Review of Charles R.Gallistel, (1990), The Organization of Learning. Part 1

A Review from a Philosophical Point of View
*

Gerd Doeben-Henisch
doeben@fb2.fra-uas.de
Frankfurt University of Applied Sciences
Nibelungenplatz 1
D-60318 Frankfurt am Main

June 18, 2019

Abstract

This is Part 1 of a philosophically minded review of the 1990-Book of Charles Randy Gallistel. It sees this book as an exciting example of a new kind of research paradigm trying to bridge the gap between observable behavior, hidden cognitive structures, and the brain as enabler of this cognitive dynamic.

1 Encounter with the Book

My encounter with this book of Charles Randy Gallistel (1990) [Gal90] was stimulated through another book 'Conceptual Spaces' (2000) by Peter Gärdenfors [GÖ0], who cited Gallistel's book. Before I started my review of Gärdenfors 2000 I thought it could be a good idea to have a look into Gallistel 1990. This idea of 'having a look into' turned out to become a lengthy and intensive reading process interacting with 648 pages. This reading stimulated me finally to try a review of Gallistel 1990 before going back to Gärdenfors 2000 (and there are more papers and books of Gallistel after 1990 and Gärdenfors after 2000!).

2 Point(s) of View

For me Gallistel 1990 is interesting from different points of view. One of my favorite views is a *philosophy of science (PoS) point of view*.

After more than 150 years the common understanding of PoS has not yet settled into a commonly accepted coherent conceptual framework.

I myself are using the concept of PoS as a conceptual tool to understand better the divergent activities of so-called empirical scientists, for to make these activities

 ISSN 2567-6458, Publication date: June 18,2019

describable and comparable. This includes that one is able to map the *observable activities* of empirical scientists into *formal structures* representing these scientists as objects of PoS acting in a certain way. That, what traditionally is called a *scientific theory (ST)* is here a special kind of a formal text (FT) which is used as part of the communication and cooperation between the acting scientists. The key to the understanding of these theories is located in the *inner states of the acting scientists*. Whether these formal texts as a whole or some parts of them have some kind of *meaning* or not is completely depending from these inner states which as such are *not observable*. Therefore a complete *framework for a PoS view of scientific activities* has to include some hypotheses about the inner states of the scientists to such an extend that one can explain the generation of the formal texts used as theories as well as their functioning as part of the communication and cooperation activities.

This view of PoS points to a fundamental problem of all kinds of thinking: the *bootstrapping of communication*!

Whatever explanation someone wants to offer to someone else he always has to presuppose some *language* which is sufficiently shared between the participants of the communication. Presupposing a language is not limited to the exchange of certain *expressions* (written, spoken, gestures) but includes always *some internal coding* to map expressions into something which is associated with the expressions. This presupposes usually a longer *history of interactions* with appropriate situations as source for possible internal encoding. There is no sharp point in time from which onward one ca say someone is a speaker of the language. Usually it is a *fuzzy time window* which marks a *transition* from *non-speaker to speaker*.

Thus speaking about empirical science within a PoS view presupposes already an elaborated knowledge of some language including expressions as well as encodings of meaning.

To reflect about these general conditions enabling a PoS view is usually regarded as the domain of *general philosophy (GP)*, a position which is not completely definable because it is *located in the bootstrapping process* as such and is that knowledge which enables a more organized PoS view.

This foundational fact is somehow reflected in the famous result of Goedel's incompleteness paper (1931) [Goe31], which demonstrates that no formal system as rich as the arithmetic (and higher) is capable of generating in a consistent and complete way all proofs which are possible for such a system. Goedel himself gives no philosophical explanation for this result. But having in mind the general bootstrapping problem of the human scientific mind it is clear that every kind of scientific theory has to make a certain amount of presuppositions based on which statements and inferences are possible. And the most important presupposition is given in the presence of the acting scientists as such: without their body (and brain) and their kind of interactions with the surrounding empirical world no theory is possible. Thus to explain the impossibility of consistent as well as complete proofs one has to include the conditions of these proofs. *The conditions are the interacting scientists as such*.

In the history of general philosophy there was some thinking about these general

conditions, especially in those discussions where the communication of people has to be taken into account (e.g. Wittgenstein when he was criticizing his own naive view of formal language and formal logic (cf. Wittgenstein (1953) [Wit53])). In PoS this critical thinking about the scientists themselves was not present in the formalist approaches which mark the mainstream (e.g. Suppe (1979) [Sup79], Sneed (1979) [Sne79]).

If one accepts (i) the view that the inevitable bootstrapping process is a presupposition of every kind of scientific theory and (ii) that the functioning of real science involves always the scientists as actors then this points not only to general philosophy as main point of view but also to the different already *existing empirical* (and therefore specialized and methodically limited) *theories* dedicated to behavior. Examples of such behavior oriented theories are *psychology* and *general biological ethology*. Because psychology can be understood as a special case of biological ethology we can stay with the latter.

3 Locating Gallistel's 1990-Book in Science

Applying the before characterized situation of philosophy and science to the 1990-book of Gallistel one could characterize it as a scientific contribution to observe and explain the *behavior of biological systems with regard to some fundamental kinds of behavior*. Thus we have the following scenario:

1. There is an *environment* with some *biological actors* (the latter understood as minimally adaptive input-output systems)
2. There are *observers (scientists)* which apply *methods of measurement* to get some data out of this.
3. The observers try to *explain* these data by *embedding* them into a *network of dynamic relations* which are presented as *formal (mathematical) structures*.
4. The possible *meaning* of these formal structures is given by the *associated data* and the *observable as well as simulated changes* in the associated states of the environment.
5. Because the formal structures with their built in dynamics can generate more possible states as can be observed and measured before the formalization of the model, there is a *meaning potential embedded* in the formal structures which has to be *kept 'neutral'* with regard to be classified as 'true' or 'false' as long as there is no real state occurring which can be interpreted as the 'real counterpart' of the 'formally described fact'.

Points (1) - (4) are somehow common place between scientists; point (5) is perhaps not so well accepted by all. Nevertheless there are even more facts, which are important but rather controversial until now.

4 A Point (6)

While philosophy starts from the *conscious* states of the brain, taking all *phenomena (PH)* as given and as important, the *empirical sciences* are limiting the focus on those subjective *phenomena (PHe)* which seem to have *counterparts (We)* in the *inter-personal world of measurable facts*. Thus the *empirical phenomena PHe* are not in contradiction to the philosophical view but are a *true subset* of this view ($PHe \subset PH$) with the specialty to be 'linked' to objects which can be measured independently from the consciousness.

This constitutes a *dual data world*: the *subjective* phenomena *without the empirically linked* phenomena (PH - PHe) and the *empirically* linked phenomena (PHe). But one should be aware that this duality is *only a methodological duality* which in the view of philosophy stays as a coherent unity! The phenomena PH are the 'basement' and the distinction into those which are linked with hypothesized empirical facts (We) and those which aren't is a *secondary epistemic construction*.

The empirically linked phenomena PHe are typically those which include observable behavior of objects and biological systems. The latter are here always understood as actors.

With the progress of the empirical sciences it became possible to reveal the inner structures of objects (matter) in general, but also of biological systems in general. Thus under the label of *anatomy* and/ or *physiology* it became possible not only to detect inner organs and their interactions but even more one could reveal the organs as *complex systems of intersecting cells*, which in turn became analyzed as complex networks of many more fine-graded biological structures consisting of complex molecules based on atoms and subatomic particles.

With these new more fine-graded empirical views one could *extend the observations of the behavior to the internal structures and processes* happening somehow simultaneous to the observable behavior.

Soon it became clear that there exists *no simple 1-to-1 mapping* between the observable behavior and the surrounding environment of a biological system with the observable inner structures. The inner structures appear to be structurally extremely complex with an even more complex dynamics which requires rather new methods of measurement and formal modeling.

5 Locating the 1990-Book - Part 2

Taking points (1) - (6) together then the 1990-book of Gallistel is very interesting. Gallistel not only deals within the framework characterized by the points (1) - (5), but he also tries to follow the options characterized by point (6). When Gallistel has worked out a first *partially formalized theory of behavior (Th.SR)* of certain kinds of biological systems (Chapters 1-13), he starts to reflect about *possible structures in the brain* which can explain why and how the before analyzed observable behavior is possible. Thus he tries to use some available empirical data from the brain, as-

sociates these with some assumptions about the functioning of the brain (Th.NN), and tries then to map his partial formal model of behavior (Th.SR) with his informal model of the brain (Th.NN).

Although in the view of the reviewer Gallistel's formal modeling of the brain as well as his mapping from behavior into the brain is not yet completely sound, his complete research program is impressive, courageous, and seems to be *a model for the research of the future* to combine behavior and consciousness.

Today there are some programs around under the heading of '*Neuro-Psychology*' but these are not yet methodologically really convincing.

It seems that Gallistel did here a great job and it is worthwhile to analyze his program with more details.

References

[GÖ0] Peter Gärdenfors. *Conceptual Spaces: The Geometry of Thought*. MIT Press, 2000.

[Gal90] Charles R. Gallistel. *The Organization of Learning*. MIT Press, 1990.

[Goe31] Kurt Goedel. Über formal unentscheidbare Sätze der Principia Mathematica und verwandter Systeme, i. *Monatshefte fuer Mathematik und Physik*, 38:173–98, 1931.

[Sne79] J. D. Sneed. *The Logical Structure of Mathematical Physics*. D.Reidel Publishing Company, Dordrecht - Boston - London, 2 edition, 1979.

[Sup79] F. Suppe, editor. *The Structure of Scientific Theories*. University of Illinois Press, Urbana, 2 edition, 1979.

[Wit53] Ludwig Wittgenstein. *Philosophical Investigations*. Macmillan, New York, 1953.