

CLARIFICATIONS ABOUT NATURAL PHONOLOGY

Anna Bogacka

Adam Mickiewicz University

abogacka@if.a.amu.edu.pl

ABSTRACT

This contribution argues that crucial as formalism is in computational linguistics and speech technology, Natural Phonology, with less rigid and less formalized claims, has important applications in the areas where language and not totally predictable human factors are involved. The paper discusses approaches to autonomy in language, explanation in Natural Phonology and applications of Natural Phonology.

Keywords: Natural Phonology

1. INTRODUCTION

A prerequisite for any discussion on usefulness of a given theoretical approach to language research is an agreement on what the goals of research are. Such an agreement seems not to have been reached between the discussants of this workshop. To clarify the aims and criteria for usefulness of Natural Phonology, this paper discusses approaches to autonomy of language. It further concentrates on the nature of explanation in Natural Phonology. Finally it shows where Natural Phonology can be practically applied, answering the needs of the context of a utilitarian ecology of science (cf. [13]).

2. AUTONOMY

For the approach favoring direct technological implementations postulated by Gibbon [14], it seems necessary to assume the autonomy of language because viewing language as a closed, self-contained structure helps in listing and formalizing of the elements involved. Language can, however, be viewed as an autonomous or non-autonomous cognitive faculty. The generativists assume that language is an innate, autonomous faculty, independent of other non-linguistic cognitive abilities. The functionalists are more likely to think that language is a non-autonomous faculty and they assume that the human ability to use a language is fundamentally not different from other cognitive abilities humans have. Natural

Phonology is a functional theory relating language to other domains of human life.

According to [2] the hypothesis that language is not an autonomous cognitive faculty has implications for the representation of linguistic knowledge and processes governing language use. The corollary related to linguistic knowledge is that knowledge of meaning and form on all levels of the language system, i.e. phonology, morphology, syntax and semantics, is conceptual. Although sounds and utterances are physical entities with a formal structure, they must be produced and comprehended. Comprehending and producing speech is possible thanks to cognitive processes, which accept speech sounds as input and produce utterances as output. The corollary related to processes governing language is that construction and communication of meaning by language are governed by the same principles as other cognitive abilities. Speaking and comprehending language involves essentially the same cognitive abilities that humans use in visual perception, reasoning or motor control. The component cognitive skills used for language processing are used for other cognitive tasks, too, and only the configuration of cognitive abilities used for comprehending and producing language is unique. This is not to deny an innate human language faculty. What functionalists deny is an autonomous innate human capacity for language. Functionalists acknowledge an innate component that gives rise to linguistic abilities unique to humans, but the emphasis of functionalist research is on the role of general cognitive abilities in language. The hypothesis that language is not an autonomous cognitive capacity has an implication for the functionalist approach to language research in the sense of holistic thinking: an adequate model of language has to involve reference to general conceptual structures and cognitive abilities.

Natural Phonology has always emphasized the role of external factors, such as cognitive abilities and physiological predispositions, in phonological processes. It has, however, undergone evolution of

its views from postulating complete innateness of natural phonological processes to accepting that processes arise at different stages of development as a result of self-organization [8].

3. EXPLANATION IN NATURAL PHONOLOGY

Natural Phonology uses “deductive inferences about grammars based on universal higher-order principles applicable to language as well as to other natural phenomena” ([10]: 77). Natural Linguistic preferences are explanatory because they are based on non-linguistic, external evidence.

“[W]e can arrive at explanations for the regularities within a certain domain by turning to theories that are not theories for that particular domain (e.g., for grammatical theories, these include: theories of phonetic production, perception, learning, memory, communication, action, semiotic theories, etc.)” ([20]: 9)

Natural Linguistics proposes a "hierarchic, deductive system within which linguistic preferences occupy a general second rank, below higher principles and above the specific linguistic consequences of preferences" ([7]: 390). Dziubalska-Kořaczyk ([10]: 76) illustrates the levels of the system with the following examples. Higher principles can be cognitive, phonetic, psychological, sociological etc., they are non-linguistic principles, like for example the principle of the least effort. Linguistic preferences include for instance a preference for simple phonotactics, for a CV structure. A linguistic consequence of such a preference is then the absence of clusters in a given language. In a conflict situation between preferences "agents strive towards maximal benefit or expected utility" ([7]: 392). Solutions for conflicts between preferences are to be found in higher-order universal principles and not in language-internal properties, because "preferences in the use and acquisition of language become frozen in preferences of language structure" ([7]: 394). It is also important to note that resolutions of conflicts can be predicted to a certain extent and therefore testable hypotheses can be postulated, but "total predictability is excluded by interlinguistic and intralinguistic language variation" ([6]: 294-295).

We have to decide whether we want to explain, what we want to explain and how we want to explain. According to Gibbon [14] “operational approaches only reach explanatory status when

given an appropriate procedural formalization and an appropriate computational implementation.” According to Natural Phonology “[s]cientific explanation is directed at gaining insight or understanding” and “[t]o ask for a scientific explanation is to ask for one or more reasons why it is as it is and probably cannot be different” ([1]: 188) (please note that this quote is taken from an author in no way connected with Natural Phonology). Natural Phonology claims that to describe and to formalize does not mean to explain. Description is a step in scientific endeavors, as the data are needed to verify a hypothesis. Formalization is also useful to test the hypothesis. Explanation, however, is answering the question “why?” Moreover, the answer to this question would not be considered satisfactory if it referred to internal explanation only, i.e. characterized the formal relationships between phonological entities within a self-contained grammar system. Natural Phonology stresses that the function of conveying meaning as well as cognitive and physiological factors influence language to such an extent that it is not feasible to describe and explain language without referring to the broadly understood functions it has.

Unlike many opponents of Natural Phonology seem to imply, it is not the case that Natural Phonology rejects formalism, i.e. very precise statements, e.g. stated in computational terms. Even though not many functionalist phonologists have endeavored to do so, there is nothing in the attempting at formalized statements, that would be incompatible with the Natural Phonological approach. In fact Dziubalska-Kořaczyk’s [11] Beats-and-Binding Phonology is stated in rigid terms.

The issue of external evidence and its function in description and explanation have been a matter of debate. According to Natural Phonology, external evidence is vital for explanation. According to its critics, structural explanation would be more useful (e.g. in technological applications), whereas relating preferences to higher-order principles only pushes the problem of explanation back one step. For Natural Phonologists, however, structural description and its formalization are mere descriptions useful before invoking more general, covering laws. The point first raised by Hempel and Oppenheim [14] and used by Eckman [12] to defend Structural Conformity Hypothesis, is also useful here. The

question “why” can be raised over again and relate to the general laws that serve phonology as explanations. These laws will act as facts for a higher-order areas and they themselves can be explained if they can be subsumed under generalizations which are more comprehensive, i.e. if they can be deduced from some more encompassing laws or principles. What is crucial is that Natural Linguistic preferences in the form of law-like statements make testable predictions.

4. APPLICATIONS OF NATURAL PHONOLOGY

The importance of considering evidence from other domains of human activity such as cognition, perception, production, memory and learning, as well as providing explanations related to conveying meaning, cognitive and physiological factors is vital in applying Natural Phonology in first and second language acquisition or speech therapy.

Natural Phonology assumes a constructivist conception of acquisition in which the model of self-organizing processes provides a bridge theory for physiology, psychology, neurology and Natural Phonology. According to this model, phonology results from the interplay of genetic preprogramming of phonetic processors and cognitive principles, and input information influencing neuron specialization and development of language modules. In contrast to the strong hypothesis [5, 18, 19], the self-organization model predicts that phonological processes are not fully innate, but they “arise at different stages of maturation in alternative set-ups” ([9]: 101). Certainly, it would be beneficial if Natural Phonology were able to formalize the stages of self-organization. The formal approach to self-organization of de Boer [3], however, focused on proving that self-organization can create vowel systems, and employed too many oversimplifications to be convincingly real: emergent patterns did not convincingly match real systems and there was no connection between the model and actual vowel acquisition or change [4]. The following paragraphs show that despite the lack of rigid formal model, Natural Phonological research can be successfully applied in areas where human factors, less predictable than computer processing, are employed.

Luschützky [16] prepared an annotated bibliography of naturalism in linguistics. Many

authors subscribing to naturalism are listed in [12]. Here two recent studies will be briefly discussed to show how Natural Phonology is applied in second language acquisition and speech therapy.

Połączyńska-Fiszler [12] examined first and second language dysarthria in TBI patients after prolonged coma. On the basis of articulatory processes emerging in child speech in first language acquisition proposed by Natural Phonology and used by Phonology as Human Behavior, she developed a taxonomy of characteristic processes found in TBI patients with dysarthria. She showed that the processes in TBI patients were more regular and involved more strictly phonetic motivation than the processes in first language acquisition. She found several new processes, which were not previously described in literature, i.e. incomplete consonant closure and consonant approximation. She demonstrated that on the basis of linguistic analysis of articulatory patches dysarthria can be diagnosed, and on the basis of knowledge which articulators were weakened it can be predicted which brain nerves were injured.

Wrembel [21] on the basis of Natural Phonological theory of second language acquisition involving self-organization of processes showed that formal instruction and metacompetence help second language learners acquire native-like pronunciation in second language. Theoretical embedding of her research in Natural Phonology, with its emphasis on phonetic and cognitive factors, allowed her to draw practical conclusions for second language pronunciation training.

These are the areas where Natural Phonological findings can be put to practice. Such contexts should be considered the environments where evidence from language use which Natural Phonology takes, is put back and applied as a product, thus closing the ecological circle (cf. [14]). This has been the case with [17] and [21] above and many other works listed in [16] and [12].

Thus assuming that Natural Phonology should inform computational linguistics [14] and criticizing it for not doing so is not well-addressed. It could be comparable to criticizing computational linguistics for not informing second language acquisition or speech therapy practice.

Computational formalisms produce applicable output of phonological modeling in the form of

speech technology systems. Computers with their speech synthesis or speech recognition systems are, however, supposed to imitate the same results that language users achieve either in speech production or in speech perception. The methods that are used in speech technology are simply expected to be efficient for its purposes and hence the use of formalisms. The methods that are used by humans to achieve the goal are not at all important in speech technology as long as the system is efficient. Linguistics, however, is the study of language as used by humans, not the study of speech technology. Therefore, it is postulated that since speech technology is interested in efficiency of computer systems synthesizing or recognizing speech, formalisms are indispensable in its realm, but in the area of Natural Phonology interested in language as the human phenomenon in the wide context, functional considerations and explanatory approach using external evidence, although perhaps not rigidly formalized, are much more useful in the ecological context of speech learning in first and second language acquisition and speech therapy.

5. CONCLUSIONS

It has been argued in this paper that the basis for a discussion of usefulness of any theoretical approach is an agreement on the goals of research. It has been shown that the methods of the study of language and the approach taken, i.e. formalist or functionalist, determine what goals we can aim at. Formalized approaches to language, producing operational computational models are useful for applications in technological domains, as for instance speech recognition or speech synthesis. Functional approaches, however, and thus Natural Phonology, are more focused on language as used by humans. This interest makes them well-suited for applications where the "human factor" with its psychological and physiological embedding is crucial: as in first and second language acquisition or speech therapy. In these domains implicational hierarchies of processes turn out to be successfully applied in teaching children who have difficulties in production in their native language or students striving to make progress in pronunciation in the second language and treating patients with aphasia or dysarthria.

6. REFERENCES

- [1] Botha, R. 1981. *The Conduct of Linguistic Inquiry*. The Hague: The Mouton Publishers.
- [2] Croft, W., Cruse, A. 2004. *Cognitive Linguistics*. Cambridge: Cambridge University Press.
- [3] de Boer, B. 2001. *The Origins of Vowel Systems*. Oxford: Oxford University Press.
- [4] Donegan, P. 2004. Review of Bart de Boer: The Origins of Vowel Systems. *Journal of the International Phonetic Association* 34(1), 95-100.
- [5] Donegan, P., Stampe, D. 1979. The study of Natural Phonology. In: Dinnsen, D. A. (ed), *Approaches to Phonological Theory*. Bloomington: Indiana University Press.
- [6] Dressler, W. 1985. *Morphonology*. Ann Arbor: Karoma Press.
- [7] Dressler, W. 1999. On a semiotic theory of preferences in language. In: Haley, M., Shapiro, M. (eds), *The Peirce Seminar Papers. Essays in Semiotic Analysis. Proceedings of the International Colloquium on Language and Peircean Sign Theory 1997*, Vol. 4. New York: Berghahn Books, 389-415.
- [8] Dressler, W. Karpf, A. 1995. The theoretical relevance of pre- and protomorphology in language acquisition. *Yearbook of Morphology* 1994. 99-122.
- [9] Dziubalska-Kołodziejczyk, K. 1998. Self-organization in early phonology. In: Puppel, S. (ed), *Scripta manent*. Poznań: Motivex, 99-112.
- [10] Dziubalska-Kołodziejczyk, K. 2001. Phonotactic constraints are preferences. In: Dziubalska-Kołodziejczyk, K. (ed), *Constraints and preferences*. Berlin: Mouton de Gruyter, 69-100.
- [11] Dziubalska-Kołodziejczyk, K. 2002. *Beats-and-Binding Phonology*. Frankfurt am Main: Peter Lang.
- [12] Dziubalska-Kołodziejczyk, K. 2002. Challenges for Natural Linguistics in the twenty first century: A personal view. *University of Hawai'i Working Papers in Linguistics*, Vol. 23, 15-39.
- [13] Eckman, F.R. Submitted. Typological Markedness and Second Language Phonology.
- [14] Gibbon, D. This volume. Formal is Natural: Toward and Ecological Phonology.
- [15] Hempel, C., Oppenheim, J. 1948. Studies in Philosophy of Science. *Philosophy of Science* XV, 135-175.
- [16] Luschützky, H.C. 1991. *Twenty Years of Naturalism in Linguistics. A Bibliography*. *Wiener Linguistische Gazette*, Beiheft 10.
- [17] Połczyńska-Fiszler, M. 2007. *First and second language dysarthria in TBI patients after prolonged coma*. Unpublished Ph.D. thesis.
- [18] Stampe, D. 1969. The acquisition of phonetic representation. *CLS* 5, 443-454.
- [19] Stampe, D. 1979. *Dissertation on Natural Phonology*. New York: Garland Publishing, Inc.
- [20] Vennemann, T. 1983. Causality in language change: Theories of linguistic preferences as a basis for linguistic explanations. *Folia Linguistica Historica* 6, 5-26.
- [21] Wrembel, M. 2005. Metacompetence-oriented model of phonological acquisition: implications for teaching and learning second language pronunciation. In: *Proceedings of the Phonetics Teaching and Learning Conference*. London: UCL. 1-4.