

The articulatory filter and the creation of sound-meaning links: A developmental study with implications for evolution.

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Abstract

This study investigates the links between a child's production, perception and early word learning. We will also speculate on how these links may have been instrumental in the phylogeny of language.

Perception study

It has been suggested that once an infant begins to produce consistent sound patterns, those patterns may become more salient for the child in input speech. This has been ascribed to an 'articulatory filter', or the cross modal matching of auditory, visual and motor information that begins when the infant starts producing stable phonetic forms (Vihman, 1993). This evidence of interactions between adult input, child production, and the experienced input/output match leads us to expect to find effects of individual infants' production experience on their processing of running speech.

From 11 months on English-learning infants were audio- and video-taped at home at least monthly, in interaction with their mothers. The headturn procedure was used once the children had given evidence of stable production of one supraglottal consonant (age range 10-16 mos.). In this experiment the children heard three passages in which nonwords (filling content word slots) were interspersed with real words to create (pseudo-)English sentences. The nonwords consisted of either (a) the stable consonants used by the child being tested (own Vocal Motor Schemes, or VMS), (b) comparable consonants used by other children ('other VMS'), or (c) consonants which are uncommon in children's early productions. Preliminary results show that each of three infants look longer to *own* than to *other* VMS passages. These results support the hypothesis that the sounds that the infant produces are more salient in connected speech than are those that the infant is not producing.

Word learning study

It has also been claimed that vocal practice, or familiarity with one or more VMS, facilitates referential word learning (McCune & Vihman, 2001). Once a child shows stable VMS control, these stable representations lead to greater automaticity in phonological processing and facilitate the efficient creation of new lexical representations (based on a limited-capacity account of language processing). We argue that children with stronger phonological representations should have more resources available, both for establishing novel semantic representations and for creating new lexical links (Schwartz & Leonard, 1981; Storkel, 2001). Preliminary results show that children who acquire VMS earlier produce referential words earlier, that children who have not yet achieved two VMS do not produce referential words, although they may produce context-limited (or 'primed') words, and that

referential words are based more heavily than context-limited words on well practiced sounds (mainly VMS, but also precanonical sounds, i.e., glottals and glides). We also expect children with earlier VMS to display a larger number of referential words in their lexicon at the point where they have 50 words by parental report. The results suggest that there is a tradeoff between experimentation with meaning and with sound. At the early stages of word learning both complex meanings and new sounds or sound sequences require resources. Therefore when attempting to recall words with little situational support the child must rely on well-practiced sounds, and when experimenting with new sounds the child can only produce words that have a strongly context-based or situationally primed meaning.

The combined results from the two studies suggest an interesting change over time in the status of the child's own VMS. In the perception study children are tested when they are just beginning to gain articulatory control. Learning to control sound production is a current focus, which leads to a familiarity effect. Infants with more practice (and more VMS) show a novelty effect for the sounds that they cannot yet produce (Vihman & Nakai, 2003). At this stage, when VMS have become routine or automatic and thus readily available, perceiving and producing them no longer creates a cognitive load. At this point VMS can serve as a useful tool for referential word learning: The child need not expend effort on reconstructing the sound form of the word but can focus on meaning and on linking form and meaning.

The developmental profile of vocal motor schemes in ontogeny suggests a possible entry into early sound-meaning links during phylogeny. Vihman & DePaolis (2000) proposed that the articulatory filter might have facilitated early sound-meaning links after the development of the modern vocal tract. Our studies suggest that as vocal motor schemes emerged, especially for labial sounds, a new or reinforced awareness of the link between motor, visual, and auditory systems could have been formed. The interconnectedness of visual, motor, and auditory systems in the recognition of a bilabial supports this idea. The regularized action plans that created consistent auditory forms already perceived cross-modally could then have been paired to meaning, permitting new cognitive systems supporting sound-meaning links to develop. This linkage would thus be possible without overloading an already stretched cognitive system.

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