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Everything Had a Name, and Each Name Gave Birth to a New Thought: Links between Early Word Learning and Conceptual Organization

Sandra R. Waxman

That living word awakened my soul, gave it light, hope, joy, and set it free! . . . Everything had a name, and each name gave birth to a new thought.
—Keller 1904, 22

Word learning, more than any other development achievement, stands at the very center of the crossroad of human cognition and language. Even before they can tie their own shoes, human infants spontaneously form concepts[1] to capture various relations among the objects and events they encounter, and they learn words to express them. I have argued that these two advances do not proceed independently. Rather, from the onset of word learning, human infants' conceptual and linguistic advances are powerfully linked.

This chapter is devoted to examining the origin and unfolding of these links. In recent work, I have proposed that infants approach the task of word learning equipped with a broad, universally shared expectation. This initially broad expectation permits infants to link novel words (that are applied to objects) to commonalities among those named objects. This broad initial link, which is available to infants at the very onset of word learning, serves at least three essential functions. First, it supports the formation of a stable repertoire of concepts. Second, it supports infants' first efforts to establish reference, and in this way promotes infants' earliest lexicons. Third, and perhaps most radically, this initially broad, universal link sets the stage for the discovery of the more specific links between particular types of words (e.g., nouns, adjectives, verbs) and particular types

of relations that they mark (e.g., object categories, object properties, actions) (Waxman 1999b). These more specific links, which are shaped by the structure of the particular language under acquisition, do not emerge all of a piece. Instead, infants first tease apart the nouns (from among the other grammatical forms, including adjectives, verbs, prepositions, and so on) and map these specifically to object categories (from among the other candidate types of conceptual relations, including properties of objects and the actions in which they are engaged). In infants acquiring English, we have evidence that by 14 months of age, infants have begun to tease the nouns and to map them specifically to categories. Once this noun-to-object category link is in place, other specific links for other grammatical form will follow, and these will be sensitive to the correlations between the grammatical forms that are represented in the native language and their associated meanings.

This is a distinctly developmental proposal, one that examines seriously the relative contributions of any initial expectations that learners bring to the task of acquisition, and any influence of the environment in shaping the initial system. This type of integrative approach has guided elegant developmental work in a wide range of domains, including the acquisition of physical knowledge (Baillargeon 1993; Spelke 1993), number concepts (Gelman 1991), syntax (Fisher and Gleitman 2002; Gleitman 1990; Gleitman and Gleitman 1992; Gleitman and Newport 1995; Goldin-Meadow 1997; Johnson and Newport 1991), and speech perception (Jusczyk 2002; Jusczyk and Luce 2002; Mehler, Christophe, and Ramus 2000; Morgan and Demuth 1996; Pallier et al. 1998; Werker and Fennell, chapter 3, this volume) in human infants. It is also apparent in ethological investigations detailing, for example, the course of acquisition of birdsong in white-crowned sparrows (Marler 1991) and the evolution of depth perception in kittens (Held and Hein 1963). Although these investigations focus on very different domains of knowledge, and even on very different species of learners, they share a commitment to understanding the rapid acquisition of complex systems, and to embracing the contributions of expectations or constraints inherent in the learner and the shaping role of the environment.

In the case of word learning, this interplay between initial expectations inherent in the learner and the shaping role of the environ-

ment is essential. Even a cursory glance at the problems addressed in philosophy, psychology, and linguistics serves as testimony to the complexity of the word-learning task (Bloom 2000; Goodman 1955; Lyons 1977; Quine 1960). Despite this complexity, infants are wizards of word learning. They acquire new words rapidly, in a seemingly effortless fashion. How do they accomplish this? Certainly, infants cull information from the environment, for they learn precisely the words of the language community that surrounds them, and precisely the concepts to which they are exposed (e.g., telephones and squirrels in the United States; scythes and peccaries in rural Mexico). But just as certainly, infants are guided by a powerful universal expectation that links words and concepts. This is important, because human languages differ not only in their cadences and their words, but also in the ways particular grammatical forms (e.g., nouns, adjectives, verbs) are recruited to express fundamental aspects of meaning. Yet in the face of these variations, there are striking crosslinguistic universals in the rate and timing of language acquisition in general, and word learning in particular (Gentner 1982; Huttenlocher and Smiley 1987; Maratsos 1998; Ochs and Schieffelin 1984; Waxman 1999a; Woodward and Markman 1998). Any theory of word learning must be sufficiently constrained to account for these universals in the face of crosslinguistic variation. At the same time, it must be sufficiently flexible to accommodate the systematic variations that occur across languages.

To accommodate these universals and variations, my colleagues and I have proposed that infants across the world's languages begin the process of word learning equipped with an initially broad, universal expectation linking words and concepts, and that the more fine-tuned links between particular grammatical forms and their associated meanings emerge later, once the process of lexical acquisition is underway.

Two aspects of this proposal are worth mentioning. Notice first that this is not a polarized position that locates the engine of acquisition solely within the mind of the child or solely within the environment. Rather, the claim is that infants' initially broad expectation guides their attention toward precisely the sorts of information and regularities in the environment that will make possible the rapid acquisition of word meaning. (See Gelman and Williams 1998 for an

excellent discussion of this theoretical approach.) Notice also that this is a dynamic proposal. Infants' initial expectation is not rigidly fixed, exerting a uniform influence throughout the course of development. On the contrary, this expectation itself evolves over the course of development, giving way to more finely tuned links between the particular grammatical forms that are represented in the language under acquisition and their associated meanings. These more finely tuned links are calibrated on the basis of regularities present in the language under acquisition.

10.1 The Puzzle of Word Learning: Three Easy Pieces?

Let us step back from this proposal for a moment and consider the task of word learning from the perspective of the infant. In the natural course of events, the young word learner is faced with something roughly like the following situation: an individual (perhaps a parent or an older sibling) points to an ongoing stream of activity (perhaps a bunny disappearing behind a hedge), and utters a novel name (saying, "Voilà, t'as vu le lapin? Où est le lapin maintenant?" in French, or "Look, did you see the bunny? Where did the bunny go?" in English). To successfully learn a word from this (indeed from any) context, the infant must solve a difficult three-part puzzle. She must (1) parse the relevant word (*lapin* or *bunny*) from the ongoing stream of speech, (2) identify the relevant entity (the bunny, not the hedge or the act of disappearing) from the ongoing stream of activity, and (3) establish a mapping, a word-to-world correspondence, between these. To put matters more formally, successful word learning rests on human infants' ability to discover the relevant linguistic units, the relevant conceptual units, and the mappings between them. Each of these puzzle pieces takes form gradually over the first year of life, and each appears to rest on fundamental perceptual, conceptual, and even psychological capacities.

10.1.1 Discovering the Relevant Linguistic Unit: Finding the Word

Over the first year of life, infants become sensitive to the cues within the speech stream that will permit them to segment the continuous

speech signal into word-sized units. To begin, we know that newborns prefer human speech (and particularly infant-directed speech) over other sources of auditory stimulation (Jusczyk and Luce 2002; Mehler, Christophe and Ramus 2000), but their ability to parse a word from the ongoing stream of speech emerges gradually. During this time, the functional significance of infant-directed speech, and the perceptual features to which infants attend, undergo dramatic change (Fernald 1992b). Initially, in the first six to nine months, the melodies of infant-directed speech serve a primarily affective and attentional function, engaging and modulating infants' attention. By approximately 9 months of age, "words begin to emerge from the melody" (Fernald 1992a, 403) as infants become increasingly sensitive to the perceptual cues (morphologic, phonetic, and prosodic) and distributional regularities (transitional probabilities) that mark the word and phrase boundaries of their native language (Jusczyk and Aslin 1995; Kemler Nelson et al. 1989; Saffran, Aslin, and Newport 1996). Infants' sensitivity to these cues also permits them to tease apart two very broad classes of words: *open-class* (or *content* words, including nouns, adjectives, verbs) and *closed-class* words (or *function* words, including determiners and prepositions) (Shi, Werker, and Morgan 1999). Infants prefer to listen to open-class words, probably because they receive greater stress and enjoy more interesting melodic contours than do closed-class words. This preference, though primarily perceptually based, represents an important step on the way to word learning. By the close of their first year, infants not only parse individual words reliably from the speech stream but devote special attention to just those words (the open-class, content words) that appear first in the lexicon (Jusczyk and Kemler Nelson 1996; Morgan and Demuth 1996; Werker et al. 1996).

10.1.2 Identifying the Relevant Conceptual Unit; Finding the Referent(s)

The solution to this second piece of the puzzle rests on the infants' ability to identify discrete objects in the environment and to notice the relations among these objects that will support categorization. During the first year, infants demonstrate a great deal of

core knowledge about objects, events, and relations (Baillargeon 2000; Spelke 2000), and this knowledge serves to organize an impressive repertoire of concepts. Some of these prelinguistic concepts are focused around richly structured category-based relations (e.g., rabbit, bottle, animal); others are focused primarily on property-based relations (e.g., red, soft) (see Quinn and Eimas 2000). Since any of these relations is a viable candidate for a word's meaning, the infants' task is to discover which of these candidates is to be mapped to the word that they have parsed (Markman 1989; Waxman 2003; Waxman and Markow 1995).

10.1.3 Establishing Word-to-World Mappings

Neither the ability to parse a novel word from the speech stream nor the ability to identify the referent of that word guarantees that the infant will successfully map a novel word to its meaning. This ability to establish a word-to-world mapping, an ability that emerges gradually over the first year, requires a firm grasp of the symbolic, referential power of words. This, in turn, depends crucially on an emerging ability to infer the goals and intentions of others, for to succeed in word learning, infants must appreciate a speaker's *intention to refer* (for a discussion, see Woodward 2000; Woodward, chapter 5, this volume). And recent work indicates that by 9 to 10 months of age, infants spontaneously follow a speaker's line of attention to discover the object of interest in a naming episode. More generally, we know that by the close of their first year, infants take advantage of the rich social and pragmatic contexts in which novel words are introduced. They have begun to make connections between words, objects, and the intentions of others, and to recruit these connections to map words to their meaning (Baldwin and Baird 1999; Guajardo and Woodward 2000).

But even this is not sufficient, for word learning entails much more than merely mapping an individual word (e.g., *bunny*) to its intended referent (e.g., the bunny running behind the hedge). In addition, the infant must be able to extend that word, appropriately and systematically, beyond the individual(s) on which it was taught, to include other objects, even some that have neither been seen nor

named (e.g., other bunnies). Solving this part of the word-learning puzzle requires an inferential leap, taking them beyond word-to-object mappings toward the establishment of word-to-concept mappings (Waxman 2002). And to establish such abstract mappings, the infant must hold some principled expectations regarding the range of possible extensions for a given novel word.

An Important Wrinkle: Different Kinds of Words Highlight Different Aspects of the Very Same Scene

This discussion raises an important wrinkle for the word learner. In any given language, many different words—indeed many different *types* of words—can be applied correctly in a naming episode. But each type of word highlights a different aspect of the same observed scene and *supports a unique pattern of extension.* This is a fundamental feature of human language. Consider, for example, a situation in which an adult points to a scene (e.g., a bunny hopping behind a hedge) and utters a novel word. For instance, for speakers of English, count nouns ("Look, it's a *bunny*") pick out the object as member of an object kind and are extended spontaneously to other members of the same object kind (other bunnies); proper nouns ("Look, it's Alice") refer to the named individual but are not extended further; and adjectives ("Look, it's *fluffy*") refer to a property of the named individual and are extended to other objects sharing that property.

Smoothing Out the Wrinkle: Evidence from Preschool-Aged Children

By the time they are 2.5 to 3 years of age, children are well on their way to smoothing out this wrinkle. Roger Brown (1957) was the first to document that children are sensitive to this fundamental feature of language. More recently, several researchers have demonstrated that children's expectations regarding the range of extension for a novel word are guided by its grammatical form (for a review of recent evidence, see Hall and Lavin, chapter 11, this volume; Waxman 1998). They extend count nouns to individuals and to categories of objects (Waxman 1999b; Waxman and Markow 1995); they extend adjectives systematically to properties of objects (Klibanoff and Waxman 2000; Mintz and Gleitman 2002; Waxman and Klibanoff 2000;

Waxman and Markow 1998); and they restrict the extension of proper nouns to the named individual (Hall 1991, 1999; Jaswal and Markman 2001). Moreover, there is now crosslinguistic evidence suggesting that the link between nouns and object categories may be universal. It has been documented in preschoolers acquiring a wide range of languages, including French, Spanish, Italian, Hebrew, and Japanese (Imai and Gentner 1997). In contrast, children's expectations regarding novel adjectives appear to vary across languages (Imai and Haryu, chapter 13, this volume; Ninio 2002; Waxman and Guasti 2002; Waxman, Senghas, and Benveniste 1997).

10.1.4 Three Easy Pieces: Summary

Thus, by the time they reach their preschool years, children have assembled the three central pieces in the puzzle of word learning. They have the *linguistic* capacity to identify novel words in the speech stream and to distinguish among words of different grammatical forms (e.g., count noun, proper noun, adjective), the *conceptual* ability to appreciate different kinds of relations among objects (e.g., category-based, property-based, event-related relations), and a clear expectation that these linguistic and conceptual pieces are linked. These finely tuned links serve as powerful tools in word learning, because any cues regarding the grammatical form of a novel word can be used to narrow the range of possible interpretations for that word.

10.2 A Developmental View

The key developmental questions, of course, concern the origin and evolution of these links between word learning and conceptual organization. Which of these links, if any, are available to infants at the very onset of lexical acquisition? And how are they shaped over the course of acquisition?

To begin to answer this question, let us take stock of the repertoire available to infants as they cross the threshold into word learning. By the end of their first year, infants are well on their way to solving several key elements in the puzzle of word learning. They successfully identify novel words in the input; they appreciate many kinds of cate-

gories and relations among objects; and they take advantage of the rich social and pragmatic cues with which novel words are introduced (Baldwin and Markman 1989; Tomasello and Olguin 1993).

These accomplishments, while impressive, cannot speak to either the origin or evolution of links between word learning and conceptual organization in infants. What remains to be seen is whether any links are evident in infants, when these become available to guide acquisition, and how they are shaped in the course of acquisition. In other words, we must begin at the beginning, tracing the origin and evolution of these links between the linguistic and conceptual systems in infants.

We have therefore developed a series of experimental tasks, each designed to pinpoint the influence of novel words on infants' conceptual organization at strategic points in development. Because infants are captivated by cadence and contours of infant-directed speech, a female experimenter produces short phrases in this preferred speech register for infants in all conditions. Our goal is to compare infants' ability to form categories in "neutral" conditions (in which the experimenter presents no novel words) with their ability to do so in the context of a novel word. If there is a link between word learning and conceptual organization, infants hearing novel words should categorize differently, and in some cases more successfully, than infants hearing no novel words. In our *No Word* control conditions, the experimenter indicates objects to the infants but provides no names, saying, for example, "Do you like this?" or "Look at this." In the remaining conditions, the experimenter introduces a novel word for the very same objects; what varies is the grammatical form of the novel word. In the *Noun* condition, she says, for instance, "This is a *blicket*." In the *Adjective* condition, she says, for example, "This is a *blick-ish* one." (For evidence that infants are sensitive to these distinct frames, see Gerken and McIntosh 1993; Waxman and Markow 1995, 1998.) We have focused primarily on novel nouns and adjectives because although words from both of these grammatical categories can be applied ostensively to individuals and to categories of objects, each grammatical form supports a different range of extension, and this permits us to examine the specificity of infants' expectations in word learning.

The logic of this design is straightforward. Performance in the No Word control condition assesses how readily infants form the various categories presented in our tasks (e.g., dog, animal, purple things) in the absence of a novel word; performance in the remaining Word conditions assesses the role of naming in this important endeavor; and a comparison of performance in the Noun and Adjective conditions permits us to trace the evolution of the finely tuned links between particular grammatical forms (e.g., count nouns, adjectives) and their associated meaning.

To illustrate the logic of this experimental approach, in the next section I will review a series of experiments designed several years ago to uncover the influence of novel words on the conceptual organization of infants on the brink of word learning.

10.3 A (Relatively) Early Demonstration: Words Serve as Invitations to Form Categories

We began by adapting the standard novelty-preference task to examine the influence of novel words on the conceptual organization of infants at 12 to 14 months of age (see Waxman and Markow 1995 for a complete description). Table 10.1 provides a sample set of stimuli and instructions. The task involved two phases. During the *familiarization phase*, the experimenter offered the infant four different toys from a given category (e.g., four animals), one at a time, in random order. This was immediately followed by a *test phase*, in which the experimenter simultaneously presented both a new member of the now-familiar category (e.g., another animal) and an object from a novel category (e.g., a fruit). Each infant completed this task with four different sets of objects, two involving basic-level categories (e.g., horses vs. cats) and two involving superordinate-level categories (e.g., animals vs. fruit). Infants manipulated the toys freely, and we used their total accumulated manipulation time as our dependent measure.

To identify any influence of novel words, we randomly assigned infants to one of three conditions. As can be seen in table 10.1, infants in all conditions heard precisely the same phrase ("See what I

Table 10.1
A schematic presentation of introductory phrases from Waxman and Markow 1995 and an example of a single superordinate-level stimulus set

	Familiarization phase				Test phase	
	Trial 1	Trial 2	Trial 3	Trial 4		
						
Animal set	yellow duck	green raccoon	blue dog	orange lion	red cat	red apple
Noun	This one is a(n) X.	This one is a(n) X.	See what I have?	This one is a(n) X.	See what I have?	
Adjective	This one is X-ish.	This one is X-ish.	See what I have?	This one is X-ish.	See what I have?	
No word	Look at this.	Look at this.	See what I have?	Look at this.	See what I have?	

have?") at test. The only differences among conditions occurred during familiarization.

Following the logic of the novelty-preference task, we reasoned that if infants noticed the category-based commonalities among the familiarization objects, they would reveal a preference for the novel object at test. If infants detected the presence of the novel words, and if these directed infants' attention toward the commonalities among the familiarzation objects, then infants hearing novel words should be more likely than those hearing no novel words to reveal novelty preferences. Finally, if infants' expectation is initially general, then infants in the Noun and Adjective conditions should be more likely than those in the No Word condition to form categories.

The results were consistent with these predictions. Infants in the No Word control condition revealed no novelty preference, indicating that they had not detected the category-based commonalities among the familiarization objects. In contrast, infants in both the Noun and Adjective conditions revealed reliable novelty preferences, indicating that they successfully formed object categories.[2]

This was a striking result because it offered clear evidence for a link between word learning and conceptual organization in infants who had just begun to produce words on their own. Infants reliably detected novel words presented in fluent, infant-directed speech, and these novel words (both adjectives and nouns) promoted categorization. This outcome supports the proposal that infants begin the task of lexical acquisition equipped with a general expectation linking novel word (be they nouns or adjectives) to commonalities among objects. It also reveals the conceptual power of this initial link. Although the novel words were presented only during familiarization, their influence extended beyond the named familiarization objects, influencing infants' attention to the new—and as yet unnamed—objects presented at test.

10.3.1 Words—or Sounds—as Invitations?

In a subsequent series, we asked whether infants' successful categorization stemmed specifically from the presentation of novel words, or whether this might have been the consequence of a more general,

attention-engaging function associated with novel auditory stimuli. We focused on 9-month-old infants, because this is the youngest age at which infants can reliably parse individual words from the ongoing speech stream. Our question was whether words are "special" at this early point in development. To answer this question, we compared the influence of novel words and tones on infants' categorization (Balaban and Waxman 1997). We used a novelty-preference task once again, but because infants at 9 months are not especially adept at manipulating objects, we presented two-dimensional images of objects, rather than the three-dimensional objects themselves, and used infants' looking time to the images as our dependent measure.

During the familiarization phase, infants saw a series of slides, each depicting a different member of a single category (e.g., nine different rabbits). See table 10.2. Infants were randomly assigned to either a Word or a Tone condition. For infants in the Word condition, a naming phrase (e.g., "a rabbit!") accompanied the familiarization trials. For infants in the Tone condition, a sine-wave tone accompanied the familiarization trials. This tone, which was created digitally, was matched precisely to the naming phrase in amplitude, duration, and pause length. The familiarization phase was immediately followed by a silent test trial, in which infants saw a new member of the now-familiar category (e.g., another rabbit) and an object from a novel category (e.g., a pig).

We reasoned that if novel words facilitate object categorization as early as 9 months of age, infants in the Word condition should detect the commonalities among the familiarization objects and reveal a preference for the novel object (e.g., the pig) at test. If this facilitative effect is specific to words, and not to auditory stimulation more generally, infants in the Tone condition should be less likely to notice the category-based commonalities among the familiarization slides and consequently less likely to reveal a novelty preference at test.

The results echoed these predictions precisely. Although both words and tones captured the infants' attention, infants in the Word condition revealed a novelty-preference at test, but those in the Tone condition did not. This suggests that there is indeed something special about words that supports the establishment of categories. In

Table 10.2
A schematic presentation of introductory phrases from Balaban and Waxman 1997 and an example of a single basic-level stimulus set

	Familiarization phase				Test phase
	Trial 1	Trial 2 …	… Trial 8	Trial 9	
					 
	(All images were black-and-white line drawings.)				
Word	"a rabbit"	"a rabbit"	"a rabbit"	"a rabbit"	Silent
Tone	Sine-wave tone	Sine-wave tone	Sine-wave tone	Sine-wave tone	Silent

subsequent studies, we have replicated this phenomenon, using a wider variety of sounds, including tones and tonal sequences (Balaban and Waxman 2002).

10.3.2 Some Conceptual Consequences of Naming

We have shown, then, that naming distinct objects with the same name highlights their commonalities and promotes the formation of object categories (Balaban and Waxman 1997; Waxman and Markow 1995). Research using different experimental paradigms has documented other links between words and concepts in infants. For example, naming distinct objects with distinct names (e.g., *ball*, *duck*) highlights distinctions among them and promotes the process of object individuation (Wilcox and Baillargeon 1998; Xu 1999). Thus, naming not only supports the establishment of a stable repertoire of object categories, but also provides infants with a means of tracing the identity of individuals within these categories.

10.3.3 Summary

The work in this section illustrates the feasibility of investigating experimentally the links between word learning and conceptual organization, even in infants who are just on the threshold of lexical development. By 9 months of age, just as soon as infants are able to parse novel words reliably from the speech stream, words exert a powerful influence on conceptual organization. Because this link between words (be they nouns or adjectives) and conceptual organization appears so early in development, we can conclude that naming has powerful cognitive consequences, even in prelinguistic infants. Words serve as invitations to form categories. Importantly, this invitation extends beyond the named individual(s) (presented during familiarization) to include new, as yet unnamed individuals (presented at test). The invitation also extends beyond the observable properties of the named individuals, guiding the discovery of hidden, perhaps deeper, commonalities that underlie some of our most fundamental concepts (Waxman and Markow 1995; Welder and Graham 2001). Thus, words are linked to concepts, and support

mental representations of individuals and kinds, in infants on the threshold of word learning.

10.4 Gaining Some Precision: The Origin and Evolution Questions

In the next series of experiments, our goal was to capture more precisely the scope of infants' early expectation for word-to-world mappings, and to trace its evolution from an initially general expectation toward a more specific set of expectations. We sought greater theoretical and methodological precision, focusing on both the word and the world side of these mappings (Waxman 1999b; Waxman and Booth 2001, 2003).

10.4.1 Advances in Theory and Methodology

On the *word* side of the mapping, we asked whether (and when and under what circumstances) infants might come to distinguish between novel words presented as nouns versus adjectives. In the previously described series, there was no evidence for such a distinction: both nouns and adjectives directed infants' attention toward commonalities underlying object categories. However, the possibility that infants might distinguish between these two grammatical forms under other circumstances remained an intriguing question.

On the *world* side of the mapping, we sought to discover the scope of infants' initial expectation. We asked whether infants embark on the process of lexical acquisition with an expectation linking novel words specifically to category-based commonalities (e.g., rabbits, animals), or whether their initial link encompasses a wider range of groupings, including, for example, property-based commonalities (e.g., color: pink things; texture: soft things) as well as category-based commonalities (e.g., animal, bunny). This step toward greater precision has implications for both theory and methodology. In previous work, the link between naming and object categories was documented with one set of materials, and the link between naming and object properties with another. For example, in experiments documenting the role of naming in infants' attention to category-based commonalities (Balaban and Waxman 1997; Fulkerson and Haaf 1998; Waxman and Markow 1995), the *only* consistent relation

among the familiarization objects was category based (e.g., animals). In other experiments, we have demonstrated the effect of naming on infants' attention to property-based commonalities (Waxman 1999b; Waxman and Markow 1998). But in these experiments, the *only* consistent relation among the objects was property based (e.g., color: purple things; or texture: smooth things).

In the current series, we retained the logic and design of Waxman and Markow's (1995) original paradigm, but shifted the focus to include objects that shared both category-based commonalities (e.g., animal) and property-based commonalities (e.g., color: purple things). This permits us to ask if infants are able to construe the very same set of objects (e.g., four purple animals) either as members of an object category (e.g., animals) or as embodying an object property (e.g., color: purple), and if their construal is influenced systematically by novel words.[3] In all experiments to date, we have included color as an object property. In several cases, we have gone on to ask whether we get the same pattern of effects using a different property (texture), in an effort to establish the generalizability of the phenomena. For the sake of simplicity and balance, in this chapter, we report the results based on color, followed by those based on texture, whenever those data are available.

Another goal of this series was to assess directly the developmental proposal concerning the evolution of infants' expectations. I have proposed that infants embark on the task of word learning equipped with an initially general expectation—that content words, in general, highlight commonalities among objects, in general. I have further proposed that after the onset of lexical acquisition, this initial expectation becomes fine-tuned in accordance with the more specific links between particular grammatical forms and meaning in the native language under acquisition. Unfortunately, however, our view of this critical developmental transition has been obscured, partly as a consequence of the difficulties of accommodating the very different behavioral capacities of individuals at either end of this developmental transition.

Virtually all of the evidence gathered thus far regarding infants' initial expectations in word learning has been based on the novelty-preference task. Although this task is ideally suited for infants up to approximately 16–18 months of age, older infants lose interest in

this passive task. At the other end of the developmental spectrum, virtually all of the evidence documenting the more finely tuned links between grammatical form and meaning have been based on a different kind of task, known as word-extension or forced-choice tasks. In these tasks, infants are taught a novel word for an object, and are then asked to extend that word to additional, and as yet unnamed, objects. Though highly successful with older infants and preschoolers, these more active word-extension tasks are not well suited to younger infants, who have difficulty choosing systematically among objects in such forced-choice tasks.

10.4.2 Bridging the Methodological Divide: A New Experimental Paradigm

To bridge this methodological divide, we developed a new paradigm, incorporating features of the novelty-preference task and those of the word-extension paradigms (Waxman and Booth 2001, 2003). This permits us to examine the evolution of infants' expectations in word learning using the same task throughout the proposed transition period. It also permits us to ask whether infants' early expectations, previously demonstrated with novelty-preference tasks only, are sufficiently robust to influence performance in a word-extension task. This new procedure involved three distinct phases. Each infant completed the entire procedure four times, using four different sets of objects. See table 10.3 for a schematic description of the procedure and a summary of the instructions presented in each condition.

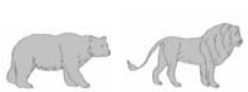
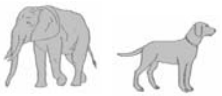
10.4.3 Familiarization Phase

The experimenter introduced infants in all conditions to four distinct objects, all drawn from the same object category (e.g., four horses or four animals) and embodying the same object property (e.g., purple). These were presented in pairs, and infants manipulated them freely.

10.4.4 Contrast Phase

The experimenter presented a new object (e.g., an orange carrot), drawn from a contrastive object category and embodying a con-

Table 10.3
A schematic presentation of introductory phrases from Waxman and Booth 2001 and an example of a single superordinate-level stimulus set

	Familiarization		Contrast	Test	
	Trial 1	Trial 2		Category	Property
Purple animal set	 purple bear and lion	 purple elephant and dog	 orange carrot	 purple horse vs. purple plate	 purple horse vs. blue horse
Noun	These are blickets. This one is a blicket and this one is a blicket.	These are blickets. This one is a blicket and this one is a blicket.	Uh-oh, this one is not a blicket!	Can you give me the blicket?	Can you give me the blicket?
Adjective	These are blickish. This one is blickish and this one is a blickish.	These are blickish. This one is blickish and this one is a blickish.	Uh-oh, this one is not blickish!	Can you give me the blickish one?	Can you give me the blickish one?
No word	Look at these. Look at this one and look at this one.	Look at these. Look at this one and look at this one.	Uh-oh, look at this one!	Can you give one?	Can you give me one?

trastive object property. She shook her head solemnly, and said either, for example, "Uh oh! This one is not a *blicket*" (Noun condition), "Uh oh! This one is not *blickish*" (Adjective condition), or "Uh oh! Look at this one" (No Word condition). She then re-presented a target object drawn from the original set of familiarization objects (e.g., a purple horse), and happily exclaimed, for instance, "Yay, this one is a *blicket*" (Noun condition), "Yay, this one is *blickish*" (Adjective condition), or "Yay, look at this one" (No Word condition). She placed this target object in front of the infant and outstretched her palm, asking, for example, "Can you give me the *blicket?*" (Noun condition), "Can you give me the *blickish* one?" (Adjective condition), or "Can you give me that one?"(No Word condition).

Why the Contrast Phase?

We designed this phase to help young infants surmount their well-documented difficulty making systematic choices in a word-extension task. By (happily) introducing a target object, and (unhappily) introducing a contrast object, we demonstrated that some objects are good instances of the target category, but that some are not. We then went one step further. By presenting the infant with only the target object, and extending her outstretched hand, the experimenter effectively coached young infants to place a single object in her palm. Success here was guaranteed (since the infant had only one object within reach), and was rewarded by the experimenter with a big smile and an enthusiastic "Thank you!" Importantly, the contrast object was drawn from a different object category (e.g., it was not an animal) than the target, and embodied a different object property (e.g., it was not a purple thing). This ensured that there was nothing in the contrast phase that could bias infants' construal of the relation among the familiarization objects.

10.4.5 Test Phase

Half of the infants in each condition received Category test trials (e.g., a purple horse vs. a purple plate). The remaining infants received Property test trials (e.g., a purple horse vs. a blue horse). We assessed both novelty preference and word extension for each set of

objects. To begin a test trial, we permitted infants to play freely with the test pair for 20 seconds. The objects were then retrieved by the experimenter. This free-play interlude served two functions. First, we recorded infants' attention to each of the objects during this interlude to derive a novelty-preference measure. Second, we have found that when infants are permitted a brief interlude of free play, they are more likely to select one of the two objects in a forced-choice test. At this point, then, we assessed word extension. The experimenter presented a target object, drawn from the original set of familiarization objects (e.g., a purple horse), and drew attention to it by pointing and saying, for instance, "This one is a *blicket*" (Noun condition), "This one is *blickish*" (Adjective condition), or "Look at this one" (No Word condition). She then presented the two test objects, placing them easily within the infant's reach, saying, "Can you give me the *blicket?*" (Noun condition), "Can you give me the *blickish* one?" (Adjective condition), or "Can you give me one?" (No Word condition).

10.4.6 Putting the Paradigm to Test

At this point in our research program, infants at 11 and 14 months of age have participated in this task. Based on previous work, we suspected that infants at these ages would span the transition from an initially general to a more refined set of expectations. We were especially curious about the 11-month-olds because to date, only a handful of experimental studies have documented successful word learning in infants at this age (Balaban and Waxman 1997; Woodward, Markman, and Fitzsimmons 1994). We examined two different kinds of object categories (basic- and superordinate-level categories) and two different kinds of object properties (color and texture). We selected these properties because they are perceptually salient to infants and because stable groupings based on these properties (e.g., purple things) can cut across category boundaries (e.g., including perhaps a plum, a t-shirt, a butterfly, and a tricycle).[4]

Our predictions were straightforward. If infants begin the process of lexical acquisition with an initially general expectation linking novel content words (in general) to commonalities among objects

(in general), then at 11 months, both nouns and adjectives should highlight both category-based (e.g., animal) and property-based (e.g., purple things) commonalities among the familiarization objects. If this initial expectation is subsequently refined, as infants discover the more precise links between particular grammatical forms and their associated meaning, then for more advanced learners, a more specific pattern should emerge.

Origins: An Initially General Link

Consider first the evidence from 11-month-old infants. If our proposal is correct, 11-month-olds who are just on the brink of producing their first words should reveal a very general expectation linking words (both nouns and adjectives) to commonalities (both category- and property-based) among objects. In the context of the current design, 11-month-old infants hearing either novel nouns or adjectives should select the familiar test object on Category test trials and on Property test trials, and they should do so at a rate that exceeds that in the No Word control condition (Waxman and Booth 2003).

We tested seventy-two infants, ranging from 11.1 to 12.3 months of age. The results, expressed in table 10.4, were fully in line with our predictions. Infants extended both novel nouns and adjectives systematically to the familiar test object (e.g., the purple horse) on both Category and Property trials. Although at this age, there was no difference between performance in the Noun and Adjective conditions, infants hearing these novel words did perform differently than their counterparts in the No Word condition.

This confirms that at the very onset of building a lexicon, novel words (independent of their grammatical form) direct infants' attention quite broadly to both category- and property-based commonalities among named objects. The results also reveal, for the first time, that this early link is sufficiently strong to support the infants' extension of novel words in a word-extension task. This clear pattern of results supports the proposal that infants on the very threshold of word learning harbor a general expectation linking novel content words (both nouns and adjectives) broadly to commonalities (both category- and property-based) among objects.

Table 10.4
Means and standard deviations of category and property test trials (for color) on which the familiar test object was chosen

	14-month-olds (Waxman and Booth 2001)		11-month-olds (Waxman and Booth 2003)	
	M	SD	M	SD
Noun				
Category trial	0.68*	0.13	0.57	0.24
Property trial	0.44	0.15	0.55	0.14
Adjective				
Category trial	0.50	0.18	0.59	0.24
Property trial	0.52	0.17	0.58	0.15
No word				
Category trial	×	×	0.46	0.15
Property trial	×	×	0.49	0.09

* $p < 0.05$ versus chance of 0.50

Evolution: The Subsequent Fine-Tuning

To examine the evolution of this initially broad expectation, we turned our attention next to infants at 14 months of age. We selected this age based on previous work suggesting that at this developmental point—once word learning was well underway and infants had established a modest lexicon—a more specific pattern of expectations begins to emerge (Waxman 1999b; Waxman and Booth 2001). Our previous work indicated that these more specific expectations do not emerge all at the same time. Instead, the evidence suggested that a specific expectation linking nouns to category-based commonalities is first to emerge from the initially general expectation. We therefore expected to find that at 14 months, infants' expectation regarding the mapping for nouns would be more finely tuned than their expectation regarding adjectives.

In the context of the current design, we predicted that infants would now map novel nouns specifically to category-based (and not property-based) commonalities, but that their expectations for novel adjectives would still be quite general: adjectives should continue to direct attention broadly to both category- and property-based

commonalities. Several different experiments with 14-month-olds provide strong support for this aspect of our developmental proposal.

In the first experiment, we tested forty-eight 14-month-old infants. Their results are given in table 10.4. As predicted, these infants were more likely to extend novel nouns to the familiar object (e.g., purple horse) on Category trials (e.g., purple horse vs. purple plate) than on Property trials (e.g., purple horse vs. blue horse). This suggests that by 14 months, infants have already begun to fine-tune the initially broad expectation. Unlike 11-month-olds, they expect nouns to refer specifically to category-based, but not to property-based, commonalities among objects. At the same time, infants' expectation regarding the extension of novel adjectives remained quite general. Mirroring their 11-month-old counterparts, 14-month-olds selected the familiar object (e.g., the purple horse) on both Category and Property test trials.

In the next experiment in this series, we sought additional evidence, this time using texture, rather than color, as a target property. The results with texture-based commonalities replicated the previous pattern with color-based commonalities precisely. This is consistent with the proposal that at 14 months, novel adjectives still direct infants' attention broadly toward a range of commonalities, including both category- and property-based commonalities (Booth and Waxman, forthcoming).

In a subsequent series, we modified the procedure in two ways, hoping to test the limits of infants' abilities by providing them with what we thought would be a more stringent task. (See table 10.5.) First, we pitted a category-based construal directly against a property-based construal at test. Infants saw the same familiarization objects as in the previous experiment, but at test they were required to select either the Same Category test object (e.g., a blue horse) or the Same Property test object (e.g., a purple chair) at test. Second, we presented each test phase twice, to ascertain whether infants' expectations for novel words were sufficiently stable to support a consistent pattern of extension.

Even in this apparently more stringent task, the results were consistent with our developmental proposal. (See table 10.6.) Infants in the No Word control condition performed at chance, suggesting that

Table 10.5
A schematic presentation of introductory phrases (Waxman and Booth 2001; Booth and Waxman, forthcoming) and an example of a single superordinate-level stimulus set

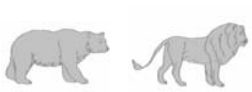
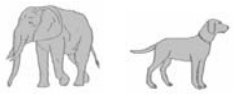
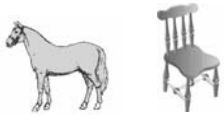
	Familiarization		Contrast	Test	
	Trial 1	Trial 2			
					
Purple animal set	purple bear and lion	purple elephant and dog	orange carrot	blue horse vs. purple chair	
Noun	These are blickets. This one is a blicket and this one is a blicket.	These are blickets. This one is a blicket and this one is a blicket.	Uh-oh, this one is not a blicket!	Can you give me the blicket?	Can you give me the blicket?
Adjective	These are blickish. This one is blickish and this one is a blickish.	These are blickish. This one is blickish and this one is a blickish.	Uh-oh, this one is not blickish!	Can you give me the blickish one?	Can you give me the blickish one?
No word	Look at these. Look at this one and look at this one.	Look at these. Look at this one and look at this one.	Uh-oh, look at this one!	Can you give one?	Can you give me one?

Table 10.6
Means and standard deviations of the proportion of word-extension test trials on which the familiar object was chosen (Booth and Waxman, forthcoming)

	Color		Texture	
	M	SD	M	SD
Noun	0.65*	0.21	0.65*	0.12
Adjective	0.47	0.15	0.51	0.17
No word	0.52	0.13	0.55	0.10

* $p < 0.05$ versus chance of 0.50

neither test object was more attractive than the other. Nonetheless, infants in the Noun condition revealed a reliable and consistent preference for the Same Category test object. This suggests that by 14 months, infants expect that novel nouns are extended to category-based, rather than to property-based, commonalities.

Interestingly, there was a hint of precocity in the Adjective condition: infants in the Adjective condition revealed a preference for the Same Property test object over the Same Category test object. This is an intriguing effect, because it is consistent with the possibility that a specific expectation for the grammatical form *adjective* is beginning to emerge at this age. However, this effect must be interpreted with serious caution. It has not appeared in any other experiment, and in the current experiment, we have not yet had a chance to seek replication with properties other than color. Future work will be required to gain more insight into this fragile effect. In contrast to this fragility, the evidence for the specific expectation linking nouns to object categories is robust across several tasks and several kinds of properties.

Nouns: Privileged Grammatical Form or Privileged Phrasal Position?
In the next experiment, we submitted this (apparently) robust noun-to-category link to greater further scrutiny. A review of table 10.5 reveals that there are systematic differences in our presentation of novel words in the Noun and Adjective conditions, particularly in the test phase of the experiment. Some of these differences might have favored the infants' ability to parse out the nouns, as compared to

the adjectives. Of course, our goal in designing these experiments was to provide unambiguous evidence regarding the grammatical form class assignment of the novel words. But in the process of meeting this goal, we may have inadvertently created a set of conditions in which the nouns were more easily parsed than were the adjectives. For instance, in every experiment, the nouns appeared in the (privileged) phrase-final position during familiarization and test. This was not the case for the adjectives, which appeared in a penultimate position at test. This imbalance is especially troubling when it occurred in the test phase. Notice also that the novel adjectives all ended with the same syllable (the suffix *-ish*), while the nouns varied in their endings. This variation in the final syllable might have rendered the nouns more "interesting." If the nouns were indeed more interesting, or more easily parsed than the adjectives, this could have consequences for performance.

To ascertain whether these differences in the presentation of nouns and adjectives influenced 14-month-olds' performance, we ran a control condition, this time presenting the novel nouns in a manner that better matched the presentation of the adjectives in the previous experiments (Booth and Waxman, forthcoming). In this new Noun condition, we constructed novel nouns that ended in the same syllable for every trial, and placed them in the penultimate position in the utterance at test ("Can you give me the blicket now?"). If infants' performance in the Noun conditions in previous work is attributable to unintentional confounds (e.g., morphology, utterance position), then performance in this new Noun condition should be less clear-cut than in the previous investigations. This was not the case: the modifications did not change infants' systematic extension of novel nouns in any way. The mean proportion of word extension in the Noun (utterance medial) condition was 0.68. This value is significantly greater than chance and greater than performance in either the Adjective or No Word conditions. It is also fully comparable to the original Noun phrase final condition. We therefore conclude that 14-month-old infants' precise extension of nouns to category-based commonalities cannot be attributed to these features of morphology or utterance position.

10.4.7 Summary

This section illustrates the promise of a new experimental paradigm designed to trace the origin and unfolding of links between word learning and conceptual organization in infants. We have proposed that infants begin the task of word learning equipped with a broad initial expectation that links novel words (independent of their grammatical form) to commonalities among named objects. The performance of 11-month-old infants fully supports this aspect of our developmental proposal.

We also proposed that this initially general expectation subsequently gives way to a more specific set of expectations, linking particular grammatical forms to particular types of meaning. In the work described here, we see evidence of this emergence in infants close to 14 months of age (Booth and Waxman, forthcoming; Waxman 1999b; Waxman and Booth 2001; Waxman and Markow 1995). Infants at this age are sensitive to at least some of the relevant cues that distinguish among the grammatical forms, and they recruit these distinctions actively in the task of word learning.

This work also reveals that as infants begin to refine their expectations, they first tease apart the grammatical form *noun* from among the other grammatical forms, and map this form specifically to category-based (and not property-based) commonalities. At this same developmental moment, infants' expectation for the grammatical form *adjective* remains more general, highlighting both category- and property-based commonalities. Apparently, then, the specific expectation linking the grammatical form *adjective* to their meaning is a subsequent developmental accomplishment, one that likely builds on the noun-to-category link, and one shaped by the semantic and syntactic properties of adjectives in the language under acquisition. In other work, we have shown that for infants acquiring English, a more specific expectation for adjectives emerges just a few months later, at 21 months (Waxman and Markow 1998). At this point, infants no longer interpret adjectives broadly; they restrict their extension of novel adjectives to property-based (and not category-based) commonalities. (See Klibanoff and Waxman 2000; Mintz and Gleitman 2002; Waxman and Klibanoff 2000 for evidence

that the mapping for adjectives is dependent on the noun being modified; see Waxman, Senghas, and Benveniste 1997 for evidence that the mapping for adjectives is indeed sensitive to crosslinguistic variation.)

10.5 Discussion and Implications

It is a fundamental feature of human language that different kinds of words highlight different aspects of the very same observed scene. In my research program, I have asked how these specific word-to-world links are acquired, which (if any) are available at the onset of acquisition, and how they are shaped over the course of acquisition. Now, with a clear view of the current evidence, let us examine the three logically possible classes of responses to these developmental questions.

One possibility is that early lexical acquisition is guided by an a priori set of expectations, linking each type of word (e.g., noun, adjective, verb) to a particular type of meaning (e.g., object categories, object properties, actions). The developmental evidence reported here does not support this possibility in its strongest form, for infants appear to begin the process of word learning with a link that is considerably more general than that observed in mature language users. A review of the crosslinguistic literature also casts serious doubt on this possibility, because the ways particular grammatical forms are linked to meaning are not universal. The grammatical form *noun* enjoys considerable crosslinguistic stability. Across languages, this grammatical form is universally represented (Lyons 1977; Maratsos 1991), and a core function of this form is to refer to individual objects and to categories of objects. In contrast, the other grammatical forms (including adjectives and other predicates) are much more variable both in the extent to which they are represented in various languages, and in the ways these forms are recruited to express meaning (Bowerman 1996; Haryu and Imai 1999; Imai and Gentner 1997; Lyons 1977; Maratsos 1991; Regier and Carlson 2001; Waxman, Senghas, and Benveniste 1997). This crosslinguistic variability, in the adjective system, is directly related to issues of acquisition, for it reveals that infants' expectations regarding these more variably

represented grammatical forms cannot be fixed from the outset. Instead, in the process of acquisition, infants must discover *whether* a particular grammatical form is realized in their native language, and *how* that form is recruited to express meaning.

A second (and radically different) possibility is that infants begin the task of word learning as tabula rasas, equipped with no a priori expectations to guide the initial steps in acquisition. This position, which has been argued forcefully, describes early word learning as the result of "dumb attentional mechanisms" (Smith 1999; Smith, Colunga, and Yoshida 2003). In this view, infants' first (scores of) words are acquired in the absence of any guiding expectations, and it is only *after* they have already amassed a sizable lexicon that they begin to detect any links between words and concepts. However, the developmental literature casts serious doubt on this possibility. There is now more than ample evidence (much of it reviewed in this volume) that infants do not approach the initial steps of word learning as tabula rasas, but instead harbor powerful, albeit general, expectations linking words with concepts from the start (Balaban and Waxman 1997; Waxman and Markow 1995; Xu 1999). The fact that these nascent expectations are in place in advance of word learning constitutes strong empirical evidence against the possibility that infants' expectations must emerge after the onset of word learning or must be induced from infants' existing lexicons.

My colleagues and I have argued for a third possibility, one that represents an interaction between an a priori expectation inherent in the infant and the shaping role of the environment (here, the structure of the native language). We have proposed that infants embark on the task of word learning not as tabulae rasae, but equipped with a broad, universally shared expectation that links words to commonalities among objects. This initial expectation, which guides lexical acquisition from the start, provides infants with a means to establish a stable rudimentary lexicon. Using this lexicon as a base, the broad initial expectation is subsequently fine-tuned, as infants begin to tease apart the various grammatical forms in the language under acquisition and to detect the correlations between these grammatical forms and the specific ways they are recruited to express meaning.

The evidence reviewed in this chapter provides strong support for this view. We have shown, for example, that for infants on the very threshold of producing words on their own, novel content words (independent of their grammatical form) highlight a broad range of commonalities among named objects (Balaban and Waxman 1997; Waxman and Booth 2003). This initially broad, universal expectation appears to be supported by several domain-general capabilities, including a perceptual preference for listening to words over other auditory stimuli, and a capacity to notice a range of relations among objects. However, the expectation itself—linking words to commonalities—appears to be specific to word learning, for it applies to novel words, but not to other auditory signals.

I have argued that this broad initial link serves at least three essential functions. First, because words direct attention broadly to commonalities, this link facilitates the formation of an expanding repertoire of categories and concepts. In this way, words serve as invitations to form categories, highlighting relations among objects that may otherwise have gone undetected in the absence of a novel word. Second, this broad initial link supports the establishment of a rudimentary lexicon, permitting infants to establish reference and to acquire a stable set of "word-to-world" mappings. Finally, and perhaps most radically, this initially broad expectation sets the stage for the evolution of the more precise expectations, which are calibrated in accordance with the observed correlations between particular grammatical forms and their associated meanings in the language under acquisition.

10.5.1 How Might This Evolution Come About?

In our view, infants discover the distinct grammatical forms of their language when they begin to notice the distinct patterns or grammatical frames within which words tend to appear, when they discover, for example, that some (kinds of) words tend to be stressed or inflected, that some tend to be preceded consistently by (unstressed) closed-class words, that some tend to occupy particular positions (initial, final) within phrases, and so on. This discovery converges with infants' emerging sensitivity to the correlations between the

particular grammatical forms represented in their native language and their links to types of meaning.

Thus, I suggest that infants' early lexicon serves as the bedrock on which infants make two discoveries: that there are distinct kinds of words (grammatical forms) in their language, and that there are correlations between these grammatical forms and the types of meaning they convey. I suspect that these two discoveries go hand in hand, each adjusting gradually to the other, in a process akin to Quine's now-classic example of the child (or the chimneysweep), scrambling "up an intellectual chimney, supporting himself against each side by pressure against the others" (Quine 1960, 93). As infants begin to scramble up the chimney of lexical acquisition, they first tease apart the nouns (from among the other grammatical forms) and map these specifically to object categories (from among the other types of commonalities, including property-based or action-based commonalities). Any subsequent linkages will build on this fundamental referential base, and will be fine-tuned as a function of experience with the specific correlations between particular grammatical forms and their associated meanings in the native language.

10.5.2 Why Is the Noun-Category Link the First Specific Link to Emerge from the More General Expectation?

On the basis of the current evidence, we cannot be certain why this is the case. Some theorists argue that this developmental priority for the noun-object category link derives primarily from factors on the *word* side of the chimney. In brief, the claim is that early emergence of this link is attributable to the acoustic, prosodic, or syntactic features that make nouns more salient than other grammatical forms in the input to children. Others argue that this developmental priority stems primarily from factors on the *world* side of the chimney. In brief, the claim is that the early emergence of the noun-object category link is a consequence of perceptual and conceptual factors that favor the representation of objects over other kinds of relations. Still others, myself included, see this early noun advantage as a product of essential interactions between linguistic and conceptual organization.

In any case, the early emergence of a noun-category linkage accords well with most current theories of language acquisition, which, despite otherwise heated debates, converge on the assumption that the learner must first identify the nouns in the input and map them to entities in the world if they are to discover the other grammatical forms and their links to meaning (Dixon 1982; Fisher and Gleitman 2002; Gentner 1982; Gleitman 1990; Grimshaw 1994; Huttenlocher and Smiley 1987; Maratsos 1998; Pinker 1984; Talmy 1985; Waxman 1999b; Wierzbicka 1984). Indeed, the argument is that discovering the meanings associated with these other grammatical forms must be grounded in the prior acquisition of nouns and the discovery of argument structure.

10.6 Conclusions

The goal of this chapter has been to articulate a developmental account of the powerful and dynamic relation between word learning and conceptual organization. What resources do infants recruit in the process of mapping their first words to meaning? How do they establish correspondences between the words, the objects, and the events they encounter? The evidence supports the view (1) that infants begin the task of word learning equipped with a broad, initial, and universally available expectation linking novel words (independent of their grammatical form) to a wide range of commonalities among named objects, (2) that this initially general expectation sets the stage for the evolution of more finely tuned expectations, calibrated in accordance with the correlations between the grammatical forms represented in the native language under acquisition and their associated meanings, and (3) that these expectations support the rapid acquisition of increasingly sophisticated language and conceptual systems that are the hallmark of human development.

Clearly, the linguistic and conceptual capacities of infants are not on a par with those of their elders. Their grammatical form distinctions are not as well defined as those of more mature speakers, and their conceptual repertoires are not as rich. Nonetheless, even before they can tie their own shoes, infants share with their elders a deep insight—that there are different types of words and that these

draw attention to different aspects of the very same observed constellation of experience.

Acknowledgments

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Notes

1. I will use the term *concept* to refer to an abstraction, a mental representation. For the concepts considered in this chapter (e.g., *dog* or *furry*), the representation will include individual instances that the infant has encountered (e.g., her own pet dog; its furry tail). The representation is sufficiently abstract to include (at least some) instances that she has not encountered (e.g., my dog; her furry ears). Used in this way, the term *concept* refers to an abstract mental representation that includes (but is not restricted to) infants' direct experiences, and may be organized around various kinds of relations, including category-based, property-based, or action-based commonalities among objects.

2. The effects in this series of experiments were most apparent on superordinate-level trials. On basic-level trials, infants in all conditions readily detected the category-based commonalities we presented.

3. This approach is predicated on the assumption that there is, indeed, a principled psychological distinction between categories versus properties of objects. Most current theorists distinguish object categories (also known as *kinds* or *sortals*) from other types of groupings (e.g., *purple things*, *things to pull from a burning house*) on at least three (related) grounds: Object categories (1) are richly structured, (2) capture many commonalities, including deep, nonobvious relations among properties (as opposed to isolated properties), and (3) serve as the basis for induction (Barsalou 1983; Bhatt and Rovee-Collier 1997; Gelman and Medin 1993; Kalish and Gelman 1992; Macnamara 1994; Medin and Heit 1999; Murphy and Medin 1985; Younger and Cohen 1986). Although infants and children have less detailed knowledge about many object categories than do adults, they clearly expect named-object categories to serve these functions (Gelman 1996; Keil 1994; Waxman 1999b; Welder and Graham 2001).

4. Note that an object's shape appears to be more central to its category membership than does its color or texture, particularly for simple artifacts and for animate objects (Booth and Waxman 2002; Waxman and Braig 1996).

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