An Interactive Approach to Enhancing Early Word Learning:

From Research to Best Practice

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INTRODUCTION

PRESSING ISSUES IN EARLY WORD LEARNING

The benefits of providing an optimal environment for language learning from which infants and young children can glean the properties of their native language are manifold. The general consensus among language researchers and speech-language pathologists on facilitating language development is that exposing the young infant to an optimal socially-interactive language environment enables the typically developing child to actively participate in it and learn a language, its sounds, words and their meaning, its grammar, and appropriate ways to use it to communicate in context (Hart & Risley, 1995; Huttenlocher, 1998; Zimmerman, Gilkerson, Richards, Christakis, Xu, Gray & Yapanel, 2009; Hassinger-Das, Bustamante, Hirsh-Pasek & Golinkoff, 2018). This is because language development, including vocabulary development, results from an ongoing interaction between the language environment and the infant (Gogate & Hollich, 2010; Samuelson & McMurray, 2016; Smith, 2005). Consequently, several sources of converging evidence illustrate that depriving the child of this language environment is detrimental to achieving a developmentally appropriate vocabulary, posing long-term negative consequences for later language and school readiness. Early vocabulary is a robust predictor of kindergarten readiness (Friend, Smolak, Liu, Poulin-Dubois, & Zesiger, 2018). Not having a developmentally appropriate vocabulary has cascading detrimental effects on children's grammar and language use during toddlerhood and during the preschool years, as well as reading skills development at grade-level (Kamil & Hiebert, 2005) and general academic success (Hoff, 2013).

The language environment provided by primary caregivers and child language development are closely associated with one another. As a classic example of this association, Hart and Risley (1995) followed-up infants from year 1 to 3 along with their primary caregivers by recording their at-home interactions. The authors found that enriched everyday parental input, both a variety of words and words used more often, to 9- to 36-month-olds is critical for them to achieve an age-appropriate receptive and an expressive vocabulary as well as achieve later language milestones. As another

example, Tamis-LeMonda, Bornstein, and Baumwell (2001) showed that maternal responsiveness during everyday interaction with 9- to 21-month-old infants predicted the timing of their achievement of language milestones. Similarly, Zimmerman et al. (2009) have shown that parent-infant active two-way interaction predicts healthy language development in children. These and other more recent studies (e.g., Golinkoff, Can, Soderstrom, & Hirsh-Pasek, 2015; Weisleder & Fernald, 2013) suggest general guidelines for talking with infants, and establish the critical role of both the quality and quantity of caregiver language-input and interaction in facilitating early vocabulary development.

When clinicians and parents look beyond this general consensus on the benefits of parental everyday interactions using a variety of words in greater frequency, or the general guidelines for talking with infants to facilitate infants' communicative development, however, the picture on exactly how to go about interacting and enhancing vocabulary development in infants and toddlers is less clear. Consequently, parents and early child care professionals are left with the daunting task of digging deeper into the complex body of scientific research for specific strategies that parents and other caregivers can use to enhance infants' vocabulary. Since parents and professionals play a pivotal role in children's vocabulary learning, making them aware of what they can do to facilitate vocabulary learning in the child is a critical component in paving the way to children's word-learning success. Increasing parental awareness about their child's development has been known to increase developmental and language outcomes in children (Rowe, 2008; also Suskind et al., 2016). The primary purpose of the present book, therefore, is to make the early word learning process as transparent as possible for parents and non-research professionals using the classic as well as most recent evidence at hand.

A wealth of research findings in child language learning have revealed invaluable insights into how early language develops. Much of this body of work, motivated in part by the pioneering work of researchers (e.g., Hart & Risley, 1995), has unearthed novel strategies that parents and interventionists could utilize to enhance word learning long prior to infants beginning to produce their first words. These developmentally-appropriate strategies, however, are published in highly technical scientific journals by expert researchers (e.g., Hirsh-Pasek, Alper, & Golinkoff, 2018), rendering them largely inaccessible and incomprehensible to the lay public. If made available in a format accessible to the lay public, these strategies, with further norming[1], could prove to be instrumental in facilitating infants'

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[1]Although the empirical findings reported in the present volume are normative, statistically significant findings, they may not have been tested using large data-sets

learning to communicate age-appropriately and could pave a solid path to preschool language readiness. After all, if developmentally appropriate strategies can be utilized prior to language production when infants are highly receptive to these environmental cues, both parents and caregivers might essentially alleviate the potential risk for language delay in their infants and toddlers, thereby reducing the need for language intervention at later ages (Gogate & Hollich, 2013; also Conti-Ramsden & Durkin, 2012). For parents and caregivers to easily access the wealth of research on enhancing infants' word learning, this volume aims to present and interpret the research findings in a user-friendly manner. My goal here, therefore, is to make the research on word learning more accessible for both parents and professionals who are not language development researchers.

Additionally, over the past decade, dedicated attempts to enhance preschool readiness in children have emerged in the form of clinical language interventions that parents (or professionals or both) can provide to enhance infants' language capabilities (e.g., Dunst, Raab, & Trivette, 2012, see www.earlyliteracylearning.org; Mendelsohn, Huberman, Berkule, Brockmeyer, Morrow et al., 2011; Roberts & Kaiser, 2011; 2015). Some of these intervention studies have found significant links between cherry picked early infant abilities (e.g., infants' ability to follow mothers' eye-gaze or share attention), or maternal interaction/language behaviors (e.g., overall maternal word counts, or the duration of daily activities such as picture book reading or toy play) and later child-language milestones (e.g., Brockmeyer Cates et al., 2012; Hassinger-Das et al., 2016). Such intervention studies, although highly informative in their own right, draw little attention to the complex bigger picture encompassing the multitude of factors that contribute to early language development (Cartmill, 2016; D'souza, D'souza, & Karmilloff-Smith, 2017; Gogate & Maganti, 2016; Yurovsky & Frank, 2017). Neither do they draw attention to recent discoveries in early word learning, a requisite for vocabulary building and preschool language readiness that will be elucidated in the subsequent chapters of this volume. Consequently, what has been noted is an overall informational gap between basic sciences research on early language and clinical intervention research on language enhancement (Hassinger-Das, Toub, Hirsh-Pasek, & Golinkoff, 2017). In particular, the results reveal a gap in findings on early language and the optimal age at which intervention is administered (Conti-Ramsden & Durkin, 2012). Language interventions need to adopt an embodied approach and optimize vocabulary learning by tying intervention to scientific findings on young learners' motoric and

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in clinical studies by using a given strategy in an intervention group while not using the same strategy in a control group.

sensory experiences (Hald, Nooijer, van Gog, & Bekkering, 2016). Researchers of language intervention have long since recognized the critical value of integrating "research into the mechanisms of vocabulary learning, [and] translational research that produces effective, feasible early-education practices in homes and schools" to improve children's outcomes and "the nation's wellbeing" (Hindman, Wasik, & Snell, 2016). The present monograph, therefore, also aims to bridge this informational gap between basic research on infants and their caregivers and language intervention studies to encourage further early intervention research.

  The primary question that the present monograph aims to address in a comprehensive manner, in the following eight chapters, is what it takes for infants to learn words, starting with the very beginning. Some of the very first words that infants learn in any given language are concrete nouns and verbs that refer to tangible objects or actions, which infants can perceive and act upon easily. Learning about a word, learning what it means, and being able to say a word involve four essential steps, with each step emerging prior to and serving as a building block or a foundation for the next higher step in the rungs shown below (Figure 0-1).

  To learn a word, infants must first learn to segment the word from an adult's continuous, albeit highly simplified, stream of speech. For example, when a caregiver playing with her infant using a toy car says- "Look at the car! Nice blue car! Want to play with the car?"- the infant must first learn to segment the word "car" as a distinct unit of speech, or separate it from the remaining continuous speech stream. This ability is observed as early as within the first 4 months of life. How can caregivers enhance this ability? Chapters 1-4 provide insights from scientific research into how young infants learn to attend to and segment words from the ongoing continuous stream of adults' speech using cues from different senses including hearing (Mandel, Jusczyk, & Pisoni, 1995; Bortfeld et al., 2005), vision (Hollich, Newman, & Jusczyk, 2005) and touch (Seidl et al., 2015; http://youtu.be /NfCj5ipatyE). These chapters also illustrate how caregivers can facilitate infants' ability to segment words, once again, using the scientific research on this topic.

Figure 0-1: Four steps to word learning
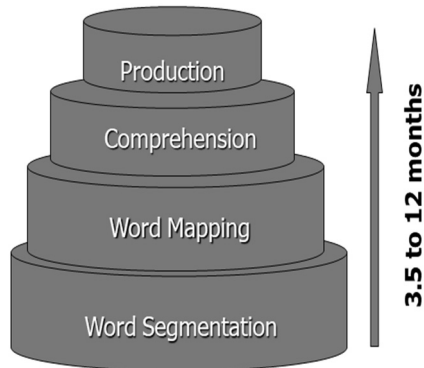
Next, infants must learn to pair the segmented word with an appropriate object (or action) among many possible referents on the scene, called word-mapping, prior to understanding what the word stands for or means. For example, given the earlier example of continuous adult speech, the infant must learn that the word "car" goes with the blue object with four wheels among several other potential objects on the scene. The ability to map words to objects is observed in infants as early as 3 months (Friedrich, & Friederici, 2017), long prior to infants producing their first word. What are some of the first words that infants pair with objects or actions? How can caregivers enhance infants' learning of novel word-object or –action pairings? Chapters 1-6 suggest several strategies that primary caregivers naturally utilize to facilitate this ability in infants. If these strategies can be taught to other caregivers (e.g., early intervention teachers) it might empower them with the means and methods to enhance this important step in infants' word learning.

The two prerequisite abilities, discussed thus far, word segmentation and word mapping, pave the way for the two latter steps in word learning - understanding what words mean or word comprehension (e.g., Golinkoff & Hirsh-Pasek, 2008; Hart, Newell & Olsen, 2003; Maouene, Hidaka, & Smith, 2008; Tardif et al., 2008), and eventually, the ability to produce words. Chapters 1 to 6 provide multiple strategies for enhancing the first three steps in word learning, namely from attention to words to word mapping and word comprehension, once again, using the available scientific

research. They explain why some words relative to others are easier for infants to attend to and understand. In these chapters, wherever possible, I will relate the process of word comprehension to word production, the fourth step to word learning. Finally, whereas the first six chapters focus on monolinguals learning a single language, in Chapter 7, I discuss the special case of bilingual infants to highlight any differences as well as similarities in their word learning relative to that of monolingual infants. Relatively little is known about how bilingual infants learn a vocabulary especially in their first two years of life. Furthermore, in Chapter 8, I will discuss cultural variations in word learning, focusing on infants' learning of nouns versus verbs across cultures learning noun-friendly versus verb-friendly languages, and draw general conclusions across the chapters.

The four steps of word learning, word segmentation, word mapping, word comprehension, and production, are inter-related and undergo refinement during and after the development of each step until language mastery is achieved. Although infants are prepared to learn language, accomplishing these milestones to learning words is hard work for the novice word learner, especially at first when one does not know much about how words work, or until infants have produced their first hundred words (Smith, 2002; Samuelson & McMurray, 2016). An important aspect about the word learning process is that infants' receptive vocabulary (the total number of words understood) is always in advance of their expressive vocabulary (the total number of words spoken after first word onset; Fenson, Dale, Reznick, Bates, Thal, et al., 1994) at any given time. Although the speech mechanism responsible for word production is always playing catch up to what a child comprehends throughout childhood and beyond, both receptive and expressive vocabulary are typically positively correlated (Fenson, et al., 1994). Simply put, infants who understand more words typically also produce more words. Consequently, by enhancing the first three steps of word learning early on, parents and professionals can help the novice word learner to build a solid foundation for an increased number of words yet to be spoken, eventually creating a sure path to preschool readiness and academic success. In this volume, the caregiver's important role in assisting the steps to word learning will be elucidated, with an emphasis on the first three steps of word learning.

Vocabulary development is a critical component of learning to read and write (Suggate, Schaughency, McAnally & Reese, 2018). A sizable percentage of children entering first grade each year show delays in their knowledge about words and how words work. Yet, until recently, according to the National Institutes of Health reading panel report (USA), a large body of research on vocabulary instruction and intervention has focused on this

language-delay problem after children's entry to the first grade (Kamil & Hiebert, 2005; 2009; Kuhn & Stahl, 1998) with little attention to children's learning prior to that period. The critical ages at which to promote language and communication have gradually decreased to include preschool children and toddlers (e.g., https://fpg.unc.edu/news/nc-pre-k-earns-high-marks-its-first-15-years), as researchers recognize the urgent need to prevent language delay by enriching teacher-child interaction as early as the pre-kindergarten years. It is unclear why this decrease in age has taken place over such a protracted period of time when even as early as the late 1970's it was evident, from reported individual cases of language deprivation (e.g., Curtiss, 1977), that the language environment plays a critical role in children's language learning early on, and that the earliest possible intervention is imperative to achieve typical language.

As a case in point, in 2017, the prestigious Frank Porter Graham Child Development Institute, University of North Carolina at Chapel Hill, recommended ten best practices to promote language and communication skills in young children on their website (FPG home, 2017, this webpage is no longer active). These ten best practices or strategies included – (1) *engaging in conversations with children, (2) giving descriptions of objects, activities or events, (3) using different types of words and grammar, (4) providing children with the names of objects or actions, (5) engaging in activities or objects that interest children, (6) using books to engage children's participation, (7) reading the same books multiple times, (8) introducing objects that spark conversations, (9) engaging in musical activities, and (10) using gestures or simple signs with words.* It is important to note that nine out of these ten strategies are focused on promoting language after children have learned to talk. In comparison, the primary aim of the present volume is to focus on best practices for building vocabulary from the ground up before infants have begun to speak or are in the first word stage of language development. After all, it is only by understanding how children develop a repertoire of words at the earliest stages of language development can we inform and engage in best practices in vocabulary enhancement long prior to its manifestation as a delay. Although, undoubtedly, promoting vocabulary development through reading and play to infants, toddlers and preschool-aged children is vital to building an already established basic vocabulary (Dickinson et al., 2019; Dunst, et al., 2012; Hassinger-Das et al., 2016; 2017; Toub et al., 2018), promoting word learning much earlier in time, when infants and toddlers first start to learn words, should be even more vital to establishing a strong foundation for vocabulary growth and preschool readiness.

Dwelling further on the ten specific language promoting strategies that adults could adopt while communicating with children specified by the Frank Porter Graham Child Development Institute, nearly half are targeted towards promoting *word learning*, namely - *giving descriptions of objects, activities or events, using different types of words and grammar, providing children with the names of objects or actions, engaging in activities or objects that interest children, introducing objects that spark conversations, and using gestures or simple signs with words*. However, no specific set of instructions to teachers and professionals on precisely how to go about giving descriptions, providing names, engaging in activities, introducing objects, and using gestures with words are provided. In contrast, a great deal of recent research underscores the highly specific nature of the practices that should assist in promoting word learning. These specific practices will be elucidated in the subsequent chapters of this volume.

In the following paragraphs, I outline the contents of each of the eight subsequent chapters contained in this volume. To reiterate, the overarching goal in these chapters is to illuminate the conditions that promote or facilitate learning in the novice word learner, using the scientific evidence at hand. Once we understand what facilitates the steps to word learning, we can better understand how to go about strategizing and enhancing each step to individual children's word learning.

Chapter 1, *Infants' First Words*, focuses on the very nature of the first words that infants learn, and its implications for the teaching of words to infants. Infants hear streaming speech all around them when caregivers and others speak directly to them or when speakers communicate to each other within earshot of infants. Which words do infants selectively attend to first when they start to separate (segment) words from these streams of speech? Which words do they first learn to pair with a specific object or action? And why are they more likely to learn some words more easily relative to others? Chapter 1 highlights the research that sheds light on these specific questions, aiming to introduce the reader to the world of communication from the infants' perspective, to elucidate the types of words infants first perceive, segment, and recognize from the speech stream, and learn the meaning for as they become acquainted with the world of communication.

Chapter 2, *Prosody Guides Word Learning*, focuses primarily on why baby talk matters to infants' and young children's learning of novel words (Golinkoff & Hirsh-Pasek, 2008; Ramírez-Esparza et al., 2014; Weisleder & Fernald, 2013). In addition, the role of infant-directed speech (Thiessen et al, 2005) in facilitating infants' segmentation of words is discussed. It also addresses how syllabic stress and rhythm help infants to learn words such as nouns and verbs and distinguish between them (e.g.,

Curtin, Campbell, & Hufnagle, 2012; Shukla et al., 2011), and how the position of a novel word in a sentence enables infants to attend best to it (Fernald & Mazzie, 1991).

In Chapter 3**,** *Space and Body Matter*, research findings that illustrate how adults, when naming objects and actions, manipulate the space between themselves and their infants (Dueker & Cunningham, 2010) are discussed, as well as other manipulations of space to enhance language. For instance, some studies illustrate that naming objects consistently in the same space makes it easier for infants and toddlers to learn the names for those objects (e.g., Samuelson et al., 2011). Next, I illustrate that infants' and children's developing physical ability correlates with their speech and vocabulary development, suggesting that physical space plays a vital role in language development. Finally, I discuss some practical benefits of utilizing physical or motor abilities when teaching novel words to children using recent intervention research.

In Chapter 4, *Timing Perception Guides Word Learning*, recent findings on how the timing between a word and a moving object or an action facilitates infants' learning of words during mother-child interactions is described (e.g., Chen et al., 2015; Gogate et al, 2006; Gogate et al. 2000; 2013; 2015; Gogate & Maganti, 2017; Zukow-Goldring, 1997). In addition, the important role of caregivers' simultaneous naming and touch (Seidl et al., 2015) in gaining infants' attention to words is examined in detail.

In Chapter 5, *Gesture and Touch Guide Word Learning*, the influence of caregivers' gestures and touch on infants' word learning is examined in detail using the research at hand (e.g., Brand et al., 2002; Brand & Tapscott, 2007; Chang et al. 2016; Suanda et al., 2016; Matatyaho, 2008; Matatyaho-Bullaro, et al., 2014). For instance, when mothers name objects or actions for their 6- to 8-month-olds in naturalistic interactions, they often shake or rotate a hand-held object of interest while naming it (e.g., Gogate, Maganti, & Laing, 2013; Nomikou, Koke & Rohlfing, 2017). Furthermore, how caregivers' pointing gestures towards an object or event of interest facilitate infants' word learning is discussed at length (Özçalişkan & Goldin-Meadow, 2005; Namy & Waxman, 1998).

In Chapter 6*, Joint Attention and Word Learning*, the important role of joint or shared attention, when caregiver and infant attend to the same object or event, in word learning contexts is examined (e.g., Morales et al., 1998; Yu & Smith, 2013; Gogate et al., 2006; Brooks & Meltzoff, 2008). The ability to share attention undergoes many developmental changes. These developmental changes, in turn, play a role in infants' word learning.

Chapter 7*, Bilingual versus Monolingual Word Learning: Similarities and Differences in the Early Years*, focuses on recent empirical research

which suggests important variations in the developmental timing of specific language milestones in bilingual versus monolingual language learners. Remarkable differences in receptivity to the basic building blocks of language(s) are evident even at birth (Byers-Heinlein, Burns, & Werker, 2010), and persist in the early years due to exposure versus the lack of it to an additional language starting in the womb. How else might bilingual and monolingual infants differ in their language learning? In this chapter, I highlight some of the differences as well as similarities between bilingual and monolingual learners in their receptive and expressive vocabulary development in the early years, owing to continued exposure to differences in their language environment. The implications of these differences for language education, in particular, preschool language readiness are also discussed, given that age-appropriate vocabulary development plays a key role in children's grammar and literacy development.

The final chapter, Chapter 8, *Conclusions, Questions and Future Directions*, draws general conclusions from the research discussed in prior chapters. Caveats or limitations of these findings, if any, are discussed. For instance, not all strategies discussed in the prior chapters might work with all infants due to variations in word learning across cultures around the world. Similarly, not all strategies will work with toddlers experiencing word-learning delays or with children with either visual or hearing impairment. Strategies for teaching words to the atypically developing child may vary. For example, taking away the face while naming to the child, helps children with Autism Spectrum disorder to learn the names for objects (Patten et al., 2017). As yet unresolved questions and further directions are highlighted as well, with the goal to inspire further research particularly in the domain of early language intervention.

CHAPTER ONE

INFANTS' FIRST WORDS

Infants hear streaming speech all around them when caregivers and others speak directly to them or when speakers communicate with each other within earshot of infants. Which words do infants selectively attend to first when they start to separate (segment) words from these streams of speech? Which words do they first learn to pair with a specific object or action? And why are they more likely to learn some words more easily relative to others? This chapter highlights the research that sheds light on these specific questions. It attempts to introduce the reader to the world of communication from the infants' perspective, to elucidate the types of words infants first perceive from the speech stream, and learn the meaning for, as they become acquainted with the world of communication. Once we understand which words infants learn first, and how and why they learn these words, parent-implemented interventions could be designed to focus on teaching the same types of words to children in need of greater assistance and intervention to acquire a vocabulary.

Frequency Builds Familiarity

Broadly speaking, when infants attend to speech in their language environment, they attend to and perceive the acoustic properties of words that are more frequent right from the start. For this reason, even English learning newborns discriminate between lists of lexical words that are relatively limitless (words that refer to tangible entities in the world- such as nouns, verbs, adjectives and adverbs) but not grammar words that are relatively limited (such as in English, the articles the and a, and the prepositions in and of; Shi, Werker, & Morgan, 1999). By 6 months of age, infants listen longer to and show a robust preference for lexical words relative to grammar words (Shi & Werker, 2001). As another example of greater frequency building familiarity, researchers have found that infants become familiar with the sound of their own name fairly early on. Around 4 months of age, infants preferred to hear their own name relative to other names even if that other name contained the same number of syllables as

their own name, suggesting a high level of familiarity and recognition of the sounds of their own name (Mandel, Jusczyk, & Pisoni, 1995). Although a large proportion of initial input to infants consists of words in isolation (Keren-Portnoy, Vihman, & Fisher, 2018), a further study found that around 6 months, infants use their own familiar names as anchors to segment other new words in sentences (Bortfeld, Morgan, Golinkoff, & Rathburn, 2005). Thus, infants separated novel words better if the novel words (e.g., ball) were embedded in phrases or sentences which also contained the infant's name than if the same sentences did not contain the infant's name (e.g., "Katy, look at the ball" versus "Look at the ball!". These findings suggest that the greater frequency of words in the input creates familiarity with the words. Thus, the infants' own name becomes familiar and plays an important anchoring role in initiating young infants to other novel words and into the communicative world. In this manner, the caregivers' frequent use of infants' names in sentences could assist infants in attending to and segmenting other novel words, such as labels for objects in the speech stream.

Similarly, word familiarity dictates which specific word classes infants learn first. In noun-dominant languages where nouns occur more frequently relative to verbs (e.g., English), and are used more often in the language addressed to infants, infants tend to learn more nouns (known as the noun-bias) and learn them far earlier than other word classes such as verbs, adjectives or adverbs (e.g., Kim, McGregor, & Thompson, 2000). In comparison, in verb-dominant languages where verbs occur far more frequently relative to nouns (e.g., Telugu), and are used more often in the language addressed to infants, the infants learn verbs relatively early and to a far greater extent (Reddy, Liebal, Hicks, Jonnalgadda, & Chintalapuri, 2013).

Word familiarity also plays an important role when infants begin to put words and persons together and comprehend the words (i.e., knowing that the word stands for a specific person). Thus, by 6 to 9 months, infants know the meanings of many common nouns and verbs that they are likely to hear often in their immediate environment (Bergelson, & Swingley, 2012; 2013). Commonly occurring concrete nouns such as "Mommy" and "Daddy" tend to be favored over less commonly occurring words and are generally learned first. Thus, even 6-month-olds looked longer when they were shown pictures of their own mother and father while hearing the words "Mommy" or "Daddy" relative to pictures of another infant's parent of the same gender (Tincoff, & Jusczyk, 1999). These findings suggest that as early as 6 months of age the words refer specifically to their own parents of a particular gender, and not generically to all parents of the specific gender.

Furthermore, familiarity plays an important role in the learning of words that refer to body parts. For example, research has shown that at about 6 months, infants know the names for their own body parts such as "hands" and "feet" and can pair them with the specific body-parts (Tincoff, & Jusczyk, 2012). During their first year, infants also learn novel, nonsense words such as "bopita" when paired with body parts such as knee and elbow, if an experimenter touches those parts while speaking the novel utterances (Tincoff, Seidl, Buckley, Wojcik, & Cristia, 2019). In their second year as well, toddlers are highly inclined to produce words that refer to body parts, which is well established in standardized language assessments (e.g., MacArthur-Bates Communicative Development Inventory–MCDI; Fenson, et al., 1994). Even in the third year, they produce words that refer to their own actions involving their body parts prior to actions involving others' body parts (Huttenlocher, Smiley, & Charney, 1983).

The frequency of body-part words in the language input to infants plays a critical role in infants' learning as well, as it is clearly established that body-part words are abundant in speech and language directed to infants (Maouene, Hidaka, & Smith, 2008). Similarly, names for objects manipulated by body parts (e.g., hands) are highly frequent in language directed to infants, and are said to have a high body-object interaction index (BOI; Pexman, Muraki, Sidhu, Saikaluk, & Yap, 2019). Additionally, certain body part words are easier to learn because infants' own hands and feet or the actions they can perform (what is being referred to - the referent) are available at close proximity for them to explore, and therefore, are highly familiar by the time infants begin to learn the names for them around 6 months. Infants, in the first few months of life, spend a long number of their waking hours visually exploring their own hands and feet as well as mouthing them, and perceive their own face and body (e.g., belly button) in their first year. Finally, added familiarity and greater opportunities to explore and be messy with nonsolid objects (e.g., salt, sugar, and liquid substances) when seated in a high-chair rather than a table allow for greater learning of the names for those substances at 16 months (Perry, Samuelson, & Burdinie, 2014).

In summary, the findings taken together suggest that familiarity, mediated by greater frequency of certain words relative to others in the input language, impacts early language learning and, in particular, vocabulary learning (Goodman, Dale, & Li, 2008). Thus, greater frequency of specific words in maternal input to 7-month-olds predicts earlier learning of those words by infants in the second year (Newman, Rowe, & Bernstein, 2016). Additionally, greater familiarity with the object or the action that is being referred to also contributes to infants' learning of first words. Using a head-

mounted camera on infants of 8.5 to 10.5 months of age during eating activities, researchers have established that the world view of these infants consists of a very small set of highly frequent objects present on the scene (e.g., a bowl, and a spoon; Clerkin, Hart, Rehg, Yu, & Smith, 2017). Consistent with this view on word and referent familiarity, adults' greater naming frequency enables infants to perceive the commonalities between objects of the same kind (e.g., <u>doggie</u> for all types of dogs, Althaus & Plunkett, 2016). The significant impact of word familiarity resulting from greater word frequency in the input as well as familiarity with the referent (e.g., infants own hands or feet) on infants' vocabulary learning is further underscored in the next two subsections of the present chapter.

The Perceived Similarity between Words and Objects and Early Word Mapping

The role of familiarity during early word mapping (learning to put words and objects together) also extends broadly to the extent of perceived similarity between the words and the objects or actions to which they refer. In other words, when words sound similar to or resemble the physical properties of the specific objects or actions to which they refer (are sound-symbolic), infants learn the word-object pairs more easily and at an earlier age, around 4 months. Thus, young infants are quite adept at learning, for example, that a rounded object goes with a word such as <u>*mamo*</u>, whereas a jagged object goes with a word such as <u>*kiki*</u> (Asano et al., 2015). When these sound-symbolic word-object relations are interchanged or mismatched, infants look longer to them than when they are matched, and show significant brain wave activity in specific regions suggesting that they detect a mismatch between what they hear and see.

The resemblance between words and their referents is particularly salient when infants and toddlers have a small number of words in their receptive or productive repertoire (Imai et al., 2008; Imai & Kita, 2014). Because infants use the similarity between sounds and sights to learn new words early on, one possible way to learn to put together (map) specific words and specific objects might be to use perceptual familiarity with the sounds of words to find perceptually similar objects. As infants' vocabulary increases, infants rely less on the similarity between the words and the actions or the objects for which they stand (Laing, 2017; also see Brand, Monaghan, & Walker, 2018; Perry, Perlman, & Lupyan, 2015). As was discussed in the prior section, infants show evidence of learning word-object relations, where the words bear no resemblance to the objects to which they refer, a bit later, around 6 months based on the frequency and

familiarity of the objects (e.g., <u>hands</u> and <u>feet</u>, Tincoff & Jusczyk, 2012). Recent evidence suggests that infants, as young as 8 months of age, also learn novel word-action relations, such as *wem* paired with a *shaking action*, and *baf* paired with a *looming action* of an object, where the words bear no resemblance to the actions to which they refer (Gogate & Maganti, 2017).

Although infants can learn word-object and –action relations of both types, words that bear a resemblance to their referents and words that do not bear a resemblance to their referents, even toddlers and adults easily learn the relations between novel words with rounded sounds (of a lower pitch), such as *bouba,* and rounded objects and words with sharp sounds (of a higher pitch), such as *kiki,* and jagged objects with sharp edges (see Figure 1-1 below), attesting to their use of sound-symbolism to learn novel words. Furthermore, they find the mismatched words and objects to be a violation of their expectation by looking longer to them (Maurer, Pathman, & Mondloch, 2006; Ramachandran & Hubbard, 2001). Research across cultures suggests that Japanese and American mothers use sound-symbolic words abundantly during naming to their toddlers in context, and that the toddlers learn such sound-symbolic words better than non-sound-symbolic ones (Yoshida, 2012). Recent findings have shown that even 3-year-old British-English speaking children learn novel sound-symbolic verb-action relations easily and remember these relations a day after they first learned the relations (Kantartzis, Imai, Evans, & Kita, 2019).

Figure 1-1: The words, *kiki* and *bouba*, presented with objects of a jagged or rounded shape in the word-mapping experiments (adapted from https://en.wikipedia.org/wiki/Bouba/kiki_effect).
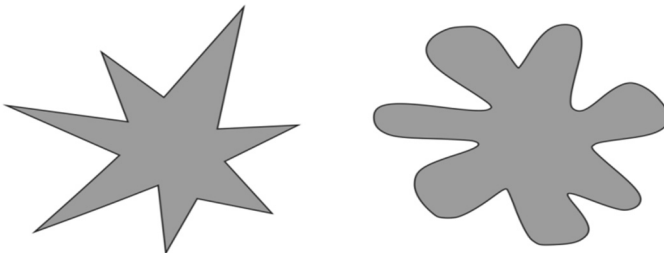
These cross-cultural research findings clearly illustrate that the sounds of words matter during word learning, and sound-symbolic words are abundantly used in caregivers' communication to infants and toddlers. Although sound-symbolic relations matter significantly more, when the number of words that children already know are relatively small, older children with well-established vocabularies as well easily learn these novel sound-symbolic relations and remember them in the long-term.

Distinct Versus Similar Sounding Words and Early Word Learning

Speech perception, in particular the sounds that make up words, clearly influences word learning (Werker & Yeung, 2005). Evidence that the sounds of words matter during early word learning can also be seen in word-mapping experiments that require infants to put novel words and objects together and present infants with similar versus distinct sounding words closely in time during a word-mapping task. For example, at about 6 to 7 months, if infants are presented with two novel words, such as _Gow_ and _Chi_, each paired with an object, infants are able to learn the word-object pairings under optimal conditions (e.g., when mothers name the objects simultaneously with object motion). Given words and objects under similar optimal conditions, in experimental studies as well, 7-month-old infants also pair highly distinct novel words such as _tah_ and _gih_, with two objects, but not similar sounding words such as _tah_ and _gah_, with the same objects. A month later, however, 8-month-old infants are able to pair the same similar sounding words under the same conditions. These findings suggest that the words infants encounter could range from being very distinct to highly similar, and that making novel words distinct from one another makes it easier for infants to learn the words, when the words occur closely in time.

This word distinctness-similarity continuum interacts, once again, with the relative familiarity of the words during toddlers' learning of word-object mappings. For example, at about 14 months of age, infants are known to experience difficulty during word-mapping tasks when the novel spoken syllables sound very similar such as _bih_ and _dih_ (Stager & Werker, 1997) but have no difficulty when the novel spoken syllables are highly distinct such as _neem_ and _lif_ (Werker, Cohen, Lloyd, Casasola & Stager, 1998). However, by 20 months, infants map similar sounding syllables, such as _bih_ and _dih_, onto objects (Werker, Fennell, Corcoran, & Stager, 2002). Of further significance to word learning, if the words presented in word-mapping tasks are familiar to the toddlers, even 17-month-old toddlers

successfully map the similar sounding words onto objects (Fennell & Werker, 2003). These findings suggest that during word learning, the distinctness-similarity continuum interacts with the relative familiarity versus novelty of the words themselves.

The ability to attend to similar sounding words, to pair them with objects for instance, and learn their meanings, no doubt, are a quintessential part and parcel of vocabulary building and development. Vocabulary building, in turn, is fundamental to later developing language and pre-literacy skills such as awareness of the sounds of words (phonemic awareness) in 4- to 5-year-old children, a prerequisite for reading development. For example, four to five-year-old (preschool and kindergarten age) children attend to and discriminate the word-initial sound /p/ from /b/ in familiar words, such as pencil, bear, box, and bell. If shown pictures of the objects along with the accompanying words they correctly identify the different word after attending to the word-initial sounds. By the time children are about 6 years of age (in first-grade), they also attend to and discriminate word-final sounds (Yavas, & Gogate, 1999). Thus, they are quite adept at deleting, for example, the sounds /k/ and /t/, from the ends of words such as peak and fleet. Once again, greater mastery of vocabulary or familiarity with words in the preschool years predicts greater awareness of the phonemes or sound patterns that make up those words in the first and second grades of elementary school (Silvén, Poskiparta, & Niemi, 2004).

Summary and Potential Applications of the Research Findings

The research reviewed in this chapter illustrates that the everyday input provided by caregivers can have cascading effects on infants' word learning. Typically language learning infants attend to the relative frequency of words in caregivers' speech (e.g., their own name, or words such as Mommy and Daddy). The added exposure to specific words creates familiarity with those words. Further, familiarity with an infant's own name serves as an anchor to segment other novel words. In this manner, infants learn to segment novel words in a sentence by using familiar words as an anchor. Next, the research presented in this chapter suggests that early word learning can be facilitated if words and objects bear a sound-symbolic relationship, where there is a perceptual similarity between the words and the objects to which they refer. Thus, infants and children could use perceptual familiarity with the sounds of words to select perceptually similar objects or actions on the scene. Further, the research showed that when novel words are presented to infants closely in time, they learn to put

them together with objects better if the words sound distinct than if they sound highly similar. However, when the words are familiar, toddlers are able to pair the similar sounding words with the objects easily.

Given these findings on word familiarity and word learning, it is plausible that in cases of language delay, parent-implemented language intervention (Roberts & Kaiser, 2011) strategies could enhance infants' familiarity with words that, in turn, could facilitate their word learning. For example, a concrete strategy for enhancing word learning and, in particular, for increasing word segmentation early on in infants with early language delay could be to have caregivers use infants' and toddlers' name with greater frequency when naming novel objects and actions for their novice word learners. A second strategy for enhancing word learning could be for parents to use sound-symbolic (e.g., animal sounds with appropriate stuffed toy animals) words more often, especially during early word learning. A third strategy would be for parents to use distinct words more often early on for their infant in naming contexts. Given the high degree of variation in caregivers' speech to infants, not all parents might use these strategies spontaneously. Therefore, optimal usage of such concrete strategies by parents and caregivers, if they are not naturally occurring during infant-caregiver interaction, could facilitate infants' and young children's vocabulary development while making caregivers more aware of how to go about gradually easing their child into the world of words.

CHAPTER TWO

PROSODY GUIDES WORD LEARNING

Infants, toddlers and children attend to a lot more than just the sounds or segmental components of words when they hear everyday speech. A wealth of evidence from developmental research suggests that they attend to the rhythm, pitch variations, specific intonation patterns, and timbre, referred to broadly as prosody, and that they skillfully use the prosodic (suprasegmental) properties in adults' speech to attend to and segment or separate words from the speech stream. Exactly how does prosody assist early word learning? To fully address this question, we must first address the unique prosodic composition and characteristics of speech typically directed to infants and toddlers, and its relative salience to infants and toddlers compared to speech that is directed to adults. In the present chapter, therefore, first, the prosodic properties of infant-directed speech (IDS) and how infants respond to them relative to their response to adult-directed speech (ADS) will be highlighted. Second, how specific types of prosody facilitate infants' and toddlers' vocabulary development will be addressed, focusing specifically on their word segmentation, mapping, comprehension and production.

Prosodic Modulations in Infant-Directed Speech

Across many cultures, speech directed to infants, toddlers and young children sounds very different compared to speech directed to adults (Byers-Heinlein et al., 2021). For instance, Fernald, Taeschner, Dunn, Papousek, de Boysson-Bardies et al. (1989) examined mothers' and fathers' speech to infants of 10 to 14 months and to an adult after recording their speech samples during home observations of their semi-structured interactions. The parents spoke French, Italian, German, Japanese, British or American-English. Speech samples were compared across many prosodic modifications such as the mean pitch (mean fundamental frequency), pitch range and variability, utterance duration and pause duration. In general, parents who spoke American English used many more modifications such as shorter utterances, greater pause durations, and more exaggerated pitch

patterns relative to the parents of other language groups to their infants in comparison to adults. More importantly, mothers but not fathers across all language groups used a higher mean pitch and a greater pitch range to their infants than to an adult. A plethora of research findings have firmly established the unique prosodic properties of mothers' speech modulations directed to infants and toddlers (Fernald & Mazzie, 1991; Fernald & Morikawa, 1993; Fernald & Simon, 1984; Kitamura & Burnham, 2003; Kitamura, Thanavishuth, Burnham et al., 2001; Masataka, 1992). These studies establish that in addition to the greater average pitch and pitch pattern variation, mothers' prosodic exaggerations to infants contain a slower rate of speech with elongated vowels in their spoken syllables.

While the findings on maternal speech modulations in IDS are well established, the findings on fathers' speech modulations have been mixed. To reiterate, Fernald et al. (1989) did not find a higher average pitch or greater pitch range in fathers' speech to 10- to 14-month-old infants from several language backgrounds such as French, Italian, German, Japanese, British or American-English. More recently, Broesch and Bryant (2018) examined the prosody of fathers' infant-directed speech across two cultures, American and Vanuatu. In contrast to Fernald et al. (1989), the authors found that fathers from both cultures used a greater pitch range when speaking to their infant relative to when speaking with an adult. However, the average pitch of the Vanuatu fathers, but not the American fathers (similar to Fernald et al., 1989), was greater to their infant compared to the adult. Further, the American fathers alone slowed their rate of speech to their infant. These findings taken together suggest that although fathers from many different cultures use a wider pitch range, fathers from some cultures may not use a higher average pitch when speaking to infants.

Broadly speaking, these findings suggest that maternal speech directed to infants across cultures is unique, despite cultural variations, and might have evolved to serve the purpose of recruiting infants' attention to speech and communication. In the next sections, I will elaborate on the research that shows that the exaggerated manner of speaking recruits infants' attention, makes phonetic distinctions more salient (Kuhl et al., 1997), facilitates word segmentation (Singh, Nestor, Parikh, & Yull, 2009) and word learning (Graf Estes & Hurley, 2013).

Infants' Attention to Infant-directed Speech

Both monolingual and bilingual infants, especially those who hear North American English, show a preference for infant-directed speech (IDS) over adult-directed speech (Byers-Heinlein et al., 2021). Infants

especially like listening to maternal speech directed to them. Fernald (1992) first suggested that mothers' speech is a biologically relevant signal and that typically developing human infants tune into their specific properties during social interaction because it is critical to their survival just as recognizing the maternal calls of any other mammalian species is critical for the survival of the young of that species. This biological view explains findings from scientific studies which illustrate that infants first tune into the prosody (rhythm and intonation patterns or pitch variability) of their mothers' speech in the womb. Consequently, at birth, they show a listening preference for their own mother's voice over that of a female stranger by sucking harder on a pacifier to keep their mother's voice playing via headphones rather than sucking at a slower rate to keep the stranger's voice playing (Fifer & Moon, 1995). More recent research established that this listening preference is only observed when newborns are presented with long strings of utterances such as stories or nursery rhymes prior to birth but not when the mothers and strangers use a single word such as "baby" (Moon et al., 2015). These findings suggest that newborns specifically tune in to the prosody or rhythm of the longer speech strings rather than to individual words when tuning into their mother's voice.

Infants continue to show a listening preference for infant-directed speech over adult-directed speech throughout their first year (Cooper & Aslin, 1990). For example, Cooper, Abraham, Berman, and Statska (1997) used a procedure in which infants of one and 4 months were able to control the voice that was played by their sustained looking to a checkerboard pattern. The 4-month-old, but not the 1-month-old, infants showed a specific listening preference for maternal infant-directed versus adult-directed speech. The 1-month-olds, however, did show a preference for ID speech when they heard a stranger's voice. Based on this evidence, the authors suggested that the preference for maternal ID speech develops over time (also Cooper & Aslin, 1994), and is counterevidence to the view that infants are born with the natural propensity to detect and prefer their own mothers' voice (e.g., Fernald, 1992). Reconciling these opposing views, an alternative possibility is that infants tune into and learn the properties of their mother's voice in the womb, consequently showing a preference for it at birth (Fifer & Moon, 1995). Subsequently, the preference might become stronger or weaker during different points in development depending on various factors. One experimental study provides evidence for such preference variations at different ages. Using a head-turn preference procedure, where infants from 4 to 14 months were trained to turn their head to the left or right to show a preference for ID versus AD speech in English or Japanese, Hayashi, Tamekawa, and Kiritani (2001) found a U-shaped

preference for ID speech across infants from the two language backgrounds at different ages. Across language backgrounds, the youngest infants at 4 months and the oldest infants at 14 months showed a clear listening preference for ID speech, whereas the preference diminished temporarily in between these ages. However, in general, the infants preferred ID speech in their native language over the non-native language.

Other research shows that infants prefer listening to the prosody of infant-directed speech throughout infancy even at older ages. For instance, 10- and 16-month-old infants prefer the higher pitch and pitch variability of infant-directed speech streams to the shorter utterances and greater word repetition that are also characteristic of infant-directed speech (Segal & Newman, 2015). What exactly carries the higher pitch and variability in infant-directed speech? Zang, Koerner, Miller, Grice-Patil, Svec, Akbari, Tusler, and Carney (2011) showed that 6- and 12-month-old infants' brain is highly sensitive (showing an enhanced response in the right brain) to the hyperarticulation and elongated vowels (i.e., exaggeration) in infant-directed speech. Several behavioral studies have consistently shown that hyper-articulation in infant-directed speech is highly salient to young infants, is associated with enhanced phonetic learning in the native language (e.g., Liu, Kuhl, & Tsao, 2003), and enables infants to learn the phonetics of their language (Kangatharan, 2014). Furthermore, research has established that mothers adapt their speech by decreasing the hyperarticulation in speech directed to children of 5 years compared to the same group in their first year (7 months to 1 year; Liu, Tsao & Kuhl, 2009).

Why do infants prefer ID speech over AD speech? One possible reason for this preference is that ID speech contains more "happy talk" than AD speech (Singh, Morgan, & Best, 2002) with a far greater extent of positive intonation patterns and affirmations rather than negative ones. Infants' preference for ID speech extends beyond the voice to faces that produce ID speech as well. Consequently, 3- and 5-month-old infants look longer at faces when they produce ID speech even if the voice is muted. This preference does not hold when the same persons are producing adult-directed speech, suggesting that infants prefer the animated and mostly happy expressions of ID producing faces to faces that are producing adult-directed speech (Kim & Johnson, 2014). As another example, when 4.5 and 9-month-old Cantonese and English learning infants are shown videos of a female speaking to her infant versus an adult in either Cantonese or English, infants of both language groups overwhelmingly preferred the ID speech videos over the AD speech videos, regardless of language (Werker, Pegg, & McLeod, 1994). A recent study has shown more specifically that 4-month-old infants attend to changes in prosody in infant-directed speech

passages if a speaker's face and voice are synchronized but not if they only experience either the face or voice alone (Bahrick, McNew, Pruden & Castellanos, 2019). These findings, taken together, suggest that infants' prefer the animated expressions that match with the hyperarticulation and other prosodic features of infant-directed speech across face and voice.

Furthermore, infant-directed speech across voice and face functions in tandem with other cues such as caregiver's eye-gaze to help infants disambiguate whether the caregiver is addressing them or someone else on the scene. In fact, an adult's direct gaze towards 6-month-old infants during infant-directed speech elicits enhanced brain responses in regions involved in processing auditory and visual aspects of social communication. These enhanced brain responses are elicited during naturalistic conversations when two adults and another infant are present on the scene (Lloyd-Fox, Széplaki-Köllőd, Yin, & Csibra, 2015). In Chapter 5, I will delve deeper into the visual body movements or gestural actions that accompany ID speech and recruit infants' attention to words.

Prosody in Infant-Directed Speech Guides Word Segmentation and Recognition

Infants easily separate or segment words from the speech stream when caregivers or other adults use ID speech. For instance, 6.5 to 7.5 month-old-infants in the United States learn to separate consistently co-occurring nonsense syllables (words) from a string of nonsense syllables if the strings are presented in ID speech but not if they are presented in AD speech (Thiessen, Hill, & Saffran, 2005). British English infants as well segment words only when they hear exaggerated ID speech with elongated vowels (Floccia, Keren-Portnoy, Depaolis, Duffy, Luche, Durrant, White, Goslin, & Vihman, 2016). Furthermore, 7- to 8-month-old infants remember the words that they segment from sentences, over long periods of time, if the sentences are presented, once again, only in ID speech (Singh, Nestor, Parikh, & Yull, 2009). Greater use of ID speech to infants at home is also associated with better word recognition at 24 months (Weisleder & Fernald, 2013), suggesting that the quality of speech to infants matters.

Infants typically start to segment nouns and verbs from the speech stream early during their first year. Exactly how do the unique prosodic characteristics of ID speech assist infants in their ability to segment these words? Mothers are known to consistently place novel words with the highest pitch in the final position of their utterances (Fernald & Mazzie, 1991). Infants in turn might detect nouns and verbs using prosodic cues that differentiate them from grammatical words. For example, infants learning

Mandarin-Chinese distinguish between nouns and verbs in maternal ID speech based on the prosodic differences between these word classes, such as the pitch of the second syllable, and the duration differences between the first and the second syllable (Aijun, Shi, & Zhao, 2011). Maternal ID speech to 4- and 11-month-old infants clearly distinguishes between nouns and verbs in French, once again, based on vowel duration within the syllables. However, ID speech distinguishes more on the basis of pitch (fundamental frequency) to the older infants who are more likely to be learning these words (Shi & Moisan, 2008). Further studies are needed to determine whether English learning infants can distinguish between nouns and verbs based on possible prosodic differences. Even newborns who hear a list of words from different languages (Cantonese, Mandarin, Punjabi, Tagalog, Spanish, French, German) distinguish nouns or verbs from other grammatical words (Shi, Werker, & Morgan, 1999), and 6-month-olds show a clear listening preference for nouns or verbs over grammatical words (Shi & Werker, 2001).

These findings from infants' word segmentation and the prosodic characteristics of mothers' ID speech taken together underscore that infants utilize the prosody of words to separate them from the speech stream and likely also use prosody to distinguish between words such as nouns and verbs in speech directed to them. The next three subsections will further elucidate the important role that prosody in infant- and child-directed speech plays in word-object or -action mapping, comprehension and production.

Prosody in Infant-Directed Speech Guides Word-Object and -Action Mapping

Research has clearly established that ID speech makes putting words and objects or actions together (word mapping) easier relative to AD speech. For example, 17.5-month-olds were exposed to specific words, either *timay* and *dobu* or *nomay* and *gabu,* each paired with one of two interesting objects (Graf Estes & Hurley, 2013). Following initial exposure to the two word-object pairs, infants were tested with the same pairs versus interchanged or switched pairs to examine if infants had learned the original pairings and would look longer when the pairings were interchanged. In one experiment these researchers presented the word-object pairs in ID speech, with a higher pitch, more pitch variation and slower tempo with greater vowel elongation. In another experiment, the researchers presented the same word-object pairs in AD speech without the pitch modulations and exaggerated vowels. The infants only learned the word-object pairs in the experiment that used ID