Biosemiotics (2021) 14:237–240
https://doi.org/10.1007/s12304-021-09443-x

EDITORIAL

Can quantitative approaches develop bio/semiotic theory?

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Received: 5 August 2021 / Accepted: 9 August 2021/ Published online: 13 August 2021

Abstract

This special issue addresses question about the place of quantitative methods in the field of biosemiotics. Many standpoints have been taken by contributing authors to demonstrate that the answer to this question is not straightforward. Considering quantitative methods in biosemiotics is necessarily related to inclusion of other scientific fields and interdisciplinary dialogue.

It is natural to perceive semiotics as a discipline based in qualitative approaches. When considering the combination of semiotic theory and quantitative methods, however, one may first recall semiotic applications in neuroscience considering semiotic interpretations of e.g., consumers' neurophysiological or psychological product perception (Compagno, 2018). For such approaches, semiotics plays the role of providing concepts and terminology, but quantitative semiotics is not yet advanced enough to directly incorporate quantitative methods into semiotic theory. These types of quantitative semiotic analysis are often used for commercial purposes (advertising, brand analysis), whether it is the use of questionnaires to determine respondents´ attitudes towards a particular sign, the use of imaging methods describing neural activities in connection to sign perception or production, or cluster analysis using specific text features.

The field of biosemiotics extends the interest of semiotics further, from culturally shared codes to the entire environment in which there are living beings and semiotic systems beyond humans. The scope of biosemiotics encompasses a wide range of phenomena to which we relate by way of our semiotic experience with human language, cultural customs, or visual signs. In this transition from human to other organisms´ environment we are often uncertain about our judgment, as our natural semiotic intuition might begin to fail. At this point the quantitative aspect of semiotics becomes self-evident: apt examples of quantitative investigations of semiotic qualities are e.g. the disclosure of 'junk' DNA function (Mantegna et al., 1995), language

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properties of DNA overlapping codes (Popov et al. 1996, Trifonov & Berezovsky, 2002), and language laws in animal communication (Ferrer-i-Cancho et al., 2013). This way of verifying theoretical assumptions in areas with an uncertain semiotic description seems to be a unique and optimal way to combine quality and quantity in semiotics (see also Eroglu, 2014, Torre et al. 2019). We are confronted with a number of problems regarding the interplay of quality and quantity as we often have no clear explanation of the quantitative characteristics of the phenomena, like in the case of language laws (Piantadosi 2014) – or we use nonspecific explanations like economization (Zipf, 1949). Quantification can also involve simply counting individual animals, in a research on animal semiotic behavior, as Delahaye emphasizes in her paper on this issue. But can we consider quantification as a principle of quality assurance? The key question of this special issue is: are there any ways of combining both qualitative and quantitative aspects of phenomena in semiotic and biosemiotic research, other than the commercial application of semiotic theory and experimental testing of the validity of theories?

Contributing authors approach the question from all possible perspectives and we hope that in its totality, the issue will provide the reader with an illustrative picture of the many ways to combine quality and quantity in semiotics and biosemiotics.

Claudio Rodríguez tries to depict the potential of quantification when contrasted with interpretive values. Rodríguez proposes exhaustive answers to the questions why, how, and what can be quantified in biosemiotics? The main question the author is trying to raise is whether the quantification can or even should be part of descriptions of semiosis and the sign.

Andrij Rovenchak and Mykola Husev draw on applied research and analyze viruses using parameters obtained from distributions of nucleotide sequences in viral RNA. Seeking for input data homogeneity, they analyzes single-stranded RNA viruses only. The defined nucleotide sequences are conceived as signs comparable to a certain extent to syllables or words as seen from the nature of their rank-frequency distributions. Thanks to the aforementioned methods, the authors defined a tool for a classification of viruses such as MERS, SARS-CoV, and SARS-CoV-2. By this approach, the biosemiotic analogy between genetic script and natural language is tested quantitatively.

Staying in the topic of genomics, Zeev Volkovich and co-author Valery Kirzhner discuss the possible "physical" meaning of the distance between genetic sequences, based on comparing the set of all words of fixed length (k-mer) occurring in two genomic sequences. Volkovich presents an interesting contribution to the problem of measuring distances between texts. He proposes a well justified mathematical approach mixing theoretical and experimentally based calculations.

Pauline Delahaye introduces prominent issues in current zoosemiotics, and she proposes quantitative methods and tools to solve these issues, including communication in corvids, dolphins and other signs not perceptible to humans. This insight brings a synthesis of current but also future quantitative methods used in the studies of animal behaviour. According to Delahaye, quantitative methods – or machines – help us to "see" the signs which would otherwise escape our perception. Dalahaye thus reflects on the relation between digital and analogue aspects of all kinds of communication and semiosis and the ways the two types of semiosis are complementary to each other.

On a similar note, Amelia Lewis presents a general overview to quantitative behavioural analysis applied to the field of zoosemiotic studies to advance the field of biosemiotics. Lewis' hypothesis is that signs and signals form patterns, which can be measured and analysed mathematically. Here, mathematical formalism is comprehended as an alternative to quantification. The author combines her findings with the data available in the traditional ethology literature, for which she provides semiotic interpretation based upon the theories by Peirce and Uexküll. In her conclusion Lewis proposes a "Semiotic Modern Synthesis" of Darwinism, which focuses on signals and their contexts, the latter being derived from Neo-Darwinian theory.

Anastasia Kolmogorova with co-authors Alexander Kalinin and Alina Malikova discuss the semiotic aspects of emotional text analysis. This paper brings results from a case study dealing with elementary emotions found in sample texts. As a conclusion the authors say that words are only used as an expression form insofar as they embody a higher range of semiotic complexity. The authors introduce a biosemiotic model of representation/interpretation of emotions. According to the authors, two semiotic facets are relevant: indexicality and emonicity.

Ramon Ferrer-i-Cancho and David Carrera-Casado have prepared a considerable research topic and its elaboration in the context of Zipf's rank-frequency law (which is considered as a universal property of language and text in contrast to artificial or non-living phenomena) in the acquisition of new vocabulary by older children and polylingual speakers. The topics of polysemy and homonymy are approached from a quantitative perspective, and a new model is proposed to be applied to further experimental research on vocabulary acquisition.

Antoni Hernández-Fernández shows some ontological consequences of the dichotomy between the qualitative and the quantitative. In his paper, phenomenological examples potentially related to semiosis are presented at different levels, contrasting the qualitative categorizations with the quantifiable physical reality. Qualitative approaches in biosemiotics are contrasted with the study of technosemiotics. The main message of Hernández-Fernández is that the qualitative precedes the quantitative in defining the path of science. At the same time, quantitative research helps with defining the important constraints and categories of physical reality, which constitute an indispensable part of the biosemiotic project.

The continuity between the quantitative and qualitative has been present in biosemiotics since the 1991 paper by Hoffmeyer and Emmeche (1991) where the notion of code duality was presented as the constitutive principle of living systems. The code duality corresponds to digital and analog codes, digital code of the DNA as a code for memory and the analog code for behaviour or action. The notion of code duality anchors the tensions between qualitative and quantitative in biosemiotics because of the understanding of the relation between digital and analog as not dualistic yet rather continuous or complementary. We believe that the theoretical grounding of the relation between analog and digital codes as a semiotic understanding of living beings is now being transformed into methodology, into the continuity between quantitative and qualitative methods which leads to a complex biosemiotics understanding of living systems.

We hope that this special issue represents the continual and complementary relations between quantitative and qualitative methods. This special issue of Biosemiotics has scope to bridge between existing qualitative methods in biosemiotics and quantitative

methods applied from other disciplines, such as DNA linguistics, bioinformatics, statistics, big data analysis and quantitative linguistics. As a consequence, applications of quantitative methods in biosemiotics lead to extending the field, its inclusion with other scientific fields, interdisciplinarity and intersectoral dialogue. Additionally, the overall aim of this issue was to challenge the potential of quantitative methods in the discipline anchored, since the beginning, in the qualitative research. With the general transformation of society and science, related to big data management and accessibility of big data and digitalization, almost all fields in the humanities have not only been transforming the methodology, but also the object of studies. Digital Humanities became a general term encompassing the current trends in human sciences. We believe that there is continuity between the qualitative and the quantitative, which has become more striking with the technical advances in recent decades. Reflecting on this current trend in human sciences will help biosemiotics remain updated and fresh discipline as it always has been.

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