely on the socio-pragmatic cues. If our theory is right, these children might never experience the naming explosion that characterizes normal development, and sets the stage for later syntactic advances (Berko Gleason, 1997). Notice that the very foundation for grammar might be compromised here as the vocabulary fails to reach a sufficient size to support the later acquisition of specific grammatical skills. If this is the case, then even successful autistic word learners should be acquiring vocabulary in a way that compensates for the dampening of the socio-pragmatic information.

Research by Hennon et al. (2003) suggests that this is exactly what happens. Three-year-old autistic children were shown *not* to have the ability to use cues to social intent in word learning even though they had amassed X words in their productive vocabulary. They tended to learn their words through increased attention to perceptual salience, responding more like typical one-year-olds in their language processing. With a more comprehensive theory of language acquisition, then, we can ask not just what is wrong or “broken” but how children might find some compensatory mechanisms to partially repair the system. If the theory of language development were socio-pragmatic, for example, without looking at the co-development of

perceptual and linguistic information, these compensatory mechanisms would not be as apparent.

A similar example comes from the study of populations who have atypical perceptual abilities. Word learning in Williams syndrome, for instance, may be partially explained by the visuo-spatial deficits associated with the disorder. Visual processing in Williams syndrome is compromised to the extent that they draw a picture not with lines, but rather with words. Thus, while they are not technically blind, individuals with Williams syndrome may not “see” the world in the same manner as normally developing children do (Mervis, 1999; Wang, Doherty, Rourke, & Bellugi, 1995). This distortion of the visual domain would be predicted to result in delay in early word learning, akin to that found in the blind child. As the exceptional social abilities of individuals with Williams syndrome begin to be utilized for word learning, they may provide a source of compensation for the perceptual difficulties. This would predict that early word learning would be exceptionally slow, when perceptual information is dominant. Moreover, even once the social information has gained in importance, the specific words learned by individuals with Williams syndrome may be “odd” as the perceptual component that is critical to early normal development is distorted or lacking in Williams syndrome. This is precisely the pattern of vocabulary development that has been found in individuals with Williams syndrome (Karmiloff-Smith, *et al.*, 1997; Mervis, 1999). If this explanation is true, then a “spurt” in vocabulary growth in Williams syndrome should be correlated with an advance in their use of social information in a non-word learning task.

A systems-based language theory that posits the interaction of multiple cues over time permits the study of alternative pathways to learning. It also makes clear predictions. First, early word learning should be facilitated when children have access to multiple cues and when these cues are redundant. That is, if the adult demonstrates the intention to label the most

interesting object in the environment (coincident information), that label should be easier to learn than if she intends to label the more boring object in the environment (conflict information).

Data from both typical and autistic children confirm this prediction. Second, children should learn even better when all three of the cues are available as opposed to when only two cues are available for word learning. Evidence comparing the word development of typical and atypical development from our lab confirms these hypotheses (Hennon, 2001). Evidence of this sort is also available for how adults identify the verb being uttered in a silent, videotaped scene of a mother interacting with her child (Gillette, Gleitman, Gleitman, & Lederer, 1999). Adults were only able to identify the videotaped actions when perceptual and social cues were available along with the frames the verbs appeared in. All three sources of information were necessary for correct verb identification. Third, the model predicts a developmental sequence in which the cues for word learning are differentially weighted such that perceptual information is the most potent early on to be followed by social cues to word comprehension and later linguistic comprehension. Work in our lab (Hollich et al., 2000) and in others (Hoff & Naigles, 2002) lead to the same conclusion. Indeed, Hoff and Naigles argue that differences in early word learning are a result of children's ability to mine the social cues speakers offer. However, by 2 ½ years, it is no longer the social cues that account for the variance in language learning but the diverse linguistic cues children receive.

The ECM is thus a quintessentially integrative and developmental model. It should be as applicable to the study of aging as it is to the study of atypical development. If language development is about the development of, use of, and coordination of multiple cues across time, then any disruption in the processing of those cues should impair the acquisition and processing of language in both comprehension and production. How might this translate into an explanatory

model for how the elderly process language?

Language in Elderly Populations

To date the ECM has only been applied to contexts of language learning with no attention to potential language degradation in the elderly. Yet, we can speculate about how the model might apply and ask whether there is any supporting evidence for these speculations. Kemper and her colleagues (this volume; Kemper, Thompson, & Marquis, 2001; Kemper, Greiner, Marquis, Prenovost, & Mitzner, 2001) and Schneider, Daneman, and Pichora-Fuller (2002, see also Hamilton-Wentworth District Health Council, 1988) report that elderly people, particularly in their mid 70's, have more trouble processing and understanding language than younger people. As Schneider et al. note:

The difficulties could be in higher-level cognitive processes such as language comprehension, memory, attention, and cognitive slowing, or they could be in lower-level sensory and perceptual processes. A complicating factor in determining how these sources might contribute to age-related declines in speech understanding is that they are highly correlated (p. 139).

At least one researcher (Kemper et al., 2001), argues that the core of the problem might come in the form of a decline in the ability to process more complex grammatical input.

The ECM model could offer a way to disentangle the multiple sources of information that might contribute to the decline in language learning and to offer corroborating evidence for the decline in grammatical processing. Elderly people's ability to learn novel words could be a test case. We could make a series of predictions that parallel what we know in the study of early language development and in the study of atypical development. First, given Kemper et al.'s and Schneider et al.'s data, we might find that the weightings of the three types of input cues shift in

a direction opposite to that from the language-learning child. By way of example, the elderly should have access to all three types of input information (perceptual, social, and linguistic) during conversation but the ability to use the linguistic information should be less heavily weighted over time. In the absence of a social context in which language is accompanied by gesture and other non-linguistic nuances, elderly adults might be expected to be less capable at deriving meanings from texts. Thus, when elderly adults are placed in a “fast-mapping” (single trial) word learning situation, they should be less able to pick up correct denotations and connotations for novel words.

Work by McGinnis and Zelinski (2000) comes closest to a fast-mapping situation, since novel words are presented once in paragraph contexts. They found that older adults do indeed produce more general and less precise definitions of novel words when they are encountered in written text. In a second experiment, they asked adults to select (instead of produce) from among one of four choices for what a novel word presented in a paragraph context meant. Adults over 75 years old selected fewer precise definitions, suggesting that the limitations observed in the first experiment were not a function of requiring production and the concomitant retrieval demands. Instead, older adults were more likely to take the meaning of a new word to be a less precise, higher order meaning than young adults. For example, for the new word “dippoldism”, an exact definition was the whipping of children. A generalization that was much less precise (“getting fired for inappropriate behavior”) was more often selected by elderly adults than the exact definition. This suggests that, as the ECM predicts, elderly adults are indeed less accomplished at fast-mapping tasks.

Second, we should find that language-compromised elderly people should learn words best when the novel word labels an object or an action that is *redundantly signaled* by perceptual

salience (something in the here and now), clear social intent, and overlapping and varied linguistic frames so that the novel words are repeated in contexts. This is for several reasons. One reason, as Schneider et al.'s (2002) results suggested, may be auditory declines. Sensory problems therefore, may be responsible for a significant portion of elder adults' comprehension problems. Redundant presentations – whether from providing repeated linguistic data and/ or having (when possible) some visual instantiation of what is being discussed, may assist comprehension. In our research, we found that 12-month-olds learned words best when all the cues were in alignment (Hollich et al., 2000). This may paradoxically true for elder adults as well.

The second reason why redundancy may help comes from Schneider et al (2002) who suggest that using multiple frames for presentation of new information may more likely trigger elderly adults' world knowledge. On the assumption that world knowledge is greater for older than for younger listeners, older adults may be more skilled at using context based knowledge to derive word and sentence meaning. This prediction also flows from our work with young children and children with atypical development. New words used in coincident contexts are more interpretable than new words used in conflict situations in which the speaker labels an object that is not in the listener's focus of attention. If elderly adults understand the surrounding context, it becomes a coincident situation for them. Note that the words in the McGinnis and Zelinski study described above were presented in written text. The ECM predicts that if the passage were presented with an accompanying video representation of the meaning – to provide redundant cues – elderly adults would do better in abstracting more precise definitions of the novel words.

Third, we might posit a developmental progression such that elderly adults first have

trouble “reading” language input cues (both from a perceptual standpoint because of auditory decline as well as from a grammatical standpoint) and later on, trouble understanding speaker social intent. If true, this order of loss would mirror in reverse the order in which these cues come on-line in children, with sensitivity to social cues coming in last. Among adults, a speaker’s social intent is signaled as it is for children – with eye gaze, body posture, gesture, and other paralinguistic devices. However, among adults and far less so among children, speaker intent is often signaled with irony. People sometimes say just the opposite of what they mean, utilizing irony and sarcasm to make their point. For example, a speaker might say how awful it is that someone needs to travel to Paris on business, meaning the exact opposite. Do elderly adults have difficulty computing the meaning of ironic statements in discourse? Here, to our knowledge, there is only anecdotal evidence. It is often reported by neurologists (Fink, 2003, personal communication) that understanding of irony declines with age, sometimes the apparent result of mini-strokes that leave the individual otherwise unimpaired. In any event, it would be interesting to see if part of the problem elderly adults experience in language comprehension is attributable to a declining ability to interpret social cues.

Fourth, we could investigate the facility that listeners have in *coordinating* the various sources of information available in the learning of new words or in the comprehension of language. If there are new words, and they are presented in complicated grammatical constructions, and they are presented in writing instead of about witnessed events, elderly adults’ information-processing system may be especially taxed. This would suggest that working memory per se is not a fundamental problem (Daneman & Green, 1996) but rather the coordination and assembly of the relevant cues for language comprehension is the problem. What exactly elderly adults rely on in such situations, and whether one could tease out which

cues hold precedence, would be important to find out. Such knowledge would enable us to play to the strengths of the elderly, to borrow a metaphor. Here too, there is little research. The ECM could guide researchers in formulating hypotheses about how the elderly coordinate the language comprehension process and which cues they rely on more heavily. If we could pinpoint the source of difficulties using novel word learning as a kind of diagnostic, we might be able to use the model to suggest ways to facilitate processing. Perhaps those who work with the elderly could enhance comprehension, for example, by making sure that their talk is about things in the here and now and showing strong cues for social intent. That is, alternative pathways for understanding language are suggested in a more integrative model like the ECM. Talking about the “here and now” and providing strong cues for social intent is exactly what is done in infant-directed (ID) speech or baby talk. Interestingly, there is a parallel register used in talk to the elderly. Much research in recent years has been directed at understanding the factors that trigger elderspeech and whether it facilitates the language comprehension of older adults (e.g., Kemper et al., 2001). Next we turn to an examination of elderspeech in the context of the emergentist coalition model.

The Case of Elderspeak

What is “elderspeak”? It is a “simplified speech register with exaggerated pitch and intonation, simplified grammar, limited vocabulary, and slow rate of delivery” (Kemper et al., 1998). This definition is virtually identical to the way that ID speech is described. Golinkoff, Hirsh-Pasek, and Alioto (2002), for example, defined ID speech as having, “...a slower rate, an extended frequency range, higher overall fundamental frequency, repeated pitch contours, marked intensity shifts, longer pauses between utterances, word lengthening, and simplified vocabulary” (p.1) (e.g., for related definitions see Morgan & Demuth, 1996; Snow, 1995).

Interestingly, however, the functions of ID speech seem to be different from the functions of elderspeak and we can analyze these differences in the context of the ECM.

Clark (2003) argued that ID speech has three functions when used with infants. First, it seems to be designed to get the baby's attention. Whether it is high-pitched or a whisper, it is designed to be differentiated from speech ordinarily addressed to adults. It is as if ID speech says, "Hey baby, this talk is for you!" Second, it is apparently used by speakers to maintain infants' attention -- not an easy thing to do. High pitch and exaggerated intonation contribute to that goal. Finally, to communicate with a listener who has much less knowledge than the speaker, the speaker must carefully choose appropriate words and make them stand out in the stream of speech. ID speech sounds almost tailored to the child's linguistic level.

What are the functions of elderspeak? Why do we observe this confluence of speech registers at opposite points of the life cycle? Before answering these questions we must distinguish between elderspeak used to elderly adults with verifiable neurological impairments (e.g., Alzheimer's disease) versus its use to healthy elder adults. When used by spouses to their partners suffering from dementia and possible Alzheimer's, it has been shown to improve performance in a picture description task (Kemper, Anagnopoulos, Lyons, & Heberlein, 1994). Spouses who used a simplified speech register that presumably reduced processing demands, had partners who were better at selecting the correct picture from among a set of choices. Thus, one function of elder speech with a population with a true disability is to improve comprehension.

What function, if any, does elderspeak serve when used with a population of elderly adults with no diagnosis of impairment? Here the results are mixed and depend on the aspect of speech that is focused on. For prosodic aspects, the use of elderspeak can cause adults to do *worse* on comprehension tasks (Kemper & Harden, 1999; Kemper, Ferrell, Harden, Finter-

Urczyk, & Billington, 1998). Why should that be? When adults are spoken to with the prosodic, high pitched, sing-song speech characteristic of baby talk, they apparently feel patronized, demeaned, and insulted. What function do the attention-grabbing features of ID speech serve for infants? Presumably the exaggerated prosody grabs and maintains infant attention. Babies prefer to listen to ID over AD speech, as early as at birth (Cooper & Aslin, 1990). The pitch fluctuations characteristic of baby talk are probably what is responsible for this preference (e.g., Fernald, 1991). Elderly adults do not need to be induced to listen to and maintain their attention to language! They know that speech is directed to them. Therefore, this aspect of elderspeak serves little function for them and yet young adults seem to have difficulty in inhibiting it in a simulation with non-impaired older adults (Kemper et al., 1998).

The aspect of elderspeak that does seem to make a difference for comprehension in a referential communication task is an increase in semantic elaborations and a reduction in the number of subordinate and embedded clauses. Such modifications are parallel to the modifications that probably assist toddlers' comprehension of ID speech, although this is but a speculation. All we know is that ID speech facilitates various phonological (Karzon, 1985) and perceptual processes (Kemler Nelson, Hirsh-Pasek, Jusczyk, & Wright Cassidy, 1989). We do not know if hearing sentences in ID speech as opposed to AD speech is a boon to understanding language, although preliminary research by Golinkoff et al. (2002) suggests that ID speech facilitates children's word learning. However, this is just what parents do when they repeat themselves and paraphrase what they have just said in another way. Exposure to this sort of input presents a word or expression in a variety of contexts, thereby providing more information about how it can be used.

For elderly adults, hearing semantic elaborations may serve two possible functions. First,

it may help them compensate for auditory declines. Using a new word in another context narrows the degrees of freedom for identifying what that word might have been. Second, it may provide more time to process the syntactic elements they are hearing and allow them to build a more complete representation (McGinnis & Zelinski, 2000). Recall that adults gave overly broad definitions of new words heard in a single context. Semantic elaborations provide additional information about how a word is used and what it means. Therefore, this aspect of elderspeak serves a similar function to its role in ID speech: To help the listener understand the speaker.

Reducing syntactic complexity allows, too, for easier retrieval of sentence meaning. The fact that this aspect of elderspeak facilitates comprehension in older adults suggests that the syntactic part of language skill may well have declined – for whatever underlying reason. The ECM predicts that the addition of perceptual, attentional, or semantic information should boost comprehension. This could come in the form of real-life or video accompaniment or by adding additional information of a semantic nature as elderspeak does. In short, there may well be ways to accommodate to elderly adults' constrained rapid word learning and sentence comprehension. These accommodations would flow out of predictions from the ECM framework.

Conclusions

We have presented a new theory of lexical acquisition in the emergentist coalition model (e.g., Hollich et al., 2000). It is a system-based view of language that combines the best of the available theories of lexical acquisition and results in an empirically testable model of the process. Because it takes the complexity into account, it provides us with a richer picture of the factors that are necessary for language acquisition, and in particular, lexical acquisition, to occur. It also spurs us to consider a variety of factors when disability occurs, as when children have

autistic disorder. Without the emergentist coalition model, it is impossible to explain how it is that autistic children still are capable of learning new words. The emergentist model predicts, however, that of the various cues that are available for word learning, an absence of sensitivity to one sort of cue (in this case, social cues) may be compensated for by sensitivity to other cues (in this case, perceptual and linguistic). Thus, the emergentist coalition model helps us to think in new ways about the variety of factors that can play a role for possible remediation.

At the same time, the ECM helps us to take a new perspective on what might go wrong in the elderly when language starts to suffer. Ironically, it appears that a theory that was developed to help account for word learning in children, gives us a new way to think about the problems elderly adults can have in language comprehension. It also helps us to understand why a register parallel to infant-directed speech – elderspeak – might have arisen. Most importantly, the ECM may offer us a new way to think about how to *compensate* for changes that might have occurred in comprehension in the elderly. An approach like the ECM moves us beyond searching for a single-factor, “smoking gun”, explanation for language degradation in elderly adults. Instead, it encourages us to take multiple, interacting factors into account. Progress in understanding complex processes in both acquisition and decline can only occur if our theories match those processes in their complexity, despite the fact that single-factor theories have intrinsically greater appeal.

Notes

¹ The research reported here and the writing of the chapter were supported by NSF grants #SBR9601306 and SBR9615391 to both authors and by NICHD grant #3U10HD25455-0552 to Hirsh-Pasek. We thank our laboratory coordinators, Dede Addy and Meredith Meyer, whose good work allowed us to concentrate on this project.

References

- Akhtar, N., & Tomasello, M. (1996). Twenty-four-month-old children learn words for absent objects and actions. *British Journal of Developmental Psychology*, 14, 79-93.
- Akhtar, N., & Tomasello, M. (2000). The social nature of words and word learning. In R.M. Golinkoff, K. Hirsh-Pasek, L. Bloom, L. Smith, A. Woodward, N. Akhtar, M. Tomasello, and G. Hollich (Eds.), *Becoming a word learner: A debate on lexical acquisition* (pp. 115-135). New York, New York: Oxford University Press.
- Baldwin, D. A., Markman, E. M., Bill, B., Desjardins, N., Irwin, J. M., & Tidball, G. (1996). Infants' reliance on a social criterion for establishing word-object relations. *Child Development*, 67, 3135-3153.
- Baldwin, D. A., & Tomasello, M. (1999). Word learning: A window on early pragmatic understanding. In E. V. Clark (Ed.), *Proceedings of the Stanford Child Language Research Forum*, pp. 3-23. Stanford, CA: Center for the Study of Language and Information.
- Berko Gleason, J. (1997). *The development of language*. Boston, MA: Allyn & Bacon.
- Bloom, L. (1978). *The semantics of verbs in child language*. Paper presented at the Eastern Psychological Association, New York.
- Bloom, L. (1993). *The transition from infancy to language: Acquiring the power of expression*. New York: Cambridge University Press.
- Bloom, L. (2000). The intentionality model of word learning: How to learn a word, any word. In R.M. Golinkoff, K. Hirsh-Pasek, L. Bloom, L. Smith, A. Woodward, N. Akhtar, M. Tomasello, and G. Hollich (Eds.), *Becoming a word learner: A debate on lexical acquisition* (pp. 19-50). New York, New York: Oxford University Press.

- Bloom, P. (2000). *How children learn the meaning of words*. Cambridge, MA: MIT Press.
- Bronfenbrenner, U., & Morris, P. A. (1998). The ecology of developmental processes. In R. M. Lerner (Ed.), *Handbook of child psychology: Theoretical models of human development* (Fifth ed., Vol 1, pp. 993-1028). New York: Wiley.
- Carpenter, M., Nagell, K., & Tomasello, T. (1999). Social cognition, joint attention, and communicative competence from 9 to 15 months of age. *Monographs of the Society for Research in Child Development* (Serial No. 255).
- Clark, E. V. (1983). Meanings and concepts. In J.H. Flavell and E.M. Markman (Eds.), *Handbook of child psychology, Vol. III, Cognitive development* (pp. 787-840). New York: John Wiley & Sons.
- Clark, E. (2003). *First language acquisition*. Cambridge, England: Cambridge University Press.
- Daneman, M. & Green, I. (1986). Individual differences in comprehending and producing words in context. *Journal of Memory and Language*, 25, 1-18.
- Diesendruck, G., & Markson, L. (2001). Children's avoidance of lexical overlap: A pragmatic account. *Developmental Psychology*, 37, 630-642.
- Evey, J.A., & Merriman, W.E. (1998) The prevalence and the weakness of an early naming mapping preference. *Journal of Child Language*, 25, 121-148.
- Fink, A. (2003). *Personal communication*, July 6, 2003.
- Gelman, R., & Greeno, J. G. (1989). On the nature of competence: Principles for understanding in a domain. In L.B. Resnick (Ed.), *Knowing and learning: Essays in honor of Robert Glaser* (pp. 125-186). Hillsdale, NJ: Erlbaum.
- Gernsbacher, M. A. (1990). *Language comprehension as structure building*. Hillsdale, NJ:

Lawrence Erlbaum Associates.

Gillette, J., Gleitman, H., Gleitman, L., & Lederer, A. (1999). Human simulations of vocabulary learning. *Cognition*, 73, 135-176.

Golinkoff, R. M., Hirsh-Pasek, K., & Alioto, A. (2002). *Lexical items are learned better in infant-directed than in adult-directed speech*. Unpublished manuscript, University of Delaware, Newark, DE.

Golinkoff, R., M., Hirsh-Pasek, K., Bailey, L., & Wenger, N. (1992). Young children and adults use lexical principles to learn new nouns. *Developmental Psychology*, 28, 99-108.

Golinkoff, R. M., Hirsh-Pasek, K., Bloom, L., Smith, L., Woodward, A., Akhtar, N., Tomasello, M., & Hollich, G. (2000). *Becoming a word learner: A debate on lexical acquisition*. New York, New York: Oxford University Press.

Golinkoff, R. M., Hirsh-Pasek, K., & Hollich, G. (1999). Emergent cues for early word learning. In B. MacWhinney (Ed.), *The emergence of language* (pp. 305-331). Mahwah, New Jersey: Erlbaum.

Golinkoff, R. M., Mervis, C., & Hirsh-Pasek, K. (1994). Early object labels: The case for a developmental lexical principles framework. *Journal of Child Language*, 21, 125-155.

Hamilton-Wentworth District Health Council. (1998). *Services for seniors study: Report of findings and recommendations*. Hamilton, ON: Regional Municipality of Hamilton-Wentworth & Hamilton-Wentworth District Health Council.

Hennon, E. (2002). *How children with autistic disorder use attentional and intentional social information for word learning*. Unpublished doctoral dissertation, Temple University, Philadelphia, PA.

Hennon, E., Hirsh-Pasek, K., & Golinkoff, R. M. (2003, April). *Speaker intention?: Autistic*

- children may learn words without it.* Society for Research in Child Development.
- Hirsh-Pasek, K., & Golinkoff, R. M. (1996). *The origins of grammar: Evidence from early language comprehension.* Cambridge, MA: MIT Press.
- Hirsh-Pasek, K., Hennon, E., & Golinkoff, R. M. (2003/Under review). *Birth of words.*
- Hoff, E., & Naigles, L. (2002). How children use input to acquire a lexicon. *Child Development, 73*, 418-433.
- Hollich, G., Hirsh-Pasek, K., & Golinkoff, R. M. (1998). Introducing the 3-D intermodal preferential looking paradigm: A new method to answer an age-old question. In C. Rovee-Collier (Ed.), *Advances in infancy research, Vol. 12* (pp. 355-373). NJ: Ablex.
- Hollich, G., Hirsh-Pasek, K., & Golinkoff, R. M. (2000). *Breaking the language barrier: An ECM for the origins of word learning.* Society for Research in Child Development Monograph Series. Chicago: University of Chicago Press.
- Kemper, S. Ferrell, P, Harden, T., Finter-Urczyk, A., & Billington, C. (1998). Use of elderspeak by young and older adults to impaired and unimpaired listeners. *Aging, Neuropsychology, and Cognition, 5*, 43-55.
- Kemper, S., Greiner, L., Marquis, J. G., Prenovost, K., & Mitzner, T. L. (2001). Language decline across the life span: Findings from the nun study. *Psychology and Aging 16*, 227-239.
- Kemper, S. & Harden, T. (1999). Experimentally disentangling what's beneficial about elderspeak from what's not. *Psychology and Aging, 14*, 656-670.
- Kemper, S., Thompson, M., & Marquis, J. (2001). Longitudinal change in language production: Effects of aging and dementia on grammatical complexity and propositional content. *Psychology and Aging, 16*, 600-614.

- Maguire, M., Hennon, E., Hirsh-Pasek, K., Golinkoff, R. M. (2003). *When does mother know best? Linguistic cues to lexical category formation in infants*. Unpublished manuscript, Temple University.
- Markman, E. M. (1989). *Categorization and naming in children: Problems of induction*. Cambridge, MA: MIT Press.
- Markman, E. M., & Hutchinson, J. E. (1984). Children's sensitivity to constraints on word meaning: Taxonomic versus thematic relations. *Cognitive Psychology*, 16, 1-27.
- McGinnis, D. & Zelinski, E. M. (2000). Understanding unfamiliar words: The influence of processing resources, vocabulary knowledge, and age. *Psychology and Aging*, 15, 335-350.
- Mervis, C. B., & Bertrand, J. (1994). Acquisition of the novel name-nameless category (N3C) principle. *Child Development*, 65, 1646-1663.
- Merriman, W. E., & Bowman, L. L. (1989). The mutual exclusivity bias in children's word learning. *Monographs of the Society for Research in Child Development*, 54,(3-4, Serial No. 220).
- Morgan, J., & Demuth, K. (1996). *Signal to syntax: Bootstrapping from speech to grammar in early acquisition*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Nelson, K. (1988). Constraints on word learning? *Cognitive Development*, 3, 221-246.
- Nelson, K. (1996). *Language in cognitive development*. New York: Cambridge University Press.
- Newcombe, N. S., & Huttenlocher, J. (2000). *Making space: The development of spatial representation and reasoning*. Cambridge, MA: MIT Press.
- Pichora-Fuller, M. K., Schneider, B. A., & Daneman, M. (1995). How young and old adults

- listen to and remember speech in noise. *Journal of the Acoustical Society of American*, 97, 593-608.
- Pinker, S. (1994). *The language instinct: How the mind creates language*. New York: William Morrow.
- Plunkett, K. (1997). Theories of early language acquisition. *Trends in Cognitive Sciences*, 1, 146-153.
- Quine, W. V. O. (1960). *Word and object*. Cambridge, England: Cambridge University Press.
- Rice, M. L. (Ed.). (1996). *Toward a genetics of language*. Mahwah, NJ: Erlbaum.
- Samuelson, L. K., & Smith, L. B. (1998). Memory and attention make smart word learning: An alternative account of Akhtar, Carpenter, and Tomasello. *Child Development*, 69, 94-104.
- Schneider, Bruce A., Daneman, M., Pichora-Fuller, M. (2002). Listening in Aging Adults: From Discourse Comprehension to Psychoacoustics. *Canadian Journal of Experimental Psychology*, 56, 139-152.
- Smith, L. B. (1995). Self-organizing processes in learning to learn words: Development is not induction. In C.A. Nelson (Ed.), *Basic and applied perspectives on learning, cognition, and development: The Minnesota Symposia on Child Psychology*, (Vol. 28, pp. 1-32). Mahwah, NJ: Erlbaum.
- Smith, L. B. (1999). Children's noun learning: How general learning processes make specialized learning mechanisms. In B. MacWhinney (Ed.), *The emergence of language* (pp. 227-305). Mahwah, New Jersey: Erlbaum.
- Smith, L. B. (2000). Learning how to learn words: An associative crane. In R.M. Golinkoff, K. Hirsh-Pasek, L. Bloom, L. Smith, A. Woodward, N. Akhtar, M. Tomasello, & G. Hollich

- (Eds.), *Becoming a word learner: A debate on lexical acquisition* (pp. 51-80). New York, NY: Oxford Press.
- Smith, L. B., Jones, S. S., Landau, B., Gershkoff-Stowe, L., & Samuelson, L. (2002). Object name learning provides on-the-job training for attention. *Psychological Science, 13*, 13-20.
- Snow, C. E. (1995). Issues in the study of input: Finetuning, universality, individual and developmental differences, and necessary causes. In P. Fletcher and B. MacWhinney (Eds.), *The handbook of child language* (pp. 180-193). Cambridge, MA: Cambridge University Press.
- Spelke, E. S. (1990). Principles of object perception. *Cognitive Science, 14*, 29-56.
- Tomasello, M., & Barton, M. (1994). Learning words in non-ostensive context. *Developmental Psychology, 30*, 639-650.
- Tomasello, M., Strosberg, R., & Akhtar, N. (1996). Eighteen-month-old children learn words in non-ostensive contexts. *Journal of Child Language, 23*, 157-176.

Figure Captions

Figure 1. The principles of word learning proposed by Golinkoff, Mervis, and Hirsh-Pasek (1994).

Figure 2. The multiple inputs available for word learning.

Figure 3. The Interactive Intermodal Preferential Looking paradigm.

First Tier

Reference

Words map to objects, actions, and attributes.

Extendibility

Words label more than original referent.

Object Scope

Words map to whole objects.

Second Tier

Conventionality

Speakers in the community prefer specific "agreed-upon" terms.

Categorical Scope

Words are extended based on category, not perceptual similarity.

Novel Name-Nameless Category

Novel names map to unnamed categories



