Chapter 7
Habit in Semiosis: Two Different Perspectives Based on Hierarchical Multi-level System Modeling and Niche Construction Theory

Pedro Atã and João Queiroz

Abstract Habit in semiosis can be modeled both as a macro-level in a hierarchical multi-level system where it functions as boundary conditions for emergence of semiosis, and as a cognitive niche produced by an ecologically-inherited environment of cognitive artifacts. According to the first perspective, semiosis is modeled in terms of a multilayered system, with micro functional entities at the lower-level and with higher-level processes being mereologically composed of these lower-level entities. According to the second perspective, habits are embedded in ecologically-inherited environments of signs that co-evolve with cognition. Both descriptions offer a novel approximation of Peirce's semiotics and theoretical findings in other areas (hierarchy theory, evolutionary biology), suggesting new frameworks to approach the concept of habit integrated with its role in semiosis.

Keywords Semiosis · Hierarchical multi-level system · Niche construction · Peirce

Introduction

We present here two different approaches of habit in semiosis: as a macro-level in a hierarchical multi-level system, where it functions as boundary conditions for emergence of semiosis; and as a cognitive niche produced by ecological and environmental inheritance of cognitive artifacts. According to the first approach, Peirce's semiosis can be modelled in terms of a hierarchical multi-level system of constraints. In our description, semiosis is modeled in terms of a multilayered system, with micro functional entities at the lower level, and higher-level processes mereologically composed of these lower-level entities (Queiroz and El-Hani 2006a, 2012). According to the second approach, habits are embedded in

P. Atã · J. Queiroz (✉)
Federal University, Juiz de Fora, Brazil
e-mail: queirozj@pq.cnpq.br

ecologically-inherited environments of signs that co-evolve with cognitive advances.

Peirce's semiotics is grounded on a list of logical-phenomenological categories —Firstness, Secondness, Thirdness—which corresponds to an exhaustive system of hierarchically organized classes of relations (Houser 1997). This system makes up the formal foundation of his model of semiosis as a process and of his classifications of signs (Murphey 1993: 303–306). Firstness as a mode of being is related to the modality of possibility. It is the category of vagueness and novelty—"the mode of being which consists in its subject's being positively such as it is regardless of anything else. That can only be a possibility." (CP 1.25) Secondness is the mode of being "which is as it is relatively to a Second but regardless of any Third." (CP 6.200) It is a kind of reaction. Like Firstness, Secondness can be related to a modality, namely, the modality of actuality (CP 6.455; Parker 1998). The actuality of a thing is simply its occurrence. Rephrased, actuality is the realization of a possibility, without thereby making reference to something larger, be that a general law or an interpretation. Peirce considered "the idea of any dyadic relation not involving any third as an idea of secondness". (CP 8.330) Thirdness is the category of mediation, habit, generality, and conceptualization (CP 1.340). The example par excellence is Peirce's semiotic process (semiosis) in which a sign is related to an object by mediation through an interpretant.

According to Peirce, any description of semiosis should necessarily treat it as a relation constituted by three irreducibly connected terms (sign-object-interpretant, S-O-I), which are its minimal constitutive parts (CP 5.484; EP 2: 171; Atkin 2016: 131). Peirce also defines a sign as a medium for the communication of a form or habit embodied in the object to the interpretant, so as to constrain (in general) the interpretant as a sign or (in cognitive systems) the interpreter's behavior (De Tienne 2003; Hulswit 2001; Bergman 2000; Queiroz and El-Hani 2006b). The notion of semiosis as form communicated from the object to the interpreter through the mediation of the sign allows us to conceive meaning in a telic, processual, non-substantive way, as a constraining factor of possible patterns of interpretative behavior through habit and change of habit.

Stanley Salthe's Model and Semiosis

Queiroz and El-Hani (2012, 2006a, b) have modelled semiosis through a hierarchical multi-level system model (Stanley Salthe's hierarchical structuralist model). Salthe's model separates complex processes in a hierarchical structure. He emphasizes that, in order to describe the fundamental interactions of a given process, we need to: (i) consider it at the level where we actually observe it (focal level), (ii) investigate it in terms of its relations to its parts, at a lower level (usually, but not necessarily always, the next lower level (micro-level), and (iii) take in due account entities or processes at a higher level, in which the focal entity or process is embedded (macro-level). The processes described at the focal level are constrained
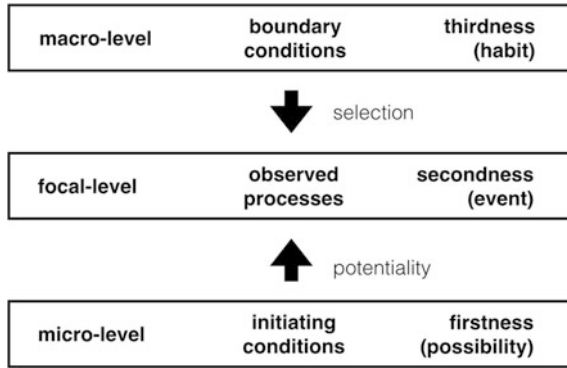
Fig. 7.1 A scheme of the determinative relationships in Salthe's basic triadic system in relation to Peirce's categories. A habit (Thirdness) is associated with the macro-level of the observed phenomenon, performing a selection, through boundary conditions, of potentialities which exist in the micro-level (associated with Firstness). The interaction between micro- and macro-level lead to the emergence of processes as observed in a focal-level (associated with Secondness)

by the influences of processes described at the higher and at the lower levels. These constraints allow us to explain the emergence of processes (e.g., semiosis) at the focal level.

At the micro-level, the constraining conditions amount to the *possibilities* or initiating conditions for the emergent process, while constraints at the higher level are related to the role of a (selective) environment played by the entities at this level, establishing the boundary conditions that regulate the dynamics at the focal level. In this model, an emergent process at the focal level is explained as the product of an interaction between processes taking place at lower and higher levels. The phenomena observed at the focal level should be "… among the possibilities engendered by permutations of possible initiating conditions established at the next lower level" (Salthe 1985: 101). Nevertheless, processes at the focal level are embedded in a higher-level environment that plays a role as important as the role of the lower-level and its initiating conditions. Through the evolution of systems at the focal level, this environment or context selects, among the states potentially engendered by the components, those that will be effectively actualized. Figure 7.1 shows a scheme of the determinative relationships in Salthe's basic triadic system.

Habit and Semiosis

The notion of "habit" can be characterized in several different ways: as a "pattern of constraints", a "conditional proposition" stating that certain things would happen under specific circumstances (EP 2: 388), a "rule of action" (CP 5.397, CP 2.643), a disposition to act in certain ways under certain circumstances, especially when the

agent of the habit is stimulated, animated, or guided by certain motives (CP 5.480), or, simply, a "permanence of some relation" (CP 1.415). Its scope is broad: "all things have a tendency to take habits", that is, "every conceivable real object" (CP 1.409). Although habits are to be found in all things, it is not reducible to any number of instantiations: "no agglomeration of actual happenings can ever completely fill up the meaning of a 'would-be'" (EP 2: 402; CP 5.467). Habits participate in a self-generative development: "[A Habit] is a generalizing tendency; it causes actions in the future to follow some generalization of past actions; and this tendency is itself something capable of similar generalizations; and thus, it is self-generative." (CP 1.409)

Semiosis can be defined as the mediation of the self-generated regularity of habits, and a Sign can be defined as the vehicle of such mediation. That is, a Sign is something that communicates a "form", or habit which is embedded in another thing (an Object), generating a constraining factor in interpretative behavior (called an Interpretant) (see Queiroz and El-Hani 2006a). Note that in Peirce's work, the notion of habit is very similar to "form". Peirce separates a similar notion into two (Stjernfelt 2007: 37–38), with form being a "mere possibility", "anterior to anything actual", and habit referring to an already generalized possibility that governs actual occurrences. That is, "form as mere possibility in Firstness, anterior to anything actual, and form as realized possibility in Thirdness, where it governs Secondness in the shape of habits." (Stjernfelt 2007: 37–38)

> [...] a Sign may be defined as a Medium for the communication of a Form. [...]. As a medium, the Sign is essentially in a triadic relation, to its Object which determines it, and to its Interpretant which it determines. [...]. That which is communicated from the Object through the Sign to the Interpretant is a Form; that is to say, it is nothing like an existent, but is a power, is the fact that something would happen under certain conditions (MS [R] 793:1–3, "On Signs". See EP 2: 544, n. 22, for a slightly different version).

We refer to this irreducibly triadic relation as S-O-I (see Fig. 7.2). The irreducibility indicates a logical property of this complex: the sign process is not decomposable into any simpler relation (CP 5.484), and must be regarded as
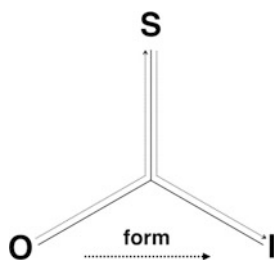
Fig. 7.2 Semiosis as a relation between three irreducibly connected terms (sign-object-interpretant, S-O-I). This triadic relationship communicates/conveys a form from the object to the interpretant through the sign (symbolized by the *horizontal arrow*). The other *two arrows* indicate that the form is conveyed from the object to the interpretant through a determination of the sign by the object, and a determination of the interpretant by the sign

associated with the interpretant, as an ongoing process of interpretation. For Peirce, "what a thing means is simply what habits it involves" (CP 5.400). It is a form embedded in the Object which allows a semiotic system to interpret the sign as indicative of a class of entities or phenomena (Queiroz and El-Hani 2006b: 183). Meaning is conceived, without any reference to psychological entities, as a constraining factor (S) in possible behavior (I) determined by a regularity of behavior previously embedded elsewhere (O). These are functional, interchangeable, roles: that which functions as a Sign in a given analytical description of the semiotic process could possibly be described as an Object, or an Interpretant, in another analysis. Note that the effect that characterizes the Interpretant does not necessarily act on an individual mind, but also, for example, on a social group or a culture (Bergman 2005: 218).

Processism and Emergence in Semiosis

This notion of semiosis as the mediation of a regularity of action allows us to conceive meaning in a processual, non-substantialist way. Processism and substantialism here refer to approaches that give more prominence to either substances or processes as basic explanatory units. Substances in substance metaphysics are ontologically basic entities, internally undifferentiated, bearers of properties and subjects of change, which are independent and durable (Seibt 2016: paragraph 4; see also Robinson 2014). In opposition to such notion, processes in process metaphysics are coordinated and systematically causally or functionally linked occurrences of changes in the complexion of reality (Rescher 1996: 38). While substance metaphysics take unchangingness as a default condition and emphasizes the need to explain changes, process metaphysics understands change as the default condition and emphasizes the need to explain stability (Bickhard 2011: 5). While substance metaphysics considers unchanging substances (e.g., atoms sensu Democritus) as the sole bearers of properties and causal powers (thus precluding emergence of new properties), process metaphysics is inherently relational and considers that some properties are presented by processes by virtue of organization, so that the emergence of new organizations may generate new properties, including causal powers (see Bickhard 2011: 5–7).

To explicate how semiosis allows us to conceive meaning in a processual way, consider the following example of process and interpretation of a process, given by Bickhard:

> If a cloud vortex produces a tornado, which then retracts, and then a funnel descends from the same cloud vortex, how many instances of a tornado process are involved? In terms of criteria of ground level damage, there are two (or more), but, in terms of criteria of locus of self-organization, there may be only one (the wind shear and consequent roll that produces the cloud vortex). (Bickhard 2011: 8)

Fig. 7.3 For the same sign
("Tornado") and the same
observed phenomenon, there
are two distinct possibilities
for what constitutes the
Object and the Interpretant of
the semiotic process.
However, these possibilities
cannot be freely combined:
the fixation of an Object
determines an Interpretant and
vice versa, by virtue of a habit
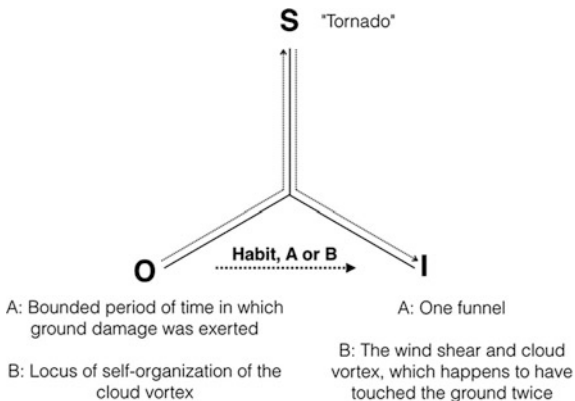
Consider "tornado" as a sign (S). It can either refer to the funnels produced by a cloud vortex (let's term it possibility A, so that the O of S is A), or to the cloud vortex itself (let's term it possibility B, so that the O of S is B). Take a dyadic description (S-A, or S-B) of the tornado sign. Such description has no explanatory consideration whatsoever of why S is connected to either A or B. It is not sufficient to say that the sign tornado is dyadically connected to some entity in the world: the connection itself depends on criteria which are irreducible to the explanation of the relation of meaning. A dyadic account of the meaning of the sign "tornado" is not explanatorily powerful. Now consider Peirce's pragmaticist model as described above: in this case the meaning process is Interpretant-dependent, that is, it produces effects. In this case A and B are described as follows in Fig. 7.3.

This example illustrates the emergence of a semiotic process: the selection of either A or B is dependent on a habit (A or B) embedded in the Object, which constrains the semiotic process. The emergence of semiosis can be modelled according to Salthe's model. First, consider that semiosis necessarily involves chains of triads (see Merrell 1995). As Savan (1986: 134) argues, an Interpretant is both the third term of a given triadic relation and the first term (Sign) of a subsequent triadic relation (see Fig. 7.4).
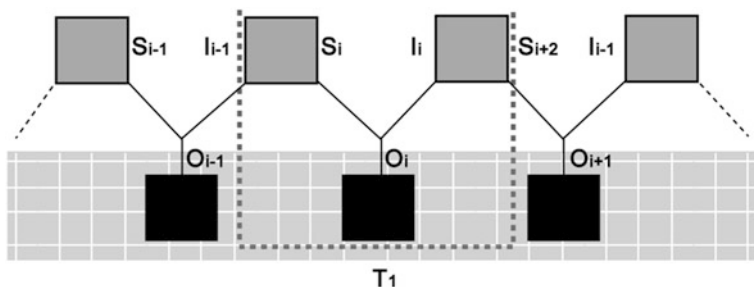
Fig. 7.4 The triadic relation S-O-I forming a chain of triads

Following Salthe's model, this dynamical semiotic process can be described at three levels (see Queiroz and El-Hani 2006b). The focal-semiotic level is the level in which a given semiotic process is observed. Semiotic processes at the focal level are described as chains of triads themselves. The micro-semiotic level concerns the relations of determination that may take place within each triad S-O-I. The relations of determination provide the way for the elements in a triad to be arranged in semiosis: the Interpretant is determined by the Object through the mediation of the Sign (I is determined by O through S) (MS 318: 81, 1907). Finally, the macro-semiotic level concerns the historically-constructed environment of networks of chains of triads, in which each individual chain is embedded. Focal-level semiosis will emerge as a process through the interaction between micro- and macro-semiotic processes, i.e., between the relations of determination within each triad and the embeddedness of each individual chain in a whole network of Sign processes, which take the form of habits in individual semiosis.

Habits exert a downward effect on the spatiotemporal distribution of lower-level semiotic items. In the "Tornado" example above, both possibilities of S-O-I triads regarding the sign "Tornado" are present at the micro-semiotic level. At the macro-semiotic level there is a historically established network of chains of triads which constitutes boundary conditions for the use of the "Tornado" sign according to certain situations (whether the situation calls for the use of 'Tornado' in the sense of a funnel, or 'Tornado' in the sense of a wind shear). This corresponds to a habit, a regularity of action (the tendency to regularly use 'Tornado' in one or another sense according to the situation), embedded in the Object.

Evolution of Habits as Cognitive Niche Construction

The notion of habit emphasizes that the emergence of meaning is dependent on context: this is a necessary condition for—and a constitutive part of—semiosis. Emergence entails that habits historically unfold and evolve, so that meaning is a temporally-situated evolutionary process. As habits can be embedded within the material properties of signs, such process is also materially-distributed.

The distributed cognition and extended mind approach (cf. Clark and Chalmers 1998; Clark 1998) have questioned the legitimacy of skin and skull to serve as criteria for the demarcation of the boundaries between mind and the outside world. According to this approach, various tools such as pen and paper, calculators, calendars, maps, notations, models, computers, shopping lists, traffic signals, measurement units, and so forth are considered non-biological extensions of the cognitive system that allow cognitive operations external to the skull (Hutchins 1999, 1995).

Accordingly, these are qualified as cognitive artifacts. On the one hand, cognitive artifacts impact cognitive performance: they may reduce the cognitive cost of an operation (such as when using a calculator to perform a division), increase its precision and efficiency (such as using a ruler to measure an object instead of just

guessing its dimensions), or allow new capabilities that would be impossible to be performed by the brain alone (such as using a graphical diagram to represent the simultaneous relation between a large number of entities and infer specific visual patterns from it). On the other hand, cognitive artifacts also influence environmental opportunities and demands for certain types of cognitive performance—they participate in the creation of new problems and problem-spaces. Language, for example, is a powerful cognitive artifact (Clark 2006) that sets new demands and opportunities related to memory, perception, navigation, forms of generalization and categorization, modes of inference, and more. We treat here all kinds of cognitive artifacts as signs: they all necessarily constrain interpretative behavior (for example, performance in a materially-extended cognitive task) according to possessed regularities of actions.

Cognitive artifacts are ecologically inherited: they become part of the environment where cognition takes place, and changes in such an environment of artifacts are relegated to later generations. This cumulative process is evolutionary in an ecological (and not genetic) sense. Evolution in this case is a matter of (semiotic) niche construction. In biology, the niche of an organism indicates its ecological role and way of life. A niche is an imaginary n-dimensional hypervolume whose axes correspond to several ecological factors affecting the welfare of the organism (see Hoffmeyer 2008: 12). Clark (2006: 370) suggested that we are immersed in cognitive niches structured by language: "by materializing thought in words, we structure our environments, creating 'cognitive niches' that enhance and empower us in a variety of non-obvious ways".

A niche is dynamic, it develops and transforms over time. This transformation is often caused by ecosystem engineers (Jones et al. 1994) that alter their environment and ecosystem. Niche Construction Theory (Scott-Phillips et al. 2013; Odling-Smee et al. 2003) stresses that the transformation of niches by organisms performs a major role in evolution, establishing a non-genetic system of inheritance that shapes selective pressures creating a feedback loop between organisms and niches. For Laland and O'Brien (2011: 192–193) niche construction "should be thought of as the dynamical products of a two-way process involving organisms both responding to 'problems' posed by their environments and solving some of those problems, as well as setting themselves some new problems by changing their environments through niche construction". The notion of *cognitive* niche construction emphasizes the ecological evolutionary nature of cognition. For Clark (2008: 62–63), cognitive niche construction is a process of transformation of problem spaces by building physical structures that, combined with appropriate culturally transmitted practices, enhances problem solving or even makes possible new forms of thought.

In our approach, the cognitive niche is the locus in which habits become available for semiosis.

To exemplify the relevance of niche construction as locus of habit, consider the widely known London Underground Diagram (LUD) (Atã and Queiroz 2014) (see Fig. 7.5). Today, adapted versions of this diagram are present in virtually every major city in the world. The LUD has established an international paradigm instructing the public how to perform simple decision-making tasks regarding
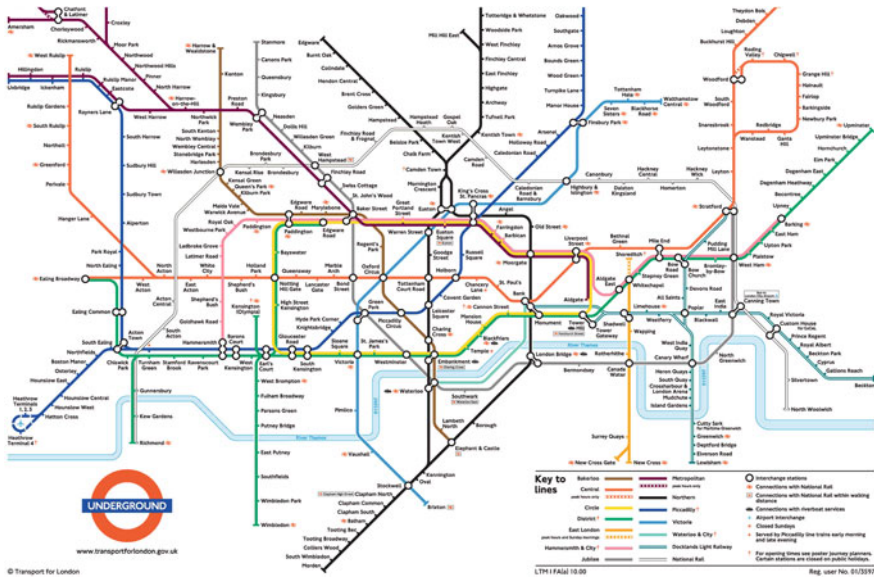
Fig. 7.5 The London Underground Diagram as we know it today, is an adaptation of Beck's original 1930's design which introduced the straight lines meeting at 45 and 90° angles and a representation of subway lines and regularly spaced blobs and ticks as a representation of stations. This diagram communicates a habit of action for thousands of underground users everyday. It is part of the cognitive niche of Londoners

networks of stations and lines. The original version of the LUD was created by Henry C. (Harry) Beck in 1933. Beck's design was based upon electrical circuit diagrams, which omit or falsify information about the real physical distribution of wires in order to convey information about connectivity. Beck noticed a similarity with the underground railway network in that it was possible to ignore the geographical information altogether and as such remove some of the sources of confusion in more literal maps. Some of the strategies, needs, and preferences of users may not be supported by the design choices of the LUD: trying to figure out which station is closer to a particular street, for example. The set of potentialities for action that a representation designed specifically for solving problems of navigation in the underground system embeds is only one between many other possible sets that might be derived from the system: that of a mechanic trying to locate a particular electrical fault in the system, for example. The set of potentialities that the LUD offers is a crucial part of any description or characterization of how thousands of commuters and tourists employ the London Underground System everyday. This habit of action is a constitutive part of the cognitive niche of Londoners. The LUD is a mediator of this habit of action and an important artifact in Londoners' niche construction process.

Conclusion

We have presented two different perspectives of habit in semiosis: as macro-level in a hierarchical structure where it functions as boundary conditions for emergence of semiosis; and as a cognitive niche produced by ecological and environmental inheritance of cognitive artifacts. The first perspective constitutes a model to study the emergence of semiotic processes, allowing a better understanding how habits participate in semiosis. The second perspective relates habit with niche construction. In this case, habit functions as an explanatory component for the co-evolution of environment and cognition. We have elsewhere stressed Peirce as an early proposer of situated and distributed cognition (Atã and Queiroz 2014). The ecological mechanism of inheritance conceptualized by the notion of cognitive niche is a necessary requisite for cognitive processes in a similar sense that the regularity of action conceptualized by the notion of habit as a requisite for semiosis. Both constitute processual strategies to approach meaning phenomena that emphasize their temporal situatedness and distributedness.

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