John Benjamins Publishing Company

Introduction

Inbal Arnon & Eve V. Clark
University of Manchester/Stanford University

Experience with language is not uniform across children, across social classes, or across cultures. The settings in which children acquire a first language can differ considerably even within a specific social milieu or a specific culture. In particular, the amount of speech young children hear addressed to them directly in their first few years of life varies across many dimensions, so their experience with language may be vastly different in the first three years.

Variations in individual experience – both in the sheer amount of language children hear and in how many speakers they are exposed to in interaction – may be one reason why children can follow different developmental paths as they acquire a first language, and attain different levels of linguistic skill in adulthood. The papers in this book deal with variations in forms, in learning processes, and in speaker features, and consider some of the ways in which variation has an impact on the mechanisms and outcomes of language learning. In particular, we are interested in the role of variation in children's generalizations about language.

In learning a first language, children must take the input they hear and convert it into structured linguistic knowledge. In order to understand and produce language, they must discover what the linguistically relevant linguistic units are, how these units are related to each other, and how their meanings map onto events in the world. How children achieve this, and in particular, how much innate knowledge they bring to the task, has been the focus of intense debate (e.g. Cowie 2008; Pinker 1989). The core of the debate hinges on which linguistic properties children detect in the language addressed to them, and which grammatical regularities they can extract. Input that is informative and learning mechanisms relevant to what children hear diminish the need to postulate innate linguistic knowledge as a factor in first language acquisition.

We now know that the input children hear is much richer than some researchers supposed: Child-directed speech is structured to facilitate language learning in several ways (e.g. Snow & Ferguson 1977; Soderstrom 2007). Children prefer to listen to infant-directed speech from early on (Cooper & Aslin 1990; Fernald 1985; Fernald & Kuhl 1987). The exaggerated intonation contours and vowel contrasts in adult speech to children may actually make it easier to discriminate words and

sounds in a noisy environment (Kuhl et al. 1997; Werker et al. 2007). Consistent marking of phrasal boundaries with pauses and the presence of some single-word utterances may help children segment speech into various-sized units (e.g. Brent & Siskind 2001; Broen 1972; Fisher & Takura 1996). The repetitive nature of adult speech to young children, and their use of recurring syntactic frames can be used to extract certain kinds of grammatical information (e.g. Cameron-Faulkner, Lieven & Tomasello 2003; Ferrier 1978; Mintz 2003). In general, the modifications adults make in talking with young children highlight many of the units and structures the children need to learn.

We also know that what children hear, and how much they hear, has a major effect on how their linguistic skills develop (Hart & Risley 1995; Huttenlocher et al. 1991; Fernald & Marchman, this volume; see also Street & Dabrowska 2010). The sounds, morphemes, words and constructions they are exposed to most frequently have a direct impact on what children themselves understand and produce first. They are sensitive to the frequency of sound combinations (e.g. Saffran, Aslin & Newport 1996); to the syllable structure of their language (e.g. Christophe et al. 1994; Jusczyk, Cutler & Redanz 1993); and to the contexts words and constructions tend to appear in (Arnon & Clark 2011; Bannard & Matthews 2008; Naigles & Hoff-Ginsburg 1998; Tomasello 2003). Their own uses of language and their ability to learn new forms mirror the variable and complex input they hear (e.g. Bloom, Tackeff & Lahey 1984; de Villiers 1985). Findings like these support emergent models of linguistic knowledge, where children's knowledge of grammar comes from identifying and analyzing units, as they abstract over what they are exposed to. The language adults address to children is important in predicting and explaining their acquisition of language.

With the development of usage-based and exemplar models of language learning (Bybee 2007; Tomasello 2003), the challenge is now to explain how children make appropriate generalizations on the basis of what they are exposed to. Given the variability and richness of the input, how do children arrive at relevant generalizations? Current usage-based and exemplar models are faced with two immediate challenges. The first is to account for how children extract structure from the language they hear. How do they assess similarity among linguistic forms? How do they integrate multiple sources of information? How do they discover the dimensions relevant to specific generalizations? More broadly, given that all children are not exposed to precisely the same input, how do they converge on a shared grammar?

The second challenge is to outline the ways in which differences in experience translate into differences in the path followed in learning. If experience plays a central role in development, as claimed by these models, we should be able to

relate individual children's development to differences in what they hear (input differences) and in what they learn from what they hear (cognitive differences).

In this volume, we will see how much children can <u>learn</u> from participating in, and being exposed to, communicative interactions, as an alternative to simply assuming innateness of linguistic structures in many domains of language acquisition. We ask how children make linguistic generalizations, and more specifically, examine the role of linguistic and cognitive experience in this process. We look at some of the many factors that shape the paths of learning that children follow as they construct specific aspects of their first language, and at the variety of cues and strategies they rely on. And in particular, we focus on the importance of variation for addressing the two challenges mentioned above: how children reach shared linguistic generalizations from variable experience.

Variation exists in every aspect of language: the same phoneme sounds subtly different when spoken by the same speaker in different linguistic contexts (in different words), and when spoken by different speakers. The same root form can be inflected in different ways to indicate tense, aspect and number, for example. The same construction can be used with different pragmatic intentions on different occasions. Variation is inherent to language use, both within and across speakers. To become proficient native-speakers, children must identify the factors that underlie variation: that is, they must recognize that there is variation in order to identify the underlying constants in the system.

All normally developing children acquire language, but they don't all get there in the same way, nor do they end up with identical linguistic skills (e.g. Street & Dabrowska 2010). They differ in the kinds and amounts of language they hear (Hart & Risley 1995); they differ in the rate at which they acquire a first language, and they differ in the particular paths they take at various stages in this process (e.g. Bates, Bretherton & Snyder 1988; Clark & Sengul 1978; Fernald & Marchman, this volume, Oshima-Takane & Robbins 2003; Oshima-Takane Takane & Shultz 1999). That is, children are exposed to variation in everyday adult usage, to variation in the amount of language they hear, and to variation in the number of adult speakers they interact with. This in turn means they are also exposed to the variation present in every adult speaker – variation in the pronunciation of the same sounds in different phonological contexts, of the same words produced on different occasions and in different syntactic contexts, and variation in the word choices and syntactic constructions produced to convey specific meanings, from one occasion to the next.

On the face of it, the variation in how individual adult speakers produce a language, and hence in how children experience it, poses a challenge for usage-based models. How do children converge on adult-like generalizations? One move is to not consider variation as a problem for acquisition but rather consider

it as part of the solution: variation in the forms children hear and in their overall experience may highlight the regularities they need to attend to in the language being used. Such variation may assist children in extracting phonological, morphological and syntactic regularities.

Child-directed speech contains a high proportion of variation-sets: sequences of utterances with partial lexical overlap like *Where is **the bunny**? I'm holding **the bunny*** (e.g. Küntay & Slobin 1996; Waterfall 2006). Adult production of such sets is correlated with syntactic acquisition (Waterfall 2006), and appears to facilitate adult learning of artificial languages. Adults show better learning of both word segmentation (preferring words over part-words) and identification of phrasal constituents when the language they hear contains variation sets, compared to the same artificial language where consecutive sentences do not share any lexical items (Onnis, Waterfall & Edelman 2008). Such systematic variation highlights the relations between words and phrases.

Another kind of variation has been shown to facilitate learning of non-adjacent dependencies. Infants and adults were better at learning non-adjacent dependencies in an artificial language when the set-size of elements that could appear in the dependency was larger rather than smaller (Gómez 2002). Having a larger number of 'interfering' elements highlighted the structure of the dependency that had to be learned. Similar effects have been found in speech perception. The learning of novel phonetic categories is improved when speakers are exposed to more variable speech, for example, speech from different speakers (Lively, Logan & Pisoni 1993). Variation facilitates not only the learning of native contrasts, but also the ability to adapt to non-native speech: speakers show better adaptation when exposed to a contrast that is more variable in terms of a phonetic feature like Voice Onset Time (Sumner 2011).

Taken together, these findings emphasize the importance of variability in making linguistic generalizations and emphasize the need to delimit the conditions under which variation facilitates language learning.

This book is made up of some 15 chapters, each devoted to one or more facets of language acquisition and the kinds of variation children are exposed to, along with the learning mechanism(s) needed, the kinds of cues available that license inferences, and any other information that supports learning and generalization of the type required for language.

In Part 1: *Extracting Regularities*, the three chapters focus on how children make use of variation in expanding their own early usage as they arrive at their first morphological and syntactic generalizations. All three researchers make use here of longitudinal corpus data on production.

Rispoli & Hadley use corpus data to look at the acquisition of tense and agreement in English-speaking children. They show how the systems of tense

and agreement are related, and how their acquisition is influenced by properties of child-directed speech as well as by such biological factors as age and gender. For example, children's learning of one morphemic contrast in English (*was/is*) is predicted by their acquisition of another contrast (*does/did*). They also found that children's inflectional development accelerates once they have mastered certain contrasts. At the same time, their productivity with inflections develops only gradually. This appears to be facilitated by how informative the input is that children hear, namely how many different verbs adults produce with specific inflected forms.

Behrens also makes use of corpus data to look at the development of inflectional paradigms in German, specifically the acquisition of case and number inflections on German nouns. In effect, children have to identify word forms – stems (here nouns) and the different affixes they occur with, and the function or meaning carried by each affix. When children encounter systems where there is not always a one-to-one mapping of form and function, it is possible to look at how they analyze and re-analyze an inflectional system, before they arrive at a mapping of forms and functions that can be generalized to new nouns in new contexts. Behrens focusses on the ambiguous German suffix *-n*, which is used to mark both plurality and case, in order to tease apart children's identification of forms and functions.

Rojas-Nieto stresses the importance of pragmatic factors in explaining children's acquisition of inflectional morphology. Using corpus data on the acquisition of Spanish, she looks in detail at the development of inflection for different verbs. She shows that children's experience with verb-inflection combinations is highly skewed: adults use some verbs with a range of inflected forms, and others with only a very limited number of inflections. They produce most verbs with a dominant inflected form, but what this form is differs from verb to verb, and is affected by verb meaning. Different verbs typically illustrate different inflectional contrasts. For example, the verb *jugar* 'play' appears with several different person markings, while the verb *caer* 'fall' displays contrasts in tense markings. This distributional diversity in turn influences children's emerging uses of inflection. Verb uses follow different paths early on, with the developmental trajectories for specific verbs reflecting the communicative settings of adult usage.

Together, these chapters illustrate some ways in which variation over forms helps children extract meaningful morphological patterns.

In Part 2: *Multiple Cues in Learning to Communicate,* the focus shifts to children's reliance on multiple cues to meaning, and on the relations between cues, as they make certain pragmatic generalizations. **Kelly** tackles the informational status of gestures in children's communicative attempts, again with one- and two-year-olds. She shows that adult caretakers respond differently to child

utterances that combine words and gestures (e.g. a one-year-old saying *fish* while reaching towards the fishbowl) compared to word-only utterances (e.g. a child saying *cup* with no accompanying gesture). Young children's utterances were more likely to elicit an action from the caregiver when they combined words and gestures. Adults generally treated these combinations as requests, compared to single-word utterances on their own, which they treated simply as acts of labelling.

Kidd, White & Aslin look at children's developing use of disfluencies in speech as cues to speakers' referential intentions. They document the presence of disfluencies in child-directed speech, and then use eye-tracking in an experimental paradigm to show that children as young as 2;6 can use such disfluencies to make predictions about the speaker's intended referent in online comprehension tasks. In adult-adult speech, for instance, speakers often produce a disfluency before they introduce a novel referent. And one- and two-year-olds appear sensitive to this tendency: they look towards whatever referent is discourse-new or novel in context when the adult speaker produces a disfluency before naming the target object (e.g. *Look at theee uhhhh ball*).

These two papers emphasize children's reliance on multiple kinds of linguistic and non-linguistic information as they make inferences about utterance meanings and speaker intentions.

In Part 3: *Discovering Units*, the papers highlight a somewhat neglected route to making a linguistic generalization: the move from larger less-analyzed units to smaller, more structured ones. In this process, children learn from an initially unanalyzed whole about the parts that constitute it. For example, they start from words in learning to identify segments by attending to phonetic contrasts between word-forms (e.g. Lindblom 1992), or, from a formulaic chunk like *how-are-you*, they learn about the individual words that make up the chunk (Arnon 2009). The chapters in this section report on such processes in several linguistic domains.

Vihman & Vihman focus on phonological development. In a case study of one child acquiring Estonian, they show how the child moves from whole words to the extraction of phonological regularities, and the identification of phoneme sequences. In doing this, they track the templates used by one child. These templates provide a form of skeleton for a set of words, where the child fills in only certain slots from a rather small segmental repertoire. Reliance on templates where parts of the 'skeleton' may bear little resemblance to the adult word form suggests that children initially depend on whole-word representations for production and only later analyze adult forms further to arrive at the segmental detail involved.

Brandt takes up a more abstract syntactic category in asking how children develop the notion of subject in German for a range of complement-taking verbs. She documents an effect of 'subject + verb' chunks on children's ability to

generalize. Children found it hard to substitute one subject for another in sentences they heard, when that move required that they break up a fixed phrase or chunk. For instance, they found it difficult to change a first-person subject into a third-person one for mental-state complement taking verbs like *believe* that almost always appears with a first-person subject. Their ability to make such changes depends, among other things, on the range of subjects that specific verbs appear with.

Bannard & Matthews use a sentence repetition task to explore the role of chunks and formulaic frames (e.g. *a piece of ___*) in forming syntactic generalizations. They show that children are more willing to form generalizations (to extract slots from such frames) when there is a lot of variability in the final slot (high slot entropy), and when the words appearing in a given slot are similar to each other in meaning (low semantic density). Their study illustrates a route from an unanalyzed-chunks to analyzed-frames as children form generalizations about the structures they are learning.

Arnon embeds the findings from these studies within the larger context of Gestalt processes in language learning. She points out that most accounts of early production go from single words, to word-combinations, to more complex utterances. But children also make use of unanalyzed chunks early on, and progress from these to gradual analysis of the constituent elements within them. This suggests that children 'build' in two directions during acquisition: they combine small units into larger ones, and they break down unanalyzed large chunks into smaller constituents. Both processes contribute to the learning of linguistic units and to learning how to combine them.

Part 4 focuses on *Individual Differences* in language learning and explores differences in linguistic experience, cognitive skills and genetic make-up and how these may impact the learning process, and so lead to different rates of generalization. **Fernald & Marchman** document some of the history of research on the causes and consequences of variability in early language proficiency, and show how new measures of children's fluency in understanding language in real time can shed light on where certain differences come from and how they are linked to later language outcomes. They also show that infants who hear more, and richer, language from caregivers not only acquire vocabulary more quickly, but also develop more efficient processing skills early on in acquisition.

Anderson, Farmer, Goldstein & Spivey show that children's experience with language (as measured by vocabulary size) is correlated with their ability to use the referential context to resolve Prepositional Phrase-attachment ambiguities (*Put the frog <u>on the napkin</u> <u>into the box</u>*). They make use of four- and five-year-olds' ability to use a computer mouse to 'place' the relevant referent at the goal, in tracking the children's understanding the ambiguous locative phrases.

The children's movements of the mouse reveal any false starts, mis-placements, and mid-course corrections as they decide on the interpretation of each instruction. The more language children know (the larger their vocabulary), the more adult-like their processing abilities.

Misyak & Christiansen ask how genetic variation can result in individual differences in language learning. In their chapter, they survey findings from behavioral genetics that provide insight into language development, and discuss recent developments in molecular genetics that align with linguistic emergentism. They propose an endophenotype approach better suited for addressing quantitative and continuous variance. Endophenotypes are quantitative measurements of behavioral traits (e.g. statistical learning abilities) that mediate between genetic antecedents and more distal, complex phenotypes (e.g. language learning). This approach, they argue, may offer a way to advance the study of subtle interactions between genes and language abilities.

Part 5 tackles a larger theoretical question: what kinds of *learning mechanisms* enable children to build grammars out of the rich and variable input they encounter? In his chapter, **Croft** addresses the nature of the grammar that children need to learn. He outlines a view of language where both language use by adult speakers and language acquisition by young children is regarded as (part of) the same process. This process, he argues, is part of a general process central to human societal functioning, namely that of joint action. While not all joint actions involve language, language always involves joint action for the speaker and addressee. In short, language use and language acquisition should be viewed as part of the larger process of joint action.

Gómez considers the roles that memory and sleep may play in children's linguistic generalizations. She reviews studies that show how the memory consolidation associated with sleep both facilitates abstraction and introduces flexibility into learning. Most experimental tests of learning, and hence of generalization, tend to be carried out immediately after learning trials, but children's retention is not always robust (e.g. Horst & Samuelson 2008). Sleep supports the consolidation of new memories bolstered still further in language learning by children's generalizations about structure.

Perfors & Wonnacott describe how Bayesian modeling can be used to explore certain constraints on learning in language acquisition. They begin by providing a brief introduction to Bayesian models, and then look at the kinds of constraints these models impose on learning and discuss their relevance for research on language acquisition. They argue that such models offer a powerful tool for examining issues in language acquisition because they allow consideration of both representational flexibility and domain-general mechanisms in statistical learning.

Together, these papers offer an overview of some ways in which experience and variation influence the process of generalization in language learning. These studies, in general, attest to the importance of looking at how adults talk with children, and how much they talk with them, in arriving at an account of just what children learn when, and why. By looking at the commonalities and differences not only in what children hear, but also in what they themselves bring to the task of learning, we arrive at a more complete picture of how children find structure in their input, and why this path can differ from one child to the next. In studying how children learn to talk we need to explain how different experiences lead to a shared linguistic system. In this book, we describe (some of) the relevant dimensions in addressing this challenge: the properties of the speech addressed to children, the richness of information and cues they are exposed to, the individual differences in the motivations and skills they bring to the task.

The process of acquisition can't be partitioned into neat pieces of language – phonology, inflectional morphology, specific construction types. Instead, children are exposed to how the language is used in the community around them: mappings of form and meaning. And while we can usefully examine particular facets of language in the process of acquisition, it is important that we remember that children are not just 'little linguists'. They are learning how to communicate what they want, what interests them, and what is happening with them and with others. The process of acquisition, we argue, is therefore sensitive to the properties (and interests) of individual learners, and is facilitated by variation – in form, meaning, and communicative situations.

References

Arnon, I. 2009. Starting Big – The Role of Multi-word Phrases in Language Learning and Use. Ph.D. dissertation, Stanford University.

Arnon, I. & Clark, E.V. 2011. Why *brush your teeth* is better than *teeth* – Children's word production is facilitated in familiar sentence-frames. *Language Learning and Development* 7(2): 107–129.

Bannard, C. & Matthews, D. 2008. Stored word sequences in language learning: The effect of familiarity on children's repetition of four-word combinations. *Psychological Science* 19: 241–248.

Bates, E., Bretherton, I. & Snyder, L. 1988. *From First Words to Grammar: Individual Differences and Dissociable Mechanisms*. Cambridge: CUP.

Bloom, L., Tackeff, J. & Lahey, M. 1984. Learning *to* in complement constructions. *Journal of Child Language* 11: 391–406.

Brent, M.R. & Siskind, J.M. 2001. The role of exposure to isolated words in early vocabulary development. *Cognition* 81: B33-B44.

Broen, P. 1972. The verbal environment of the language-learning child. *Monograph of the American Speech & Hearing Association* 17.

Bybee, J. 2007. *Frequency of Use and the Organization of Language*. Oxford: OUP.

Cameron-Faulkner, T., Lieven, E. & Tomasello, M. 2003. A construction based analysis of child directed speech. *Cognitive Science* 27: 843–873.

Christophe, A., Dupoux, E., Bertoncini, J. & Mehler, J. 1994. Do infants perceive word boundaries? An empirical study of the bootstrapping of lexical acquisition. *Journal of the Acoustical Society of America* 95: 1570–1580.

Clark, E.V. & Sengul, C.J. 1978. Strategies in the acquisition of deixis. *Journal of Child Language* 5: 457–475.

Cooper, R.P. & Aslin, R.N. 1990. Preference for infant-directed speech in the first month after birth. *Child Development* 61: 1584–1595.

Cowie, F. 2008. Innateness and language. *Stanford Encyclopedia of Philosophy*. ⟨http://plato.stanford.edu/entries/innateness-language/⟩

de Villiers, J.G. 1985. Learning how to use verbs: Lexical coding and the influence of input. *Journal of Child Language* 12: 587–595.

Fernald, A. 1985. Four-month-old infants prefer to listen to motherese. *Infant Behavior & Development* 8: 181–195.

Fernald, A. & Kuhl, P.K. 1987. Acoustic determinants of infant preference for motherese speech. *Infant Behavior & Development* 10: 279–293.

Ferrier, L.J. 1978. Some observations of error in context. In *The Development of Communication*, N. Waterson & C. Snow (eds), 301–309. New York NY: Wiley.

Fisher, C. & Tokura, H. 1995. The given-new contract in speech to infants. *Journal of Memory & Language* 34: 287–310.

Gómez, R.L. 2002. Variability and detection of invariant structure. *Psychological Science* 13: 431–436.

Hart, B. & Risley, T.R. 1995. *Meaningful Differences in the Everyday Experience of Young American Children*. Baltimore MD: H. Paul Brookes.

Horst, J.S. & Samuelson, L.K. 2008. Fast mapping but poor retention in 24-month-old infants. *Infancy* 13: 128–157.

Huttenlocher, J., Haight, W., Bryk, A., Seltzer, M. & Lyons, T. 1991. Early vocabulary growth: Relation to language input and gender. *Developmental Psychology* 27: 236–248.

Jusczyk, P., Cutler, A. & Redanz, N.J. 1993. Infants' preference for the predominant stress patterns of English words. *Child Development,* 64: 675–687.

Kuhl, P.K., Andruski, J.E., Chistovich, I.A., Chistovich, L.A., Kozhevnikova, E.V. & Ryskina, V. 1997. Cross-language analysis of phonetic units in language addressed to infants. *Science* 277: 684–686.

Küntay, A. & Slobin, D. 1996. Listening to a Turkish mother: Some puzzles for acquisition. In *Social Interaction, Social Context, and Language: Essays in Honor of Susan Ervin-Tripp*, D. Slobin & J. Gerhardt (eds), 265–286. Hillsdale NJ: Lawrence Erlbaum Associates.

Lindblom, B. 1992. Phonological units as adaptive emergents of lexical development. In *Phonological Development: Models, Research, Implications,* C.A. Ferguson, L. Menn & C. Stoel-Gammon (eds), 131–163. Parkton MD: York Press.

Lively, S.E., Logan, J.S. & Pisoni, D.B. 1993. Training Japanese listeners to identify English/r/ and/l/: II. The role of phonetic environment and talker variability in learning new perceptual categories. *Journal of the Acoustical Society of America* 94: 1242–1255.

Mintz, T.H. 2003. Frequent frames as a cue for grammatical categories in child directed speech. *Cognition* 90: 91–117.

Naigles, L. & Hoff-Ginsburg, E. 1998. Why are some verbs learned before others? *Journal of Child Language* 25: 95–120.

Onnis, L., Waterfall, H. & Edelman S. 2008. Learn locally, act globally: Learning language with variation set cues. *Cognition* 109: 423–430.

Pinker, S. 1989. *Learnability and Cognition*. Cambridge MA: The MIT Press.

Saffran, J., Aslin, R.N. & Newport E.L. 1996. Statistical learning by 8-month-old infants. *Science* 274: 1926–1928.

Snow, C.E. & Ferguson, C.A. (eds), 1977. *Talking to Children: Language Input and Acquisition*. Cambridge: CUP.

Soderstrom, M. & Morgan, J.L. 2007. Twenty-two-month-olds discriminate fluent from disfluent adult-directed speech. *Developmental Science* 10: 641–653.

Oshima-Takane, Y. & Robbins, M. 2003. Linguistic environment of second-born children. *First Language* 23: 21–40.

Oshima-Takane, Y., Takane, Y. & Shultz, T. 1999. The learning of first and second person pronouns in English: Network models and analysis. *Journal of Child Language* 25: 45–575.

Street, J.A. & Dabrowska, E. 2010. More individual differences in language attainment: How much do adult native speakers of English know about passives and quantifiers? *Lingua* 120: 2080–2094.

Sumner, M. 2011. The benefit of phonetic variation in the perception of accented speech. *Cognition* 119(1): 131–136.

Tomasello, M. 2003. *Constructing a Language: A Usage-based Theory of Language Acquisition*. Cambridge MA: Harvard University Press.

Waterfall, H. 2006. A Little Change is a Good Thing: Feature Theory, Language Acquisition and Variation Sets. Ph.D. dissertation, University of Chicago.

Werker, J.F., Pons, F., Dietrich, C., Kajikawa, S., Fais, L. & Amano, S. 2007. Infant-directed speech supports phonetic category learning in English and Japanese. *Cognition* 103: 147–162.