Progress in Biophysics and Molecular Biology xxx (2017) 1–6

Contents lists available at ScienceDirect

Progress in Biophysics and Molecular Biology

journal homepage: www.elsevier.com/locate/pbiomolbio

What is it like to be “the same”?

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ARTICLE INFO

Article history:
Received 23 August 2017
Received in revised form
24 October 2017
Accepted 26 October 2017
Available online xxx

Keywords:
Systems dynamics
Topology
Borsuk-Ulam theorem
Computation

ABSTRACT

A unifying principle underlies the organization of physical and biological systems. It relates to a well-known topological theorem which succinctly states that an activity on a planar circumference projects to two activities with “matching description” into a sphere. Here we ask: what does “matching description” mean? Has it something to do with “identity”? Going through different formulations of the principle of identity, we describe diverse possible meanings of the term “matching description”. We demonstrate that the concepts of “sameness”, “equality”, “belonging together” stand for intertwined levels with mutual interactions. By showing that “matching” description is a very general and malleable concept, we provide a novel testable approach to “identity” that yields helpful insights into physical and biological matters. Indeed, we illustrate how a novel mathematical approach derived from the Borsuk-Ulam theorem, termed bio-BUT, might explain the astonishing biological “multiplicity from identity” of evolving living beings as well as their biochemical arrangements.

Contents

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https://doi.org/10.1016/j.pbiomolbio.2017.10.005
0079-6107/

1. Introduction: sameness and matching descriptions

The concept of "sameness" is the tenet of approximate reasoning, treatment of imprecision, assessment of physical systems and biological classification. Indeed, techniques such as pairwise comparison (Koczkodaj et al., 2017), rough sets and Fraenkel-Zermelo group theory are based on the concept of "equality" among different features. In particular, recently introduced versions of the Borsuk-Ulam theorem (BUT) state that a feature on a n-manifold projects to two points with "matching description" onto a $n+1$ manifold (Peters, 2016; Tozzi and Peters, 2016a). Starting from this rather simple and abstract claim, a fruitful general framework has been built which is able to elucidate disparate real physical and biological phenomena, from quantum entanglement (Peters and Tozzi, 2016) to brain activity (Tozzi et al., 2017a), from biological gauge theories (Tozzi et al., 2017b) to pre-big bang scenarios (Tozzi and Peters, 2016b).

Summarizing the novel topological approach, we may observe that, by taking into account projections on functional or real dimensions of physical and biological systems onto corresponding feature spaces, a system of mappings is achieved with "matching description" that fits very well with experimental results. This allows us to assess countless issues in far-flung scientific branches spaces (Angel and Leong, 1994; Benson et al., 2016; Giusti et al., 2016; Kida et al., 2016; Kleineberg et al., 2016; Simas et al., 2015). Nevertheless, what does "matching description" mean in a topological context?

Matching descriptions are termed "descriptively near sets", i.e., two (or more) features that lie on the same manifold, but that have no points in common. In a semantic framework, a matching description encompasses all information about two nodes in two structures which semantically correspond to one another. In what follows, we will describe other possible meanings of matching description in different scientific contexts, providing testable examples. We will subsequently introduce a novel version of Borsuk-Ulam theorem (BUT), dubbed bio-BUT, that takes into account the overwhelming evolutionary complexification of living beings. Within the bio-BUT framework, we will use the concept of "matching description" in order to compare mathematical, physical and biological features of signals such as amplitude, duration and intensity.

2. The problem of connection and unity

2.1. Some fundamental questions

Here we may ask, paraphrasing the seminal paper by Nagel (1974), what is it like to be a matching description? In order to tackle this issue, here we need to ask before: has matching description anything to do with "identity"? In the "classical" BUT, the matching features are just points, therefore a point is equal to another and we might easily state that they are "identical" (Borsuk, 1933). On the other hand, in the novel BUT variants, the matching features stand not just for simple topological points, but also for more intricate features, such as shapes of space (spatial patterns), shapes of time (temporal patterns), vectors, tensors, functions, signals, thermodynamic parameters, movements, trajectories, lexical structures (either syntactic or semantic), or most generally, symmetries and symmetry breaks (Peters et al., 2017; Matoušek, 2003).

Thereafter, we may ask: apart from the two dimensional points of the classical BUT, are other types of matching features identical? When you compare a pair of "equal" features, how do you state that they are equal? Do they have the same feature, or two different features with something in common? In order to solve the issue, we analyze the "principle of identity" (Heidegger, 1957), which is one of the three tenets of classical logic.

2.2. First answer: sameness

The principle of identity states that A = A. The formula expresses, in its usual description, an equality of A and A. One A is equal to another A. Therefore, we can state that A is the same as A, because "identical" (from Greek and Latin) means: "**the same**". We will see how "matching description" standing for "sameness" can be found not just in the rather abstract disciplines of philosophy, logic and mathematics, but also in the "objective" accounts of physics and biology and in the "subjective" realm of single individual's mental activity.

2.3. Second answer: equality

In another version, the formula A = A speaks of "equality". A is A. It does not say that A is the same, but that **every A is itself the same**. Or, in other words, each thing itself is the same for itself and with itself.

2.4. Third answer: belonging together

It can also be stated that matching description "belongs to" an identity. In this case, sameness stands for a "**belonging together**". In "belonging together", the world "together" means to be assigned and placed into the order of a together, to be established in the unity of a manifold, **to be combined into the unity of a system**. Such assignment and placing occur thanks to connections and mappings of the one with the other. Belonging together means that two features are put orderly into a common feature that is outlined against the background.

Therefore, two interpretations are feasible: a) matching description is determined by an identity as a feature of that identity; b) identity is represented as a feature of matching description.

To make an example, night and day belong together: if you say just "day", you do not yet acquire knowledge, if you not think the day as lasting until the night's onset. The night is night just because it stands for the day fading. Therefore, night and day are not just two interchangeable features; rather they have to be taken together. Two contrasting features such as night and day stand out in sharp relief just because they are two and meet one with each other.

2.5. Fourth answer: coincidentia oppositorum

Another possible interpretation for A = A might be extrapolated from de Cusa (1440) and Bruno (1582): the so-called *coincidentia*

Please cite this article in press as: Tozzi, A., Peters, J.F., What is it like to be "the same"?, Progress in Biophysics and Molecular Biology (2017), https://doi.org/10.1016/j.pbiomolbio.2017.10.005