20 Overview

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The key questions in language acquisition concern what linguistic concepts, if any, might be built into the child's language-learning mechanism, what the role of linguistic experience is, and what procedures the child uses to develop her language(s). How, in short, does the child use the language she hears—which comes to her ears in the form of an undifferentiated stream—to arrive at the abstract knowledge of language that adults and older children have? Language acquisition involves mastery of sounds and phonemes (or their handshape equivalents), morphemes, words, syntax, semantics, and pragmatics. Each of those aspects of language requires abstract mental representations. The consonants, vowels, and tones of language are abstract, the rhythm, intonation, and stress are abstract; words are abstract, syntax is abstract; and semantics is abstract. The miracle of language acquisition and use is that learners turn mere sounds into the abstract syntactic structures used to recover meaning.

At birth, the neonate has already analyzed the basic prosody of her language and has analyzed specific vowel sounds. Within the first few days of life the child distinguishes the rhythm, intonation, and stress of the language heard in the womb from languages with a different prosodic pattern—but not from languages with a similar prosodic pattern. For example, four-day-old infants exposed to French *in utero* could distinguish French from Russian, languages with different prosodic patterns, while infants exposed to neither language *in utero* did not distinguish them (Mehler, Jusczyk, Lambertz, Halsted, Bertoncini, & Amiel-Tison, 1988). Thus, experience *in utero* allows neonates to extract the pattern of their language. That infants do not distinguish the pattern of their language from another with a similar pattern is evident from a study with two-month-old English-hearing infants. They can distinguish English from Japanese, but not from Dutch. That is because the prosody of English at the word level is much different from the prosody of Japanese but similar to the prosody of Dutch (Christophe & Morton, 1998). Infants

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who heard English in the womb also do not distinguish French from Japanese, despite the prosodic differences between the two languages: as English-hearers, they have extracted a prosodic pattern only for languages like English.

Newborn infants show that they have not only acquired prosodic patterns in the womb, but particular features of their language as well. They respond differentially to vowel sounds from their language and similar vowel sounds from another language. Neonates who heard either English or Swedish in the womb differentiated between English and Swedish vowels within a few days after birth (Moon, Lagercrantz, & Kuhl, 2013). Further, the number of hours post-birth was not related to how sharp their differentiation was. It was the *in utero* learning that mattered. The infants heard variants of the vowels and not just a single example. They appeared to treat the variants from their own language as examples of the same vowel, but to treat the variants from the other language as different vowels. Not only were children learning in the womb, but they were creating classes of vowel sounds that they treated as equivalent. The creation of equivalence classes—categories in which all members behave similarly in one or more ways—is crucial for language acquisition.

Studies like these demonstrate that the learning that occurs in the womb is spontaneous and already abstract. Learning takes place even though it occurs in social isolation, with no meanings attached to the sounds, and with no reinforcement given for the development of categories. Most of language acquisition, including acquisition of the sound structure of one's language, of course takes place outside the womb. The purpose of these examples is to show that the acquisition of linguistic patterns occurs even earlier than one might have thought.

The protean nature of language acquisition is amply demonstrated in the chapters in this section. Language acquisition occurs at all major life stages—in infancy, childhood, and adulthood. People are typically exposed to their first—and in some cases, only—language in infancy and early childhood, but "late" acquisition is common for deaf individuals in hearing-only households. Most existing research is on monolingual English hearer-speakers, reflecting the fact that there are more researchers who are native English speakers than there are researchers speaking any other language or set of languages, but, fortunately, this has begun to change. Deen provides examples of morphological development in a number of different languages. According to Ethnologue (Lewis, Simons, & Fennig, 2016, https://www.ethnologue.com/guides/how-many-languages), 7097 languages were documented as of 2016, so a concentration on a mere handful of the world's languages would be misguided and benighted. Since the field is increasingly benefiting from studies of acquisition of a wide range of languages, both spoken and signed, we can expect a corresponding broad range of insights.

What counts as a language is important at two levels in language acquisition. One level is in distinguishing one language from another (and its related manifestation of noticing that two languages are mutually intelligible). American and British English seem intuitively to be dialects of the same language, even though there are some lexical differences (*elevator* versus *lift*) and some minor syntactic differences (British English allows "I might do" as an answer to "Are you going to

the movies tonight?" and some dialects allow "I gave it her" in addition to "I gave her it"). But many Chinese people speak two "dialects" that are not mutually intelligible, such as Mandarin and the language of their local community. If mutual unintelligibility is the criterion for distinguishing languages, those individuals are actually bilinguals.

The other level at which what counts as a language matters is in distinguishing language from communication systems. Kegl makes that distinction in order to separate some gestural communication systems that deaf children with their hearing relatives might develop and use at home, from natural language. She suggests that the type and amount of input deaf children receive are related to the type of system that the child develops.

Only intensive cross-linguistic research can provide answers about what is universal in language acquisition and what is language specific. The wealth of data presented in the chapters in this section demonstrate that intensive study, rather than a cursory look, is necessary, because a great deal of data are required to confirm or disconfirm hypotheses. Many of the chapters describe results that are inconsistent or difficult to explain fully via any existing models. Best, for example, compares three models of how children learn that some sound contrasts are meaningful in their language, while others are not. The models are not necessarily mutually exclusive, and none of them fully account for children's behavior. Explanatory theories require a great deal of information. With small amounts of data, it is possible to prematurely accept incorrect theories.

As with the concentration on English, research on monolinguals is more common than research on bilinguals, even though some researchers suggest that bilingualism is at least as common as and perhaps more common than monolingualism in the world (Grosjean, 2010). More than 50% of citizens in the European Union (EU) can carry on a conversation in more than one language, and in some EU countries, more than 90% of the inhabitants speak more than one language (Luxembourg, Latvia, Slovenia, Lithuania, Malta, the Netherlands, and Sweden; European Commission (2012), http://ec.europa.eu/public_opinion/archives/ebs/ebs_386_en.pdf). In the United States, according to census data from 2009-2013, 21% of the population over age 5 speaks a language other than English at home (United States Census Bureau, 2015, http://www.census.gov/data/tables/2013/demo/2009-2013-lang-tables.html). Of those, 58% say they speak English less than very well. Knowing more than one language is common. For that reason alone, we need to understand how it occurs. Again, without intensive study of bilinguals as well as monolinguals, we will be unable to determine what is universal about language acquisition and what is specific to learning a single language.

There are many ways of being bilingual. Some children grow up being exposed, roughly equally, to more than one language. But that pattern is only one of many patterns. Some children instead spend their first years as a monolingual, speaking their single language at home; they are exposed to a second language only when they start attending school. If the language at school is the language of the community, or the majority language, the child may get increasingly less exposure to her first language, and end up knowing it less well than monolinguals of that

language do. So-called *heritage* speakers are often in a position where there are two home languages, one of which is the majority language. The majority language can become more and more dominant, and the learner may either never acquire or lose information that full native speakers have. In French, Spanish, and many other languages, for example, nouns have a gender; adjectives and articles must agree in gender with the nouns they are in construction with. Heritage language learners make more errors and have less facility with gender agreement than native speakers do in some tasks (e.g., Montrul, Foote, & Perpiñán, 2008; Montrul, Davidson, De La Fuente, & Foote, 2014; Polinsky, 2008). Yet other children become exposed to another language later in life, sometimes through immigration, and retain their first language.

Papers in this section address whether acquisition differs, depending on whether it is a first or second language, or on whether it is one of two languages being simultaneously acquired, or on whether it is acquired late. A second language can be acquired either simultaneously with a first language, or in later childhood or adulthood. How similar are simultaneous and successive types of acquisition? What effect does already knowing a language, for example, have on acquiring a second (or third) language? Several authors in this section address bilingual, second, and late language acquisition: Kegl, Klein and Martohardjono, Meisel, and Byers-Heinlein and Lew-Williams. One issue with acquiring more than one language, or acquiring a language late, is the quantity and quality of language that the learner is exposed to—the input. Children who are exposed to two languages from birth, for example, effectively receive half as much language input as children who are exposed to a single language. For children who are exposed to language late, as is the case for many deaf children, the late and partial exposure may lead to non-optimal acquisition. Although researchers do not find strong evidence for a critical period, except perhaps for acquiring a native-like accent, it may be necessary to be exposed to *some* natural language early in life. Kegl addresses these and other issues.

Klein and Martohardjono distinguish between bilingual acquisition and second language acquisition. If a child is exposed to two languages before the age of three, she is bilingual. If one language is not present until after age three, the child is acquiring that language as a second language. If an individual is not exposed to the second language until after puberty, that person is considered an adult second language learner, rather than a child second language learner, but Klein and Martohardjono note that different researchers have different time periods.

Acquisition post-birth almost always occurs in a social context. Roseberry Lytle and Kuhl hypothesize that natural language learning requires social interaction between the child and the people around her. Chinese sounds, for example, are learned by nine-month-old English-speaking infants when they interact with a live speaker, but not when they see a video of a speaker or hear a recording of a speaker. The same superiority of social interaction holds when word learning and syntax learning are examined. A video chat is as conducive to learning as a live chat with 24 to 30 month olds, showing that the speaker does not have to be physically present, but does have to be responsive. Roseberry Lytle and Kuhl suggest that social interaction acts at many levels, by

directing the child's attention to speech, increasing the amount of information the child receives, and developing and maintaining the child's motivation to participate meaningfully in the interaction. Mutual eye gaze is one social cue children use in word learning. Byers-Heinlein and Lew-Williams report that bilinguals more effectively use eye gaze than monolinguals do in detecting where a toy has been hidden. Bilinguals may be even more sensitive to social cues than monolinguals. Clear evidence of the value of social interaction comes from studies of deaf children of hearing relatives who enter a school for the deaf, as Kegl describes. By having language partners who also use only a visual-manual system, individuals develop a much more extensive communication system.

As Roseberry Lytle and Kuhl point out, the results with social interaction might seem surprising, since infants do learn patterns from strings of syllables that are presented to them in the laboratory, with no social interaction. And, as we have already noted, the fetus learns the prosody of ambient language and creates equivalence classes of sounds that are specific to the ambient language. Roseberry Lytle and Kuhl point out that babies exist in a very rich linguistic world. The kind of learning that is required when a baby is exposed to a full language from multiple speakers may be very different from the kind of learning that is required in a laboratory setting or in the womb.

How the infant processes sounds brings up the question of whether the child brings domain-specific or domain-general abilities to the process of language acquisition. Best addresses the difficulty of answering this question in practice, even though the two are easy to separate in principle. If the child has domain-specific abilities, for example, she may take speech sounds that are on a continuum and impose a categorical structure on them. The difference between *ba* and *pa* seems categorical in perception, even though they are actually on a continuum. We accept a range of sounds as *ba* and then suddenly shift to perceiving a range of sounds as *pa*. A nice demonstration of this can be found at https://www.youtube.com/watch?v=4V5pQyKsgg4.

As voice onset time (the time it takes the vocal cords to start vibrating after air flow is released following an initial blockage due to pronunciation of the start of the consonant) decreases we continue to hear *ba* as *ba*, but somewhere between 30 ms and 0 ms we hear the sound as *pa*. Even one-month-old infants show this phenomenon (Eimas, Siqueland, Jusczyk, & Vigorito, 1971). As Best points out, such phenomena were interpreted as demonstrating that "speech is special" and unique to humans. But it turns out that humans treat non-speech sounds as well as speech sounds categorically. It also turns out that chinchillas—after much training with the end points of the continuum—can also make categorical distinctions of speech sounds (Kuhl & Miller, 1975). Perhaps, then, children are using general perceptual mechanisms when hearing speech, mechanisms that are shared with other animals and that are utilized for a range of stimuli. Or, categorical perception may, in its origin, be specific to speech and recruited to handle other stimuli. Chinchillas may be exploiting a different mechanism than humans do, as the extensive training suggests.

Along similar lines, rats can use changes in item frequency in a sequence as an ordering cue (after training) in a way similar to infants (Toro, Nespor, & Gervain, 2016), suggesting another domain-general ability. They can also use pitch alternations to distinguish different sequences (de la Mora, Nespor, & Toro, 2013). When frequency is pitted against prosody, human infants (Gervain & Werker, 2013), but not rats (Toro *et al*., 2016), use prosody as a cue, suggesting that the ability to use some cues for higher-order processing, such as drawing inferences about syntactic structure, may be unique to humans.

Best considers at length how the infant's experience affects her ability—and loss of ability—to make certain speech contrasts, and how the child uses speech perception to begin recognizing words. Best compares a number of models for each process. The different models are unusually specific and detailed compared to models for the development of syntax, semantics, and other aspects of grammar. In the case of reorganization of the sound system, one possibility is that the child tunes her system to the sounds that are used in her language, thus reducing—but not forever losing—the ability to distinguish sounds used only in other languages. Another possibility is that during an early critical period the child's brain becomes committed to the sounds of the system she is acquiring. And a third possibility, which Best favors, is similar to the idea that the child reorganizes her sound system, but also predicts that the child will be able to make non-native contrasts if they can be assimilated to the contrasts in her native language.

Best also compares theories that address how the child solves the problem that people pronounce the same word in different ways. Female speakers sound different from male speakers, old people sound different from young people, and so on. How do children come to distinguish sound differences that do not signal word-level differences from sound differences that do signal word-level differences? The word *tree*, for example, can be pronounced in different ways. A canonical American and British pronunciation can be found here: http://dictionary.cambridge.org/us/pronunciation/english/tree. Most English speakers may not even detect a difference between them. But they do hear the difference between *tree* and *three*, even though some speakers, especially non-natives, pronounce them the same.

However complicated early speech perception is for monolinguals, it is even more complicated for bilinguals. Yet, as Byers-Heinlein and Lew-Williams describe, bilingual babies appear to make most of the same distinctions that monolinguals do. At the same time, bilingual babies may have a different learning trajectory for exactly the case we've been describing, where sound differences may or may not signal word differences. Spanish-Catalan babies hear vowels in Catalan that mark word differences, and distinguish them at age 4 months and at age 12 months, but not always at age 8 months. Monolingual Catalan babies distinguish the vowels throughout that period. One conjecture is that bilingual babies go through a period when they realize that, across their two languages, a vowel difference need not signal a word difference. The words *pilota* and *pelota* both mean "ball." That similarity in word meaning coupled with a difference in vowel character may lead infants to temporarily ignore such vowel differences.

The way that children learn labels for words also differs in some respects between mono- and bilinguals. Although both groups may take as their first hypothesis about a new noun that it refers to a whole object rather than a part of an object, Byers-Heinlein and Lew-Williams note that the groups differ with respect to mutual exclusivity. Monolinguals assume, when they hear a new noun, that the noun is not a synonym for a noun they already know, but refers to a different object. For bilinguals, however, who have the experience of learning different words that mean the same thing across their two languages, mutual exclusivity does not hold. Bilinguals also differ from monolinguals in knowing fewer words in each of their languages than a comparable monolingual does. That is presumably one consequence of having less input in either language than a monolingual peer does. If the total number of different words the child knows across her two languages is tabulated, her total vocabulary is comparable to a monolingual's. That too suggests that the child's vocabulary is tightly linked to the linguistic input she receives. For vocabulary, it could not be otherwise.

The only way a child can learn a word is by hearing it. Thus, vocabulary size in one language is not correlated with vocabulary size in another language. Word learning depends on exposure. The richer the input at 18 months, the greater the vocabulary and processing efficiency at 24 months. As Byers-Heinlein and Lew-Williams note, processing efficiency, like vocabulary, is not correlated across a child's two languages. The child may be much more efficient in processing one of her two languages.

Once the child has been exposed to a word, whether it is a noun or a verb, what strategies does she use to learn what the word means? Levine, Strother-Garcia, Hirsh-Pasek, and Golinkoff suggest that only a hybrid model can explain how the child acquires word meanings. That hybrid makes three main assumptions. The first is that the child will use a variety of cues in learning a word. We have already seen that social interaction, and the myriad cues it provides, aids word learning. Perceptual cues are another aid, as are linguistic cues. The second assumption is that the child may use cues to different degrees as she develops. Perceptual cues may be paramount early in acquisition, but less important later in acquisition. The third assumption is that the child has internal biases that she brings to the word-learning situation, such as the bias that a noun refers to a whole object.

Word learning is not an all-or-nothing phenomenon. Levine, Strother-Garcia, Hirsh-Pasek, and Golinkoff note that it takes several different experiences with a word, in different contexts, before a child can determine its full meaning. Word learning, unlike other forms of language acquisition, continues across a lifetime. English-speaking adults know many thousands of words, while one year olds know only a few. Nouns tend to be produced more frequently than verbs cross-linguistically, though children in some languages produce verbs more often than children in other languages do. The "noun bias," Levine, Strother-Garcia, Hirsh-Pasek, and Golinkoff suggest, is due to the greater concreteness of nouns compared to verbs. Nouns that refer to objects that have a consistent shape and are easy to perceive, nouns that are concrete and imageable, are nouns that are easier to acquire.

Although, as we have said, vocabulary is dependent on exposure, that statement is only true if we are talking about word roots. We can distinguish between word roots and the morphemes, or small units of meaning, that can be combined with words. There are two productive processes that allow a child to produce new words even if she has never heard them. A child can be productive by adding *–s* to create plural nouns or to create third person singular present tense verbs. Such processes are morphological: they deal with the structure of words. Deen describes the two types of morphology: inflectional, as in the example just presented, and derivational. Derivational morphology takes prefixes and suffixes to create a new word. When a child understands how morphological processes work, and has the relevant morphemes, she can create new words based on roots and affixes she already knows. A word like *antidisestablishmentarianism* has *establish* as its root, with the affixes *anti-*, *dis-*, *ment-*, *arian-*, and *ism* added to the front and back ends.

Inflectional morphology is at the border between morphology and syntax. The distinctions that are made in inflectional morphology, such as tense, person, grammatical gender, and so on, are distinctions that are relevant to syntax. When we speak of subject-verb agreement, for example, we are relating two word forms. In English, with the verb *be*, subject-verb agreement is more visible than it is with standard main verbs. Only the form *I* can be used with *am*; in that sense the subject and the verb agree. Similarly, as already discussed, in languages like Spanish, the article and the noun agree in gender. In English, inflectional morphology is rather limited compared to other languages.

Regardless of language, Deen notes that children acquire inflectional morphology before age four. In principle, the moment the child understands that *–ed* is how English represents the past tense and can be added to any verb (except irregulars), she should uniformly use the past tense when the occasion demands. Yet two year olds are inconsistent in their use of past tense in English. When they use it, they use it correctly, but they do not always use it when they should. The reasons for omission are not clear, particularly since, as Deen notes, children in languages with rich morphology seem to master morphology very early, although omission is common in the acquisition of every language. Although errors of omission are common, errors of commission are rare. For example, children very seldom use third person singular present tense *–s* with first person verbs. In agglutinative languages like Turkish and Swahili, where each affix encodes a different grammatical property (like tense, person, and gender), children put the affixes in the correct order. Children's errors of overregularization, such as saying *foots* instead of *feet*, or *runned* instead of *ran*, are particularly good evidence that the child has an internal rule. Those are forms that the child has never heard, so the child's production shows that she is overapplying a rule.

The acquisition of morphosyntax by children who are bilinguals is described by Meisel. A major question is whether the child's two languages develop independently of each other or whether one of them influences the other. Meisel provides evidence that, even at the beginning of acquisition, the child does not have a single merged system but two systems. If, for example, the two year old's two languages

differ in the word order they use for subjects, verbs, and objects, the child properly obeys the word order of each. Similarly, in cases where one language requires the verb to be in the second position but the second one does not, children do not appear confused. There is, however, some cross-linguistic interaction, though it does not occur for all children. Meisel suggests that children's use of properties from one language in a second language reflect processing rather than grammatical differences. The interaction effects appear to be quantitative. For example, English-Italian bilingual children may use subjects more in Italian than is standard for monolinguals (Serratrice, Sorace, & Paoli, 2004), though it is by no means the rule (Valian, 2016).

The acquisition of morphosyntax in a second language, as described by Klein and Martohardjono, shows both similarities to and differences from acquisition of morphosyntax in a child's first language. Among the differences is the fact that errors of commission are more common in children's acquisition of a second language. One example is the use of *be* where it does not belong, as in "he is go." Child learners of a second language, such as learners of German who had Chinese as the native language, appear to have no difficulty acquiring tense markers even though their native language does not express tense overtly. In other instances, there may be evidence of transfer from the child's first language to their second language. Unlike child learners, adult learners of a second language may persist in their morphosyntactic errors, especially in production.

Klein and Martohardjono review different models of those persistent errors. One set of models attributes the adult's errors to a lack of knowledge. In one variant, the problem is at the level of morphosyntax, in a second it is at the level of phonology or prosody, in a third it is at the level of the lexicon. In all the cases, aspects of the learner's first language are being transferred to the second language. Depending on the model, the learner is or is not hypothesized to be able to recover from the erroneous transfer from the first language. In models that propose that the learner continues to have full access to universal language principles, as well as transferring properties from the first language to the second language, the learner can "recover" from the errors.

Another set of models attributes the adult's errors to processing or parsing difficulties, rather than to lack of linguistic knowledge. For example, the fact that learners' performance is equivalent to native speakers' in grammaticality judgment tasks, but worse in on-line tasks, suggests that processing difficulties may be responsible when poor performance is observed. The second language learner may use different parsing strategies than the first language learner uses, or may use the same strategies but have difficulty employing them due to processing difficulties.

The theme of needing to distinguish between errors that reflect differences in grammar from errors that reflect differences in processing recurs throughout this section. Just as it is relevant in morphosyntax, it is relevant in syntax. Hyams and Orfitelli consider several syntactic error phenomena, some from two year olds and some from older children. In each case they review the possibility that the children's errors are due to deficits in grammatical knowledge (competence

deficits) or to processing (performance deficits). For the cases they review, they conclude that the children have deficient grammars, even if they also have processing problems. As one example, two year olds in languages like English and German produce what are sometimes called root infinitives. In English, children produce verbs without inflections; in German, they produce the infinitival form instead of a tensed form. These errors are most common in languages, like English and German, that require that sentences have subjects. Hyams and Orfitelli describe competence- and performance-deficit accounts, as well as a hybrid account. As another example, Hyams and Orfitelli describe explanations of children's failure, in languages like English and German, to produce subjects for sentences as often as they should. Here, too, there are competence- and performance-deficit models, and, here, too, Hyams and Orfitelli conclude that children have a competence deficit. Four and five year olds seem to misunderstand sentences like "Bert hugged Ernie before playing the piano," in some cases taking the player of the piano to be anyone at all, even someone not mentioned in the sentence. Here, there are several explanations, all of them relating the child's non-adult interpretation of such sentences to immature structural analyses or to extra-syntactic factors.

Learners must not only acquire knowledge of their languages, but they have to put that knowledge to use. That in turn requires skills in planning, integrating, and remembering. McKee, McDaniel, and Garrett suggest that limited production or comprehension on the child's part cannot be taken to imply imperfect knowledge on the child's part, a point that Klein and Martohardjono also make when considering children's acquisition of a second language. For adults, speaking and listening are such highly practiced skills that they seem effortless. As speech errors attest, even this highly practiced behavior occasionally goes awry, and when it does, it goes awry in principled ways. Consider speech errors in which the speaker substitutes an intruded word instead of the target, as when a child says *cookie* instead of *candy*. When intrusions occur, both children and adults substitute a word of the same syntactic category. Children also make errors that adults do not, such as by omitting words like Determiners (e.g., *a* and *the*) and inflectional suffixes (e.g., third person singular *–s*). Comprehension experiments suggest that the child's grammar represents such elements but the production system has difficulty retrieving them and fitting them into a prosodic pattern. McKee, McDaniel, and Garrett propose that the architecture of the child's and adult's production system is the same. The difference is that the child is unable to exploit all the resources of that system.

No part of acquisition occurs in isolation from any other part. Once one contemplates the sheer range of knowledge and abilities that the child or adult learner must bring to bear in typical language acquisition, one is stunned that learners succeed so well so quickly. How in the world do they do it? The chapters in this section explore several answers to these questions, bringing to bear a wealth of data. The reader will be awed by children's accomplishments and by researchers' ingenuity in investigating those accomplishments.

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