

# From the binomial “phonetic-phonological disorder / dyspraxia” to the concept of isomorphopathy: a logopedic proposal of dynamic-functional classification of SSDs

Gessica Marinari, Elvira Tozzi, Giuseppe Costa, Maria Rosaria Barillari, Umberto Barillari

Division of Audiology and Phoniatrics, Department of Mental and Phisic Health and Preventive Medicine, Luigi Vanvitelli University, Naples, Italy

## Abstract

Speech therapists frequently find, during their daily clinical practice, pictures of speech and language disorder in the developmental age, especially in the phonetic and phonological fields.

There are many possible causes for this disorder, and the heterogeneity of its manifestation is very “variegated”. Therefore, we asked ourselves whether we could identify more than one sub-frames with different shades or even real pathological situations, differing for aetiology and also for diagnostic picture. In order to provide an answer, we had to step back, looking at the physiological development of verbal language, but with a slightly different perspective.

Thus, our research proposal is based exclusively on the assumption that perception and production are the two sides of the same coin (i.e. verbal language), and there is a close, deep bond that unites them.

We analyze here in detail the 3 types of clinical manifestations that we have taken into account

GROUP I: functional etiology is *in input*. The diagnostic hypothesis might be Auditory Processing Disorders (APD);

GROUP II: functional etiology is *in output*. There might be two diagnostic hypotheses: dyspraxia or working hypomotility;

GROUP III: functional etiology is the *inferential link between input and output*. The diagnostic hypothesis might be “*isomorphopatía*”, i.e. when a child proprioceptively believes that the motor pattern he has chosen for the unicum is correct but, in reality, it is jointed incorrectly to the auditory image. This neologism in the phoniatric-logopedic field, might be a new window on to phonetic-phonological disorders.

*Key words: dyspraxia, phonetic-phonological disorder, SSDs, isomorphism, isomorphopathy.*

## Introduction

Frequently in our job, dealing with disorders of language in the developmental age, we find ourselves faced with pictures of phonetic-phonological disorder. Speech sound disorders (SSDs) at 3 years of age are around 6-15%, decreasing between 1 and 4% towards six years age (Campbell et al., 2003; ASHA, 2000; McLeod and Harrison, 2009). Briefly, the incidence of the disorder does not appear to be very high, but the remediation strategy should not be underestimated.

But what is phonetic-phonological disorder? The diagnostic criteria described by DSM-V are the following:

- persistent language unintelligibility characterized by fusions, omissions, distortions or substitutions of phonemes: they interfere with verbal communication.
- such alterations interfere with social participation, academic performance or results of academic performance in any combination thereof.
- onset of symptoms occurs during early childhood.

- symptoms are not attributable to other medical or neurological conditions including TBI (APA, 20 13)

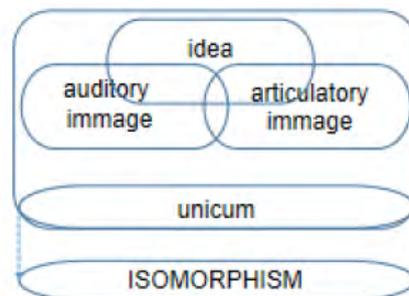
There are many possible causes of this disorder and we very “variegated” is the heterogeneity of its manifestation. Therefore we asked ourselves whether or not, within the various symptomatic frameworks identified as phonetic-phonological disorder, we could identify sub-frames with different shades or even real pathological situations that differed for their aetiology and therefore represented a different diagnostic picture.

processing its input and elaborating an image, just an auditory one. To make the idea communicable with its auditory image it is therefore necessary to associate it with an attempt at verbal production, i.e. at output. Therefore, we constitute an articulatory image, forged by tracing the auditory image.

The idea, the auditory image and the articulatory image travel together to form an “unicum”, which is an informative and / or communicative starting point (Figure 1)

This type of schematization seems reductive and “mathematical” but wants indeed to

Figure 1. Idea auditory image articulatory image isomorphism



Trying to give an answer to our questions, we realized however that it was essential to step back: to return to looking at the physiological development of verbal language, but with a slightly different perspective, although, in any case, respecting to date scientific evidence.

So, starting from observation in clinical practice, and therefore of pathology, we tried to go back to a model of language development, based exclusively on the assumption that perception and production are the two sides of the same coin (i.e. verbal language), and therefore on the close, deep, indissoluble bond that unites them.

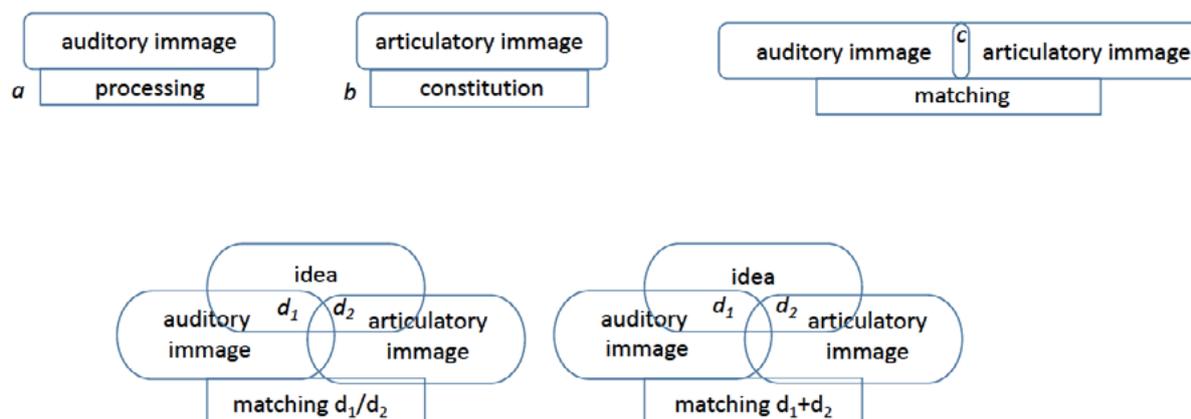
In practice, it is evident that the mental image of an object, an idea, an experience, remains such only if we are able to give it a “name”, placing it inside our memory warehouse. We can give a name to the idea thanks to the experience that we can make of it as input, being exposed to the native language from an early age, or rather during fetal life. In other words, we are able to gradually perceive that acoustic sensation (the “name”),

highlight, in an immediate way, what is the physiological process called isomorphism, starting from the assumption that a series of functions and capacities contribute to the realization of this “project”. When functions and the abilities are potentially sufficient for the realization of the project, but putting it into practice we find ourselves faced with dysfunctional alterations of the result, we think we have to look for the cause of the symptom manifested in one of the steps in the process of isomorphism.

We could have difficulty, therefore, in the processing of the auditory image, in the constitution of an articulatory image, or in the precise combination of the auditory pattern with the motor one, or in associating the correct auditory or / and articulatory image to the idea. (Figure 2)

So we are in the full mechanism of isomorphism, so much so that the cornerstones of this process are affected. But the great etiological distinction arising from contrasts instead with the apparent homogeneity of the symptomatology, characterized by pictures

Figure 2. Difficulty



that actually fade into one another, even to overlap, while preserving each his own identity instead. In fact, in most cases is evident an alteration in phonetic-phonological level, but with different causes as we have just mentioned, and consequently completely different enabling presuppositions.

## Methods

We analyse in detail the 3 types of manifestations that we seemed to identify, as they appear to the speech therapist in everyday practice.

GROUP I: functional aetiology in input (Figure 3)

Let's considering the first group, represented by the subjects that have greater difficulties in input, that is in the processing of the auditory image; we specify that we are not dealing with children with hearing impairment or with obvious difficulties in understanding, but usually a bit "slow" in processing information and analyzing it, especially for what is the informative aspect on phonological level. They are children who have difficulty in identifying the physical characteristics of the verbal sound and, by processing the input with difficulty, they associate it with a similarly inaccurate motor output. In our opinion, these are subjects who have auditory processing problems and, as a consequence, cannot be precise in production. The result will be the production of a sound, just inaccurate from the point of view of the distinctive features of one's own language, forged in practice on an imprecise processing of the incoming ver-

bal message. In these cases, the child is not aware of expressing himself incorrectly and therefore unintelligible.

He is therefore an uninhibited communicator. And if the adult was deliberately mistaken in imitating his articulatory error in a provocative way, he would not always be able to identify the error, primarily because of his difficulty in processing at entry (APD diagnostic hypothesis).

GROUP II: functional etiology in output (Figure 4A)

The second identified group shows the greatest difficulty in organizing the output, therefore it has greater difficulties on the production side. In these subjects perception and processing of the input are not affected but the planning, the motor coordination or in any case the precise execution of the motor scheme is not effective. These people are aware of their mistake and very often they experience this condition with (discouragement, dejection, drop?) because they realize that they are not able to produce what they heard clearly. The attitude, in fact, is almost always closing, shyness: we are faced with an inhibited talker.

These subjects identify the error on themselves, and obviously also on the other, processing the auditory input correctly (diagnostic hypothesis of dyspraxia) (Figure 4A).

In the context of the functional etiology in output it is also necessary to make another distinction: the just mentioned children have a deficit in the quality of the movement, having difficulty just in identifying what motor output corresponds to that auditory input, to memo-

alize it and to reproduce it over time. The situation is different for those children who have a deficit of “quantity” of movement: we refer to a generalized hypomotility of the oro-facial district that can be linked to various causes, such as spoiled habits (such as prolonged use of the pacifier), which induces them to be inaccurate in the production as they are not sufficiently tonic. Therefore, there is no difficulty in planning and coordinating movement but simply a productive ineffectiveness that can arouse (provoke?) repercussions on the efficiency of programming and coordination (hypomotility diagnostic hypothesis). (Figure 4B)

Here we are faced with a partly inhibited communicator.

The third group is those children who have no difficulty in input or output but in the inference between input and output. Taking a step back and retracing what happens at a very early age, we want to highlight what

we hypothesized starting from the observation of physiological development: in a very first step, the auditory image is matched by the child to the articulatory image, almost like a reflex arc, without a real analysis process, but with simply mesencephalic activity. This is what happens in the production of the first-order onomatopoeia (as mentioned in “I Care” No. 4, October to December 2016, by the same author), for example the reproduction of the barking of the dog.

In the early stages of language development, that is, the source of the noise is imitated by a laryngeal sound and a rough vocalized joint, a sort of reproduction by ear, in short.

Our opinion is that the basing ability of this jointing is the isomorphism: from the Greek «ἴσος μορφή» «same form», that is, in our case, being able to identify the “same shape”, on two different channels: auditory and motor, that is the correspondence of what heard with the motor pattern.

Figure 3. Diagnostic Hypothesis: APD

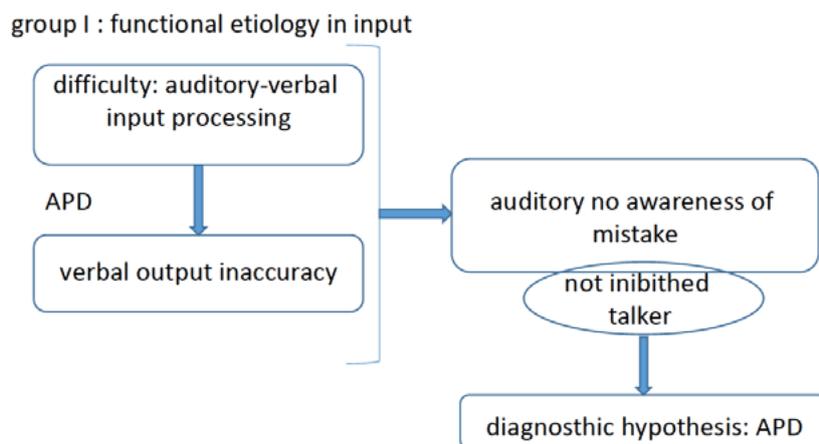


Figure 4A. Diagnostic Hypothesis: Dispraxia

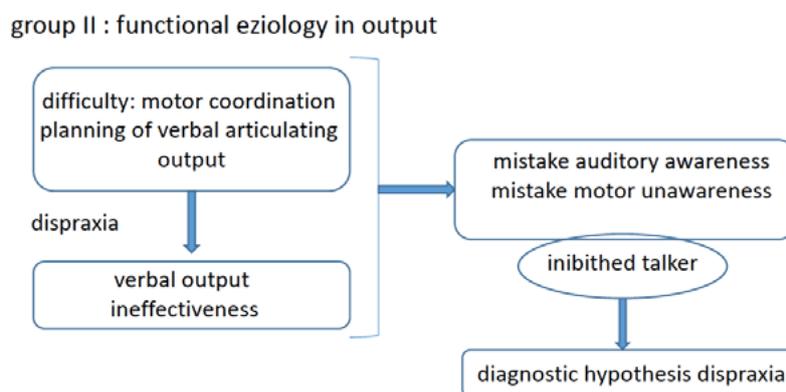
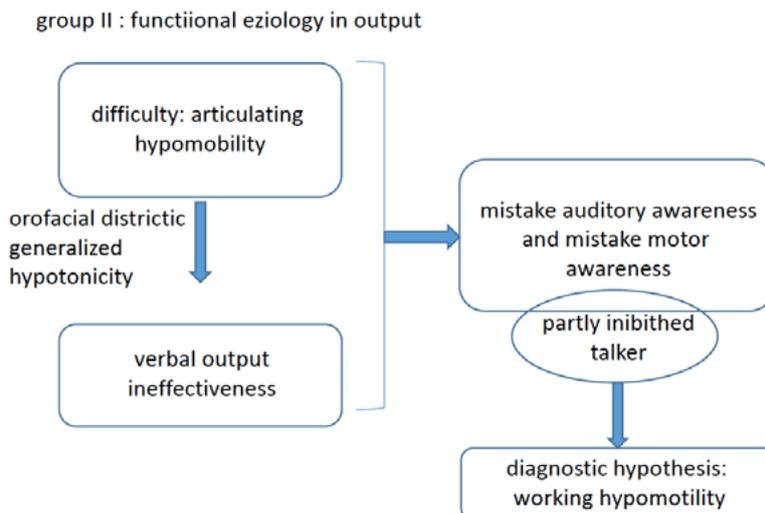


Figure 4B. Diagnostic Hypothesis: working hypomotility



## Results

Furthermore, we believe that this process, not entirely aware and not completely corticalized, can represent a kind of “first degree isomorphism”. (Figure 5A)

But when this auditory-motor jointing represents an idea, a concept, the “unicum” is born (see Figure 1). It consists of the semantic aspect, its perceptive and verbal producing image. The desire of sharing an idea, the concept, makes “reproduction” become a more articulated and more shareable production (Onomatopoeia of second order, *ibidem*) (i.e.: dog barking is “bau”).

In this case, therefore, it is necessary to activate more sophisticated analysis processes, auditory on the one hand and proprioceptive on the other, in order to be able to overlap a verbal producing image as precise as possible on the auditory image. This process may represent a second step, a kind of “second degree isomorphism”; this process is supported by executive functions. (Figure 5B)

In line with the criterion of functional aetiology, even when both auditory processing and articulatory dynamics are not affected, some uncertainties can nevertheless be found in the resulting verbal production of the child. In this case, they arise from the jointing mechanism of inputs and outputs, then in the isomorphism: in this case the II degree one.

Briefly, we can start from the assumption, that each production (“semantic phono-articulema”, in: “KEA” theoretical- practical update course - Acts of the XLVI Congress SIFEL. Milan, 27-29 June 2012), that means and is repeated over time, represents a single entity, a real unity constituted by the mental image of the object or of the concept expressed, combined with the auditory image and the articulatory image. Then we can realize how, in this case, the child will create a wrong “Unicum”, characterized by an incorrect jointing of auditory image and articulatory scheme: of input and output in short.

It must be said, however, that this situation of uncertainty in the input-output jointing is a completely physiological transition phase, but if this situation continues over time the problem crystallizes and a speech therapy intervention must be planned. This situation has a very precise remedial temporal window, within which the mistake does not root, but once this window is over, the child is convinced of “saying well” even when he is in error and it is more difficult to remedy the problem: it is like if he had acquired it incorrectly. Then speech therapist have to reconstruct the correct “unicums”.

This category of children, very often, is convinced that they express themselves correctly, but their verbal production is almost un-

intelligible, despite having a lexical inventory often quite large. They are usually not necessarily inhibited on the verbal-communicative side, but they close and become intimidated only when they believe that it is the adult who does not understand them (see figure 5). In fact, they are not aware of their mistake but at the same time they are perfectly able to recognize it in the adult. They recognize the mistake in the adult because their capacity of perception and processing of the input is intact and they associate correctly with the concept. They do not recognize the mistake on themselves verbal production probably because although the auditory image is correctly perceived, while they verbally produce proprioceptive feedback prevails, rather than the auditory feedback (i.e. the self-listening).

In conclusion, they control proprioceptively if the motor pattern *they* have chosen for the unicum is correct, but in reality it is incorrectly jointed to the auditory image.

And this is a further proof for a specific difficulty in the exact jointing of perceptive input and articulatory output, and not on one or the other "sides of the coin" only.

In order to the above concepts, that is the subtle complexity of the pathological situation, it is easy to understand how difficult it may have been for us to give a name as precise as possible to this pathological picture!

And yet, having identified its root in a deficit of isomorphism, we still feel we can call it isomorphopathy (a functional diagnostic hypothesis: isomorphopathy).

Figure 5. Diagnostic Hypothesis: "Isomorphopatìa"

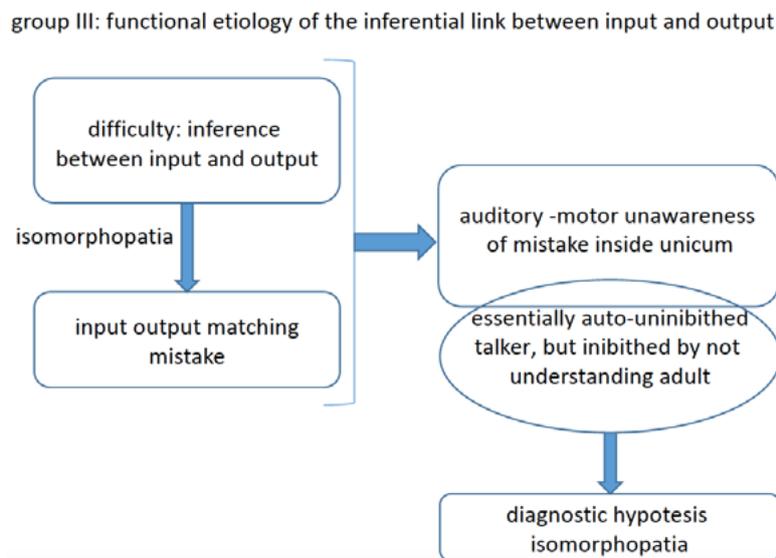


Figure 5A. First degree isomorphism

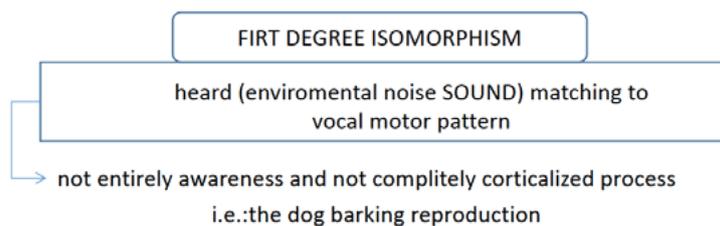
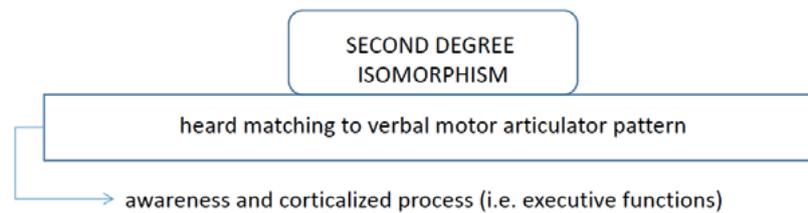


Figure 5B. Second degree isomorphism



## Discussion

In summary, beyond the proposal of dynamic-functional classification of SSDs, what has emerged powerfully from our study is the concept of “isomorphopathy” which, beyond the neologism in phoniatric-logopedic field, actually wants to be a new window from which to return to look at phonetic phonetic-phonological disorders.

Not a nosological alternative, therefore, but an exquisitely exclusively logopedic and therefore functional approach, both in the evaluation and in the remedial field.

Therefore, it is necessary to go beyond the symptomatological manifestation expression to set up the remedial intervention treatment on the true, deep root of the problem, starting from the assumption that we do not always find dysfunctional pictures with the same etiology also if it is , included in the same diag-

nostic symptomatic framework, find dysfunctional pictures with the same etiology.

We pointed out, in fact, that we can have a problem more related to the input and its processing (group 1, Apd diagnostic hypothesis), or to the output and its motor organization (group 2a, diagnostic hypothesis dyspraxia and group 2b, hypotonia diagnostic hypothesis of the district o-f), or again to the inference between input and output and their combination (group 3, isomorphopathy diagnostic hypothesis).

In order to what has been said so far, for us isomorphism becomes centering isomorphism as a basic mechanism, we would say almost ancestral: key to interpret the physiological processes and the relative pathologies and therefore to approach the remedial-enabling treatment.

## References

- Albano Leoni, F. (2009) Dei suoni e dei sensi: il volto fonico delle parole, Il mulino
- American Psychiatric Association. (2013) Diagnostic and Statistical Manual of Mental Disorders, 5th Edition, Washington DC
- American Speech Language Hearing Association. (Retrieved March 17, 2014) American Speech Language Hearing Association, Speech Sound Disorders: Articulation and Phonological Processes, from <http://www.asha.org/public/speech/disorders/speechsounddisorders.htm>
- Board of Regents of the University Of Oklahoma, Common Development Speech and Language Disorders, The Department of Communication Sciences and Disorders (Retrieved March 22, 2014) from [http://www.ah.ouhsc.edu/csd/leaps\\_disorders.asp](http://www.ah.ouhsc.edu/csd/leaps_disorders.asp)
- Bortolini, U. (1995) Lo sviluppo fonologico. Manuale di neuropsicologia dell'età evolutiva, Zannichelli
- Boxus, N. et al. (2018) Update on developmental dyspraxia in children. *Rev Med Liege*. Mar, 73(3):156-161.
- Braz, J. et al. (2016 Jan-Feb) The influence of (central) auditory processing disorder in speech sound disorders, *Otorhinolaryngol.* ;82(1):56-64. doi: 10.1016/j.bjorl.2015.01.008. Epub 2015 Oct 20.
- Genovese, E. Conti, G. (2013) Percezione uditiva e patologia del linguaggio, Omega Edizioni

- Hearnshaw, S. et al. (2018 Jan - Feb) The speech perception skills of children with and without speech sound disorder *J Commun Disord.* 71:61-71. doi: 10.1016/j.jcomdis.2017.12.004. Epub 2017 Dec 5.
- Munson, B. (2017 May) Phonological encoding in speech-sound disorder: evidence from a cross-modal priming experiment. *Int J Lang Commun Disord.* 52(3):285-300. doi: 10.1111/1460-6984.12271. Epub 2016 Jul 18.
- Nicolai, F. (2003) Argomenti di neurolinguistica, Edizioni del Cerro
- Orsolini, M. (2011) Il suono delle parole: percezione e conoscenza del linguaggio dei bambini, La Nuova Italia
- Prosser, S. Martini, A. (2013) Argomenti di audiologia, Omega Edizioni
- Sabbadini, L. (2013) Disturbi specifici del linguaggio, disprassia e funzioni esecutive, Milano, Springer Verlag
- Tozzi, E. Barillari, U. (2015) APD Auditory Processing Disorders (Approccio logopedico: dalla valutazione al trattamento abilitativo) Volume I, Omega Edizioni
- Tozzi, E. (2009) Verso il superamento del concetto di fonema: una nuova prospettiva di intervento logopedico nel disordine fonetico-fonologico, Convegno Siaf, Firenze
- Zalesky, A. (2016) Fundamentals of Brain Network Analysis, Academic Press