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Research paper

Language learning is hands-on: Exploring links between infants' object manipulation and verbal input☆

Kelsey L. West[a,*], Jana M. Iverson[b]

[a] Department of Psychology, University of Pittsburgh, 3215 Sennott Square, 210 S. Bouquet St., Pittsburgh, PA 15260, United States
[b] Department of Psychology, University of Pittsburgh, 3415 Sennott Square, 210 S. Bouquet St., Pittsburgh, PA 15260, United States

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ABSTRACT

Research demonstrates that object manipulation may provide infants' with optimal sensory input for successful word learning to occur (Yu & Smith, 2012). Thus, it may be important to understand the relation between infant object manipulation and caregiver labeling in a naturalistic environment. The present study examined 13 parent-infant dyads longitudinally at 10, 12, and 14 months in their homes. The frequency and context of ideal labeling moments—-wherein infants are holding and visually attending to an object when the label is presented—-were examined. Results revealed that when infants were holding objects, caregivers' verbal input was less frequent but contained a significantly greater proportion of labels relative to moments when infants were not holding objects. Additionally, ideal labeling moments were more likely to occur during particular infant actions than during passive holding alone. Findings have implications for understanding the role that manual motor behavior plays in infants' early language environment.

1. Introduction

The notion of embodiment—that infants' actions on the world around them enhance learning—has a long history in developmental psychology (e.g. Gibson, 1988; Jean, 1954) and has received a surge of attention in the past decade (e.g. Libertus & Needham, 2010; Rieser, Lockman, & Nelson, 2005; Smith, 2005). It is theorized that the sensory input infants receive from self-produced action engenders learning about the environment in ways that passively experienced input does not. In particular, infants' manual exploration of objects has been shown to promote development in a wide range of domains, from object perception (Needham, 2000; Soska, Adolph, & Johnson, 2010) to social interactions (Libertus & Needham, 2011; Sommerville, Woodward & Needham, 2005). Notably, recent research has demonstrated that infants' object manipulation may be an important component of early language acquisition (Pereira, Smith, & Yu, 2014; Yu & Smith, 2012). This worksuggests that successful word learning is most likely to occur during moments when an infant is holding an object such that it dominates the visual field, and a caregiver provides the corresponding label. Understanding how these ideal moments for word learning unfold in the naturalistic environment may be useful in understanding processes that underlie early word learning. The present study investigates how infants' object manipulation behavior relates to the verbal input—in particular object labels—that they receive from caregivers, and how this relation changes as infants' object manipulation becomes progressively more sophisticated.

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* Corresponding author at: Department of Psychology, University of Pittsburgh, 3215 Sennott Square, 210 S. Bouquet St., Pittsburgh, PA, 15260, United States.
E-mail address: kelsey.west@pitt.edu (K.L. West).

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At around one year of age, infants begin to produce their first words, arguably one of the most dramatic achievements of toddlerhood (Hollich et al., 2000; Schafer & Plunkett, 1998; Woodward, Markman, & Fitzsimmons, 1994). Given that word learning occurs in a cluttered environment and with few obvious or direct cues, this transition into language has led many researchers to investigate how infants are able to successfully map a heard word to the intended referent and encode this connection sufficiently for future recall. Work by Yu and Smith (2012) suggests that infants' object manipulation may play a facilitative role in this process. They propose that through *embodied attention*—a phenomenon in which held objects dominate the infant's view due to short arms and stature—infants are able to isolate the object from the environment and encode its label without the burden of selecting a referent from a cluttered visual array. This perspective underscores the importance of infants' object manipulation in the process of learning labels.

To test this hypothesis, they conducted a study in which infants wore a mini head camera and played with several novel toys with a caregiver in a lab setting. Prior to the play session, caregivers were taught novel labels for each of the items. They were then asked to interact naturally with the infant; no instructions were given regarding labeling the objects. Following the play session, an experimenter tested the infant's knowledge of the novel labels in a forced-choice task. Infants' performance in this task was then related back to the head-camera footage of the play session in order to examine whether and how infants' views of the objects differed for learned vs. non-learned labels. Results revealed that successful learning of word-object pairs was most likely to occur during moments of embodied attention, that is, when the label was presented while the infant was holding the object and it dominated the infants' view. Thus, these "right label at the right time" moments may be critically important for learning novel words.[1]

The embodied perspective builds upon a large body of work reporting that joint attention (i.e. moments when an infant and a social partner are simultaneously attending to the same object) is an important component of early word learning. This research has found that individual differences in the frequency and quality of joint attention between dyads—in particular caregivers' ability to follow the infants' attention—predict language development in the toddler years (e.g. Baldwin, 1995; Tomasello & Farrar, 1986; Tomasello, 1988). This work is closely related to the embodied perspective previously discussed, as joint attention is a necessary, but not sufficient, component of these "right label at the right time" moments. The essential distinction that embodied attention makes is that the quality of joint attention may also vary along another dimension: the sensory-motor experience of the infant. Thus, moments of joint attention that occur while the labeled-object is simultaneously being held by the infant (these "right label at the right time" moments) may provide the *optimal* sensory-motor input for infants to encode novel labels.

Additional support for the hypothesis that infants' object manipulation plays a role in early language development comes from naturalistic studies of infants' early word learning. In a seminal study by Nelson (1973), caregivers kept diary records of the words their infants produced and reported on them at monthly intervals. The first 50 words produced by the infant—regardless of chronological age—were examined. A clear pattern was evident in these early words: the majority were labels for objects that infants were likely to manipulate (e.g. "cup"). Although household objects that could not be manipulated were often present in the infants' environment (e.g. "table") they were far less likely to appear in the infant's repertoire than items on which the infant was able to act. Nelson notes:

Frequency of personal experience, exposure to words, strength of need, or desire cannot apparently explain the selection of these words…It is apparent that children learn the names of things they can act on, whether they are toys, shoes, scissors, money, keys, blankets, or bottles…With very few exceptions all the words listed are terms applying to manipulable or moveable objects [p. 31].

Although these findings are descriptive and causal inferences cannot be made, they are nevertheless consistent with the hypothesis that the ability to hold an object may aid infants in learning its label.

An important implication of this framework is that, in practice, it relies heavily on the coordination of infants' object manipulation and caregiver labeling. Whereas other well-studied mechanisms for infants' word learning depend on the *infant* to extract relevant information from patterns and cues in the environment, this embodied perspective relies on the *dyad* to coordinate infants' actions and caregivers' labels. Thus, if word learning is facilitated by these "right label at the right time" moments, as some studies suggest (Lifter & Bloom, 1989; Pereira, Smith, & Yu, 2014; Smith & Yu, 2008), it is important to understand: (a) how these moments unfold in naturalistic interactions between infants and caregivers; and (b) whether caregivers' verbal input differs—either in frequency or content—during infants' object manipulation, as opposed to moments when infants are not handling objects.

Insights into these questions come from studies investigating parental responsiveness. This work has yielded evidence that caregivers coordinate their verbal input with infants' object manipulation, and that this verbal input frequently consists of labeling utterances (Tamis-LeMonda, Kuchirko & Tafuro, 2013; West & Rheingold, 1978). West and Rheingold (1978) tested whether a wide variety of infant behaviors—including object manipulation—would elicit caregivers' verbal input. They brought mothers and their 12 month-old infants into an experimental suite equipped with microphones and cameras for 15 min and observed their naturalistic interactions. Experimenters coded these sessions for a variety of infant behaviors, including object manipulation, as well as maternal verbal input. If maternal input began after the onset of the infant's behavior or within 2 s following the behavior, it was coded as a response to the behavior. Overall, results showed that 70% of maternal utterances were produced in response to infant behaviors,

[1] Learning language is a complex problem, and so it likely requires a complex solution. It is probable that there are many mechanisms that account for world learning in infancy and they are not necessarily mutually exclusive to each other. Many other influential factors have been investigated in word-learning, such as cross-situational statistical regularities (Akhtar & Montague, 1999; Plunkett, 1997; Smith & Yu, 2008; Smith, 1995; Smith, Jones, & Landau, 1996), unlearned assumptions about language (Markman 1990; Markman 1991; Merriman, Bowman, & MacWhinney, 1989; Waxman & Kosowski, 1990), and children's already acquired vocabularies (e.g. Bergelson & Swingley, 2012), among others. Although the embodied perspective presented here is unlikely to account for word-learning completely, it does dramatically reduce the problem of referential ambiguity—the quintessential obstacle of early word learning—which makes it a particularly compelling factor in infants' early language acquisition.