Some considerations for adding reference back into early language development

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In the early days of the study of language development, structural aspects of language (phonology and morphosyntax) were hypothesized to be acquired via reference/meaning. With regard to phonology, children were thought to first learn enough word form–referent minimal pairs, such as *girl* and *curl*, to determine that the phonological features involved in the minimal pair (in this case voicing) were used contrastively/phonologically in the language (e.g., Trubetskoy, 1969/1958). An example from morphosyntax comes from work on parameter setting in language acquisition, in which "the assumption is that the learner attempts to generate an input sentence with her current grammar (i.e., parameter-settings) and if she can't generate it, she changes the setting of a parameter" (Wexler, 1998, p. 32). That is, the learner knows what a sentence uttered to her means and attempts to generate the sentence–meaning pair with her own grammar. Those earlier accounts on which learners employed reference to assist with structural properties of language focused on the period of 18–24 months. Infants' vocabularies grow rapidly during this period (Goldfield & Reznick, 1990), and children of this age can be tested by traditional picture-pointing methods (e.g., Shvachkin, 1973/1948). As I will conclude at the end of this Commentary, this is also the age at which meanings become sufficiently stable that they might reliably contribute to language structure.

An important shift in our thinking about the relation of form and reference/meaning in language development began with the breakthrough work of Eimas, Siqueland, Jusczyk, and Vigorrito (1971), and continued with the work of Werker herself (e.g., Werker & Tees, 1984), as well as the work of other infant speech perception researchers such as Jusczyk, Luce, and Charles-Luce (1994). Largely due to new methodology, it became clear that we could study infants' perceptual discrimination of sound properties of their target language without worrying about meaning. Similarly, we could study infants' discrimination of some aspects of morphosyntax without requiring our participants to interpret the utterances they were hearing (e.g., Shady, Gerken, & Jusczyk, 1995; Shafer, Shucard, Shucard, & Gerken, 1998). These studies opened the door to research with younger language learners than had ever before been systematically studied (even newborns), and they allowed us to watch the learning of new language forms in the laboratory (e.g., Gómez & Gerken, 1999; Jusczyk & Aslin, 1995; Marcus, Vijayan, Rao, & Vishton, 1999; Saffran, Aslin, & Newport, 1996). It seemed possible that one of the reasons why learning a language from infancy results in superior mature performance compared to learning as an adolescent or adult is that infants start with form and only add meaning later, whereas older learners must combine form and meaning from the beginning of acquisition (e.g., Gómez & Gerken, 2000).

In her thorough review of infant speech sound and word perception, Werker makes the following provocative statement, which is the focus of the rest of my

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comments: "With the increasing evidence that the foundations for referential word learning are in place far earlier than once expected, we can again consider the idea that establishment of native speech sound categories (even in the earliest stages of infant development) involves acquisition of sound categories *within the context* of the earliest appreciation of differential meaning." This statement challenges the view of young infants as "form-first" learners (see Bergelson & Swingley, 2012; Swingley, 2009). Focusing on words as the nexus of form and reference also promises a bridge between researchers who study early perceptual development and those who study early language production (for a recent review from the production side, see Stoel-Gammon, 2011).

However, even as we embrace the rediscovered link between forms and referents/meanings, we must acknowledge that now we are faced with understanding the development of two independently difficult-to-acquire systems and their intersection. In a nutshell, both word forms and referents appear to have relatively unstable or malleable representations during the first 1 to 2 years of life. Here I will very briefly outline some of the evidence for instability of word forms and referents, as well as some evidence that associating forms and referents presents its own challenges.

Let us begin with the instability of early word forms when association with a referent is not being tested. In one study, 7.5-month-old infants (but not 10.5-month-olds) were unable to recognize word forms spoken by one talker when the same word forms were spoken by another talker (Houston & Jusczyk, 2000). Such results suggest that early word forms reflect an amalgam of acoustic information, some of which will ultimately be weighted more heavily in a mature language system. Similarly, Singh, Morgan, and White (2004) and Singh, White, and Morgan (2008) found that 7.5-month-olds were unable to recognize a word spoken with different pitch or affect than the same word heard during familiarization. Extending the view that infants do not know what parts of the speech signal to weight most heavily, Schmale and Seidl (2009) found that English-learning infants under 1 year were not able to recognize words spoken in a foreign accent.

The instability of early word meanings has perhaps been pursued more in the field of memory development than in language development, but the parallels to word form instability are striking (for reviews, see Gómez & Edgin, 2016; Wojcik, 2013). In one telling study, Robinson and Pascalis (2004) presented infants and toddlers with pictures of toys on colored backgrounds. At test, they presented the original picture and another one. While even 6-month-olds looked longer to the novel picture when the original picture was presented on the same background, it was not until 18–24 months that toddlers could recognize the same picture they had just seen when the background color was changed. More recently, Hendrickson and Sundara (2017) looked at the effect of referent variability on infants' ability to associate a referent category with a word form. They found that preexposing 14-month-olds to three tokens of pictures of common objects prevented them from associating one of the pictured referents with its label, although they could make the association when they were preexposed to just one token of each object. Generally speaking, it appears that the ability to learn a new word form–referent pairing and to remember that pairing changes

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considerably from the middle of the second to the middle of the third year of life (e.g., Bion, Borovsky, & Fernald, 2013; Horst & Samuelson, 2008; Nazzi & Bertoncini, 2003; Vlach & Johnson, 2013).

Finally, while associating a word form with a referent might offer some advantages in helping learners to know which sound distinctions are important in their language (e.g., Swingley, 2009), the presence of referents can also hinder word form perception. This was the point of Werker's pioneering work with the "switch" paradigm, in which speech sound discriminations that are easily made by younger infants become difficult when sound discrimination is associated with referent discrimination (e.g., Pater, Stager, & Werker, 2004; Stager & Werker, 1997). Similarly, although 9-month-olds discriminate phonotactically frequent from infrequent forms (Jusczyk et al., 1994), 16-month-olds (but not 20-month-olds) are willing to associate phonotactically foreign word forms (frequency = 0) with referents (Vukatana, Curtin, & Graham, 2016). In addition, 14-month-olds may be willing to treat talker gender as potentially relevant for differentiating words when a referent is involved (Quam, Knight, & Gerken, 2017), but not when recognizing word forms without referents (Houston & Jusczyk, 2000).

To conclude, I applaud Werker's efforts to steer us into a new era of thinking of early speech perception in the context of reference and meaning, and to encourage us more generally to think of language forms and meanings as importantly linked in early language development. However, a growing literature suggests that word forms and referents are both relatively unstable until some time around 18–24 months, which is probably why, when researchers in the past targeted this age for study of "early" language development, "meaning-first" accounts were so prevalent. However, due to the important contributions of Werker and others, 18–24 months no longer counts as *early* language development. Therefore, the bottom line is that, for our field to begin thinking about form learning in the context of reference in what we now see as early language development (essentially beginning at birth or before), we need to develop sophisticated ways of thinking about how two unstable systems might influence each other, ultimately to the benefit of both.

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A Commentary on Werker (2017): Limitations of the laboratory and the role of variability in language learning

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In the 1970s and 1980s, infant speech perception and word learning were relatively new fields. Eimas, Siqeland, Jusczyk, and Vigorito's (1971) study demonstrating that 1-month-olds could distinguish /b/ and /d/ defied widely held preconceptions of the limited linguistic potential of young babies. It was in this context that Janet Werker (Werker & Tees, 1984) made her now classic discovery that phonetic perception changes significantly over the first year of life in support of native language acquisition. Since this time, Werker has not only developed and refined a toolbox of methods widely used to study infants' linguistic sensitivities but also broken new ground with a wealth of studies on how phonetic sensitivity relates to later word learning. Her work is methodologically stunning and theoretically rich. In her Keynote article, she offers a compilation of her results as she describes infants' journey from sounds to words.

Distinguishing this article from previous reviews are two significant contributions. The first is that word learning affects perception just as perception affects early word learning. The second is that speech perception, itself, is a multisensory

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