Sign Systems Studies 47(3/4), 2019, 382–399

Cartographies of the mind: Generalization and relevance in cognitive landscapes

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Abstract. The problem of relevance, at individual agent scale – or how we decide what is adequate for our interpretation of the signs we encounter in the world – is a question that keeps reappearing in semiotics and other disciplines concerned with meaning. In this article I propose an approximation on relevance that conceives meaning as a trajectory across a cognitive landscape. Unlike conventional accounts on relevance, which presuppose mental processes built on feature-based representations, my proposal suggests conceiving cognition as a fluid and emergent field of attractors basins that become specified and modified when experiences appear, and conceiving meaning as a trajectory across the cognitive field. Consequently, I suggest that when cognitive landscapes better fit world experience, agents' categorizations will be more relevant. My proposal is mainly supported by two approaches: the enactivist notion of structural coupling and the theories of dynamic neural populations of Walter Freeman III.

Keywords: relevance; categorization; generalization; cognitive landscape; semiotic scaffolding; neurodynamics; index

Introduction

Meaning relevance, at individual agent scale, is a problem about choice in sense-making. When it is possible, agents have to choose apparent relevant meaning in order to cope with the world, and, in consequence, must have rules, strategies, or tendencies to decide what should be considered relevant. Relevance is an important concept for semiotics, because, as Kalevi Kull suggests, the mere essence of semiosis, the act of sense-making, resides in choice: "By 'semiosis' we mean the process of choice-making between simultaneously alternative options" (Kull 2018: 454). In this article I propose that agents choose relevant categorizations of their experiences because they recurrently give shape to cognitive landscapes,

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https://doi.org/10.12697/SSS.2019.47.3-4.02

not because they create codified feature-based representations of the world, as is the predominant view. Based on neurodynamics and the concept of structural coupling, I argue that we should understand categorization as the process of reshaping a personal cognitive landscape that dynamically fits everyday experience and, as a result, decides relevance at the individual agent scale.

Considering types of relevance

First, for the sake of clarity, we can divide the relevance problem in discussion in two: relevance about generalization and relevance about elaboration. However, this is just a methodological differentiation, since the limits of both forms of relevance are fuzzy and vague. Relevance about generalization, the focus of this article, can be summarized as follows: if an agent perceives a sign that has a set of features x, how does the agent know that the sign belongs to a particular category if the agent knows multiple categories that encompass, possibly among others, the same set of features x? That is, how does the agent choose what is the apparently relevant category to signify the sign? For instance, how to categorize a sign that has x if it could belong to the category A={x, a, b}, B={x, c, d}, or D={x, e, f}? In less abstract terms, suppose that a person sees a vague small figure crossing the sky. With scant information, how would the agent choose if she should consider the figure a bird, a plane or an alien? And how would she do this relevantly, that is, approaching certain adequacy to the purposes she is directed to?

Relevance about elaboration, on the other hand, can be summarized in this way: if an agent uses a category to interpret a sign, what set of features or responses related to the category are relevant for the interpretation? For example, if somebody shouts: "Watch out, a dog!", how should the agent interpret the sign 'dog'? As, usually, many aspects of dogs are available to a human agent's mind: dog={bites, has teeth, has hair, good olfaction, is loyal, is dangerous...}. What are relevant ideas about dogs that should be actualized in the mind of the agent, and consistently, what actions should she take? Or, in other terms, what are the relevant connotations of the sign 'dog' in a particular situation (Eco 2011[1968])?

The problem of the relevance problem

Relevance, in both senses presented in this article, is a problem transversal to many fields that investigate semiosis, even inadvertently. Let me illustrate this with a few examples.

During the 1960s, many prominent semioticians engaged in what is today called the 'debate about iconism'. In the debate, which was mostly moderated by Umberto Eco, the centre of discussion was the notion of 'resemblance' of iconic signs. Semioticians could not agree on what it meant to resemble an object, or if such resemblance could be codified and decodified. That is, if it was possible to establish a rule to determine if a sign resembled its object. The debate about iconism was a debate about relevance, and it, after the discussion faded away, remained unresolved. Eco comments on this: "In any case, it is singular that, after the row exploded, the general discussion reached an impasse, as if it had become a dead letter. There was a hiatus, I should say, of a decade: and then it flared up again, in the hands of others, who had taken a second look at the whole business" (Eco 1998[1997]: 338-339). In an apparently distant field, computer scientist Marvin Minsky proposed his 'frame theory', a model for representing knowledge in computers (Minsky 1988). Minsky's research gave place to the so-called "frame problem" of computation, which later on extended to philosophy of mind. In general terms, the frame problem asks about how to decide what elements in a frame, a structure of knowledge about an event, are relevant when the situation changes. For example, if somebody tells me that the frying pan is burning, should I think about other objects in the kitchen? Which ones? And how do I know? The frame problem is a problem about relevance, and it is still discussed in technical and philosophical debates. Correspondingly, cognitive semantics have similar discussions when facing cases of polysemy. For example, in that field of study there is an important discussion about how meaning is chosen in the hypothetical case in which somebody utters the phrase "This surgeon is a butcher" under different circumstances (Grady, Oakley, Coulson 1999; Brandt, Brandt 2005). Likewise, it is a problem about relevance. In pragmatics, the so-called "relevance theory", originally proposed by Sperber and Wilson (1986), presupposes that individuals tend to interpret communicative phenomena depending on how economical, in cognitive terms, and efficient, with respect to a task at hand, an assumption turns out to be. That is, for relevance theory, people infer that something is relevant depending on how effortless, but also fruitful, the cognitive effect is. It is a theory that presents humans as rational economists that maximize the utility of meaning.

Depending on the commentator, solutions to the relevance problem are taken for granted, are trivial, or constitute one of the hardest problems of philosophy. As Terrence Deacon (2011) argues, it is common to assume "homuncular" explanations about an agent's intentionality, or, better, ententionality, a broader term he coined to name how meaning is directed towards the world. Taking relevance for granted means assuming that it just happens, without showing how it works. It means assuming that a homuncular entity, a thing that simply does it, chooses what is relevant. For example, even though it had an important role for his logic and semeiotic, Charles Peirce left his notion of abduction underspecified in terms of how best explanations or hypotheses are decided (Schurz 2008). Contrariwise, in the more practical field of artificial intelligence, relevance cannot be taken for granted, so different guises of the frame problem and practical solutions have been proposed (see Chow 2013 for a review). These solutions offer technical optimizations and error reduction algorithms, which are useful in practical terms, but are focused on engineering machines that execute limited, well-defined functions, not in replicating the flexible adaptive mechanisms of semiosis in living beings. On another extreme, philosophers like Daniel Dennett (2006) and Hubert Dreyfus (2007) think that relevance problems, like the frame problem, remain unsolved, and that this situation shakes the foundations of our conceptions about minds, artificial or otherwise. Dennett insists that relevance is a very serious, non-trivial problem, and that it must be solved sufficiently in order to really understand cognition.

Most theories on categorization conceive concepts and mental knowledge as sets of codified mental feature-based representations. They correspond to the so-called classic theory of concepts, which postulates that a category is a "complex mental representation that is composed of a set of features (semantic markers)" (Lewandowska-Tomaszczyk 2007: 144). Feature-based representationalism (FBR) is the predominant view because of the prevalence of theories about minds as discrete content computers, which in turn is derived from logical reductionist stances that assume that a category is composed of an abstract reduction of minimal properties about things. FBR requires that mind and environment have some sort of isomorphism; that mind represents the world iconically. From this point of view, our acquaintance of the world is built upon simple conceptual units, which build more and more complex units, and, as a consequence, this implies that the strategy for categorization should be based on finding rules or a code of equivalence between the mental representations of the world and the signs we encounter in it.

The FBR point of view is pervasive to many fields concerned with sense-making. A couple of decades later, after the debate about iconism, Groupe μ, a prominent Belgian group of semioticians, still sustained that iconic types "can be described through a series of conceptual features […]. These features constitute a product of paradigms whose terms are in a relation of logic sum"[2] (Groupe μ 2010[1993]: 122). Prominent computer scientist Leslie (Valiant 2013: Chapter 9.3) explicitly insists that, "[i]f we had a good theory of which primitive features

2 Translation by the author of this article.

are computed by the human nervous system at birth, then we could program a computer to compute those primitives, an then perhaps educate the computer just like humans educate babies". Wilson and Sperber (2004: 609) assert that "the greater the positive cognitive effects achieved by processing an input, the greater the relevance of the input to the individual at that time" and "the greater the processing effort expended, the lower the relevance of the input to the individual at that time".

Nonetheless, the description of generalizations as codified representational reductions of the world makes the relevance problem ill-posited; relevance is an important problem for sense-making, but it must be addressed by eliminating the assumption that categories are composed by atomic units that represent abstractions of experiences, or inputs in computational terms. Reduction and abstraction are useful cognitive tools of reasoning, but they are not at the core of semiosis, at the basic process where meaning emerges from life. Reductionism is too logical to account for emergent processes of meaning; it tries to equate logical, algorithmic processing with the vital process of semiosis of living beings. FBR, and its passive conception of meaning as input manipulation that produces an output, is precisely the assumption that philosophers such as Dennett and Dreyfus call to abolish to avoid the crisis on relevance.

Structural coupling and habit formation

An alternative to the FBR view can be found in the notion of structural coupling proposed by enactive cognitive science: "[...] history of continuous structural change with conservation of congruency among the system and its circumstance"[3], as Maturana (2009) puts it. Structural coupling of organisms must be understood in a broad sense: organisms structurally change their bodies, and their conditions of perception, but also their minds and their brains (Fig. 1). Neural dynamics physically transform when agents learn to cope with the world. Under this view, concepts do not represent the features of the world but they fit with the world as two pieces of a puzzle. Fitting categorization to the world is precisely what relevance means. Generating concepts is a process in which the agent self-organizes and establishes a domain of relevant distinctions inside its own structure (Varela *et al.* 1993). Deacon (2011) would call this the "absential" aspect of mind. That is, the mind as having a disposition to receive something that is not present, the world to come. Structural coupling requires a rule that makes

[3] All translations of excerpts of this text cited in this article were made by the author of this article.

adaptation and habit emerge, a rule that develops constraint of meaning, not a rule of decodification and recognition of features.

As Peirce claims: "[…] there are three elements of cognition: thoughts, the habitual connection between thoughts, and processes establishing habitual connection between thoughts" (CP 7.355); structural coupling of thoughts is the process of establishing habits that let the agent fit the world. In this sense, as Jesper Hoffmeyer (2015: 154) observes: "[…] value is a systems property, not a property of any singular calibration mechanism operative in the system". Thus, showing how structural coupling emerges in minds is showing how world experience imprints and transforms the structures of organisms, how habits take shape in cognition – how we get acquainted to act more relevantly and, thus, adequately, in the world.

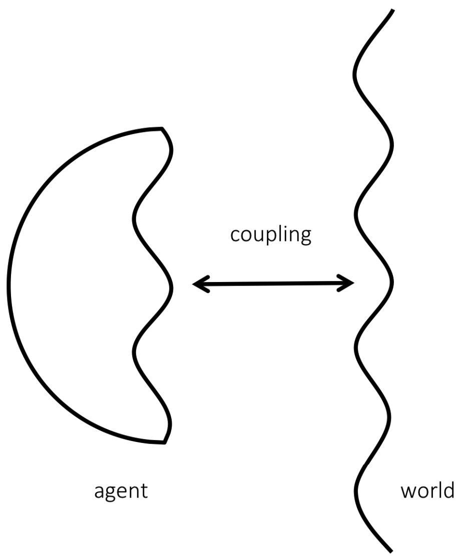

Figure 1. Structural coupling of organisms.

Here, I want to show how neurodynamics reveals the mental processes that justify the philosophical notion of structural coupling, and how this insight can help us to find a less problematic account on relevance about generalization. Neurodynamics shows how brain processes adapt in order to create the indexical shape of expectations, and, at long term, the constant process of habit formation. In the sense of Hoffmeyer (2007), it is an endosemiotic process that scaffolds possibilities of sense-making.

Neurodynamics and cognitive landscapes

Walter Freeman III was a neuroscientist who developed the subfield of neurodynamics, or the study of change in brain activity. Neurodynamics works not at the scale of single neurons but at the scale of neural populations; that is, at the mesoscopic and macroscopic levels: "[…] in the simplest description, we conceive sensory cortex as a self-regulating, self-stabilized system of neuron populations" (Freeman, Quiroga 2013: 88). During his career, Freeman helped to improve the brain imaging techniques of electroencephalography (EEG) and electrocorticography (ECoG), and developed a theory of sense-making based on his experimental observations under the lens of complex systems approaches. Although he did not enter the academic field of semiotics formally, his studies show an insightful technical as well as philosophical reading on meaning.

Most of Freeman's observations were based on an extensive study of the brains of rabbits by using ECoG and EEG techniques, especially the observation of the olfactory system: "Olfaction remains the simplest among the sensory systems. For this reason, if no other, the study of sensation and cognition might well begin with the sense of smell" (Freeman 1988a: 19). Freeman used rabbits because ECoG is an invasive technique, which makes it difficult to implement it in humans for experimental purposes. Nonetheless, as Freeman argues, seen on the evolutionary scale, the structure of the olfactory system is a primitive development, and, as such, is closely similar for animal classes such as reptiles and mammals (Freeman 2000). This, in turn, gives us a window to understand generalization as a capacity that belongs to different kinds of animals and not just to humans: "Each animal has a brain within that has basically the same capabilities that our brains do" (Freeman 1988b: 380).

On experiments about how rabbits categorize odorants, Freeman found that the patterns of activation in neurons on the cortex exhibit a cognitive landscape of attractor basins, and that the landscape continuously changes when the rabbit experiences new odorants. The parallel information from receptor cells is transformed and mapped into the olfactory bulb and then into the cortex, and, subsequently, neuronal populations self-regulate in a process of mutual inhibition and excitation, which shows topographic dynamics. In complex systems theories, an attractor basin is the set of all conditions in state space that tend to evolve to the same trajectory. The basin is a domain of influence inside a system. A useful and widely extended metaphor for attractor basins consists in imagining a marble rolling down a bowl (Fig. 2). Whenever we put the marble in the bowl it will tend to stabilize at the bottom of the recipient; such stable point is its attractor.

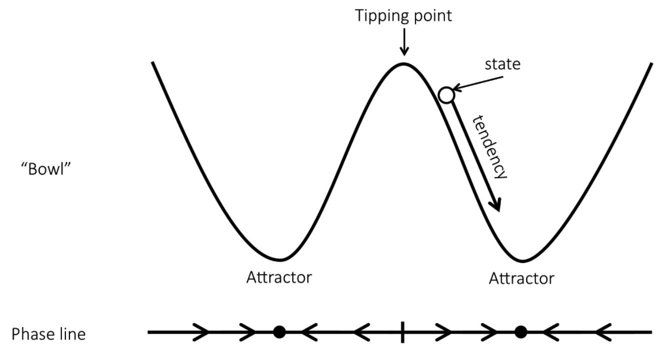

Figure 2. The bowl metaphor of attractor basins.

In the case of rabbit olfaction, amplitude patterns in the cortex, elicited by the stimulus produced by an odorant, tend to get attracted to states or sets of states of activity. All the patterns that start from different conditions but ultimately follow the same trajectory are said to be inside the same basin of attraction. We could picture these patterns as marbles that are thrown into the same bowl. Nonetheless, it is not necessary for an attractor to be a stable point; it can be a cycle or a chaotic trajectory. The bowl is a convenient analogy, but it does not capture the full picture. Consequently, in a cognitive landscape of attractor basins, different stimuli produce neuronal patterns that can tend to be attracted to the same or to different basins as other patterns, depending on the particular learning of the rabbit. Thus, the landscape configures a mechanism of relevant choice by the influence of the basins. In a biosemiotic sense, the emergent structures of the basins are semiotic scaffoldings:

> Semiotic scaffolding consists in biologically instantiated sign relations interlocking with and reinforcing one another, and by so doing, providing *directionality* towards and away from other sign relations in the network, through the dynamic emergence and canalization of *semiotic pathway biases and constrains.* (Favareau 2015: 237)

In general terms, what the cognitive landscape of attractor basins exhibits is the process of generalization itself: every basin is a category, and a stimulus projection into the brain gets attracted to a particular category. Peirce himself used a similar analogy: "We have particularly drawn attention to the point which thought flows, and that it finally reaches: a certain level, as it were – a certain basin, where reality becomes unchanging" (CP 7.337).

Furthermore, as a result of an experiential feedback loop, the stimulus changes the landscape and lets the agent learn new generalizations or modify previous ones. This is consistent with the enactivist notion of structural coupling: "[…] changes of activity in the nervous system result in changes in the interactions of the organism, and changes in the interactions of the organism result in changes in the state dynamics of the nervous system" (Maturana 2009: 192). In other words, the process of cognitive landscape formation and transformation is the regulated fitting that allows an agent to establish relevant categorizations. When a rabbit learns, it modifies its cognitive landscape by changing the topography of the basins, and, therefore, it changes its capacity to choose, or to tend towards relevant meaning from possible expectations: "Whenever an odorant becomes meaningful in some way, another attractor is added, and all the others undergo slight modification" (Freeman 2000: 85). This process provides important flexibility to the animal, and allows it to interpret perceptions it has never experienced before. Cognitive landscapes, therefore, exhibit generalizing tendencies as Peirce conceived them: "[…] imagine any kind of a law or tendency which would thus have a tendency to strengthen itself. Evidently it must be a tendency toward generalization, – a generalizing tendency" (CP 7.515). This consequently shows how adaptation makes the agent produce consistently relevant categorizations without representing the features of the object in its mind.

The conception of mind as a landscape differs greatly from FBR and reductionist notions of cognition. For these views, the nervous system should contain encoded representations of the world. On the contrary, neurodynamics of rabbits show that "the central pattern does not represent any of the odorant presentations, which are not knowable and, in any case, of no further use" (Freeman 2009: 215). Minds do not represent the features of the world; they get shaped based on the past experiences of the agent, which scaffold future meaning, this is "what makes history matter to an organism" (Hoffmeyer 2015: 154). We could say that, if minds represent something, they represent the previous history of an agent's experience, and that representation is predominantly an index, not an icon. The relation within the experiential world and the mental landscape is, then, indexical, is a subjective history that has been carved in the neural substrate. Freeman writes: "Each AM pattern is as unique for each rabbit as the individual history of the animal, as the shape of its body and the colour patterns of its fur" (Freeman 2000: 75). Cognitive landscapes are shapes of habit formations, contained in the brain of the rabbit as an index of world experience. As Kull (2015: 227) argues, agents "embed in themselves the findings of active searching-event of semiosis. The resulting structure is a scaffolding. It canalizes further behaviour. It is the frame for the formation of new habits".

A cartographic representation of cognitive landscapes

Freeman was a polymath, an expert in mathematics, biology, medicine, neurosciences, complex systems and even philosophy – he used to draw analogies between his studies and the writings of Thomas Aquinas. However, his insights do not need to be exclusive to scholars expert in brain dynamics who have access to sophisticated brain imaging machines and rabbits to experiment with. In his work, he promoted an interdisciplinary approach on mind and meaning, and he looked for crosslinks between different fields, and ways in which different points of view converged. Freeman's scientific studies can prompt an imaginative exercise, fruitful and useful for semiotics. In this sense, brain dynamics can help us to be like artists picturing a scene, but, in our case, painting a cognitive landscape, a scene of possible semiosis that will let us get a better understanding of categorization and relevance.

A methodological virtue of many cognitive semiotics theories is the emphasis they put on simplified and elegant visual representations of mental processes. Visual representations do not only illustrate a theory, they constitute part of the theory when descriptions are insufficient. A good graphic allows us to make organized predictions; they are like maps that let us navigate a complex problem more efficiently. As Fabrikant and Buttenfield (2001: 265) argue, "[…] physical and visual representations are easier to learn, understand, and communicate than are abstract numeric or textual information". Accordingly, in order to have a better grasp of the significance of cognitive landscapes, it is useful to sketch a model for its visual representation that captures, at least in general terms, the notion of structural coupling and transformation of brain dynamics for relevant categorization. This, in turn, will serve as a tool for understanding our own and other living beings' minds and possibilities of sense-making, and, possibly, for making simulations of such processes. Here I propose that visual models of cognitive landscapes should be adapted from the radial representations used in prototype theory, proposed originally by Eleanor Rosch (Rosch 1973; Rosch, Mervis 1975) and further developed by other researchers on cognitive semantics.

In the field of cognitive semantics it is said that a category exhibits prototype effects if its semantic structure is defined not by necessary and sufficient conditions but by the 'family resemblances' of its members – "a complicated network of similarities overlapping and criss-crossing: sometimes overall similarities, sometimes similarities of detail," in the sense of Wittgenstein (1986[1958]: 32). Furthermore, for prototype theory, not every member is equally representative of a category; typicality is a matter of degree. There are more central, or more typical members, and more marginal, or less typical members inside a category depending on how many features they share with other members. Because of this structure, it is common to visualize categories with prototypical effects by using radial representations, in which the degree of typicality is represented by how close the member is to the centre of the circle (Fig. 3). Far from the centre, categories are fuzzy, because marginal members are in the critical space where other categories might overlap. Consequently, radial representations offer a method of spatialization, namely, "the creation of a graphic representation based on a spatial metaphor and the transformation that condenses large complex data domains into their essential components" (Fabrikant, Buttenfield 2001: 266).

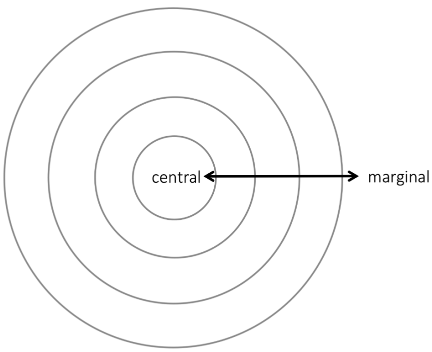

Figure 3. Radial representation of a category.

We can establish analogies between prototype categories and attractor basins because they both share a topography-like structure: there are stable members of a category, which are closer to the attractor, or the centre, and there are unstable, marginal members, which, depending on the circumstances, namely, how relevance exerts a force, can be attracted to one category or another. In a real landscape, a drop of water that starts in the summit can follow different paths, depending on subtle initial conditions, until it ends in a lake or an ocean; it starts in an unstable state and ends attracted to a more stable one. We can borrow the representational model of prototypes and adapt it to represent cognitive landscapes, because it already is a step into the task of making cartography of mind to some extent. Interestingly, prototype categorization theory has been used in the production of soil maps (Qi *et al.* 2006), which confirms the analogies between mind representations and terrain topologies.

Nonetheless, the main difference between cognitive attractor basins and prototype theory is that, as was argued early, basins do not represent reductive features of concepts, while prototypical structures are subject to decompositional analysis of features (Geeraerts 1989), even if it is assumed that they are not criterial – that is, they do not need to be necessary and sufficient as in classic definitions. Although the radial structure is comparable between basins and prototypes, cognitive basins do not depend on the sum of common features shared by members on a category; instead, they depend on previous history of the agent and its structural coupling with the world because they are indexical in nature.

We can call a cognitive landscape map the simplified and hypothetical graphical representation of a cognitive landscape; a speculation about how dynamic categorization is organized for a particular agent. A cognitive landscape map resembles a topographic map in the sense that it shows the texture and the elevation of a terrain, but its geography is given by the conjectural organization of concepts in an agent's mind, as a reference to the studies in neurodynamics by Freeman. In this sense, a cognitive landscape map constitutes a map of informal geography (Kinberger 2009), a map-like visualization of non-geographic information, which is half artistic representation, half data visualization. The cognitive landscape is a texture that conserves the shape of recurrent previous experiences; it is the contact surface of biographical development, and as such it is memory saved in the form of an indexical sign, like the geographical accidents that the earth exhibits and that show the history of its existence. "If the Sign be an Index, we may think of it as a fragment torn away from the Object, the two in their Existence being one whole or a part of such whole" (CP 2.230). The map is an operative fiction, a map of informal geography, which loosely captures the process of categorization and habituation of the cognitive landscape. Basins in the plot show domains of influence of a category, its centre represents the attractor and its limits represent critical places of ambiguity of meaning. Thus, the basins follow a similar depiction to the radial representations of prototypes, and follow familiar conventions for cognitive semantics representations, but also capture part of the complexity exhibited by neural dynamics and the notion of landscape:

> [...] when a system possesses multiple point attractor states in the absence of stimuli, then the history of prior stimuli can determine the neural circuit's current activity state – the particular attractor in which it resides – so the system can retain memories. (Miller 2016: 3)

An experience starts in a part of the landscape, represented as a state space of all the possible perceptions given by a particular sense, and then it follows a trajectory to the centre of its basin of attraction, to a more stable pattern.

I suggest that three elements are important in cognitive landscape maps: (1) relief, or how stable or unstable the categorization of an experience is; (2) boundaries, or how "narrow" or "wide" the basin is; that is, what is the disposition of the agent to accept different experiences as belonging to the same category; and (3) toponymy, or place names that help the reader of the map understand the topology of categorization. Reading relief, boundaries and toponymy can give us useful information about categorization and relevance in choosing meaning. For example, noticing unstable parts in a landscape can show us how an agent produces the "intelligent guessing" (CP 6.530) characteristic of abductions. An unstable point in the map, an elevated, tipping point, shows the disposition of an agent to interpret an experience as barely belonging to a category, and, thus, shows a tendency to establish relationships from scarce information. A point can become more stable after "testing a hypothesis" and reshaping the cognitive landscape. As Peirce claims: "What, then, is the end of an explanatory hypothesis? Its end is, through subjection to the test of experiment, to lead to the avoidance of all surprise and to the establishment of a habit of positive expectation that shall not be disappointed" (CP 5.197). In other terms, relief can show us the process of habit formation and the creative relationships established in abductions. If we follow the texture of the landscape, we can understand relevance without having to address Feature Based Representations. Boundaries, on the other hand, can show us how flexible an agent is in her categorization. Narrow basins show strict, precise concepts, while wide basins show flexible, vague concepts. Fig. 4 is a representation of colour classification as a subjective interpretation of the author's own cognitive landscape.

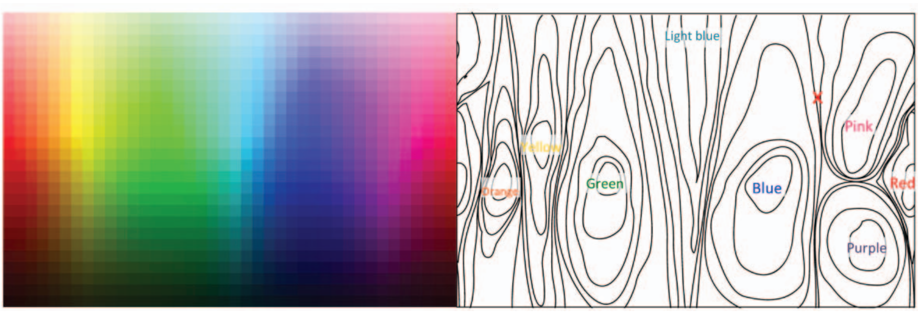

Figure 4. Colour categorization: the subjective map of a cognitive landscape. Each basin labelled with a toponym represents a category. The red X shows a tipping point, that is, a critical colour in an unstable state between pink and blue.

The purpose of a cognitive landscape plot is not to control and fully capture the territory by representing it in fine detail, but, on the contrary, to understand its messiness and ultimate unpredictability. Our history is imprinted in our bodies, but is not entirely knowable.

Recurrences, hysteresis and landscape modulations

As I argued in another article (Rodríguez 2016), three different processes ground sense-making: phylogenetic recurrence, ontogenetic recurrence, and collective recurrence. Ontogenetic recurrence is the process by which agents acquire new capabilities to act and new purposes through their individual history. That is, agency and agendas, respectively, according to agentive semiotics (Niño 2015). Cognitive landscapes are capabilities acquired through ontogenetic recurrence because they are part of the habit formation substrate that helps the agent act with relevance; they make part of the self-regulating structure of the organism, its agency. Moreover, cognitive landscapes influence purposes and direct a particular reaching out, a search for fitting within the enactive world. In this sense, cognitive landscapes direct the agent ententionally towards future states. Better-fitted cognitive landscapes produce more relevant categorizations. It is a Telic development in the sense of Alexander (2008: 79) "[…] *telos* involves the dynamic holistic constraints that increase the likelihood of certain patterns whose effects then further constrain". Additionally, the study of brain dynamics developed by Walter Freeman III showed that cognitive landscapes are subject to additional modulations depending on the state of the agent. In the case of rabbit olfaction, the landscape changes if the animals are exhaling or inhaling, in deep rest, hungry, thirsty, or having a seizure. Cognitive landscapes change as the agent experiments state transitions.

At the ontogenetic recurrence scale, cognitive landscapes are thus inserted in a feedback flow: an agent modulates its expectations according to its actual state; it couples perceptively with its environment; its current landscape defines a relevant categorization, and, as a consequence, an ententional, purposeful response; such response fits or does not fit with the world and prompts in turn a "reafference" in Freeman's terms, or a correction of the hypothesis in Peircean terms, which adjusts the agent's state, and the loop starts back again. Consequently, cognitive landscapes make part of a hysteretic path, namely, a dynamic tendency that depends on previous history. During such a path, relevance is decided through a constant negotiation with the world, and not a passive feature-based representational processing of information.

Conclusions

The studies on neurodynamics developed by Walter Freeman III are a window to the dynamic organization of neural substrates during semiosis. Such organization shows how an agent's brain changes in structure, as do its physical and perceptual structures, in order to fit the encounter with the experiential world. The concept of cognitive landscape is a semiotic account on semiosis based on brain dynamics that provides a non-feature-based account on relevance and categorization. The introduction of this concept grounds and opens up a horizon of research on relevance that is in line with theories such as enactive cognitive science, biosemiotics and complex systems approaches. Further research should be focused on the simulation of the process of cognitive landscape formation and modulation, on strategies to visualize and formalize the emergent structure of cognitive landscapes, on establishing the relation between cognitive landscapes and complex mental sign relations or connotations, and, finally, on producing an integrated account on relevance that encompasses not only individual-level relevance but also relevance in evolutionary changes and social interaction.

Although this article only focuses on ontogenetic recurrence, further research should be invested in inquiring how cognitive landscapes integrate into the bigger picture of Rodríguez's (2016) phylogenetic recurrence (evolutionary scale) and collective recurrence (social and cultural scale). For both biosemiotics and enactive cognitive science it is important to insist that semiosis occurs at all levels of life interaction and not just at subjective, individual agent scale. Such integration could be achieved by following the spirit of foundational works in biosemiotics like René Thom's (2018[1972]) catastrophe theory and Conrad Hal Waddington's (2014[1957]) "epigenetic landscape", which also conceive a wide range of biosemiotic processes as emergent self-regulating attractor landscapes. Research by Maturana and Varela, Freeman, Thom, Waddington and others shows a remarkable confluence and a plausible route map for semiotics interested in intertwining life and meaning.

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Картографии разума: генерализация и релевантность в когнитивных ландшафтах

Проблема актуальности на уровне индивида - или как мы судим об адекватности нашей интерпретации знаков, с которыми мы сталкиваемся в мире, – это вопрос, который постоянно возникает в семиотике и других дисциплинах, занимающихся значением. В этой статье предлагается такой подход к релевантности, который определяет значение как движение по когнитивному ландшафту. В отличие от обычных подходов к релевантности, которые рассматривают ментальные процессы как основанные на характерных представлениях, тут предлагается рассматривать познание как текучее

и эмерджентное поле аттракторов или „бассейнов аттракторов“, которые становятся конкретными и модифицированными, когда появляются навыки, и воспринимают значение как траекторию, переходящую через когнитивное поле. Следовательно, чем точнее когнитивные ландшафты соответствуют восприятию мира в опыте, тем более адекватна категоризация агентов. Мое предложение в основном поддерживается двумя подходами: энактивистским понятием структурной связи и теориями динамических нейронных популяций Уолтера Фримена III.

Vaimu kartograafiad: üldistus ja relevantsus kognitiivsetel maastikel

Relevantsuse probleem üksikagendi tasandil – või see, kuidas me otsustame, mis on adekvaatne tõlgendamaks märke, mida me maailmas kohtame – on küsimus, mis semiootikas ning teistes tähendusega tegelevates distsipliinides ikka ja jälle esile kerkib. Selles artiklis pakun välja lähenemise relevantsusele, mis kujutab tähendust üle kognitiivse maastiku kulgeva trajektoorina. Erinevalt konventsionaalsetest relevantsuskäsitlustest, milles eeldatakse vaimsete protsesside lähtumist omaduspõhistest representatsioonidest, panen ette, et kognitsiooni võiks mõista atraktorikooslustena, mis täpsustuvad ja modtifitseeruvad, kui ilmuvad kogemused, ning tähendust trajektoorina kognitiivsel väljal. Seetõttu oletan, et kui kognitiivsed maastikud sobituvad paremini maailmakogemusega, muutub agentide kategoriseerimine relevantsemaks. Minu ettepanekut toetab peamiselt kaks lähenemist: struktuurse paardumise enaktivistlik mõiste ning Walter Freeman III neuraalsete populatsioonide dünaamika teooriad.