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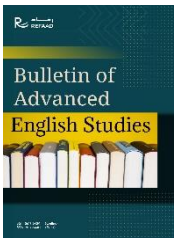

A Critical Account of Articulatory Phonology: A Subject Review

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Abstract: Phonological theories are in constant search for common points among natural languages, but there are complexities in applications weaking such theories. Articulatory phonology started as a system of gestures that are based on phonological units depending on phonetic articulation. However, it has ended widith loose terminology, a poor economy of principles and rules, vague concepts and dimensions, following subjective methods of analysis, and poor workability. This has left the theory without further applications and studies that are yet to be addressed.

Keywords*: Articulatory; Phonology; Critique; Gestures; suprasegmentals.*

1. Introduction

In their article about articulatory phonology, Catherine Browman and Louis Goldstein (1986, 1988, 1989, 1990a, 1990b, 1992) approach phonology from a language development viewpoint. The aim is to provide a phonological framework through such notions as gestures, task dynamics, etc. Gestures are regarded as the events and the units of contrast in lexical and articulatory aspects. Gestures have nothing to do with features and segments although rarely participate in their production.

Historically, Catherine Browmanand Louis M. Goldstein (1986) collaborated on a linguistic theory of phonology to unify phonetics and phonology under two levels of analysis; physical and cognitive. The physical level is the one that deals with phonetics, i.e., all types of phonetics that are categorized under certain abstract units to control the phonetics ones.

The units of planning orcategorization are organized in gestures that gather to constitute a gestural score which is the abstract level of the physical/phonetic representation. This is conducted through the dynamic model proposed by Elliot Saltzman. The gestural score indicates the constrictions that are hit by the gestural scores within the vocal tract. Reviewing such cognitive theory of phonology unfolds certain points of strength and other points of weakness. This article is to explore the theory and raise the weak points that could add to the workability of this theory if taken into account. The folliwng is the extract of the core theory:

> *Articulatory phonology[1][2] is a linguistic theory originally proposed in 1986 by Catherine Browman[3] of Haskins Laboratories and Louis M. Goldstein[4] of Yale University and Haskins. The theory identifies theoretical discrepancies between phonetics and phonology and aims to unify the two by treating them as low- and high-dimensional descriptions of a single system. Unification can be achieved by incorporating into a single model the idea that the physical system (identified with phonetics) constrains the underlying abstract system (identified with phonology), making the units of control at the abstract planning level the same as those at the physical level. The plan of an utterance is formatted as a gestural score, which provides the input to a physically based model of speech production - the task dynamic model of Elliot Saltzman.[5][6] The gestural score graphs locations within the vocal tract where constriction can occur, indicating the planned or target degree of constriction. A computational model of speech production developed at Haskins Laboratories combines articulatory phonology, task dynamics, and the Haskins articulatory synthesis system developed by Philip Rubin and colleagues.*

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2. Gestures as Dynamic Articulatory Structures

Gestures are sent to the articulators to do certain actions. Accordingly, these gestures are framed to restrict the vocal tract to language-specific needs. Such events are conducted under the task dynamics, i.e. the formulation of events. Task dynamics are the movements of the articulators such as the gesture /m/ needs the lips and the jaw to make certain movements. These movements are referred to as the variable of the tract. This applies to all the articulators involved.

The gestures have the primary significance in distinguishing meanings through the differences in gestural composition and organization, e.g. add vs. bad vs. had …etc. The presence or absence of a single gesture leads to such a type of contrast. Gestures are different in terms of assembling these utterances in that they might be the same gestures, but their organization is different according to the different goals that these gestures may hit. Gestures can be different due to different task dynamics in the sense that they differ in the range of the organ of speech; the tongue, and the lips, for instance, can have either turbulences or complete closure.

According to articulatory phonology, the description of the sound is based on the dimensions of neutral articulatory, acoustic, aerodynamic, auditory, and microscopic and macroscopic levels.

Based on the process of assimilation in most languages, it is argued that the formulation of gesture is to represent natural classes in a hierarchical order. This is based on the idea that gestures are found in the human vocal tract as universal basics.

3. Combinations of Gestures

By definition, gestures are conducted through physical events used in time and space. This implies that they are vulnerable to the effect of a certain process during speech. Utterances are to be regarded as a constellation of gestures, depending on certain codes of phasing as syntagmatic and paradigmatic inventories of gestures. Gestures are coordinated with one another to constitute a gestural score. The gestural score is the time and the space of the gestures as collected and sent to the articulators through the task dynamics. It is like the electoral flashing.

To account for the constriction degree resulting from overlapping gestures, Bird (1990) develops 'the Tube Geometry': Figure 1.

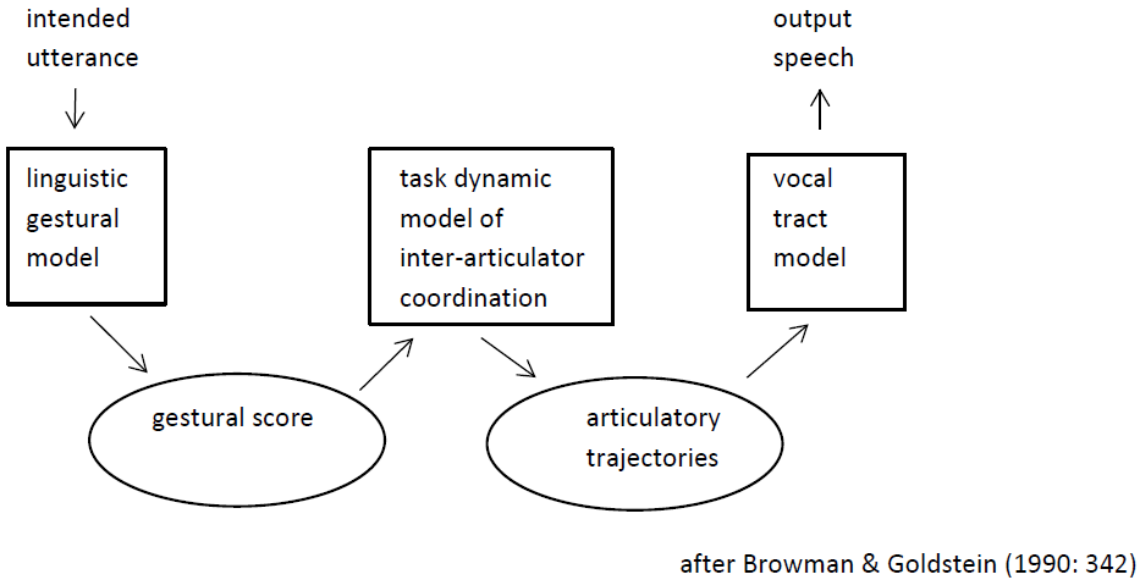

Figure (1): the Tube Geometry

A computational model is followed to account for how the gestures are activated, overlapped, and sent to the articulatory vocal tract through task dynamics. The way these gestures are combined within certain timing is regarded as a rich point in the system.

The same gestures yield different organizations that can be, for example, explained as pre/post aspirated stops or pre/post nasalized stops. The gestural evens as related to time exclude the need for phonological adjacency. In other words, assimilations or co-articulation, in general, are proof that there are certain gestures co-occurring together. On the other hand, Zsigra and Byrd (1990) and Zsiga (1993) assert the idea of not resorting to any phonological process in the sense that it is a matter of gestural overlap (Bird and Klein, 1990).

Coordination of gestures varies among languages according to acoustic studies Italian differs from Japanese in the intervocalic consonants from singleton to geminate (Smith, 1991).

4. Contrastive and Allophonic Variation

In articulatory phonology, the input-output dichotomy is employed; "input represents the gestural organization and output" represents the acoustics. This brings the difference between articulatory phonology and other feature/segmental approaches.

Using gestural analysis instead of segmental or features analysis reveals a different wider range of allophonic variation. The input, on the other hand, reveals a simple way of contrast. Another point that merits attention is that articulatory phonology captures certain generalizations that are not found in the traditional segmental or feature analysis. For example, the cases of stress and syllable placement show a very similar influence on gestures of different types.

Putting gestures syntagmatically, gestural organizations yield different types of output such as coordination and allophonic differences.

> "*When the same invariant consonant gesture is coproduced with different overlapping vowel gestures (e.g., [ada] vs. [idi], the articulator motions produced by the dynamic model will differ" (31).*

This is in core, related to co-articulation which deals with the behavior of the consonant gesture affected by the preceding and following vocalic gestures. Accordingly, such an effect could lead to the different organizations of the gestural scores, depending on the overlapping gestural variation.

Although traditional analysis of certain phonemes is based on position, articulatory phonology is based on the function of the position. Relying on an instance of glottal gestures leads to the positional and other variants. Glottis spreading has an important role in making allophonic variations. The presence or absence of the glottal gestures as an input affects the opening and closing gestures as a matter of aspiration. This is due to the function of timing that is associated with the glottal gestures. The disparity between the input gesture and the output causes a lack of aspiration.

In articulatory phonology, similar environments of glottal and oral movements are argued to be observed due to position and stress differences.

5. Variation during the Act of Talking

Using the gestural approach can benefit to be used as a way of analyzing phonological processes that depend on phonetic variations. Based on errors taken in connected speech, articulatory phonology makes an experiment in terms of production of /l/, recording the muscle activity. The result is that in connected speech, gestures overlapping may cause certain constriction to be acoustically hidden. This is shown by the X rays such as /t/ and /k/ assimilation. The /t/ becomes /k/ in "late …calls". This proves that the /t/ exists, but is hidden within the neighboring gestures.

It is also argued that speech alternations are taken place due to two reasons:

- the increasing overlap of gestures to the extent that the constrictions are hidden;
- the decrease of gesture magnitude through the functions of prosodic structure.

Finally, articulatory phonology claims that gestures are found in children as pre-linguistic units. These units participate in the development of the child's language. The older the child becomes, the more contrasts the gestures have.

6. Criticism

The theory is criticized according to four points. It is tested in terms of economy and/or simplicity, emphasizing the way how the theory tackles terms, rules, and principles that could lead to solid conclusions. The second point is how the theory is effective in phonology and outside of phonology, in terms of its relatedness to other disciplines. Another point is that whether the theory can explain new phenomena, meaning that the flexibility of bringing suitable, representative enough data to be based on. Next, the theory is tested for its accuracy, for every theory without accurate use of terms, strategies, and mechanisms is characterized as an ambiguous one. Finally, a mention is given regarding its practicality.

It is neither economic nor simple. It uses so many symbols of computational or electro terms, a matter that needs different fields of knowledge to be involved. This widens the distance between phonetics and phonology instead of unifying them. It is completely dependent on phonetics and other experimental sciences such as computer and synergy science.

- They do not clarify how gestures are made. They are ambiguous, leading to the lack of economy which complicates the matter.
- The gestures used in articulatory phonology all belong to English data which means that they rely on language-specific aspects. Such a way of using data causes the theory to lose its simplicity.
- In articulatory phonology, it is claimed that there are schematic principles that govern the gestures, a matter which contradicts the creative human nature. It is true to some extent, however, one cannot generalize things

without fully justifying the claims in all areas relative. Still, the question of children developing language is unanswered. Do they develop schemata all the time?

- It is argued that gestures are goals, not movements. This means that articulatory phonology deals with the cognitive side of phonology –not phonetics- however; all types of phonetics are involved such as articulatory phonetics, acoustics phonetics …etc. This matter is too far from being economic or simple.
- For things to be simple is to employ clear mechanisms that can logically tackle the data. In articulatory phonology, it is many mechanisms that one cannot predict any type to follow, meaning it takes more computations to achieve the targets of the gestures successfully. This is in no way simple.
- Different computational models are used; each model is responsible for certain steps ranging between the gestures and the articulatory dynamic movements. The computations account for the phasing of the gestural scores used to convey movements. These processes consider many types of gestures, among which are irrelevant to the data, leaving the matter even more complicated instead of being simple.
- The justification for adopting the task dynamics seems poor in that there is no economic reasoning why the overlapping occurs. Task dynamics cannot fully solve this issue as it is a non-speech model by Bernstein (1967), a model which is improperly used.
- There is no space for simplicity or economy in using electro-magnetic, EMALEMMA, ultrasound, X-rays, microbeam, and real-time MRI. Too many tools are used in the data. Psychologically speaking, most of the aforementioned tools are characterized by their drawbacks.
- Articulatory phonology is after theorizing about gestures and only gestures, without paying attention to the matter of how to obtain the representative data from such acoustic recordings, especially in connected speech. They claim that certain gestures are hidden in connected speech. The problem is how to make the discretion in the first place.
- There is no possibility to include more subjects to be representative enough. Articulatory phonology depends on individual speakers because it will take much time and many costs, there is no economics at all.

7. Conclusions

Reviewing the theory in question has come up with the following conclusions:

- In terms of the economy of the theory, it is difficult to attain a definite set of terms, rules, and principles that could justify the significance of the theory.
- The theory is in a weak position to be explicit enough and to have its impact on other fields of linguistics.
- In terms of analyzing phonological data, it is difficult or ambiguous how the theory herein can give a suitable model of analysis.
- At the level of practicality, this theory shows poor modes of practicality as it highly deals with computational and electronic devices.
- Above all, it lacks accuracy and it is ambiguous to be applied in phonology.

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