

Encyclopedia of LANGUAGE DEVELOPMENT

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an infant's language. Several recent studies by Helen Neville and colleagues have used tone and speech probes to show that children with language impairment have reduced attentional resources for processing stories.

Future studies should focus on understanding how infants segment connected speech and process speech at the syllabic and segmental levels, and further explore processing of speech in more complex discourse.

In summary, we have described the principal electrophysiology methods used for studying child language and have presented a brief review of major findings. The number of studies using ERPs to examine child language development is slowly but steadily increasing. Methods for analyzing ERP multichannel data are also being developed that will allow for more precise characterizations of ERP correlates and more confidence in findings. Another important development will be to combine ERPs with other methods that show better localization. For example, Near Infrared Spectroscopy (NIRS) provides better localization than ERPs and is relatively inexpensive and easy to use with young children. However, the ERP method will remain an important tool for the study of child language because it is tolerant to the difficulties encountered in studying children.

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See Also: Lexical Development; Parsing/Sentence Processing; Phonological Development; Processing Deficits in Children With Language Impairments; Speech Perception and Categorization; Speech Processing.

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Emergentist Coalition Model of Word Learning

One of the most difficult challenges that infants face is word learning. By the end of their second year of life, they move from knowing no words to being expert word learners. Several theories (e.g., the Constraints-Principles theory, the Social-Pragmatics theory, and the Associationistic view) have been proposed, each emphasizing a single factor. Even though these theories successfully explain different parts of word learning, they do not independently account for the entire word learning process. G. J. Hollich and colleagues posited the Emergentist Coalition Model (ECM), which offers a system-based, developmental model that borrows the strengths from each of the theories, weaving them together into an empirically testable model of word learning.

The ECM takes into account both the developmental nature of language acquisition and the diverse and complex factors that impact word learning. It portrays infants' word learning as the emergent product of these different factors. The ECM is founded on three principles for guiding children's hypotheses about what a word might mean (1) children are sensitive to multiple cues in the input, (2) children differentially weigh certain cues over others in the course of word learning, and (3) the principles of word learning are emergent as each principle changes from an immature to a mature state. After describing these principles with empirical evidence, some of the implications of ECM will be discussed.

Principle 1: Children Are Sensitive to Multiple Cues for Word Learning

The various cues for word learning are available in infants' environments even if they may not take

advantage of all of them. The cues are broadly divided into three types: perceptual, social, and linguistic cues.

First, perceptual cues narrow down the available referents that might be the recipient of a label. By 10 months, infants assume that a label offered by a speaker maps to the object in the environment that they find most salient. In early word learning, perceptual cues include novelty and movement. Infants are drawn to perceptually salient objects over objects they consider boring. In addition, when learning to associate word forms with objects at 7 months, infants begin by using temporal synchrony, the synchronized presentation of a spoken word and an object. Attending to these perceptual cues may be crucial at the start of word learning for infants to recognize the links between words and their referents. The associationist view argues that mapping a word onto an object is a process of children linking the most frequently heard label with the most interesting exemplar. According to this view, infants implicitly calculate the likelihood that a label refers to a particular exemplar. By using this strategy, the most likely label-referent mapping arises, and children learn that pairing. Research in the ECM framework has shown that, even though the associative process continues to be used, children gradually shift from the dominant use of perceptual cues to using social cues to discern what a speaker is labeling.

Second, children are sensitive to social cues in word learning. Infants are likely to recruit social cues from the adults in their environment later in development than perceptual cues. The most common social cues include eye gaze, pointing, object holding, and manipulation. Infants as young as 6 months can follow the direction of an adult's eye gaze; by 19 months, infants use an adult's eye gaze to infer which of two objects the adult intends to name. Pointing is another social cue that infants use. Infants can follow a speaker's point to an object by 12 months and point themselves toward objects, actions, or events by 12 to 14 months. Ten-month-olds check adults' eye gaze after they point to an object, possibly to ensure that the adult is following their interest. By 17 months, infants make a connection between their own or others' pointing and labeling. Although infants are sensitive to social cues early in life, it is not until their second year that they start to harness social information for word learning.

Social-pragmatic views of word learning argue that social cues are of paramount importance in word learning. The most important factor that influences and motivates infants to understand a novel word

is their need and desire to communicate with others. Adults provide linguistic information about the objects, actions, and events that children focus on, and this enables children to learn words. However, there is some slippage on both sides in this process. Other research suggests that adults are not always accurate in guessing the child's intent: Which object is the child requesting a name for? Children make errors too; they do not always correctly note which objects or object parts are being named by adults.

The last group of available cues for infants' word learning is the language itself. Linguistic cues can be further divided into segmentation and grammatical cues. Segmentation cues refers to how infants must break the speech stream into smaller units, thereby demarcating syllable and then word boundaries. Research by K. Graf-Estes and colleagues suggests that by at least 17 months, infants can link a word resulting from the segmentation process to meaning. Furthermore, toward the end of the first year of life, infants are capable of segmenting speech into syllables using prosodic and statistical cues.

Infants take advantage of the prosodic features (e.g., rhythm, stress, intonation) of their language for segmentation. Even by 9 months (but not 6 months), infants prefer to listen to words that have the stress pattern of their language. For example, infants from English-speaking households prefer to listen to words that have a strong-weak stress pattern (e.g., *Table*) rather than words with a weak-strong stress pattern (e.g., *guiTAR*). Given that 90 percent of English polysyllabic content words have this strong-weak stress pattern, infants appear to use this information to infer that a strong syllable signals the beginning of a new word. Although relying solely on stress patterns for speech segmentation leads to some inaccurate segmentations initially, by 11 months, infants develop the ability to use other types of cues (e.g., allophones) along with stress cues to facilitate segmenting words even with weak-strong patterns.

Infant-directed speech (IDS), characterized by exaggerated intonation and pitch, may provide other prosodic cues for segmentation. Research by W. Ma and colleagues suggests that infants not only recognize familiar words better but also learn new words more readily at 21 months from IDS relative to less exaggerated, adult-directed speech (ADS). In addition, prosodic cues in IDS may provide infants with information about sentence structure. Infants as young as 6 months of age preferred to listen to sentences

in IDS that included one-second pauses at clausal boundaries rather than pauses within clauses. Infants showed no difference when the stimuli were offered in ADS. Thus, infants may use the prosodic cues of IDS to begin identifying the grammatical constituents of their language. Infants can also take advantage of statistical cues such as transitional probabilities for speech segmentation. In a classic experiment, J. R. Saffran and colleagues discovered that 8-month-olds could compute transitional probabilities to determine which syllables tended to follow one another. Exposed to a two-minute stream of nonsense syllables, infants could distinguish between three syllables that reliably co-occurred versus three syllables that did not. These prosodic and statistical cues provide infants with tools to segment speech into word-like units, preparing them to map meanings onto those units.

Finally, infants can take advantage of grammatical information of their language. K. Hirsh-Pasek and R. M. Golinkoff found that 16- to 18-month-old infants were already sensitive to the word order of five- and six-word sentences when their own utterances as few as two words in length. Moreover, children can use morphological endings and function words (e.g., *the* and *a*) to help them discern the meaning and part of speech of a novel word. C. H. Echols revealed that 19-month-olds looked at an object when hearing *the blink* but looked at an action when hearing *blinking*. In addition, children can use the configuration of sentences to help them discern the lexical category of a novel word and even glean something of its meaning. Research on syntactic bootstrapping shows that, toward the end of the second year of life, infants can recognize whether a novel word is likely a transitive or intransitive verb, depending on the number and position of the nouns that appear with it.

In summary, infants gradually come to be able to use the perceptual, social, and linguistic cues that are available for word learning. However, while all these cues are available, they are not all accessible to infants through the first two years of life.

Principle 2: Children Differentially Weigh Certain Cues Over Others in the Course of Word Learning

The Interactive Intermodal Preferential Looking Paradigm allows researchers to pit the available perceptual, social, and linguistic cues against each other. A baby is seated on a parent's lap and plays with two novel toys, one that interests him or her (e.g., a colorful clacker) and one boring toy (e.g., a beige plastic bottle cap

opener). Then, during the labeling phase, the two novel toys are attached with Velcro to a rotating board. The experimenter then gets the child's attention and looks back and forth between the child's eyes and one of the toys while providing a novel label (e.g., *Look at the modi!*). Finally, at test, the experimenter ducks behind the board and asks the child where the *modi* is. It is expected that children will look more to the object that was named than to the object that was not named. Children's looking patterns are recorded and coded offline.

S. M. Pruden and colleagues assigned 10-month-olds to one of two conditions: coincident or conflict. In the coincident condition, the experimenter named and looked at the perceptually interesting novel object that coincided with what the infant liked. In the conflict condition, the adult looked at and named the boring object instead, resulting in a conflict between the perceptually attractive choice and social choice that the experimenter intended to name. Ten-month-olds apparently weighted perceptual cues most and looked at the object they liked the best regardless of which object the adult labeled. That is, they learned the name for the interesting object even when the adult labeled and looked at the boring object!

G. J. Hollich and colleagues conducted a similar study with 12-, 19-, and 24-month-olds. Twelve-month-olds continued to learn the name of the interesting object in the coincident condition. In the conflict condition, they no longer attached the newly heard label to the interesting object. This indicates that 12-month-olds may not yet be certain of the roles that the social cues play but start to show sensitivity to them. By 19 months, children began using the social cues the adult offered to learn the name of both the interesting and the boring object—although perceptual attraction to the interesting object was still strong. By 24 months, infants relied on the social cues for word learning and easily learned the names for the boring and the interesting objects.

E. Hoff and L. Naigles found that, shortly after children learn the importance of joint attention for word learning, the richness of the lexical input they receive becomes the primary indicator of how a child's language will develop. Two- to 4-year-olds showed that, when both social (e.g., adult eye gaze) and linguistic cues were available, social cues won out for linking a novel word to a novel object. Once children attend to and determine which cues are most reliable, the weight given to the different kinds of cues shifts from perceptual to social and eventually to linguistic.

Recent work has shown even younger children use linguistic cues. For 14-month-old children, the presence of a grammatical structure was necessary for their understanding of a speaker's intention when encountering a novel action; that is, social cues alone were not enough for the children to imitate the action.

Principle 3: The Principles of Word Learning Are Emergent as Word Learning Changes From an Immature to a Mature State

This principle highlights progress along a continuum and stresses that immature and mature learners approach the task of mapping words to referents in different ways. Immature learners are sensitive to the variety of cues in their environments, but they do not yet know which cues are reliable. Consequently, they approach the task from their own perspective, mapping the word to the object that they find interesting, thereby relying on perceptual salience. Thus, immature learners require more support to learn words. Having perceptual, social, and linguistic cues coincide, and several opportunities to experience the name-object combination, increases the likelihood that immature learners will make a word-to-referent mapping. For these reasons, word learning is an initially slow process.

Over the course of development, infants learn that certain cues are more reliable than others. Only after they learn that social cues are most trustworthy for revealing a speaker's intention do infants shift from their own perspective to that of the speaker. Around the same time, children begin to note the usefulness of linguistic cues in word learning. These infants have become mature learners undertaking the word-learning task in a different way. Only mature learners can take advantage of social and linguistic cues provided by others and require less support for making the link between a label and its referent, which results in more rapid word-referent mappings.

Implications of the Emergentist Coalition Model for Language Disorders

The ECM can be used to help explain what individuals with various language disorders lack. A model that includes perceptual, linguistic, and social cues permits identification of which cues such individuals rely on at the expense of other cues. For example, the language issues observed in children who fall on the autistic spectrum can be captured within the ECM. Autism, a disorder characterized by the reduced use

of social cues, provides an opportunity to test the ECM. Children with autism may rely relatively more on perceptual cues due to their lack of sensitivity to social cues (such as eye gaze) that reveal speakers' intentions. Research has borne out this prediction. In a study involving children with autistic spectrum disorders and mental age and chronological age controls, J. Parish and colleagues observed that 68 percent of the variance in vocabulary size was accounted for by children's sensitivity to the intentions of others. Understanding atypical patterns of language development in children with disorders may allow for the development of targeted interventions.

The ECM captures the dynamic nature of word learning using three principles: (1) infants are sensitive to multiple cues for learning words, (2) they weigh these cues differently over developmental time, and (3) infants evolve from immature to mature learners. While previously posited theories emphasize a single factor, the ECM welcomes researchers to view these factors as complementing each other, rather than competing with one another, to paint a more complete portrait of language acquisition. Children must use perceptual, social, and linguistic cues to succeed in word learning, just as a chef must use many different ingredients to create a dish. Similar to cooking, the end result of word learning is greater than any of the individual components alone.

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See Also: Associative Processes; Autism and Language Development; Child-Directed Speech (Features of); Dynamic Synchrony and Early Word Learning; Early Word Learning; Lexical Development; Metrical Segmentation; Multiple Cues in Language Acquisition; Preferential Looking/Head-Turn Preference Procedures; Social Foundations of Communicative Development; Syntactic Bootstrapping; Word Learning Constraints; Word Segmentation; Word-to-World Mapping.

Further Readings

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