J. Child Lang. **37** (2010), 275–279. © Cambridge University Press 2010
doi:10.1017/S0305000909990456

Vocal motoric foundations of spoken language – a commentary on Iverson's 'Developing language in a developing body: the relationship between motor development and language development'*

D. KIMBROUGH OLLER
University of Memphis

The article by Iverson (this issue) provides a persuasive argument for change from the simplistic factorial analytical model of language learning that constituted the primary approach to theory for decades toward a more synthetic view compatible with dynamic systems and integrated cross-modality thinking. She argues for this broader view by highlighting the importance of considering the child as a multi-faceted actor upon the environment, and in terms of the importance of these motoric actions in laying the groundwork for learning and acquisition of complex skills, especially language. She thus suggests a systems approach to thinking about the underpinnings for language that acknowledges and emphasizes the interactions of various components of action with the potential for acquiring related skills and components of related skills. These ideas stand in contrast with the common notion that language is an isolated, highly modularized capacity, unrelated (or scarcely related) to the remainder of cognition and motoric life (Chomsky, 1966).

Being so enthusiastic about this review, and having nothing but quibbles to moderate its basic thrust, my inclination is not to critique it, but to add something to it. Iverson explicitly left something that I think is central out of her review. She wished to show that motoric development OTHER THAN THAT WHICH CONCERNS VOCALIZATION PER SE is important in the study of language acquisition. I agree heartily, but I wish to argue in addition that MOTOR DEVELOPMENT OF VOCALIZATION ITSELF has been largely ignored as a foundation for the speech communication capacity, and that this omission has hampered and delayed the establishment of a workable science of early spoken language and its acquisition. Iverson conceded that motor development other than that which concerns vocalization per se is neither

[*] This work has been supported by a grant from NIDCD (R01DC006099 to D. K. Oller, PI) and by the Plough Foundation. Address for correspondence: D. Kimbrough Oller, School of Audiology and Speech–Language Pathology, The University of Memphis, 807 Jefferson Ave., Memphis, TN 38105. tel: 901 678 5841; e-mail: koller@memphis.edu

https://doi.org/10.1017/S0305000909990456 Published online by Cambridge University Press

necessary nor sufficient for language acquisition. I am inclined to think, however, that motor development of vocalization itself is very much necessary (though not sufficient) in spoken language acquisition.

Any natural communicative system (by definition) involves a transmission mechanism consisting of a set of actions (motor events or 'signals') paired with a set of functions (or 'values') that those actions serve. Accordingly, there is a signal–function (or '*signifiant*/*signifié*') distinction to be drawn for every communicative act (de Saussure, 1968). Further, a logical necessity for spoken language (or a precursor to spoken language) is the motor capacity to produce the actions (in this case the phonological signals or precursors to those signals) that transmit the functions of speech (or precursors to those functions).

Interestingly, phonological actions and precursors to them (babbling, cooing and the like) in humans can always in principle be performed in the absence of any intended social function or message – humans, for example, engage in vocalization free of social function in vocal play. Human infants begin this sort of vocal activity in the first months of life, and sometimes it occurs when infants are all alone. Through this motoric exploration, infants develop a repertoire of sounds that are not speech, but manifest an emerging capacity to manage and control properties of speech signals (Koopmans-van Beinum & van der Stelt, 1986; Stark, 1980), and importantly they develop CATEGORIES of vocalization (for example squeals, growls, raspberries, vowel-like sounds and so on), that are recognized AS categories by parents and treated as a basis for early vocal communication. Importantly this communication is very unlike speech because it does not involve well-formed (or 'canonical') syllables (Oller, 1980), and it does not involve meanings in the normal sense of the term. In particular, this early communication does not involve reference to objects or other entities, but instead the infant vocal categories are interpreted by parents as transmitting illocutionary forces (Austin, 1962) such as complaint, exultation or social affiliation. Sometimes parents interpret infant vocalizations as having social forces even though the infant sounds are produced without apparent social intention – fussy vowel-like sounds, for example, are often thus interpreted as complaints even though babies sometimes produce them merely out of discomfort, with no apparent awareness that anyone might be listening. Of course, on other occasions infants produce these speech-precursor sounds with clear intention to direct them to caregivers, complaining, entertaining and sometimes interacting reciprocally in what appear to be bonding activities. Also, the functions that are served by each vocal category appear to be variable from one occasion to another, even within child, and even on the same day (Oller & Griebel, 2005). For example, a vocalization identified as a 'squeal' can be used on one occasion as a complaint, on another as an exultation, and it can also be used in mere vocal play with neutral affect.

https://doi.org/10.1017/S0305000909990456 Published online by Cambridge University Press

This 'functional flexibility' is a signature characteristic of human infant vocalization, and it is salient because no other primate at any age shows such functional flexibility in vocalization (Griebel & Oller, 2008). Further, no other primate at any age shows 'signal flexibility' to the extent that human infants do within the first months of life – other primates do not appear to 'create' new vocal categories – instead each vocalization type they produce appears to be a specific precursor to one of a small set of species-specific vocal categories, each of which has a particular communicative function, such as warning, aggression, food announcement, greeting and so on (Hauser, 1996; Snowdon, 2004).

The key point here is that all of the human infant's vocal communication activities are rooted in motoric exploration and development of the vocal system itself, both phonatory and articulatory. This may seem trivially true, but in fact this point has often been ignored due to the assumption that speech sound production is innate (Jakobson, 1941). Those who have taken seriously this traditional Jakobsonian view of vocal development have assumed that there is no necessary motoric development for speech sounds – infants are viewed instead as able to produce all the sounds of all the world's languages from birth. The facts contradict this notion, since, even in canonical babbling, the range of speech-like sounds produced in a controlled fashion by infants is quite narrow and appears to be limited to a relatively universal set of syllable types (see review in Locke, 1983). Jakobson may have been confused by having listened to exploratory vocal activity of human infants, which is similar in many ways to exploratory behaviors of infants in hand and arm movement in the first months of life (Thelen, 1981), especially in that early vocal activity is similarly characterized by a wide variety of poorly organized actions. He may have interpreted these varied and poorly controlled actions as well-formed speech sounds from many languages, even though the great bulk of them are notably different from mature speech and only a small proportion constitute canonical syllables. When infants begin to produce canonical syllables in a controlled fashion, the syllables are recognized by parents as potential bearers of meaning, and parents appear to propose meanings for them in interaction with the infant (Papoušek, 1994). Motoric development of these canonical syllabic categories, occurring around the middle of the first year, is of course, a significant step in the development of the speech capacity, since an open-ended lexicon can be formed by recombination of such syllables.

It is critical, however, to notice that canonical babbling does not represent the beginning of the motoric foundations for speech. From the very first months of life, long before canonical syllables can be produced systematically by infants, logically necessary precursors to the speech capacity appear to be developed in the context of vocal exploration of the phonatory capacity, yielding vowel-like sounds, squeals and growls, for example, where no

https://doi.org/10.1017/S0305000909990456 Published online by Cambridge University Press

supraglottal articulation is necessary. Still, these sounds emerge as categories that can be used in primitive illocutionary communication, as indicated above. Notably, the Jakobsonian view on vocalization in infancy ignores these precursor phonatory sounds altogether. Even more modern (and more biologically grounded) thinkers have not been inclined to view these early phonatory categories as precursors to the speech capacity (MacNeilage, 1998). And yet both these primitive phonatory categories and those of the later canonical stage that incorporate both phonatory and articulatory control appear to emerge in patterns that abide in large measure by widely accepted principles that have been the focus of modern theories explicating development of hand and arm movement or locomotion from primitive, poorly organized precursors (Thelen, 1995).

Thus, I concur with Iverson and add to her timely analysis on the importance of motor development in language acquisition. Perhaps the most important amplification I have proposed is that while other realms of motor development may (as Iverson concludes) be neither necessary nor sufficient for language, the motoric development of the vocal capacity itself appears to constitute a necessary condition for the acquisition of spoken language.

REFERENCES

Austin, J. L. (1962). *How to do things with words*. London: Oxford University Press.
Chomsky, N. (1966). *Cartesian linguistics*. New York: Harper and Row.
de Saussure, F. (1968). *Cours de linguistique générale*. Paris: Payot.
Griebel, U. & Oller, D. K. (2008). Evolutionary forces favoring contextual flexibiliity. In D. K. Oller & U. Griebel (eds), *Evolution of communicative flexibility: Complexity, creativity and adaptability in human and animal communication*, 9–40. Cambridge, MA: MIT Press.
Hauser, M. (1996). *The evolution of communication*. Cambridge, MA: MIT Press.
Jakobson, R. (1941). *Kindersprache, aphasie, und allgemeine lautgesetze*. Uppsala: Almqvist and Wiksell.
Koopmans-van Beinum, F. J. & van der Stelt, J. M. (1986). Early stages in the development of speech movements. In B. Lindblom & R. Zetterstrom (eds), *Precursors of early speech*, 37–50. New York: Stockton Press.
Locke, J. L. (1983). *Phonological acquisition and change*. New York: Academic Press.
MacNeilage, P. F. (1998). The frame/content theory of evolution of speech production. *Behavioral & Brain Sciences* **21**(4), 499–546.
Oller, D. K. (1980). The emergence of the sounds of speech in infancy. In G. Yeni-Komshian, J. Kavanagh & C. Ferguson (eds), *Child phonology, Vol. 1: Production*, 93–112. New York: Academic Press.
Oller, D. K. & Griebel, U. (2005). Contextual freedom in human infant vocalization and the evolution of language. In R. Burgess & K. MacDonald (eds), *Evolutionary perspectives on human development*, 135–66. Thousand Oaks, CA: Sage Publications.
Papoušek, M. (1994). *Vom ersten Schrei zum ersten Wort: Anfänge der Sprachentwickelung in der vorsprachlichen Kommunikation*. Bern: Verlag Hans Huber.
Snowdon, C. (2004). Social processes in the evolution of complex cognition and communication. In D. K. Oller & U. Griebel (eds), *Evolution of communication systems: A comparative approach*, 131–50. Cambridge, MA: MIT Press.

https://doi.org/10.1017/S0305000909990456 Published online by Cambridge University Press

Stark, R. E. (1980). Stages of speech development in the first year of life. In G. Yeni-Komshian, J. Kavanagh & C. Ferguson (eds), *Child phonology, Vol. 1: Production*, 73–90. New York: Academic Press.
Thelen, E. (1981). Rhythmical behavior in infancy: An ethological perspective. *Developmental Psychology* **17**, 237–57.
Thelen, E. (1995). Motor development: A new synthesis. *American Psychologist* **50**(2), 79–95.

https://doi.org/10.1017/S0305000909990456 Published online by Cambridge University Press