

**A DEVELOPMENTAL LINK BETWEEN PERCEPTION AND PRODUCTION:
TYPICAL DEVELOPMENT AND CHILDHOOD APRAXIA OF SPEECH**

Theoretical background: Since the proposition of the Motor Theory of Speech Perception, a psychological link between speech production and perception has been highlighted; the common ground shared by different theoretical hypothesis being that sensorymotor knowledge of speech movements plays a role in our capacity to perceive the linguistic signal.

A large body of behavioral and neurofunctional data demonstrates the involvement of sensorymotor information during speech perception, proving even fine-grained connections (cfr. for ex. Pulvermüller et al., 2006). Despite this vast amount of reliable evidence, though, a crucial question remains open, i.e. whether the contribute of sensorymotor information to speech perception is a necessary feature, without which human perceptual abilities would be imperfect, or just an epiphenomenon due to the strict neurofunctional association between these two activities.

In order to contribute to answering this central question, a useful possibility is offered by the study of the link between the two abilities in language acquisition. Under such perspective, the focus is shifted from the analysis of adult and (at least ideally) fully developed linguistic systems to developing ones. The relationship between sensorymotor knowledge and speech perception is observed during the pathway to phonetic/phonological acquisition, with the aim of evaluating whether the first has or has not a crucial impact on the second.

A young and promising line of research is currently producing data on the subject. Assuming that sensorymotor knowledge is gained through repeated experience with language production, one aims at assessing: (i) in general terms, whether infants and children undergoing perception tasks obtain better performances when they show better production abilities (e.g. does an infant already producing many linguistic sounds complete a perception task more successfully than an age-mate producing less linguistic sounds?); (ii) more specifically, whether precise relationships can be found between the abilities to produce and to perceive specific sound patterns (e.g. is an infant who actually and stably produces a certain phoneme faster to process it in a perception task, when compared to an infant who does not already produce such sound?).

Some evidence is already available offering a positive answer to such questions. Sensorymotor information seems, in fact, to facilitate speech perception in infancy and this holds

both when the recruitment of such information is elicited by the experimental procedure (cfr for ex. Yeung & Werker, 2013) and when it stems from the participants' everyday experience in articulating the target language (cfr. for ex. De Paolis et al., 2010 and 2013; Majorano et al., 2013; Streri et al., 2016; Altvater-Mackensen et al., 2016). Moreover, the correlation seems to work also the other way around; both infants and children, in fact, demonstrate a loss of proficiency in speech perception when the experimental procedure involves the inhibition of the (potential) activity of the articulators involved in the production of the phonemes tested (cfr. (Bruderer et al., 2015 and Turner et al., 2015).

Aims and research questions: In this framework, a role of particular heuristic relevance is played by children with output disorders. In fact, if a robust experience with language production is actually important for the development of speech perception, then such clinical populations should display perceptual atypicalities, and this seems to be the case (cfr. for ex. Nijland et al, 2009 as well as Desjardins et al., 1997).

Within this family of disorders, a condition of major interest is represented by idiopathic Childhood Apraxia of Speech (CAS), a neurogenic congenital disorder in which precision and consistency of speech movements are impaired in the absence of neuromuscular deficits: despite having normal cognitive abilities and neuromuscular endowment, children with CAS are unable to voluntarily plan and program phono-articulatory movements.

As a consequence, the major correlate of the pathology is an almost unpredictable variation in speech productions (50-100%). Such core feature causes these children to live a dramatically reduced and unreliable experience with language production. In a nutshell (and before therapy begins), they are forced to face phonological acquisition in the lack of sensorymotor skills. CAS appears, thus, an ideal condition to test the hypothetic importance of this ability for the full development of speech perception.

A research project is currently undergoing, focusing perceptual abilities in children with CAS as compared to typically developing peers and adults, with the aim to assess the presence of correlations between proficiency in production and perception skills in the three populations.

The three groups undergo an audiovisual speech discrimination task where the experimental stimuli are organized in an order of growing difficulty and selected with the aim of evaluating whether the complexity of the phono-articulatory movements required to produce the phonemes involved has an influence over the subjects' performance. An evaluation of the abilities of speech production is also carried out, with particular attention to the collection of indexes pertaining to speech motor control abilities (first of all, diadochokinesis). Finally, the relationship between the

participants' profile in production and perception will be assessed, in order to understand if significant statistical correlations exist.

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