

Learning that Reflects the Living: Aligning Anticipation and Edusemiotics

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Joining educational philosophy with theoretical biology has come to form an important part of the growing edusemiotic movement. Edusemiotics has followed the example of biosemiotics (the understanding that the emergence of life is coextensive with the emergence of semiosis) to describe the process of learning itself as being coextensive with semiosis (or, sign-action). Following this recent turn in scholarship this paper argues for a perspective of learning rooted in the dynamics of the living. By 'living', I am referring to the integrated dynamics of reaction and anticipation that is definitional of living organisms, as distinguished from (non-living) inanimate matter. This calls for a theoretical perspective that transcends the realist/idealist divides often inherent in educational theory; offering a possible middle way between the constructivist emphasis on *mind dependent* reality, and the positivist emphasis on *mind independent* reality. Such a theoretical approach must be able to account for interactions in states of becoming, and thus calls for a broader causality than reductionist methods or computationalist accounts allow. To approach this re-conceptualization, I attempt to explore the combined relevance of two theoretical perspectives --- anticipatory biology, and the edusemiotic understanding of learning-as-semiosis. To address how anticipatory systems research from biology can be applied to learning theory, I first explore Nadin and Rosen's notion of (Gödelian) G-complexity, and how this contributes to an understanding of the living as *complex*. Secondly, I address Peirce's notion of semiosis as it is embedded in his categorical system and overarching cosmology. In conclusion, I consider the confluences and differences between the concept of semiosis and the triadic relations that Peirce saw as fundamental to the origins of life, and the anticipatory processes that these theoretical biologists use to define living organisms, and examine how and if these two conceptions (taken in union) can potentially enrich theoretical accounts of learning. In this final analysis, the combined relevance of these two perspectives is applied to understanding the process of improvisation as an anticipatory/semiotic dynamic, to demonstrate the possible pedagogical relevance of this theoretical alignment.

Keywords: philosophy of education, anticipation, edusemiotics, biosemiotics, improvisation, music learning

The phenomenon that distinguishes life forms from inanimate objects is semiosis. This can be defined simply as the instinctive capacity of all living organisms to produce and understand signs.
Thomas Sebeok (2001, p. 3)

1. Introductory remarks

Aligning semiosis with the living has been the great contribution of Thomas Sebeok's (1991, 1994, 2001; Danesi and Sebeok, 2000) biosemiotic project. In fact, this central idea has been referred to as *Sebeok's Thesis* by Kull, Emmeche and Hoffmeyer (2011, p. 2). This has encouraged some scholars and researchers in the emerging field of edusemiotics¹ to similarly align semiosis² with the learning process.

¹ For some recent introductions to edusemiotics, see Noth's (2010) thorough literature review, Semetsky's (2010) edited anthology outlining many different approaches to edusemiotics, of which Nöth's article is included; see also (Strand, 2013; Campbell, 2015a, 2016) for the relevance of Peirce's categories for philosophy of education, as well as two recent introductions (Semetsky and Deely, 2017; Semetsky, 2017). The term edusemiotics was coined by Marcel Danesi (2010) in the forward to the above-mentioned volume edited by Semetsky. It must be noted, of course, that educational semiotics has been studied (in various capacities) at least as far back as Morris (1946).

Within the edusemiotic understanding, learning is not strictly developmental, constructivist, or behaviourist, but rather based on an interaction of *complementarity* (between an organism's cognized environment and its operational environment).³ To conceptualize something that is not in the mind-brain of the learner, nor an act of (Gibsonian-like) direct perception of external objects, requires a conceptualization that can tolerate ambiguity, under-determination and vagueness. In short, it involves the difficult task of describing learning outside the lens of the reductionist process of *fractionation*; i.e., “the reduction to components whose behavior is aggregated in the behavior of the whole” (Nadin, 2017a, p. 154). This is the understanding that learning constitutes a *complex* interaction (see Section 2.2), that is, an integrated embodied process characterized by continuous change and therefore not something that can be broken down into parts — with the expectation that these parts can be consistently and completely described and used to construct formalized models that purport to explain the whole of the natural occurring phenomenon. Rather, it is required within such a framework that learning be explained as a *relation* mediating observer and observed.

The American theoretical biologist Robert Rosen (whose work has been championed and developed for applications in semiotics, computer science, and artificial intelligence by Mihai Nadin) emphasized in three major books (Rosen, 1978, 1985, 1991) that the dynamics of the living were not being properly accounted for by the dominant methods of (what he broadly called) the *Newtonian paradigm* (see Section 2). He explained that the reductionist approach has – despite its successes in describing and inquiring into the properties of matter (which of course all organisms are embodied in) – proven inadequate to account for the complexity of living things. This is because the living organism *anticipates* a future state of being, and through such anticipatory action remodels its relation to the present, and indeed the past. Such a dynamics of anticipation simply does not occur in inanimate matter.

In the world of educational research, we see a similar inability to conceptualize the complexity of the learning process. Within both (more or less) constructivist and (more or less) positivist learning theories we see the same logic of materiality operative in the deterministic worldview of Newtonian causality. Nesher (2001) for example, has shown that the logic of computationalism cannot account for learning. Within such frameworks one can make inferential entailments based on a set of production rules (deduction) and check the validity of these inferences in external phenomenon that are themselves *encoded* into formal systems (induction). But one cannot account for the growth of knowledge, represented by *abductive* inference and the process of learning generally. The fact that most of the world's formal education systems rely heavily on standardized forms of evaluation is a symptom of an inability to conceptualize learning outside of both positivist and constructivist accounts. Rather, learning is nothing but a state of

² Semiosis is the action between signs (CP: 5.473), this is a triadic process that contains (1) a sign, (2) its object, and (3) an actual or potential interpretant, that is in no way reducible to any one of these three parts. Sebeok (1991, p. 83) states that semiosis “particularly focuses upon the way that the interpretant is produced, and thus concerns what is involved in understanding or teleonomic (that is, goal-directed) interpretation of the sign”.

³ For the distinction between cognized and operational environment, see D'aquilli et al., (1979), and these researchers' broader *bio-genetic structuralism* project (1974), which may be considered a notable precursor to modern biosemiotic developments.

transformation: a process of becoming, and not strictly an act of information processing or computation.⁴

In earlier work, I used John Deely's (1990, 2000, 2001, 2009) interpretation of Peirce's late medieval semiotic (1632/1885) to put forward an understanding of learning, where learning is conceptualized neither as a psychological state attained *inside* an organism, nor in the perception of a *mind independent* reality, but as the learner's *supra-subjective capture* of relations that mediate organism and environment. Defining learning as semiosis is in part a recognition that the species-specific world of the organism (it's *Umwelt*⁵) is not a world of things so much as it is a world of semiotic objects: of signification processes within the organism's awareness. Learning is thus not a form of information processing, but rather the growth of semiosis within the organism; that is, the recognition of relations that enable receptiveness to novelty and continual adaptation and future growth (Campbell, 2016). This is a reminder that the world of living beings is a world of (qualitative) meanings and not of (quantitative) data, represented metaphorically by the *semiotic web* that Sebeok spoke of: "a web woven of sign relations, at whose nodes alone stand the objects of experience as experienced, whatever be their further status as 'physical' or 'real' independently of the experience within which they are given" (Deely, 2000, p. 17).

This article argues for a perspective of learning rooted in the dynamics of living beings. This calls for a theoretical perspective that transcends the realist/idealist divide that plague educational theory,⁶ offering a possible middle way between the constructivist emphasis on *mind dependent* reality (*ens rationis*), and the positivist emphasis on *mind independent* reality (*ens reale*). Deely's (2004, p. 19-20) words are useful here in explaining the futility of reducing learning to an internal psychological mechanism while explaining the notion of objectivity that his semiotic is built upon:

On the contrary, there are no such thing as psychological states disconnected from objectivity. Objectivity precisely depends upon psychological states which give the subjective foundation or ground for the relations which terminate in the publicly experienced interpretations that are precisely what we call objects. The key to the whole thing is relation in its unique being as irreducible to its subjective source always terminating at something over and above the being in which the relation is grounded.

Such a theoretical approach must be able to account for interactions in states of becoming, and thus calls for a broader sort of causality than computationalism allows. This is the recognition that the integrated dynamics of reaction and anticipation, of *living creatures* — as well as semiosis generally — are expressed in action. In this spirit, the aims of this article are to suggest possible answers to the following three questions:

1. How can the processes of learning be re-conceptualized outside of a Cartesian/Newtonian framework that seeks to reduce the natural world to

⁴ See Cunningham (1987, 1988, 1998) and Shank (1995) for how semiotics can offer a middle way between constructivism and behaviourism in educational research.

⁵ The famous concept developed for ethology by the Estonian/German scientist Jacob von Uexküll (1864-1944); see von Uexküll (1934/1992) and Kull (2011), for a historical detailing of the concept and its relevance for semiotics and biosemiotics.

⁶ See Carr (1997), for a subtle reading of this divide, in the context of philosophy of education.

- immutable axioms that can be modelled within purely formal and syntactic (as opposed to semantic) systems?
2. What is the relationship between the continuous flow of semiosis and the triadic relations that Peirce saw as fundamental to the origins of life, and the anticipatory processes that theoretical biologists (like Rosen and Nadin) use to define living organisms?
 3. Is it possible to develop a theory of learning that can account for (a) potentiality, (b) teleological (goal-directed) processes, and (c) the complementary (or mediation) of subject-object, mind-world, culture-nature, inner-outer, and therefore recognize processes of signification themselves as essential constituents in learning?

These points can be grouped under one grand and (I'll admit) ostentatious question which takes us to the heart of this inquiry: *How can we imagine learning that reflects the complexities and dynamics of living beings.*

To address these questions, I will explore the combined relevance of two theoretical perspectives — anticipatory biology, and the edusemiotic understanding of learning as semiosis — for informing conceptualizations of the learning process. In Section 2, I explore Nadin and Rosen's notion of G-complexity, and how this contributes to an understanding of anticipation as being definitional of living systems. In Section 3, I address Peirce's notion of semiosis as it is embedded in his categorical system and overarching cosmology. Section 4 considers the confluences and differences between semiosis and anticipation and Section 5 how these two conceptions (taken in union) can influence edusemiotic understandings of the learning process. I will close the article by articulating some of the pedagogical implications of this comparison by drawing upon my personal experiences as a musician and music educator. Following Deely's philosophical delineation of the relational quality of semiosis, my goal is to demonstrate that learning itself is necessarily a relational interaction that refuses to be segmented to one side or the other of the binary tightrope: not something *out there* in an hypothesized operational environment, nor locked away within internal psychological states.

2. Complexity and the living

2.1 The “modelling relation”

Rosen (1991), in his seminal work *Life Itself*, demonstrates that the persistent trend towards formalism in mathematics radically shaped the trajectory and shape of contemporary physics. With his broad knowledge of the history of Western science, Rosen explains how mathematical truth has come to possess two distinct iterations in modernity: *semantic truth* (i.e. reference to some external referent) and *syntactic truth* (i.e. coherence between the propositions that make up a mathematical system). These two different notions of truth, Rosen shows, are very much opposed to one another. The formalist school asserts that problems arise when mathematics must consider semantic factors, and argued instead that “[s]emantic truth could always be effectively replaced by more syntactic rules” (1991, p. 6 [italics in original]). With this underlying logic, the goal of mathematical inquiry is to create formal systems that can be entirely and consistently

described without reference outside of the system: “The mathematical world is embodied in precepts but exists independent of them. “Truth” in the mathematical world is likewise manifested in, but independent of, any material embodiment and is thus outside of conventional perceptual categories like space and time.”⁷ (1991, p. 6)

A syntactic formal system requires three things: (1) a conventional symbolic alphabet, (2) a finite set of rules for combining these symbols into formulas, and (3) a set of basic axiomatic *production rules* from which anything inferred by the system, not expressed in the production rules, can be inferentially entailed (Rosen, 1991, p. 6). Through a long and elegant argument that runs the length of the book, Rosen demonstrates that this tendency for reduction into formal systems “is exactly parallel to the mechanical picture of the phenomenal world as consisting of nothing more than configurations of structureless particles, pushed around by impressed forces” (1991, p. 7). Such a view of the world represents what Rosen has referred to as the *Newtonian Paradigm*. Simply put, this is the view that there is an observable and underlying order to the universe and that our formal systems can consistently and completely describe the natural world. What this amounts to is essentially nothing less than the way that we in modernity *do* science. This is encapsulated by Rosen’s famous *modelling relation* (Rosen, 1985; 1991):

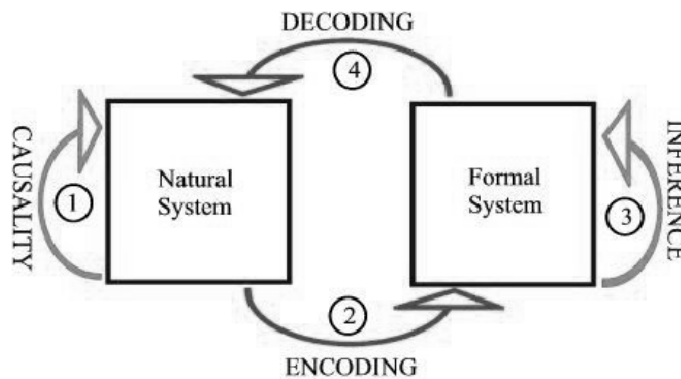


Figure 1. The modelling relation (adapted from; Rosen, 1991, p. 60)

A full description of the enormous implications of this diagram will not be provided here, but a brief description should be useful: **arrow 1** represents the reality the observer perceives through *percepts* (objects within their awareness). The formal system represents a computational structure that, through inferential entailment (or implication; **arrow 3**), tries to in some way represent (analogously) the causality perceived in the natural system. The natural system must be *encoded* (**arrow 2**) into the formal system; that is, certain

⁷ But *why* does mathematics seek such absolute formalism? Rosen (1991, p. 29) explains that this is because this is what mathematicians have come to consider beautiful. In other words, it is aesthetics that drives this quest for the complete decidability of mathematical systems: “Mathematics seeks the smallest set of conditions under which mathematical truth obtains, because this is the most elegant, the most parsimonious, the most illuminating, in short, the most beautiful”.

perceived features or aspects of the natural system are, through measurement⁸ made to conform to the production rules devised in the formal system. Finally, we *decode* (**arrow 4**) the implication event (the inferences/implications arrived at through our formal system) and check to verify how this conforms to the causal inferences perceived in the natural system. When this procedure is successful – when our formal systems seem to (at least asymptotically) match up – we have established the following: **1=2+3+4**

This is the understanding that the form of causality perceived in the natural system has been modelled through formal inference. Rosen says that the prevailing ideology of the Newtonian Paradigm has made the modelling relation so taken for granted that it is often operative (to greater or lesser degrees) outside of the awareness of most scientific practitioners. His general criticism is that much modern experimental science has come to consider its task as simply being the “fitting of models”, without stopping to consider the underlying creative act involved in the very translation of encoding and decoding operations. The “dictionaries” we create to encode and decode the two systems are themselves independent of both formal and natural systems. This is what makes establishing a modelling relation as much an *art* as it is a methodology:

The first matter of importance is to note that, from the standpoint of the formalisms being compared, the encoding and decoding arrows... are unentailed. In fact, they belong to neither formalism, and hence, cannot be entailed by anything in the formalisms. The comparison of the two inferential structures... thus inherently involves something outside the formalisms, in effect, a creative act, resulting in a new kind of formal object, namely the modelling relation itself. It involves art. (Rosen, 1991, p. 54)

This is to say that there are always semantic elements that cannot be accounted for by syntactic elements alone, that formal models will never completely be able to describe the complex behaviour of the world, and that in fact, the encoding and decoding of models is, in a certain understanding, the construction of linkages between sign systems. This is a process/activity that Rosen associates with aesthetic sensibilities. The ideology that the universe itself can be adequately described by such formalisms is the belief that the universe is a mechanistic (and thus simple, as opposed to complex; see Section 2.2) system, and thus something that can be separated from the observer (the scholastic notion of *ens reale*).

But what specifically is this complexity that exists within living organisms that the reductionist worldview is not accounting for? What, to reference Nadin, makes the rock different than the cat when we drop it off a building?

2.2 Complexity and anticipation

In stark reply to this persistent and ubiquitous trend towards formalism, Gödel, in his celebrated incompleteness theorem (Gödel, 1931), demonstrated that the most fundamental theory of mathematics, number theory itself, cannot be completely formalized and explained through number theory alone (that such a mathematical system cannot be reduced to a set of base-line axioms from which every variable can be described through processes of inferential entailment). Rosen (1991, p. 35) explains the ingenuity of Gödel's theorem as follows:

⁸ See the exhaustive treatment of all that is implied in this concept of measurement by Rosen (1978).

Gödel showed how to represent assertions *about* Number Theory *within* Number Theory. On this basis, he was able to show that Number Theory was not finitely axiomatizable. In other words: given any finite set of axioms for Number Theory, there are always propositions that are in some sense theorems but are unprovable from those axioms (unless, of course, the axioms are inconsistent to begin with – in which case everything is a theorem).

Rosen, and modern anticipatory scientists like Mihai Nadin, who has for decades championed the often-neglected genius of Rosen, use the incompleteness theorem to describe biological life through the *threshold of complexity* (Nadin, 2014a). With this understanding, the difference between the living and the non-living is the difference between “undecidable complexity and decidable complication” (Nadin, 2017a, p. 154). According to Gödel’s theorem:

[A] complex system cannot be fully and consistently described. All other systems (those that can be unequivocally specified) qualify either as simple or, at most, complicated. Within this view, complexity is not a matter of scale. Moreover, it does not accept degrees (the empty formula of “higher complexity” and the like). Since the living is characterized by complexity, it follows that any formal representation, including the modeling of the natural system, can be only a reduction. (Nadin, 2014b, p. 78)

Following this reasoning, we can assert that because biological systems are undergoing continuous change, and defined through an *anticipatory dynamic*, no natural (living) system can be completely described by a formal model. Nadin (2010, p. 111) explains that what we are in fact describing when we study life through the reductionist framework, is physical processes, but not “life itself”:

Indeed, all living entities, from the monocell, to vegetation, to insects, to the most complex forms (the human being, for instance) are embodied in matter. The laws of physics (themselves subject to progressive refinement as our knowledge about the world advances) apply without any exception to the living, without fully expressing its more complex behavior. Therefore, one has to conclude that they explain only the unambiguous physics of life, but not life itself, in its ambiguous expressions.

Here we are clearly presented with something different than the mechanistic world represented by the Newtonian Paradigm; this is a world of flux and transformation, where every action and indeed every act of mind, models a possible virtual future and through this anticipatory action, remodels the past, a world where the observer is inextricably tied up in their observations:

Within physics-based explanations, the current state of a system is determined by its past and is deterministically well defined, i.e., non-ambiguous. An anticipatory system is a system whose current state depends not only on previous states, and eventually its current states, but also upon possible future states. (Nadin, 2010, p. 112)

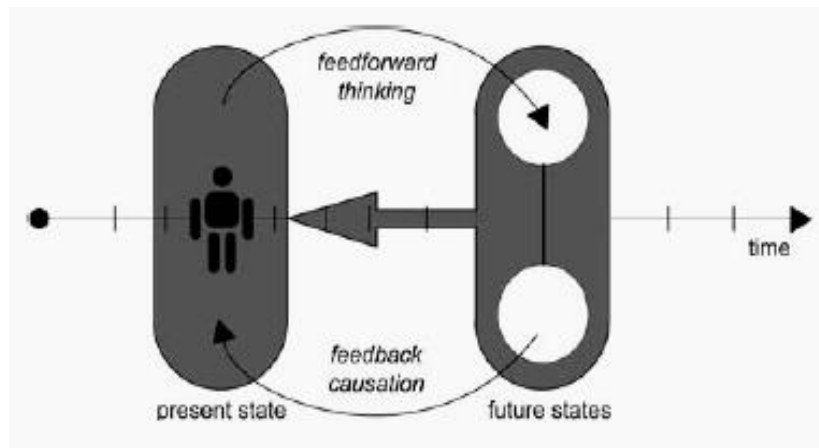


Figure 2: Anticipatory system as unity of reaction and anticipation (adapted from: Nadin, (2010, p. 112)

The goal-oriented dynamics of anticipation – which Nadin (2017) highlights is the domain of meaning, not of data – does not reduce neatly to algorithms or syntactic rules, and thus any such attempts at completely decidable descriptions can only be futile in understanding what is distinctive about life-processes. Even if such descriptions were possible, the Rosen/Nadin argument informs us that they would lack consistency, for the simple fact of the interactivity of subject-object relations. This is the recognition that “the external world and the internal reality of integrated mental and physiological activity go into what is expressed in the anticipatory action – a realization from the large space of the possible” (Nadin, 2017a, p.156). Determinist accounts cannot account for potentiality (outside of probability), nor the impact of the virtual (how something not materially present, still affects the present).

Along the lines of these ideas, I would like to propose that the process of learning may be understood as a “G-complex system... endowed with self-evolving anticipatory processes in which past, present, and future are entangled” (Nadin, 2017b, p. 21).⁹ In the context of applying anticipatory science to medicine, Nadin (2017b, p. 19) writes “A G-complex system is characterized by the fact that its information level is always higher than the information received from the environment; that is, a G-complex system generates information”. This feature, I argue, is equally applicable in helping to distinguish the process of learning as a form of continuing adaptive growth (explored in Section 5.2), in opposition to the more narrowly “complicated” processes of computation. This insight into learning theory allows us to re-imagine the space of possibilities within the learning-teaching dynamic. An approach to learning rooted in the physical sciences (the Newtonian paradigm), emphasizes unitary descriptions. G-complex systems however are unique (Nadin, 2017b, p. 20), and thus undecidable. If we take the following statement from Nadin (2017b, p. 19) and simply replace the word medicine and physician

⁹ This anticipatory dynamic can be expressed mathematically as: “ $x(t) = f(x(t-\infty), x(t), x(t + \beta))$ ” Where “ $x(t-\infty)$ is previous state(s), $x(t + \beta)$ is future state(s), and $x(t)$ is present state” (Nadin, 2017b, p. 21).

with ‘education’ and ‘teacher’ respectively, we can gain insight into how anticipation can function as a fundamental pedagogical orientation:

What a [teacher] “takes in” from [teacher] education... is quite different from what, on account of creativity (itself based on interaction), is expressed in the practitioner’s activity. If only the effort of individualization were to be considered, this would already confirm the idea. Anticipation-driven [education] is by necessity individualized, because the living is infinitely diverse. All machines are the same; no two persons are.

As Rosen has made clear (1991, p. 20), the Newtonian Paradigm gave the western world one of its most persistent and ubiquitous metaphors: *the human being as machine*. Although the world of matter (the non-living) may be well explained by the mechanistic-reductionist method of Newtonian physics, the world of the living is not. For the living is a world of interaction; by simply observing, the observer is changed and they themselves change the observed. This complementarity of observer and world, is absent from “the machine metaphor (supported, of course, by the corpus of modern physics) [and what] ... ultimately drives, and justifies, the reductionism so characteristic of modern biology” (Rosen, 1991, p. 21).

Part of my argument in connecting semiosis with a theory of anticipation is that the non-reductionism that is a result of considering seriously the modelling relation (and thus the complementarity of subject-object relations) reflects a *triadic* orientation. This point takes us nicely to our next topic, the details of Peirce’s triadic semiosis, which I argue is the primary underlying theory that allows us to approach learning as an anticipatory dynamic and concurrently a process of semiosis.

3. A short account of Peirce’s triadic philosophy

I propose that regardless of how it may be articulated, the recognition of a relational self-generated world – an *autopoietic* world of intertwined networks and processes – requires a triadic (hence non-dualistic) orientation. But what specifically constitutes such a triadic perspective? Three things: (a) the ability to account for: *the possible* (Firstness), defined by atemporal singularity; (b) *the is* (Secondness), the materially and existentially actual; and (c) *the would be* (Thirdness), the anticipatory and habit-taking process of mediation, with a first and a second coming into relation (Merrel, 1997, p. 27). The following popular “black board” analogy from Peirce illustrates this tripartition of experience. The black board is a continuum of pure potentiality. Its two dimensions will signify an infinite and indefinite potentiality:

I draw a chalk line on the board. This discontinuity is one of those brute acts by which alone the original vagueness makes a step towards definiteness. There is a certain amount of continuity in this line. Where did this continuity come from? It is nothing but the original continuity of the blackboard which makes everything upon it continuous... The whiteness is a Firstness --- a springing up of something new. But the boundary between the black and white is neither black or white, nor neither, nor both. It is the *pairedness of the two*. It is for the white the active Secondness of the black: for the black the Secondness of the white... We see the original generality like the ovum of the universe segmented by this mark. However, the mark is a mere accident, and as such may be erased. It will not interfere with another mark drawn in quite another way. There need be no consistency between the two, but no further progress beyond this can be made, until a mark will *stay* for a little while; that is, until some beginning of *habit* has been established by virtue of which the accident acquire some incipient staying quality, some tendency toward consistency.

The habit is a generalizing tendency, and as such a generalization, and as such a general, and as such a continuum or continuity...

The whiteness or blackness, the Firstness, is essentially indifferent as to continuity. It lends itself readily to generalization but is not itself general. The limit between the whiteness and blackness is essentially discontinuous, or antigeneral. It is insistently *this here*. The original potentiality is essentially continuous, or general. (CP¹⁰ 6.203-207)

This long passage helps illustrate how, according to Peirce's cosmology, chance occurrences give way to the generalizing tendency, i.e. to habit formation (see also CP 6.262). Potentiality is impossible to comprehend unless it is realized as *acting upon* (the brute force and dynamical nature of dyadic interactions), and to realize such Firstness through Secondness is to introduce mediation and thus reference to "abstential processes" (Deacon, 2012): to something *not present* that despite its immateriality still impacts and affects the present. Mediation requires that the organism is forming a relation to the environment, and thus, that it *means* something to it. Kull (2009, p. 82) similarly explains the Peircean triadic sign model through reference to anticipation and abstential phenomena:

The sign vehicle, or representamen (or sign, *sensu stricto*), stands for an object. This is the relation that is created by semiosis. The object, thus, has an interesting duality – it is both there and is not there – because it is both connected and anticipated. The relation of *standing for* is possible owing to the absence of what is referred to (the object) and, concurrently, there cannot be semiosis without the existence of a reference (an object)... Semiosis is what makes anything plural.

This can be understood as a reaffirmation of Sebeok's Maxim, for, as Kull also goes on to suggest in this interview with Magnus and Tønnessen (2010), the emergence of plurality is also the emergence of life, for *to mean is to be plural*. Since semiosis is necessarily a continuous flow or process, semiosis and the creation of meaning are also dependent on plurality.¹¹

Relevant to our previous discussion on defining the living through anticipation, Peirce connects the irreducibly triadic nature of the universe to the problem of the origin and evolution of life itself:

[T]he problem of how genuine triadic relationships first arose in the world is a better, because more definite, formulation of the problem of how life first came about; and no explanation has ever been offered except that of pure chance, which we must suspect to be no explanation, owing to the suspicion that pure chance may itself be a vital phenomenon. (CP 6.322)

¹⁰ The abbreviation "CP" as per convention refers to the 8 volume *Collected Papers of Charles Sanders Peirce* (1935–1966). The numerals represent volume and paragraph, respectively.

¹¹ "M [Interviewer]: What kind of plurality are we talking about? K[ull]: The difference between anything meaningful and anything that has no meaning can be described as a difference between the unique and the plural, or one and many. Everything that has meaning is plural. M: So what is unique or unitary, what is only one, cannot be meaningful, because being meaningful implies multiplying of what is meaningful. K: The problem is that it is almost impossible — or at least quite hard — to imagine something that completely lacks meaning. On the other hand — this is exactly what physics has to do. M: A non-semiotic approach would treat an object of biology as one objectified object only, and not as a plurality, and would thus lose a lot of the meaning involved..." (2010, p. 77-78)

This is in line with biosemiotics, which examines “the processes and consequences of habit-making via sign activities in living beings” (Affifi, 2014, p. 73). Biosemiotics rests upon the hypothesis (expressed by the above quotation) that “there is a semiotic core seeding the emergence of biological systems, from cells to ecologies” (ibid, p. 74). Part of this orientation concerns the “processes and consequences” of semiotic habit-making (the emergence of Thirdness) that enable growth (in terms of both ontogeny and phylogeny) to occur.¹² The dynamics of organic life are approached by the biosemiotic project as mutual webs of habit, or what Hoffmeyer (2008, p. 15) calls *semethic interaction*: “Whenever a regular behavior or habit of an individual or species is interpreted as a sign by some other individuals (conspecific or alter-specific) and is reacted upon through the release of yet other regular behaviors or habits, we have a case of semethic interaction”. This is essentially how an organism’s action in the world effects (through a constantly evolving anticipatory dynamic) how the organism will continue to act, and how through these actions the environment itself changes (by incorporating the actions of the organism into it and breeding semiosis plurality).

So, to recapitulate, Peirce believed that all forces progress from (1) states of pure chance, or potentiality (Firstness) to (2) states of dyadic (material) resistance, the Firstness of pure potentiality realized as *something*, and therefore asserting itself upon *something else* in terms of this initial potentiality possessing some permanence or duration (Secondness), to (3) states of relation, regularity, and generality (Thirdness). This progression from Firstness to Secondness to Thirdness – which Peirce recognizes as the flow of semiosis itself – is effectively the self-generating “tendency of all things to take habits.” In a similar sense learning, in its most biologically simplistic form, can be understood as the tendency of habit taking (of forming relations between percepts, both sensory and culturally informed) that enables the growth of future habit-making.¹³ Learning, in this understanding, is the realisation of qualitative potentiality (Firstness) through the material and dyadic resistance of coming into contact with some exterior-other (Secondness), and connecting this fallibilistic interaction with the continuity of our experience (Thirdness). How we notice and make use of these initial sensory engagements (Firstness-through-Secondness) determines how we form habits that we will project into the future (Thirdness) in an anticipatory dynamic. But since, according to Peirce, all experience consists in Thirdness, with only the imprint/memory of Firstness and Secondness, then it follows that all thought, all cognition and all experience is in signs (Peirce, 1868). This is synonymous with Peirce's assertion that experience itself is irreducibly triadic. A representamen (or signifier) signifies some object (be it a physically existent thing or a thought-thing). But semiosis does not merely terminate in the organism’s mental representations, as the more analytic perspective maintains (Deely and Semetsky, 2017). Rather, the sign reaches outwards to something other than itself, always to a new sign that can be further interpreted: to the wider world of semiosis and the web of relationships that constitute the world of the organism. With this innovation, a sign (or representamen) signifying an *immediate object* (the object as actually present in the sign) no longer terminates in the private “idea” of some interpreter, but rather enters a

¹² The concept of pedagogical growth is central to Affifi’s (2014) conception of biological pedagogy, and will be explored in Section 4.

¹³ Donna West (2016) has, in this journal, recently advanced a similar understanding in the context of childhood development.

vast web of sign relations that can be understood (again in relation) to a (hypothetical) global universe of semiosis.¹⁴

This is the perspective Floyd Merrell (1997, p. 11) puts forward in his zen-style dialogue between three actors; Alpha, Omega and the Master — each in themselves representing the three points of Peirce's tripod. Alpha asks the Master when discussing the process of semiosis: "Must not the addressee and addresser also enter the equation?" The Master responds by emphasizing the *future memory of the interpretant*:

While the components of the sign tripod are democratically situated, I would suggest that it is the location of the mediating interpretant that ultimately provides for meaning. As Alpha put it, meaning is not in the sign, the skull of the addressee or addressee, the air ripples between them, the object to which it relates, or black marks on white. Rather, relations between the components of the sign make way for, and engender, meaning. Although the object of the sign in a certain sense determines the sign, it is by way of further determination of the sign - its relation to the interpretant - that it means something *for* someone. Peirce qualifies this further determination as an interpretant, or translantant, of the sign, which in turn engenders another sign. There are no 'facts' of the matter – or pure – unmediated signs. Rather, the destiny of a sign demands that it be interpreted in (translated into) another sign.

The interpretant¹⁵, as it constitutes the relationship of a first to a second, is representative of the experiential realm of Thirdness, the modality of being in relationship to something else where semiosis and (per the biosemiotics perspectives of Hoffmeyer and Affifi) life itself occurs. "A Sign... is a First which stands in such a triadic relation to a Second, called its Object, as to be capable of determining a Third, called its Interpretant, to assume the triadic relation to its Object in which it stands itself to the same Object" (CP 2.242). Since a relation is never stagnant or determined (it is always becoming, being either sustained or destroyed) the interpretant (like the anticipatory dynamic) is always re-imagining and mediating our relation to the past, and present; it is in fact the way new possibilities (Firstnesses) are realized.

4. A brief comparison

In the previous section, we established that within a Peircean framework the physical world is one of dyadic processes of interaction and reaction (characteristic of the domain of Secondness) while the world of living things is irreducibly triadic. This is because the living being is constantly bringing itself into relation with its embedded and emerging ecologies. In this sense, we can say that effective anticipatory dynamics is parallel to effective semiosis, that is, being able to "read" and make use of the signs within one's Umwelt and thus to create habits that enable the future growth of habit — habits that are open and receptive to future semiosis. Deely (2000, p. 36) summarizes this fundamental Peircean notion, while describing the "supra-subjective" nature of semiosis:

The relations in which signs consist according to their proper being as signs differ from physical relations in nature in having of necessity (or "in principle") three terms united rather

¹⁴ "it is necessary to distinguish the Immediate Object, or the Object as the Sign represents it, from the *Dynamical Object*, or really efficient but not immediately present Object" (CP 8.343).

¹⁵ It should be specified that Peirce devised multiple forms of interpretants (CP 8.343). These nuances of interpretant theory will not be addressed here.

than only two. In other words, it suffices for intersubjective instances of relation to be dyadic, whereas the suprasubjective instantiations of relations as signs (which realize the indifference in the nature of relation to provenance from physical being as such) must always be triadic. A car can hit a tree only if there is a tree there to be hit; but a sign can warn a bridge is out whether or not the bridge is out, or, for that matter, whether or not there is even a bridge there at all where the sign "leads us to believe" there is a defective one!

Both concepts (semiosis and anticipation) are defined through teleology¹⁶; the sign, like all living things anticipates a future state of being. The rock will always fall the same way, adhering to the same laws of gravity and resistance; the same cannot be said for a person or a cat.

This outward potentiality contained in the sign – modelled by a theory of unlimited semiosis – reflects the anticipatory drive of organisms and can thus be associated with the biosemiotic project that asserts that semiosis converges with the emergence of life. Additionally, it reflects that all learning is a potential for transformation that is expressed in anticipatory action. It is revealing how remarkably similar anticipatory biology is with the Peircean perspective. Still, we must ask, if the two can be fully equated. To some semioticians, such as Nadin, semiotics concerns problems of representation and of how knowledge is inevitably tied up in the forms it takes. In this school, semiosis is approached not so much as a cosmological force, but rather a construct within the understanding of the observer (Nadin, 2014b). But within Peirce's doctrine of synechism (and concurrently Deely's (1990) more recent speculative theories of physiosemiosis) the progression from Firstness to Thirdness, is a tangible force in the universe that can be thought of as a necessary component in the emergence of organic life from in-organic matter.¹⁷

Peirce's synechism refuses to consider mind or consciousness as something distinct from physical matter but also from the general universal flow of signs. In contrast, Nadin, in the interest of experimental science, would rather say something more specific. Peirce apart from opening the door for future semiotic inquiry, does not help us in the here and now locate what is distinctive about organic lifeforms. Honing in on the integrated dynamics of Anticipation has allowed Nadin and Rosen (and others) to focus on observable experimental phenomena that are, at least at our current level of analysis, clearly distinctive of biological lifeforms.¹⁸ This research does not require Peirce's metaphysical and cosmological theories, although it does require semiotic analysis generally, specifically, the ability to account for the qualitative (meaning-driven) dimensions of adaptation (Kull, 2009). This said, and as I have argued elsewhere (Campbell, 2015a, 2016), Peirce's categories provide a relatively intuitive conceptual framework for considering often neglected aspects of teaching and learning. So, although Peirce's broad metaphysical considerations might hurt the applicability of his philosophy (to both education and experimental science) his general emphasis on the irreducibly triadic nature of consciousness and experience is important. Also important is aligning semiosis with the process of learning, and this is what we turn to next.

¹⁶ Ransdell (1977, p. 163) reminds us that Peirce conceived of his own semiotic "as precisely the development of a concept of final cause process and as a study of such processes".

¹⁷ This is expressed by the following often quoted Peircean quotation: "All this universe is perfused with signs, if it is not composed exclusively of signs" (CP 4.539).

¹⁸ Nadin's (2017a, 2017b) recent applications of Anticipatory science into neuro-science and medicine respectively are good examples of this applicability.

5. Implications for edusemiotics

5.1 Thirdness is learning

In the remaining sections I will argue that, in the interest of philosophy of education, aligning semiosis and anticipation can be conceptually useful in demonstrating one of the basic premises of edusemiotics: how learning can be understood as semiosis.

As we have discussed earlier, formalization requires the reduction of phenomena/processes into baseline production rules (or algorithms) from which information not expressed in these rules can be inferentially entailed: “there is *always* a set of parts, into which *any* material system (and in particular, any organism) can be resolved, *without loss of information*” (Rosen, 1991, p. 21). This requires a process of fractionation, which rests upon a notion that parts can be isolated from their emergent contexts and interactions, adumbrated and then used to derive information about the whole phenomenon/process. In semiosis because past states effect the present just as much as possible future states, such a reduction is effectively impossible for it would imply a dyadic (and hence *non-triadic* and non-dialogic) sign model (a structuralist model of signifier-signified, or expression plane-content plane). Similarly, Rosen believes that no structural (syntactic) modelling can describe the complexity inherent of the Living:

Just as nobody has been able to characterize an organism in terms of a discrete list of properties, no one has been able to characterize a “natural language” (let us say English) in terms of a list of production rules. Indeed, if it were possible to do this, it would be tantamount to saying that a (natural) language can be completely characterized by syntactic properties alone, i.e., made independent of any semantic referents whatever. (1991, p. 43-44)

This is because the “code” of a semiotic system is not purely self-referencing or closed, but defined by triadic and constantly evolving sign-processes.

An edusemiotic model of cognition and learning, as opposed to an information-processing model (for the distinction, see Cunningham, 1987, 1998) insists upon an *open system*: that is, a *complex system*, in the technical sense used in this study. A triadic sign model tells us of the impossibility of reducing the complexity of the living to formalizations; semiosis does not function in a closed circuit, for the simple fact that the sign is *triadic* and not *dyadic*. It is only with such a triadic model that we can escape the dichotomous foundations emblematic of modern philosophies, as diverse as determinism (with its glaring mind-body problem) and even contemporary phenomenology, with its explicit subject-object distinction (Deely, 2001, 2009). John Dewey long insisted on the inadequacy of such approaches for understanding learning and educational contexts, reminding us time and time again that “[s]ubject and object antithetically defined can have logically no transactions with each other” (Dewey 1958 [1925], p. 239). To remedy these dualist conceptions in education is in many ways the central task of the emerging edusemiotic project. As Semetsky says (citing Nel Noddings), this task is to recognize that “relation is ‘ontologically basic’ (Noddings, 2010, p. 390) and therefore defies stable substances as the furniture of the world presupposed by the analytic tradition” (Semetsky, 2014, p. 494).

In terms of Peirce's categories, the being of relation is Thirdness. Thirdness, in a Peircean edusemiotic, is a concrete learning objective. It is in fact the goal of learning in its broadest sense. Torill Strand (2013) has even declared that "Thirdness is learning", for what is learning but the ability to make relationships between objects within experience — to realize the habit-forming and generalizing tendency of semiosis? To reference Peirce's famous article (1868), it is the place where we reach beyond a basic perceptual acquaintance with an object (the first grade of clearness, in a certain sense characteristic of Firstness) and beyond a formal abstract formulation (conventionalized symbolic knowledge) towards an understanding of the relationships between the object within my awareness and such a mental formulation.¹⁹ It must be stressed that Thirdness is not limited solely to abstract symbolic modelling, just as Firstness is not solely iconicity, and Secondness is not solely indexicality. This is important because much formal education adheres to an implicit learning theory that emphasizes symbolic formal systems often in place of (or completely severed from) their embodied iconic and indexical foundations. The Thirdness we are alluding to here is more general and experiential than what is called by modelling systems theory (Sebeok and Danesi, 2000) the *tertiary modelling system*, or "the modelling system that undergirds highly abstract, symbol-based modelling" (p. 201). Thus, we have the Edusemiotic focus on experiential learning processes which involves realizing that behind every formal symbolic system there is a sensory beginning, and that learning involves action in and to the world (Semetsky, 2014). As Dewey (1916/2004, p. 134) reminds us:

To 'learn from experience' is to make a backward and forward connection between what we do to things and what we enjoy or suffer from things in consequence. Under such conditions, doing becomes a trying; an experiment with the world to find out what it is like; the undergoing becomes instruction – discovery of the connection of things.

A triadic orientation is similarly about recognizing all aspects of experience, not just what is easily decidable and explainable, that is, what is easily *reducible*. Anticipation is central to this understanding of living-learning, since it is always expressed in action (not in stable structures or substances frozen synchronically).

This experiential focus amounts to the recognition of the irreducibly triadic nature of semiosis (ex. CP 5.473) — as opposed to the dynamic reactions of brute force, cause and effect that is characteristic of Secondness and the physical world. In this understanding Thirdness adheres neither to realism nor idealism, neither to mind-independent being, nor mind-dependent being, but occurs prior to any sort of dichotomization such a philosophical distinction implies: the observer and the observed, inner and outer, nature and culture. In regards to these limiting polarizations anthropologist Tim Ingold (2009) asks:

Can there be any escape from this shuttling back and forth between enclosure and disclosure, between an ecology of the real and a phenomenology of experience? So long as we suppose that life is fully encompassed in the relations between one thing and another – between the animal and its environment or the being and its world – we are bound to have to begin with a separation, siding either with the environment vis-à-vis its inhabitants or with the being vis-à-vis its world.

¹⁹ For the educational implications of these three grades of clearness, see; (Campbell, 2015b).

The reach beyond the subjective-objective barrier lies in the relational dimension of semiosis. When our focus is turned away from sign vehicles (signifier-signified, representamen-immediate object) to the relations between signs and signification, we can escape such dichotomizations that work against the continuous flow in which experience presents itself to us. And now, finally, we can justify why Peirce's categories of existence are needed in education. This is because quite simply, experience is not reducible to existents or non-existents, between an "ecology of the real, and a phenomenology of experience" (ibid.). Potentiality and future mediation are always weighing upon our learning in the world.

Our ability to recognize what Deely (1990) has called the *stipulable* sign — the signification processes explicit in signs "apart from its context and circumstances of utterance" (CP 5.473) — is to effectively understand the learning process as complex (in the Gödelian sense), not as it occurs in distinct contexts or iterations or as attached to any particular knowledge content, but for its *constantly evolving potential*. This is because learning is itself a relation; it cannot be fully understood as a psychological state in the mind-brain of the learner, nor in the objects they are trying to understand, but as Deely says echoing Poincaré, something radiating "*over and above them*" (2009: 69).

Because the essential content or being of the sign is relative, the key to understanding what is proper to the sign is the notion of relativity, relation, or relative being. Without this content, the sign ceases to be a sign, whatever else it may happen to be. Stripped of its Thirdness, the sign slips back into the dyadic order of mere actual existence or, perhaps even further, into the monadic order of mere possibilities and dreams beyond which there is nowhere to go. (Deely, 1990, p.35)

The orientation that the living is complex and thus cannot be described (completely and consistently) through symbolic/formal reductions validates the edusemiotic perspective that learning be observed and conceptualized through signification processes that mediate subject-object, mind-world. Thus, edusemiotics studies *virtual* phenomena: immaterial "supra-subjective" relations that although possessing subjective/material fundamentals (of the order of Secondness), transcend "over and above" such spatial-temporal terminus, reaching both forwards and backwards in time. Adopting the notion of subjectivity and objectivity revealed by semiotic analysis,²⁰ Deely (1990, p. 100) describes the type of objective reality that edusemiotics purports to study:

[A]ny attempt to restrict semiosis to cognition falls short at the level of theory for the reason that nature and culture mutually penetrate one another in the constitution of experience, so the objects of experience *also* reveal themselves more suited to some significations than to others in any given context or inquiry. The objective sphere reveals itself as neither closed nor closable upon itself absolutely... The full semiosis of experience, thus is never merely actual, but is suffused at every moment with elements and factors passing in and out of varying degrees of actuality and consciousness through the virtualities that remain in their own right semiotic (whether rooted primarily in the psychic or the physical side of subjectivity).

Less technically this is to say that edusemiotics addresses *not* directly the material effects of learning (brain states, material learning outcomes) but rather how learning is

²⁰ Where a subject is 'what it is independently of what anyone thinks it to be', and thus of the order of *ens reale*; and an object is something that exists within the awareness of some organism.

displayed in the sign-processes that learners use, and how these sign-processes enable (or disable) the learner to continually grow and flourish within their changing relationships, environment and settings.

5.2 Pedagogical growth

The Deweyian pedagogical concept of growth informs our comparative study of triadic semiosis and anticipation. Affifi (2014) has incorporated this aspect of Dewey's educational philosophy within the purview of biosemiotics, to inform an approach to learning that he calls *biological pedagogy*. As we learn from Peirce's cosmology, semiosis is unlimited and continuous, so semiotic-habit formation cannot be merely the operationalizing of behaviour and action. For Dewey, growth is about the formation of habits that will engender a receptiveness to novelty. Affifi (2014, p. 76) explains:

For Dewey, growth occurs when possibilities open up for an organism, thereby "enhancing its ability to participate in its environment" (Gouinlock, 1972, p. 238). It is the process of developing habits that allow the organism to interact more spiritedly, responsively, and openly to arising circumstances. By contrast, a lack of growth limits possibilities of encounter, as the organism relies on preformed habits that stultify, ossify, and close it off to novelty... growth is predicated on habits that enable future habit-forming, whereas the restriction of growth occurs when existing habits monopolize the operational domain (see, for example, Dewey 1916, pp. 44-48).

In a similar sense, anticipation as a pedagogical concept is about furthering the growth of future habits that enable the organism to better navigate and expand the meaningfulness of its Umwelt. For a sign to be a sign, "reference to the future (in a third element, the interpretant) is essential ... regardless of whether the thirdness is actual here and now or only virtual and "waiting to be realized" (Deely 1990: 34). Thus, the interpretant is related to and dependent upon anticipatory dynamics, in the sense that both can be understood "as a process or form of *becoming*... over and above the essential structure that nevertheless makes signification (as the production of meaning or sense) possible in the first place" (Deely and Semesky, 2017, p. 2). Interpretants do not emerge as deterministic stimulus-response reactions separated from the world in which they occur (as the formalist maintains) but are always contextual and meaning-driven (they function as objects within the web of relations that make up the Umwelt of the learner). For example, the same stimulus — the howl of a male wolf — can signify very different things, whether it occurs on a recording, in a city, in the desert, and whether I am a female wolf, a human, or a sheep. In fact, such an alignment (between anticipation and interpretation) has recently been made by Nadin (2017a, p. 158), when he argued for a less quantitative, more semiotic (meaning-based) approach to understanding life:

To be successful (in the evolutionary sense), action (through which anticipation is expressed) has to predate, not to follow, changing circumstances. Ergo: Evolution is predicated upon successful anticipatory action driven by the meaning of change in the world, not by quantitative variations. No living entity measures—it interprets. Measurement is a human activity associated with the construct called numbers, which define quantities. Interpretations, in a variety of forms, are part of the dynamics of life.

And if we recognize that the living itself is defined by anticipation then it follows that the potentiality for full-fledged semiosis is implied in all living things. It is in this sense that signs contain a future-memory as well as a past one: realizing the inchoate qualitative potential in interpretants is akin to realizing their potential for growth. Aligning semiosis with learning is similarly about realizing such potential for transformative growth in learners themselves.

Deely elaborates this future memory of semiosis in his seminal essay *Evolution, Semiosis, and Ethics* (Deely, 2010, p. 79) — he might as well be describing anticipation:

Chance itself becomes assimilated in its outcomes to the various processes of semiosis whereby the meaning of what exists now is influenced by what the “now” has made possible that was not possible in earlier “nows”. That influence of the future which determines the present relevance of whatever is “past”, according to the ever changing boundary between “real” and “unreal”... is the essence of semiosis, the distinguishing feature which separates Thirdness as an action of signs from Firstness as ‘pure possibility’ and Secondness as possibility concretely determined by physical interactions here and now.

To recognize how this “action of signs” mediates the “possible” with the “here and now” — again to recognize the *stipulable sign* — is effectively to recognize learning as semiosis. To reflect on and bring awareness to this stipulability is in fact the objective of every educator. For the educator (against popular belief) is not simply the conveyor and gatekeeper of semiotic content, or knowledge — a teacher’s job is not simply to ensure a student’s familiarity with already determined curricular objects. This is the reductionist-mechanistic perspective towards learning we see reflected in much formal training. *The educator, in actuality, teaches students to be in relationship* — to an object or objects within their awareness, whatever that object be a literal (subjective) physical object like a guitar, carving knife, or iPad; or to an object of thought, such as a philosophical concept, a mental representation, or a mathematical object, like the variable x which already possesses a purely relational identity to begin with. Student and teacher alike, *learn* from these relationships, which (in itself) involves some degree of stipulation and abstraction, in the sense that the student/teacher must recognize that there are signs, and not merely use them.²¹ These relational processes always emerge from a situated sensory encounter with the environment (Firstness through Secondness); but, to carry this beyond the world of accumulated information, that is, to *learn* from these sensory beginnings, we must bring these perceptual signs into relation with our acquired experiences. The interpretant, as it is not strictly a mental mode of being (it is not a specific interpreter!), is essentially what mediates “the difference between objective and physical being, a difference that knows no fixed line” (Deely, 1990, p. 27). The learner utilizes the stream of interpretants within their experience to form the foundation for habits that will (ideally) enable future habit making, habits that are rooted in embedded ecologies.

So to recapitulate: the process of learning itself can be conceptualized as an interaction and immersion in the continuous flow of semiosis (CP 1.412) in which all our relations with the world present themselves. To do this is to realize the universe of discourse for its constant flux: signs becoming new signs in a process of unlimited semiosis. Conceptualizing learning in this way is to recognize the *palimpsest nature of*

²¹ The fact that humans not only use signs (as all animals do) but know also that there are signs is what makes us, according to Deely (2005) “the semiotic animal”.

experience (Campbell, 2016). To realize the aesthetic/sensory potentiality of Firstness, and the brute realization of Secondness in every interaction, even though experience is necessarily of the nature of Thirdness. Learning, in this understanding, exists on a node, a sign in the process of translation into a new sign, but a sign not yet *become*, a sign that is always *becoming*. To imagine learning as something to be attained and possessed is to ignore that learning is a continual stream or process, and diminish it to a knowledge-object (a signifier-signified dyad, a closed circuit, not a triadic and out reaching sign). Learning is not something dug out of the ground, something unearthed, but a process to enter into relationship, something to join in equilibrium.

Of course, one can fall out of equilibrium with learning. To conceptualize learning in such a relational way requires an analog that is poly-dimensional as well as flowing/continuous. Sound and wind come to mind: a sailor can harness the power of the wind to guide her boat; she can enter into balance with it, just as she can fall out of balance and find the same wind working against her vessel. If we approach learning with this conceptual analog, learning is something achieved by attuning oneself to the constant flux of the world, and in this sense, concerns a tuning to anticipation.

6. Closing remarks

6.1 Reflections of a music teacher

As a way of applying the above analysis and of tracking the scholarly journey you have kindly embarked upon with me, let me draw upon my experiences as a music teacher.

Many musical methods – such as, to use a Canadian example, the Royal Conservatory of Music (RCM) – deal primarily with mechanics already encoded into formalized systems. Students are taught the separate components of music: scales, chords, arpeggios, repertoire, theoretical rudiments, etc., as they are embedded within formalized sign-systems of harmony and notation. Even ear training is often approached in such a content driven manor, as students are generally drilled on interval recognition, and the ability to recognize individual chord qualities before they approach learning an actual piece of music by ear, or attempt to realize music already in their memory on their instrument. In the context of Rosen’s Modelling relation, we can say that instead of aligning learning with the student’s actual perception and experience of music-making, these more formal approaches generally begin with musical phenomena *already determined* through highly abstract formal systems. From these formal systems students are explained “basic axioms” from which musical information can be inferentially entailed. With a relational approach to music learning, the mechanics are inevitably dealt with but they are principally the medium through which the learning takes place, and in this sense, secondary to the primary goal of learning to be in relationship with some other. This “some other” can be many things; it can be the students’ embodied relationship to their instrument — how they hold the instrument, how they care for it, how they play it — or it can be a musical object within the awareness of the student, such as a melody the student is learning by ear, or a new mode they are becoming acquainted with, etc. Again, fundamentally an edu-semiotic approach is routed in experiential learning.

Susan O’Neill’s theory of *transformative music engagement* (TME) is very much in line with this basic orientation. Such a theoretical lens involves “[s]hifting our thinking

about music learners from being to becoming”, providing “a framework for engaging music learners as active agents in their own musical development” (O'Neill, 2012, p. 164). O'Neill (2012, p. 164) explains such a shift in thinking: “Whereas the idea of *being* a music learner suggests a bounded and static entity, with a nature that is prescribed, determined, or unchangeable, *becoming* a music learner is infused with notions of unfolding, openness, and dynamic potential”. Related to my argument here, a theory of TME involves a turning away from positivist expectations in music education that tend to view learners “from within a deficit versus talent/expertise framework” (O'Neill, 2012, p. 166), following the standards and expectations characteristic of “formal conservatoire approaches to music learning” (p. 169).

As a jazz/improvising musician I know that being in relationship with the music you are actively creating is the primary objective of improvisation, whether in a group context or solo. All students of improvisation know these moments when your ears are wide open and receptive to the present moment, something that could somewhat misleadingly be linked with the psychological concept of *flow* (Shernoff et al, 2014). And conversely, all musicians know the shock to be returned from this transcendent relational state by a slip of the fingers, a mistakenly placed note, that all at once sends you hurtling back to *reality*. This is the fallibilistic “dynamical” reality of Secondness (CP 5.50, 5.484).

The experiential aspect of learning (embodied by Thirdness and semiosis generally), is of course not reducible to any “complexus of dyadic relations” (CP 2.274). That is, semiosis-as-experience is “not a drawn out series of steps” but an immediate cognitive event, that involves “not only the brute actuality of interaction between *two* as a pair, but also the interpretation of this interaction” (Quay, 2016, p. 83-84), no matter how automatic, pre-rational/instinctual, or anticipatory this interpretant-process appears to be. All this by way of saying that Thirdness as a pedagogical value must have a memory of the aesthetic pre-cognitive dimensions of experience embodied by the monadic consciousness of Firstness, and the embodied knowing of Secondness. But since all experience occurs in Thirdness, so must learning. The goal of a Peircean edusemiotic is thus to begin with the *stipulable sign* (taking notice of signification processes as embedded in specific learning-contexts and *emergent* perceptual encounters), and in a sense work backwards to realize the other categories as *inchoately* contained in this Thirdness.

When, in improvisation you realize such an awareness of all categories – the proper goal of a Peircean edusemiotic – you are better able to *anticipate* the music’s developments. You transcend the reactionary state of just trying to find a comfortable pocket, just trying to react sufficiently to the info the other musicians are sending your way. When in relationship to the music, you are in a state of pure Thirdness, *you are comfortably in step with semiosis*, able to anticipate interpretants as they emerge, able to “hear ahead”, but also aware of the underlying sensory/qualia driven aspect of the music (Campbell, 2015a) as well as responsive to the embodied “*indexical rub*” (Campbell, 2016) of coming up against the unknown. The sign possesses a *future memory*, and is thus not reducible to a logic of cause and effect, nor to a computational model of cognition. In musical situations, this future memory is experienced poly-dimensionally, and at various levels of temporality. The ensemble collectively creates a localized ecology – an ecology in various states of flux. A bebop tune like *Donna Lee* is

progressing at a more rapid pace than a monotonous dominant drone, but both are in flux, for this is the nature of semiosis. Analogously, this is the nature of the living. Each musician is constantly trying, to the best of their ability, to merge and be in harmony, in equilibrium, with this constantly becoming collective ecology, in the scholastic way of speaking characteristic of Deely: *to realize a being proper to relationship*.

6.2 Implications and directions for future research

The orientation to define learning as semiosis, as noted by Cunningham (1987, p. 214), sensitises us to an understanding that learning, and cognition generally, is always concerned with “an interaction between the physical world and the cognizing organism”. This is a pertinent reminder for education: that, no matter how abstracted, extensional or symbolic/conventional our knowledge-systems become, learning always has a sensory origin. This is why Danesi (1998) suggests, in his monograph on Thomas Sebeok’s semiotic, that we must never lose “the body in the sign” (Danesi, 1998). Learning is something that living things do to constitute their relationship to the world. As such, learning can be thought of as an extension of the complexity inherent in the living. Learning in this understanding is not the application of a single model of the world (an act of computation), but rather the ability to form and realize the signification processes underlying all our interactions (mental, physical/mechanical, perceptual etc.).

I have here argued that the logic of the semiosis (embodied by the interpretant function) in many ways parallels the anticipatory logic that Rosen espoused in his important works in theoretical biology. This alignment is also in line with one of the principle insights of biosemiotics: that “the intentional aspect of sign processes... parallels the teleological-teleonomical aspect in life processes” (Kull, Emmeche, and Hoffmeyer, 2011, p. 15). As noted by these three leaders in biosemiotics, “Rosen’s approach is a path towards biosemiotics” (2011, p. 10). Following this study, I would also insist on the need for future biosemiotic and edusemiotic studies to consider and collaborate with contemporary research into anticipatory systems (as in the *Ante Institute* out of the University of Texas).

Together these perspectives – edusemiotics, anticipatory systems, and biosemiotics – can build bridges across the humanities and the “hard” sciences, for all these perspectives seek to better understand the immensity of meaning inchoate in this concept/process of learning. To address our inquiry-questions from earlier (see Section 1), such a collective and integrated theoretical understanding transcends the causal-determinist perspective and provides a lens from which to understand the complexity of the living by accounting for forces that traditional Newtonian physics cannot, such as

- continuous fluctuation and change;
- inchoate possibility (Firstness) and as well as future mediation (Thirdness) having the ability to impact upon the present;
- a continuity between *ens rationis* and *ens reale* and thus the requirement for using many different representational models to explain phenomenon;
- complementarity of subject-object relations and thus the recognition of relationality (or semiosis, or more narrowly of interpretative processes) as a tangible force in our engagements with the world.

Realizing these points are, as I see it, the goal of pedagogy that strives towards recognition of *being* (that is, ontology) in its fullest sense. The perspectives I have explored – Peirce’s triadic semiotics, his categorical system, and a theory of anticipation as definitional of living beings – all realign the processes of learning with the complexity of life. They inchoately explain that if the living is not reducible to a deterministic logic then neither is learning. What I propose is (in the spirit of Peirce’s pragmatism) a regulative ideal for an educational framework that recognizes the triadic nature of consciousness and learning. Recognizing the ways in which *the possible* and *the anticipatory* influence and determine how learning occurs is essential for a pedagogy that realigns with the dynamics of life. Such a triadic approach, I would insist, is the only way learning can realign with experience and be conceptualized (in the Deweyian sense) as a form of growth, outside of reductions to either constructivist notions of mind-dependent reality, or positivist conceptions of mind-independent reality. Like life-processes, learning is not reducible to even an aggregation of systems, for as we have seen, a complex system is not ever entirely describable. Learning constantly exceeds being realized in any single state or in any formal system; it constantly spills over any singular representation of the world. Hence, my emphasis on exploring an aggregation of different perspectives and approaches. Hopefully this study – by bringing things into relation – can point the way to future realizations about living and learning.

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