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Biosemiotics for postdigital living: the implications of the implications

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Abstract: The postdigital condition is discussed from the perspective of Paul Cobley's biosemiotic approach to culture. While semiotics is often concerned with cultural criticism, there has been no explicit biosemiotic approach to culture, until only recently with Cobley unfurling such a research program. The key to this is the biosemiotic notion of *modeling*, which accounts for co-evolutionary processes encompassing biology and culture. This approach responds to recent calls in the humanities and social sciences to understand culture as constituted through technology, but also as something not strictly human (more-than-human). By undermining both vitalism and reductionism, biosemiotics avoids biologism and culturalism, which is of much importance for theorizing culture and learning in light of evolution. This has consequences for construing cultural pluralism. Mainstream notions of multiculturalism rely on cultural holism and, hence, advocate the separation of communities and languages for the pretense of maintaining diversity. Cobley's theory avoids this pitfall, offering a view of cultures as intrinsically heterogeneous and open systems. This suggests further implications for how we understand the aims of literacy and state-run education. We present an account of biocultural learning that accommodates contemporary posthumanist and postdigital orientations. Construing learning as ecologically contextual is necessary for addressing ongoing technological transformations.

Keywords: cultural pluralism; evolution; learning theory; modeling; postdigital education; technology

1 Introduction: technological and cultural implications of biosemiotics

This paper examines learning from the perspective of Paul Cobley's (2010, 2016) biosemiotic approach to culture. In this regard, Cobley did not develop a

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new theory or approach, but only unfurled "the cultural implications of biosemiotics" (2010, 2016). This is a particularly important point for which, perhaps surprisingly, Cobley's work is particularly original and salient. While biosemiotics has been thoroughly developed as a theory and it is enjoying considerable popularity, there has been great hesitation to approach culture from a fully biosemiotic perspective.

We argue that Cobley's approach implies an evolutionary-developmental theory of learning, as understood in light of biocultural evolution – a project also pursued in semiotic research on education, particularly in the work of Andrew Stables (Gough and Stables 2012; Olteanu and Stables 2018; Stables 2012). By explaining the evolutionary continuity within which (human) culture has developed and taken shape through *modeling*, Cobley (2010, 2016, 2018a) invites a posthuman (Taylor 2017; Taylor and Pacini-Ketchabaw 2018; Ulmer 2017) and postdigital reconsideration of educational research and philosophy (see Jandrić et al. 2018; Jandrić et al. 2019; Jandrić and Ford 2022; Lacković 2020; Lacković and Olteanu 2023).

The theoretical cornerstone in our discussion is a merit that Hoffmeyer (2015b: 252) first observed in Cobley and Stjernfelt's (2015) discussion on the concept of *semiotic scaffolding*. Namely, Cobley and Stjernfelt's (2015) employment of semiotic scaffolding, a concept originally coined by Hoffmeyer opens possibilities for "tracking the ways of human cultures" (Hoffmeyer 2015b: 252) as externalizations of the human mind. As such, we explain cultural pluralism as construed in linkage to technology, adopting a broad biocultural definition of technology, as any kind of extension or evolution of an organism's embodied affordances for meaning-making. We link this redefinition with Peirce's research program of synechism (doctrine of continuity) – a philosophical method which seeks continuities in place of discontinuities (body–mind, nature–culture, mind–matter, etc.) and linked with Peirce's pragmatic method.

This biosemiotic approach to culture and learning theory is valuable for contemporary educational research (e.g. Campbell et al. 2021; Smythe et al. 2017), particularly because of the reconfiguration of educational practices caused by the recent diversification and explosion of (digital) media technologies. Traditionally, education has been construed as a program to deliver *literacy*, namely skills for operating with the alphanumeric symbols of print technology. The notion of *literacy* is bound to the rise of the modern literary genre of the novel (Cobley 2014 [2001]: 38–40), in the same historical period, not accidentally, when modern public education, paid for through taxation, was starting to be established in the mid-19th century. The emergence and popularity of the novel was enabled, of course, by the printing press technology, accompanied with a popularization of reading and writing skills. In this context, reading and writing,

together with basic arithmetic, have been deemed *literacy*, namely the set of skills that allow a person to be engaged as a citizen, as someone professing an agency dislocated from the social roles in feudal societies. *Literacy* was the modernists' weapon against feudalism, against the rigid and discriminating social stratification of old, centralized empires and, contextually, toward the foundation of nation-states (e.g. Anderson 2006: 77–78, 115; Said 1993: 299).

As such, *literacy*, the rationale of modern education to empower people to pursue their political interests as citizens, is, in fact, a mode of representation. On this account, a responsible and engaged citizen, that is, a *literate* person, is someone capable of representing the world in/through print. This is a monomodal (Kress and van Leeuwen 2001: 1) and glottocentric (i.e. language-centric) representation of the world. Literacy, unfortunately, has not been historically implemented as a means to enable critical thinking, which was the hope of Enlightenment philosophers, such as Kant (1999 [1784]) and Humboldt (1988 [1836]), to give two prominent examples among many. In this line of thinking, as particularly evident in Humboldt (1988 [1836]), *literacy* also had to serve establishing a certain sociotechnical imaginary, to use a contemporary term that captures the situation. Jasanoff and Kim (2009: 120; see also Jasanoff and Kim 2013) define sociotechnical imaginary as "collectively imagined forms of social life and social order reflected in the design and fulfillment of nation-specific scientific and/or technological projects." Modern education had to deliver a sociotechnical imaginary that corresponded to how print and coal-powered railway networks politically reacted against the feudal and imperial world order (see also Rifkin 2011). As such it entrenched a rigid notion of *identity*, at what has become the nation scale, that corresponds to how this complex of technologies could inculcate an illusion of monolingualism. By monolingualism we mean the (unjustified) assumption that within a language, as a clearly distinctive sign system, there can and, ideally, should be no variation. This ideal of modern education was clearly first formulated by the *Académie Française* (1995 [1635, 1752, 1816]) in the 17th Century. In the *Status et règlements* of the *Académie Française* it is argued that there is one proper version of the French language, toward which the language must be "purified," as this version alone is best for both the arts and sciences. Academic institutions followed this model, as based on a shared ideology of nationalism, monolingualism, and (mono-)culturalism.

The goal of modern education to stimulate critical thinking has always been tainted by the political drive to sediment a rigid identity as corresponding to the vision of a nation-state. This has of course, often meant that schools specifically function in the service of settler colonialism, as is particularly the case in countries like Canada (but not only Canada) with its genocidal residential school system and policies associated with the Indian Act (see Barman 2012; cf. Milloy

1999; Miller 2017). As argued persuasively by Leanne Betasamosake Simpson, Indigenous cultural and educational resurgence requires nothing short of "a radical break from state education systems – systems that are primarily designed to produce communities of individuals willing to uphold settler colonialism" (2014: 1). As another example, Said (1993 [1994]: 299) explained that, in the context of Arab-speaking populations in the Middle East reacting against European imperialism, "more effort is spent in sustaining the connection, bolstering the idea that to be Syrian, Iraqi, Egyptian, or Saudi is a sufficient end, rather than in thinking critically, even audaciously, about the national program itself. Identity, always identity, over and above knowing others." What Said observed is, sadly, that populations that were colonized may repeat the mistake of the colonizers, namely for communities to organize chiefly around a rigid notion of (national, linguistic) identity, rather than seeking out and acknowledging other forms of solidarity and relationship.

The contemporary problems that arise from an education system chiefly modeled on and driven by print-literacy as defined to serve such imaginaries goes beyond discrimination (as damaging as this is, in itself). Having moved not only to post-print but also properly into *postdigital ways of living* (Lacković 2020), coupled with the existential threat of human-induced climate change, print-literacy is, simply put, economically and politically no longer useful or effective in addressing contemporary educational challenges. Indeed, a focus on the post-digital allows educational researchers to locate a nexus of interrelated challenges, occurring at the intersections of technology and the climate crisis (see Jandrić and Ford 2022). Though the postdigital is notoriously difficult to pin down, a central premise/notion of postdigital thought is that simplistic dualisms such as digital/analog, off-line/online, and by extension, body/mind (and human/non-human) are inadequate in this historical moment: "The postdigital is both a rupture in our existing theories and their continuation" (Jandrić et al. 2018: 895).

Kress (2003: 28), too, points to the ideological loopholes of modern philosophy and its close relationship with "industries of mass-production":

> In the era of the modernist state, of its secondary industries of mass-production, of the mass-organisation of that state's bureaucracy and economy, competent use of a resource, whatever it might have been, was prized. Competent use envisaged both a stable system of resources for representing – 'the' grammar of 'the' language – and a user of that system who was content with being able to use this resource competently. He or she would 'acquire' that grammar – whether as a first speaker of the language or as a learner of the resource as a foreign language to a level where competent use could be more or less guaranteed – at least at the level required, hence the notion of functional literacy.

We consider that Cobley (2016) attacks the problem at its ideological core by opposing, through biosemiotics, *glottocentrism*, namely the assumption that *discourse* as a predominantly, if not exclusively, linguistic type of modeling constitutes a *worldview*, a frame within which normativity is established. Kress (2003) emphasized the singularity and rigidity of the sign system from which semiotic resources are to be extracted, according to the modern view. This sign system is identified as a language and, more specifically, a *grammar*, meaning, in this context, containing a fixed set of rules. On this account, the individual needs only to learn the code to become an efficient (human) resource herself, worthy of the political and legal acknowledgment of the state. The role of education is to deliver this code to individuals so as to maintain it as a fixed/static system of social representation and cultural expression. Here, teachers are often reductively conceived as mere deliverers of state-mandated curriculum and not as agents of change themselves (see Biesta and Priestley 2013; Biesta 2015; Campbell 2018).

Enlightenment humanism championed education as a specifically human possibility through which individuals become fulfilled. Biosemiotics undermines this assumption, which appears obsolete from the array of contemporary perspectives that refute classical humanism (such as posthumanist, antihumanist and transhumanist movements). We agree that a biosemiotic orientation in cultural theory can guide inquiries in several recent fields and discourses that challenge classic humanism and, most importantly, their interdisciplinary dialogue:

> Emerging approaches in environmental humanities, ecocriticism, ecophenomenology, cultural ecology, the study of embodiment, and posthumanism indicate a desire for the kind of revolution in understanding culture that biosemiotics so clearly and radically presages. The conflicts in institutionalised glottocentrism entail that some species-level issues concerning language which afford the potential benefits of a broader view remain off the agenda. In cynical institutional terms, this is understandable – if a discipline and its workers can become self-perpetuating and removed from what might be seen as the deleterious effects of other disciplines, there can be little surprise at the desire for maintenance when this is achieved. (Cobley 2016: 26)

Our contribution here, follows this biosemiotic approach to educational theory (see Olteanu and Campbell 2018; Campbell 2019) chiefly through conceptualizing learning itself as more than "the human species' possibility of pulling themselves out of a life of purely biological needs and into a cultural existence" (Olteanu and Stables 2018: 410) but as a process we can broadly label *embodied* and *ecological* (see Olteanu and Campbell in press).

The specific biosemiotic argument, posited by Sebeok (e.g. 1986) and on which Cobley (2016) founds an approach to culture, is that, as in the case of any species, the most basic system through which an organism meaningfully organizes its

phenomenal world is not linguistic. It is more basic, namely preverbal and environmentally situated, and thus even more deeply appropriated by the organism than language is. Viewing learning (and teaching) from this perspective allows for an investigation of technological transformations within education not solely in terms of verbally enunciated discourse, but as a continual quest to understand and respond to what new technologies and new media afford and limit.

We will first address the task of overcoming humanist assumptions in learning theory through an *affordance-driven* approach, going on to critique the view that human language constitutes a primary modeling system separating humans from the other animals and the biosphere. Finally, we address the mind–technology problem, and the merits that a broad biosemiotic perspective on technology brings to contemporary educational and semiotic theory.

2 Learning

As it transpires in Cobley's work (Cobley 2018a; Cobley and Stjernfelt 2015), learning is not a linear and unidirectional progress. Rather, like evolutionary adaptations, learning shapes affordances within an organism's phenomenal world (in the sense of Gibson 1979, which has been eagerly adopted in biosemiotics, e.g. Campbell et al. 2019). For an organism, learning implies a growth of semiotic freedom, or a richness of response (Stables 2012) or decision-making potential – but growth itself implies constraints (Cobley 2018a). Kull (2015) observes that, from a biosemiotic perspective, learning involves choosing, in the sense that decisions/choices always exclude certain possibilities. At one level, this is to say that the experience of learning is always a crucial part of learning, and that these experiences cannot be ditched, so to say, once a supposedly abstracted mental conception, understood as the desired outcome of learning (or teaching, or education), is deemed comprehended. Similarly, if the subjective experiences of the learner are part of learning, culture is a means of cultivating and enhancing habits of learning and, implicitly, the growth of plurality. More learning results in more diversity. Instead of viewing cultures as distinct systems separated primarily through linguistic differences, biosemiotics construes cultures as developed through semiotic scaffoldings, that is, embodiments of histories of learning (Hoffmeyer 2015a), at both ontogenetic and phylogenetic levels. Semiotic scaffoldings, it is important to remark, are means for "the out-sourcing of memory and experience" (Cobley 2016: 127).

In recognition of this, it is a mistake to design educational programs and curricula with the goal to entrench a specific sense of identity, such as national-

patriotic identities, by promoting a (national) language as a system to underpin a corresponding (national) culture. The assumption that language and culture fundamentally mirror each other, termed the Sapir–Whorf hypothesis (see Hill and Manheim 1992; Olteanu 2019), in reference to the celebrated anthropologists, is undermined by evolutionary views on culture and plurality, such as that of biosemiotics.

A basic bio-anthropological argument (but far from the only one) is that the emergence of human culture dates back to pre-hominin times – well before the modern emergence of *Homo sapiens* some 160,000 thousand years ago. Through this account, the cultures of modern humans, as we now know them, developed through the modeling tools and affordances inherited from other prelinguistic hominids as part of a continuous semiotic evolution. For instance, Tomlinson (2015) presents an extremely well-researched account of how Aacheulian hand-ax-making industries were passed on culturally (intergenerationally transmitted/learned) for hundreds of thousands of years, long before modern hominins even add the morphological/biological capacity for speech (descended Larynx), relying instead on proto-musical and complex indexical forms of communication and modeling:

> Ritual without modern language may seem a puzzling concept, but to see this likelihood we need only picture social complexities among hominins as far back as half a million years ago, which involved pedagogies of tool making, divisions of labor in organized hunting or scavenging, communal sharing of the resulting spoils, and other similar behavioral patterns. The absence of modern language in such societies need not have blocked the coalescing of ritual, because they possessed well-developed vocal and bodily communicative resources referred to today as "protolanguage" or "protodiscourse." (Wagner and Tomlinson 2022: 13)

Similarly, Sebeok's (1986, 1991) specific argument in early biosemiotic literature, through which Cobley (2010, 2016) opens a timely outlook on culture, is that hominids developed language as a modeling system before and, initially, irrespective of their capacity to produce verbal speech by articulating phonemes. Accidently, verbal speech proved a useful means of representing language, through which, also, the role of language to model the world fused with its new role to communicate. As such, language strengthened the sociability of the *Homo* species, becoming a uniquely efficient semiotic system. Sebeok (1986, 1991, 2001a) explained that language has become a modeling system, shaping human societies and cultures, not as an adaptation, in the original Darwinian sense, but as an exaptation, adopting this term from Gould and Vrba (1982). In brief, humans discovered that the vocalization of language, due to the accident of being able to produce phonemes and articulate speech, is a very useful resource for

communicating and, in general, *out-sourcing* (see also MacLarnon 2012; Olteanu and Stables 2018).

That species can influence evolution and niche-expansion through their behavior and cultural transmission implies a continuity, on some level, between phylogenesis and ontogenesis. Of course, the two must not be confused (Cobley 2016: 50). The notion of semiotic scaffolding is particularly useful to scrutinize this continuity. Extrapolating from the classic social constructivist notion (e.g. Bruner 1957, 1960, 1966), Hoffmeyer (2015a: 154) redefines scaffolding on a (bio) semiotic account as "what makes history matter to an organism (or a cultural system)." The learning experiences that lead the knowing subject to its present self are part of the knowing subject, and they shape affordances and competences for future learning. On this account, Cobley and Stjernfelt (2015: 292) explain, "the scaffold metaphor is stretched a bit – or used creatively, as it were: the scaffold is not taken down when the building behind it is finished, rather, the scaffold becomes, over time, part of the building itself." In this sense, subjective learning experiences are also part of what is learned, defining the object of apprehension, instead of supposing its *a priori* existence, as a fixed idea that can be simply employed as a predefined resource and delivered from one mind (teacher) to another (learner). Learning, in this view, is a type of modeling. While an organism learns, it also fashions the object of its learning, but not in the (exaggerated) solipsism of Cartesianism or, arguably, structuralism, according to which all that is known is strictly the creation of the (individual) mind. Rather, this invites a more subtle view (Cobley 2018b: 23) on *observership*, namely "the recognition that 'reality' is inherently unstable because it cannot exist as a settled phenomenon divorced from observership." As such, the subjectivity of cognition as embodied, viewpointed, and embedded in cultural and ecological contexts implies neither solipsism nor biases in knowing. This is a recognition of learning as participation in the learned or, more precisely, of the mutual effect that learner and learned have on each other. In agreement, Stables (2012: 49) defined experience as "a sentient entity's implication in events and processes, where 'implicated in' includes 'affected by.'"

On this account, culture is intrinsically heterogeneous, as by scaffolding their lifeworlds, each individual and community brings unique viewpoints and makes unique choices. Indeed, as Stables (2012: 49) further explains the implications of such a view on experience, "[t]he event cannot occur without the involvement of that [sentient] entity, and can only be understood from the perspective of understanding entities. Thus each individual experiences events in a somewhat distinct way, but this does not imply that she or he has made it up." On this account, which Stables (2012) labels relativist and realist at the same time but "not solipsistic," cultural pluralism does not consist in the co-existence,

in parallel, of various supposedly distinct cultural monoblocs, but rather in the heterogeneity that cultural living itself produces continually. One of the contributions that we see biosemiotics bringing to cultural studies, hence, is that of accounting for the intrinsic plurality of culture. As such, biosemiotics avoids cultural holism and exaggerated versions of cultural relativism. Cultural holism can be understood as collective solipsism, given its argument that distinct cultures cannot properly understand the habits of one another (following Eagleton 2000; Eriksen and Stjernfelt 2012; Olteanu 2019).

From the biocultural evolutionary perspective articulated by Cobley (2016; Cobley and Stjernfelt 2015), many semiotic scaffoldings, which support present and future learning, are shared across various cultural formations. As such, labeling cultures in the singular, by criteria such as social class, education, economic status, or ethnicity is misleading. Labels such as working class, gen Z, British, Canadian or Quebecois may describe some social relationalities and may be contextually useful shortcuts, but they do not capture singular and bounded cultural systems in their entirety, and their supposedly corresponding identities. Understood as *identity*, in the modern sense, such labels obstruct criticality because, citing Peirce's (EP II, 48) celebrated phrase, they "block the way of inquiry." Cultures, like phenomenal worlds and psychological states of mind, overlap (see Stables 2012: ix–xi, 35, 49–51). In biosemiotic terms, *cultures can/do share scaffolds*. This undermines the holistic assumption, championed by the Enlightenment educational program (e.g., as clear in the case of Humboldt 1988 [1836]; see Eriksen and Stjernfelt 2012; Olteanu 2022), that cultures are self-justified, distinct, and independent wholes (Cobley 2016; Hoffmeyer 2015b).

We argue that an important epistemic virtue of Cobley's approach resides in how it responds to recent calls in the humanities and social sciences to understand culture as both constituted through and mediated by technology, but also as something not explicitly or chiefly human (i.e., animal cultures). Specifically, Cobley's scrutiny of the cultural implications of biosemiotics offers an account of biocultural learning, as we present it here, that is jointly accommodating of both posthumanist (Taylor and Hughes 2016) and postdigital (Jandrić et al. 2018, 2019) orientations, that accommodates the ecological context and emergence of learning (Olteanu and Campbell in press), as well as the realities, challenges, and transformations brought to the fore by our profoundly technologically mediated, 21st-century historical moment. This is fostered by Cobley's approach, primarily, by dislocating the gravitational center of cultural theory away from linguistic modeling to a broader notion of modeling that lends itself to the work of *any* sign system, involving any or, more accurately, *all* the senses and modalities that an organism has at its disposal. Most importantly, this view refutes the possibility that

semiotic systems may be clearly bounded, functioning in isolation, as the notion of *code* may suggest. As built on Ferdinand de Saussure's (1959) semiology, structuralism and mainstream cultural theories of the 20th century posited that sign systems, such as languages and cultures, can function only in virtue of perceived and defined boundaries (e.g. Lotman 1990).

3 Technology

Cobley (2016: 28) observes that to understand culture from a biosemiotic perspective is to conceive it "in the interrogation of modeling," as this theory's cornerstone concept. From the first glance, this recommends biosemiotics as a cultural theory for postdigital contexts. The obvious reason is that the rationale and work of computers is to model (see Ciula and Eide 2017; Ciula and Marras 2019; Olteanu and Ciula 2022). Consequently, it is worth noting, the main practice and research method of digital humanities research is modeling.

In biosemiotics, modeling is understood following Thomas A. Sebeok (2001a) as *Umwelt*, the latter concept being inherited from von Uexküll's theoretical biology (1926) and roughly translated from German to English as *environment*. To develop a theory of organisms' biological modeling of environments, Sebeok adopted Charles S. Peirce's semiotics, which, conveniently, also contains a continuist theory of evolution. As much of Sebeok's work (e.g. 1986, 1991, 2001a; also Sebeok and Danesi 2000) explicates the notion of modeling as *Umwelt* taken in a Peircean semiotic key, Cobley offers an illuminating shortcut to the crux of this notion:

> *Umwelt* […] is the means by which organisms "capture 'external reality'" in response to semioses. Most importantly, though, an Umwelt is composed by the circulation and receiving, insofar as it is physically allowed by an organism's sensorium, of signs. (Cobley 2016: 7)

The two main implications of taking such a view, which Cobley explores in detail, are (1) the refutation of glottocentrism (language-centrism), which dominated the humanities at least since the Enlightenment (and particularly prominent in cultural studies because of the origins of anthropology in Romanticism, see Eriksen and Stjernfelt 2012), and (2) the undermining of a series of dualisms that cultural studies inherited from the modern formulation of the *mind–body problem*. Following this line of thought, Cobley opens up a wide array of currently salient cultural issues to the scope of biosemiotic investigation. Very importantly, we argue, Cobley follows and develops a (semiotic) scholarly vein that favors replacing the modern formulation of the mind–body problem with the

mind–technology question, a shift that accompanies recent criticisms of humanism (Clowes et al. 2021). Anti-glottocentrism is an important aspect that recommends the biosemiotic approach to culture, as unfurled by Cobley, for highly technologically mediated societies, such us undergoing digitalization.

As human societies are expanding onto virtual spaces (which should not be thought of as non-material, let alone non-real), as afforded by digital technology (Leonardi 2010), they are also becoming articulated through increasingly diverse media and multimodal complexes. However, as much as they add layers of social representation, these technologies, modalities, and medialities are not disconnected from human embodiment. On the contrary, even more than, to begin with, print (but also than broadcasting), digital technologies tend to more directly engage the human sensorium (see Hopkins 2020; Olteanu 2021). As such, biosemiotics can open up pathways to rethink and retheorize critical literacy, which, seen as forms of modeling, can partake of any (multi-)modalities, not only a language, natural or academic, rigidly understood. This is needed for cultivating critical thinking in contemporary societies (see Mills 2016) in a way that does not induce the illusion of humanity's detachment from nature; of our intellectual capacity from our embodiment. As Rouvroy explains, for example, in the contemporary data-laden societies, operations with data

> make linguistic modalities of 'evidence' appear obsolete compared with the operationality, immediacy and objectivity of data behaviourism. If, therefore, the computational turn does not have any impact on the phenomena of causality and human agency and the reflexive capabilities it presupposes and leaves them untouched, it nevertheless deflects concerns or attentions away from these previously privileged perspectives of causality and intentional agency or individual and collective 'authority' (that is, for our purpose, the capability to 'author' one's actions, to have the 'authority' to give account of the meanings of one's actions). (Rouvroy 2013: 151)

In brief, we advocate the biosemiotic approach to culture because the digital and computational turn, through its non-linguistic modalities, involves behaviors and social organizing that cannot be accounted for through extrapolating from language as a generalizing model for other sign systems. In plain language and simplifying, as humans are currently witnessing it all too strikingly with the rise of fake news: by thinking of argumentation and inference as something strictly linguistic, we cannot tell facts from made-up fantasies anymore. Moreover, this turn dismisses the modern questioning of how the mind and body interact as distinct ontologies by questioning how the mind expands into new environments, that is, how it incorporates artifacts into its computation. The important point is not only undermining substance dualisms such as mind/body but undermining it while not succumbing to glottocentrism. The linguistic turn avoided Cartesian dualism by

taking language instead of (amodal) ideas as the main vehicle of epistemology. The computational turn, ushering in the mind–technology question, avoids both dualism and glottocentrism through the avenues opened by the extended mind theory (Clark and Chalmers 1988). This view, too, finds support in Peirce, who in a timely manner reflected that capacities to think and express oneself (such as, particularly the capacity for language) are equally located within the subject's contained embodiment and in its out-sourcing extensions:

> A psychologist cuts out a lobe of my brain […] and then, when I find I cannot express myself, he says, "You see your faculty of language was localized in that lobe." No doubt it was; and so, if he had filched my inkstand, I should not have been able to continue my discussion until I had got another. Yea, the very thoughts would not come to me. So my faculty of discussion is equally localized in my inkstand. (CP 7.366)

Recently, Fuller (2022) remarked on the importance of Peirce's view on evolution for ushering a *trans*humanist and more broadly, we add, *non*-humanist perspective on the *human*. According to Fuller (2022: 248), Peirce should be credited for inspiring "a 'continuist' turn of mind that tends to reduce differences of kind to differences of degree." Indeed, Peirce's doctrine of continuity, which he termed *synechism, is a* central characteristic of his logic and the entailed taxonomy of signs. In brief, synechism is "the tendency to regard everything as continuous," in the sense that "continuity governs the whole domain of experience in every element of it" (EP II: 1). Adhering to synechism means supposing that dualisms are (metaphysically) impossible. Peirce went as far as clearly positing that not even *being* and *non-being* are opposites, because "being is a matter of more or less, so as to merge insensibly into nothing" (EP II: 2).

With this in mind, for example, a symbolic sign is not opposed to an indexical sign or an iconic sign (see EP II: 291–292). Even more interestingly, instead of being opposites, subject and object are conceived as *prescinded* from a continuity, namely that of a proposition in which they partake (see EP II: 352–354, 428, 478; Stjernfelt 2014, 2022: 73–77). Perceptual judgments, as what reality impresses upon the knowing subject, according to Peirce, have propositional form. This is to say that organisms experience subject–object relations, that is, propositions, before they can differentiate, often not without serious/intentional cognitive effort, the subject and the object. While sign types are different, more complex signs involve simpler ones in their constitution. The evolution of meaning is continuous, which does not imply unidirectional/hierarchical accounts of learning and significant (e.g. from simple to complex). Following this logic, Cobley (2010, 2016) explains that biosemiotics must undermine certain commonplace dualisms in cultural criticism. Indeed, nature/nurture debates have been unfruitful for cultural studies, implying a "dialectic of inside/outside" which "troubled theorists of subjectivity" (Cobley 2016: 56). Seeing

evolution and development through the prism of the semiotic concept of scaffolding eschews such polarization and entailed binarisms, such as organism/environment, culture/biology, language/brain. Cobley explains:

> The verbal/nonverbal is collapsed in primary modelling. The non-human/human binary is collapsed in scaffolding (where the human is not separated from its cultural artefacts) and in the general synechism (where the human is not separated from other collections of signs). Similarly, the binary of individual/collectivity, is also thoroughly undermined by synechism. In a related fashion, agent/subject loses some of its purchase as agency is shown to exist across nature and a kind of subjectivity or selfhood derives from reactions which take place at the level of the cell. The Cartesian opposition of body/mind is put to rest by endosemiosis. (Cobley 2016: 56)

4 Language and human exceptionalism

From the biosemiotic perspective, language is not seen as an *evolutionary miracle* that sets the human species apart from the animal-biological. Classically, the anthropocentrism of the humanities is fed by the assumption that the capacity for language, as a primary modeling system, defines humans and places them aside (or above) the animal realm (Jaroš and Maran 2019). Reassessing the place of humans among the other animals is indeed an important consideration, for if language is no longer our principal way to demarcate and assess the appearance of culture, then animals and the ecological-embeddedness of human culture and learning cannot be quickly and swiftly removed from consideration in the humanities and social sciences.

Biosemiotic theory helps to explain that, while we would not deny that language is an important or even central aspect of culture, many other aspects of ritual and culture extend well beyond the realm of language (including non-human animal cultures, cf. Laland and Janik 2006; Laland 2008; Sastre 2018). In this sense, cultural theory would do well to align with advances in ethology and animal communication in accounting for the continuity of human cultural life with the complex social learning and "imitative pedagogies" (Tomlinson 2018: 8) on display among birds, particularly corvids, as well as certain primates and cetaceans (Jablonka and Ginsburg 2022; cf. Campbell 2022). When cultural behavior is not defined solely through the criteria of the exceptionality of human language and symbolically mediated cognition and learning (language as primary modeling system), then culture becomes *pedagogically* defined, emerging through an "environmentally situated sociality" (Wagner and Tomlinson 2022: 6) that is cultivated through intergenerational learning and proto-pedagogy:

> The transmission of learned behaviors across generations is nothing other than a transmission of meanings in the niche of a given species, and these meanings are generated by linking things or actions to one another as sign and object (cf. Boyd & Richardson 2005; Wagner & Tomlinson 2022: 11).

Rather, current theories of language evolution suggest that language is only one sign system among many, with its own specific selective advantages and affordances. The obvious benefits of language as a system for modeling and communication are, to begin with, proved by hominins' adoption of language *intergenerationally*. Spoken language is one technology among many that is afforded by the conditions of human embodiment.

The evolutionary view on language propounded by biosemiotics, seen as scaffolded and scaffolding, is compatible with Daniel Dor's concept of language as communication technology. This construal implies "that language has to be ontologically classified together with the other communication technologies humans have invented, such as the book, fax, telephone, computer games, and Facebook—not together with social institutions (such as government or the family), or cognitive capacities (such as vision or rationality)" (Dor 2015: 1).

To further illustrate the broad biosemiotic account of technology, we consider how a cognitive capacity and mental process such as *conceptual blending* (Faucconnier and Turner 2008; Fauconnier and Turner 2002) falls under the category of technology, too. Conceptual blending, or conceptual integration, refers to the merging of concepts from various mental spaces to create new concepts. While the mental spaces (or domains) invoked may partially contradict, blending them is a basic cognitive process through which humans make sense of their world and express themselves. Fauconnier and Turner (2002: 469) define conceptual blending as "a basic mental operation whose uniform structure and dynamic properties apply over many areas of thought and action, including metaphor and metonymy." Without going into the details of a complex cognitive theory of conceptualization, conceptual blending explains how the mind pragmatically integrates contradicting concepts to create new, useful concepts. It explains, for instance, how and why a phrase such as *This surgeon is a butcher* makes sense and conveys concrete information while *surgeons* and *butchers* are different things. Fauconnier and Turner introduced this theory by explaining how it changed the evolution and development of humans:

> Fifty thousand years ago, more or less, during the Upper Paleolithic Age, our ancestors began the most spectacular advance in human history. Before that age, human beings were a negligible group of large mammals. After, the human mind was able to take over the world. What happened?

> The archeological record suggests that during the Upper Paleolithic, humans developed an unprecedented ability to innovate. They acquired a modern human imagination, which gave them the ability to invent new concepts and to assemble new and dynamic mental patterns. The results of this change were awesome: Human beings developed art, science, religion, culture, sophisticated tools, and language. How could we have invented these things? (Fauconnier and Turner 2002: v)

Their answer to the question is conceptual blending. Commenting on the exactitude and veracity of blending theory is beyond the scope of this paper. Our point is that what could be described simply as a strictly cognitive capacity for stretching the imagination actually constitutes a technology. Conceptual blending has served as a tremendously useful semiotic scaffolding. It is more basic than language. In turn, it was, of course, supported by other scaffoldings, be they physical, morphological, social, or of other kind. What we mean by this is that, *in the interrogation of modeling*, to repeat Cobley's (2016) formulation, conceptual blending is the same type of work as, say, the development of agricultural tools or the computing machine. Computers, in actuality, were enabled by the capacity for conceptual blending: that is, conceptual blends served as semiotic scaffoldings for developing computers.

Language became the important sign system we know it today because of how hominins put to use an adaptation that served a different function to codify language into speech through vocalizing phonemes (see MacLarnon 2012). Again, as Sebeok (e.g. 1986, 2001a) first observed and employed the term of Gould and Vrba (1982), language has become a cross-generationally transmitted modeling system as an exaptation, not an adaptation. That hominins can talk (communicate verbally) was made possible accidently because of an evolutionary adaptation with a different purpose. That humans actually talk and construct their environments through this capacity is a kind of *choice* that, indeed, channeled the evolution of the species. Arguably, conceptual blending, too, can be seen as an exaptation, one more basic than the emergence of language and which was required for the use that humans later found for language.

As such, biosemiotics draws the attention away from language, as a marker of anthropological difference, to the more encompassing notion of *modeling*, or meaning-making as embodied environmental construction, which any organism undergoes and undertakes as implied by the concept of Umwelt. Embodied semiotic competences other than language form the primary modeling system of humans, language being a secondary system. Of course, this implies that the much-sought anthropological difference, whatever it may be, marks a difference in degree, not kind, as the continuity of semiosis along evolution. Modeling occurs through a variety of sign systems, which often cannot be clearly distinguished one from the other. From this perspective, the human is a natural and ecologically embedded subject, whose agency is not completely unique in the natural world

(see Cobley 2016: xiv). This means that the object of study of the humanities (be it *meaning* or something else) – if this long-lasting academic tradition is to endure – must be (re-)construed so as not to imply a difference of kind or degree for the human in respect to non-human nature. The Humanities must posit the situatedness of the human subject within the biosphere and fully consider all possibilities to extend toward more-than-human conditions.

5 Mind–technology, emergence, and pluralism

Technologies have always shaped environments and, hence, channeled evolution. Stretching the sense of this word, evolutionary adaptations, such as growing longer fangs or an opposing thumb, can be thought of as technological developments, as much as forms of traditional ecological knowledge (or TEK), like clam gardens/middens or fish weirs (Nelson and Shilling 2018), developing agricultural tools, writing technologies, combustion engines, or computational machines. What matters here is not an exact definition of *technology*, but understanding the full continuity and complexity of biocultural evolution. Following Peirce's doctrine of continuity (or synechism), these are differences of degree, not of kind (CP 6.170).

Of course, the agency of organic matter should not be confused with what inorganic matter may perform in interrelationship with the living. Collapsing everything to the material – as is the path of much *new materialist* discourse in education (see Petersen 2018) and the social sciences – amounts to a kind of physicalist reductionism that biosemiotics avoids from the start through its alignment with biology, ecology, and the life sciences and through its foundational hypothesis that meaning (semiosis) and life are co-extensive, implying that meaning characterizes organic life (Sebeok 1991, 2001a). The opposite fallacy, that of vitalism, should also be avoided: life and inorganic matter should not be conceived as fundamentally and ontologically distinct. That living organisms are inextricably linked to and indeed co-construct the material conditions of their niches and the biosphere of which they are a part is a fundamental biological and ecological fact. Cobley (2010, 2016) has the merit of explicating how biosemiotics takes the narrow path in between, which avoids both these fallacies. This line of inquiry, which finds inspiration in the semiotics of Charles S. Peirce across several disciplines (see also Rodríguez-Higuera 2019), allows for conceiving inorganic matter as providing contingencies that can enhance the computational capacities of living agents (Fuller 2022; Magnani 2022). This path remains, for now, narrow because of the metalanguage that the humanities has historically developed. Cultural studies frameworks often fall short in offering ways of thinking that

oversimplify by either ontologically polarizing or confusing nature and culture. This comes down to the fascination for language that the humanities entertained for generations, as particularly advocated by Enlightenment. As Cobley points out, exaggerating what language does to and for humans implies a view of the human as disconnected from nature. Nature, from such a solipsistic perspective, can only be what humans make up as "Nature" (Wulf 2015). This concept of *Nature* justified the modern Western enthusiasm for putting the power of the human mind to use for the production of technologies "for the purpose of conquering nature" (Cobley 2014 [2001]: 137). Sadly, apparently only something as grave as the global environmental crisis could shake humanity out of the daydreaming of Romanticism and the reductive idealism of the Enlightenment project.

Technology, in the broad and encompassing sense that biosemiotics accommodates, has always shaped human (bio)cultural evolution. This is important to understand, as we are now undergoing profound societal and cultural changes driven by technological progress. Old humanist notions of culture and technology, often understood as opposites, fail to understand or even to come to terms with these transformations. Romanticism fosters fear toward technologically modified humanity, toward what the cyborg and cyborganization *may* be, toward the possible futures that digital technologies, through their great computational capacities, *may* hold for humanity and the planet. Indeed, computing technologies have become very powerful and they can be dangerous. They already caused and are causing harm, for instance, by efficiently enabling disinformation to affect vast populations through the virality of the media that they afford. However, we cannot stop the future from unfolding. We must understand it, by understanding the complexities through which it determines the present. We must *abductively* work on what we may become, instead of passively fearing it. Faced with these ongoing transformations, humanism becomes a conservative ideology, contrary to what it served initially. It resists change, as its notion of "human" is challenged.

Cobley (2016: 66) labels biosemiotics as "anti-humanist," adopting this term from Althusser 1969. While this might well be a uniquely important epistemic aspect of biosemiotics, Cobley's biosemiotic approach to culture can be taken up in posthumanist and transhumanist frameworks, too (see Cobley 2016: 257). The common ground is envisaging "humans within semiosis and within *Umwelten*" (Cobley 2016: 57).

Seeing humans in this way results in a notion of cultural emergence as realized through scaffolding. On this account, as well, agency cannot be reduced to a polarization of individual and collective. Following Peirce, Cobley explains:

> […] the author's brain is indispensable for writing the book – but the contents of the book as a whole were never once present in the author's mind; rather, the long and cumbersome

> process of writing constructs an artifice which contains thoughts and reasonings whose sum transgresses, by far, the online capacities of the author's here-and-now consciousness. This immediately is an offload function: the book remembers far more, and far more accurately, than the brain involved in its construction. But that is not all: having externalized an argument structure in a book chapter, the writer is free to take the results as new starting points, as scaffolds, for the next chapter – effectively constructing the book as a long, coherent argumentative arc which was never present to the author's mind in its entirety. Signs, in this way, are indispensable scaffoldings for humans in thought and action. […] (Cobley 2016: 55–56)

Cobley also explains how the media studies school of Toronto, beginning with Innis and McLuhan (e.g. McLuhan 1994 [1964]) has been concerned with scaffolding processes, just under the different formulation of media as *extensions of the self*. Herein, we see the opportunity for a media semiotic theory, based on biosemiotics, to lend its theoretical framework to the more recent but already very salient domain of science and technology studies. This, we argue, is one important implication of the cultural implications of biosemiotics that Cobley (2016) unravels. Biosemiotics accounts for the incorporation of artifacts into human modeling and the evolutionary processes that this entails:

> Institutions, arts, crafts, infrastructure and technology form externalized scaffolds, molding human behaviour in certain directions, affecting the bequests and reinterpretation of these scaffolds as well as the ongoing cultural selection between them, making possible their further development over generations. (Cobley 2016: 56)

Further, this underpins a view on culture as intrinsically heterogenous, namely as a sum of collectively shared scaffoldings. It would be impossible or at least highly unlikely that two individuals or geographically situated populations would share the exact same scaffoldings at a moment in time. Another highly unlikely scenario is for two individuals or geographically situated populations not to have any scaffoldings in common at all. On this account, then, *culture*, as an operational concept, cannot be distinctly identified within certain borders, territorially, socially, economically, or otherwise. Human cultures and cultural habits and ways of life are blended, enmeshed, entangled. The biosphere is one big and messy (multispecies) producer of culture! The biosphere is a semiobiosphere, as Petrilli and Ponzio (2005) call it, as a correction to Lotman's (1990) anthropocentric and relativist notion of semiosphere. On the account that culture is a catalyst of plurality, as unique semiotic scaffoldings are being continuously produced even in very similar contexts, the semiobiosphere is not a *melting pot*, uniformizing everything into a global monoculture and trumping regional agencies.

Chiefly built on Cobley's biosemiotic view on culture, Olteanu (2019, 2022) advocates a view on multiculturalism that implies a sharp criticism on the politics

of identity as stemming from cultural relativism, and as argued, in particular, by another prominent scholar in semiotics, namely Frederik Stjernfelt (2011, 2012; Eriksen and Stjernfelt 2012). The intricacies of Cobley's theory for multiculturalism, but also contemporary learning and educational theory, imply an orientation toward embedding technology and mediality within our theories of learning and culture.

Cobley's (2010, 2016) unraveling of "the cultural implications of biosemiotics" is of great importance for semiotics and, we believe, for cultural studies broadly. Again, it is curious that until his endeavor, biosemiotics has only seldom been employed for cultural criticism, let alone explored as a theory of culture itself. More than for any other purpose, semiotics is commonly employed as a cultural theory (e.g. Eco 1976; Halliday 1978; Lotman 1990). Biosemiotics has been a full-fledged and appreciated theoretical framework for a long time, starting with the pioneering work of Thomas Sebeok (e.g. 1965, 1968) and properly sedimented by remarkable scholars such as Jesper Hoffmeyer (1996), Donald Favareau (2010), Claus Emmeche and Kalevi Kull (2011), to name only a few.

Despite having covered a wide range of topics that underpin a theory of culture, such as evolution, emergence, pluralism, communication (including interspecies communication), learning, cognition, and perception, apart from Cobley's recent work, biosemiotics has not been taken up as a prism for reflection and discourse on culture. A remarkable case that comes close is Susan Petrilli and Augusto Ponzio's semioethic theory (see Petrilli and Ponzio 2005, 2019; Petrilli 2014, 2022). This broadly encompassing theory relies on biosemiotics, particularly on Sebeok's (2001b) idea of "global semiotics," to cover meaning in its many dimensions, from biological to cultural and ideological. Petrilli and Ponzio's theory is original in its own right. It is not a fully and strictly biosemiotic exploration of culture. While their theory nevertheless involves such an exploration, Petrilli and Ponzio take as essential to their argumentation insights from other theories, such as Bakhtin's dialogism (1981) and Levinas' (1969 [1961]) metaphysics of the Other, to arrive at an outstanding theory that is also in need of a label of its own. In Cobley's work, biosemiotics itself is explored and developed as a theory of culture. Semioethics, as Ponzio and Petrilli's theory is termed, is, of course, one important pathway that Cobley acknowledges in exploring the cultural implications of biosemiotics (e.g. Cobley 2016: 63). However, he (Cobley 2016: 64) also points out possible humanist readings of semioethics, which, aligned with other current trends in cultural studies, biosemiotics can avoid.

The hesitation to approach culture from a biosemiotic perspective comes across stringently in Stjernfelt's work. While a remarkably salient scholar in both (Peirce's) semiotics (e.g. Stjernfelt 2007, 2014, 2022), often in a biosemiotic key, and

in multiculturalism (see above), so far, Stjernfelt has not brought these two together. In his work on multiculturalism, he did not employ any specifically Peircean or semiotic considerations. This remark is not meant as a criticism, as pointing out something that Stjernfelt might have overlooked. On the contrary, if the separation of these two themes in his work proves anything, it is Stjernfelt's impressive scholarship and rigor, by, for instance, not allowing his affinity for Peirce's semiotic logic taint his incursion into cultural anthropology.

What we want to remark on is the general hesitation to approach culture from a biosemiotic perspective. Paul Cobley alone has undertaken this project in an explicit and encompassing manner. This takes some courage because, recent intellectual history shows that attempts to inform the humanities and social sciences with insights from evolutionary theory tend to be met with some contempt, both from academic colleagues and from the broader public. These were the cases of, for example, sociobiology (Alcock 2001; Wilson 1998 [1975]) and the adoption of the concept of coevolution in evolutionary anthropology (Kendal 2015). Also, one more thing that all these efforts have in common is that they were eventually successful. They proved that (natural) evolution cannot be overlooked in the analysis of culture. Further, this realization also impelled greater scientific rigor, necessary for avoiding vitalist and reductionist assumptions and their politically dangerous consequences, such as racism or, respectively, a religious enthusiasm toward automatizing human societies and removing the human element from decision making. Scholarship in semiotics, as a discipline generally regarded to belong to the humanities, has already expressed skepticism toward biosemiotics (e.g. Eco 1976) and biosemiotics is, by now without doubt, successful in establishing itself as a thorough and important contemporary theoretical framework. While biosemiotics dates back to the time when animal communication, particularly primate studies (Desmond 1979; Linden 1976), generated a revolution in the humanities in general, only recently has a fully biosemiotic approach to culture been explored, again, namely by Cobley. This delay, we think, aroused suspicion among skeptics, justifying the question of whether biosemiotics has anything new to offer to, on the one hand, cultural studies and/or, on the other, to the natural sciences (see Martinelli and Bankov 2008).

Interestingly, the only context where possible intricacies of Frederik Stjernfelt's semiotic view for multiculturalism are mentioned is in regard to the (biosemiotic) notion of semiotic scaffolding in an article he co-authored with Paul Cobley (Cobley and Stjernfelt 2015). This convergence is the focal point of this paper. Hoffmeyer (2015b), who first coined the concept *semiotic scaffolding* (2006), noted that Cobley and Stjernfelt's (2015) exploration of this notion opens

up a view on cultural and technological evolution as emergence. This contributes to construing evolution without vitalist implications, as a continuous, albeit not linear process, within which, again, differentiations are matters of degree, not of kind. Because learning fundamentally shapes affordances in a reciprocal and continuous process – establishing and cultivating over time/space scaffolding structures/processes to channel learning in particular directions but not others – there is no such thing as unlimited semiotic freedom. Every choice or response embeds openings as well as closures, and these are always matters of degree. As Hoffmeyer writes:

> The invention of social semiotic scaffolding mechanisms such as dance and art, written language, city life, military organizations, cathedrals, the printing press, fast moving transportation systems, radio, telephone, movies, TV, personal computers and mobile phones, the internet etc. has gradually offered new generations stronger and stronger […] semiotic scaffolding structures, implying that not only new agendas for creativity are opened but also that deeper and deeper meaning contents can be grasped and shared […] through human history. Each new jump to higher level semiotic scaffolding systems tends to homogenize cultural performances at the lower level while opening up new agendas of expressivity at the higher level. Thus, compared with the diversity of ways handwritten manuscripts had been designed earlier, manuscripts published as books after the advent of the printing press became much more standardized. (Hoffmeyer 2015b: 251–252)

From this perspective, both what may be labeled as natural and as technological evolution fall under the notion of semiotic scaffolding and have the same type of result, namely the acquisition of new affordances and, consequently, semiotic modeling competences.

6 Conclusion

Paul Cobley has shown how biosemiotics notably avoids several relativistic and anthropocentric assumptions of mainstream cultural theories (including semiotics) that assume human–animal/nature–culture discontinuity and which further imply problematic notions of culture (and learning and literacy) as being primarily linguistically construed. Through the notion of species-specific modeling (Umwelt), biosemiotics embeds the human in the ecological (more-than-human) to account for the embodied, preverbal, multimodal, and ecological aspects of culture that are often neglected or diminished by language and anthropocentric theory. This opens an approach to technology and cultural emergence that can be applied in conjunction with the recent criticism of classical humanism coming from science and technology studies.

We have presented how biosemiotic theory presents multiple pathways to challenging modern dualism and have specifically located important contributions that biosemiotic theory can make at the intersection of posthuman and postdigital research and education. In response to these challenges, we propose an approach to understanding *literacy as modeling competency*, building on earlier definitions (Campbell et al. 2019; Olteanu 2021). This approach orients literacy and education away from mono-modality, text-based and glottocentric frameworks, to recognize that learning is more primarily embodied, ecological, and multimodal. This approach is notably postdigital as we argue that digital and multimedia learning are deemed to rest on environmental and embodied affordances – thus embedding the human in the more-than-human and obscuring digital/non-digital divides. We also argued that embedding embodiment within medial considerations – summed up by the view we advanced with Nataša Lacković, of "embodied media and ecology" (Campbell et al. 2021) – implies a heterogeneous view of culture, but also a (nascent) transdisciplinary biocultural revolution.

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References

Académie Française. 1995 [1635, 1752, 1816]. *Status et règlements* [*Statutes and regulations*]. Available at: http://www.academie-francaise.fr/sites/academie-francaise.fr/files/statuts_af_0.pdf (accessed 29 October 2022).

Alcock, John. 2001. *The triumph of sociobiology*. Oxford: Oxford University Press.

Althusser, Louis. 1969. *For Marx. Trans. Brewster, B*. New York: New Left Books.

Anderson, Benedict. 2006 [1983]. *Imagined communities: Reflections on the origin and spread of nationalism*. London: Verso.

Barman, Jean. 2012. Schooled for inequality: The education of British Columbia's Aboriginal children. In Sara Z. Burke & Patrice Milewski (eds.), *Schooling in transition: Readings in Canadian history of education*, 255–276. Toronto, ON: University of Toronto Press, Scholarly Publishing Division.

Bakhtin, Mikhail M. 1981. *The dialogic imagination*. Caryl Emerson & Michael Holquist (trans.). Austin: Texas University Press.

Biesta, Gert & Mark Priestley. 2013. Capacities and the curriculum. In M. Priestley & G. J. J. Biesta (eds.), *Reinventing the curriculum: New trends in curriculum policy and practice*, 39–50. London: Bloomsbury.

Biesta, Gert. 2015. How does a competent teacher become a good teacher? On judgement, wisdom and virtuosity in teaching and teacher education. In R. Heilbronn & L. Foreman-Peck (eds.), *Philosophical perspectives on the future of teacher education*, 3–22. Oxford: Wiley Blackwell.

Boyd, Robert & Peter J. Richerson. 2005. *The origin and evolution of cultures* (Evolution and Cognition). New York: Oxford University Press.
Bruner, Jerome S. 1957. *Going beyond the information given*. New York: Norton.
Bruner, Jerome S. 1960. *The process of education*. Cambridge: Harvard University Press.
Bruner, Jerome S. 1966. *Toward a theory of instruction*. Cambridge: Belknap.
Clowes, Robert W., Klaus Gärtner & Inês Hipólito (eds.). 2021 *The mind-technology problem: Investigating selves, minds and 21st century artefacts*. Cham: Springer.
Campbell, Cary. 2018. Educating openness: Umberto eco's poetics of openness as a pedagogical value. *Signs and Society* 6(2). 305–331.
Campbell, Cary. 2019. Educating semiosis: Foundational concepts for an ecological edusemiotic. *Studies in Philosophy and Education* 38(3). 291–317.
Campbell, Cary. 2022. Embracing the learning turn: The ecological context of learning. *Biosemiotics*. https://doi.org/10.1007/s12304-022-09507-6.
Campbell, Cary, Nataša Lacković & Alin Olteanu. 2021. A "strong" approach to sustainability literacy: Embodied ecology and media. *Philosophies* 6(1). 14.
Campbell, Cary, Alin Olteanu & Kalevi Kull. 2019. Learning and knowing as semiosis: Extending the conceptual apparatus of semiotics. *Sign Systems Studies* 47(3/4). 352–381.
Ciula, Arianna & Øyvind Eide. 2017. Modelling in digital humanities: Signs in context. *Digital Scholarship in the Humanities* 32(1 Suppl). i33–i46.
Ciula, Arianna & Cristina Marras. 2019. Exploring a semiotic conceptualisation of modelling in digital humanities practices. In Alin Olteanu, Andrew Stables & Dumitru Borţun (eds.), *Meanings & co.: The interdisciplinarity of communication, semiotics and multimodality*, 7–32. Cham: Springer.
Clark, Andy & David Chalmers. 1988. The extended mind. *Analysis* 58(1). 7–19.
Cobley, Paul. 2014 [2001]. *Narrative*, 2nd edn. London: Routledge.
Cobley, Paul. 2010. The cultural implications of biosemiotics. *Biosemiotics* 3(2). 225–244.
Cobley, Paul. 2016. *Cultural implications of biosemiotics*. Cham: Springer.
Cobley, Paul. 2018a. Growth as constraint. *Recherches sémiotiques/Semiotic Inquiry* 38(3). 97–115.
Cobley, Paul. 2018b. Observership, 'knowing' and semiotics. *Cybernetics and Human Knowing* 25(1). 23–47.
Cobley, Paul & Frederik Stjernfelt. 2015. Scaffolding development and the human condition. *Biosemiotics* 8(2). 291–304.
Desmond, Adrian J. 1979. *The ape's reflexion*. New York: The Dial Press.
Dor, Daniel. 2015. *The instruction of imagination: Language as a social communication technology*. Oxford: Oxford University Press.
Eagleton, Terry. 2000. *The idea of culture*. Oxford: Blackwell.
Eco, Umberto. 1976. *A theory of semiotics*. London: Indiana University Press.
Eriksen, Jens-Martin & Frederik Stjernfelt. 2012. *The democratic contradictions of multiculturalism*. New York: Telos.
Emmeche Claus & Kalevi Kull (eds.). 2011. *A semiotic biology: Life is the action of signs*. London: Imperial College Press.
Faucconnier, Gilles & Mark Turner. 2008. *The way we think: Conceptual blending and the mind's hidden complexities*. New York: Basic Books.
Fauconnier, Gilles & Mark Turner. 2002. Metaphor, metonymy, and binding. In René Dirven & Ralf Pörings (eds.), *Metaphor and metanomy in comparison and contrast* , 469–487. Berlin: Mouton de Gruyter.

Favareau, Donald. 2010. *Essential readings in biosemiotics: Anthology and commentary*. Dordrecht: Springer.
Fuller, Steve. 2022. The mind–technology problem. *Postdigital Science and Education* 4. 247–252.
Gough, Steven & Andrew Stables. 2012. Interpretation as adaptation: Education for survival in uncertain times. *Curriculum Inquiry* 42(3). 368–385.
Gould, Stephen J. & Elisabeth S. Vrba. 1982. Exaptation: A missing term in the science of form. *Paleobiology* 8. 4–15.
Halliday, Michael. 1978. *Language as social semiotic*. London: Arnold.
Hill, Jane & Bruce Manheim. 1992. Language and world view. *Annual Review of Anthropology* 21. 381–406.
Hoffmeyer, Jasper. 1996. *Signs of meaning in the universe*. Trans. Barbara J. Haveland. Indiana: Indiana University Press.
Hoffmeyer, Jesper. 2015a. Introduction: Semiotic scaffolding. *Biosemiotics* 8. 153–158.
Hoffmeyer, Jesper. 2015b. Semiotic scaffolding: A unitary principle gluing life and culture together. *Green Letters: Studies in Ecocriticism* 19(3). 243–254.
Hopkins, Julian. 2020. The concept of affordances in digital media. In Friese Heidrun, Marcus Nolden, Gala Rebane & Miriam Schrieter (eds.), *Handbuch Soziale Praktiken und Digitale Alltagswelten*, 47–54. Wiesbaden: Springer.
Humboldt, Wilhelm von. 1988 [1836]. *On language: The diversity of human-language structure and its influence on the mental development of mankind*. Peter Heath (trans.). Cambridge: Cambridge University Press.
Jablonka, Eva & Simona Ginsburg. 2022. Learning and the evolution of conscious agents. *Biosemiotics*. https://doi.org/10.1007/s12304-022-09501-y.
Jasanoff, Sheila & Sang-Hyun Kim. 2009. Containing the atom: Sociotechnical imaginaries and nuclear power in the United States and South Korea. *Minerva* 47. 119–146.
Jasanoff, Sheila & Sang-Hyun Kim. 2013. Sociotechnical imaginaries and national energy policies. *Science as Culture* 22(2). 189–196.
Jandrić, Petar, Jeremy Knox, Tina Besley, Thomas Ryberg, Juha Suoranta & Sarah Hayes. 2018. Postdigital science and education. *Educational Philosophy and Theory* 50(10). 893–899.
Jandrić, Petar, Thomas Ryberg, Jeremy Knox, Nataša Lacković, Sarah Hayes, Juha Suoranta & Andrew Gibbons. 2019. Postdigital dialogue. *Postdigital Science and Education* 1(1). 163–189.
Jandrić, Petar & Derek R. Ford. 2022. Postdigital ecopedagogies: Genealogies, contradictions, and possible futures. In Petar Jandrić & Derek R. Ford (eds.), *Postdigital ecopedagogies*, 3–23. Cham: Springer.
Jaroš, Filip & Timo Maran. 2019. Humans on top, humans among the other animals: Narratives of anthropological difference. *Biosemiotics* 12(3). 381–403.
Kress, Gunther. 2003. *Literacy in the new media age*. London: Routledge.
Kress, Gunther & Theo van Leeuwen. 2001. *Multimodal discourse: The modes and media of contemporary communication*. London: Arnold.
Kant, Immanuel. 1999 [1784]. An answer to the question: What is enlightenment. In Mary J. Gregor (ed.), *Immanuel Kant: Practical philosophy*, 11–22. Cambridge: Cambridge University Press.
Kendal, Jeremy R. 2015. Gene–culture coevolution. In Wright D. James (ed.), *International encyclopedia of the social and behavioral sciences*, 2nd edn., 813–818. Amsterdam: Elsevier.
Kull, Kalevi. 2015. Evolution, choice, and scaffolding: Semiosis is changing its own building. *Biosemiotics* 8(2). 223–234.

Lacković, Nataša. 2020. Postdigital living and algorithms of desire. *Postdigital Science and Education* 3. 280–282.
Lacković, Nataša & Alin Olteanu. 2023. *Postdigital higher education: Relationality and multimodal communication in contemporary education*. London: Routledge.
Laland, Kevin N. 2008. Animal cultures. *Current Biology* 18(9). R366–R370.
Laland, Kevin N. & Vincent M. Janik. 2006. The animal cultures debate. *Trends in Ecology & Evolution* 21(10). 542–547.
Leonardi, Paul M. 2010. Digital materiality? How artifacts without matter, matter. *First Monday* 15(6). https://doi.org/10.5210/fm.v15i6.3036.
Levinas, Emmanuel. 1969 [1961]. *Totality and infinity: An essay on exteriority*. Trans. Alphonso Lingis (trans.). Pittsburgh: Duquesne University Press.
Linden, Eugen. 1976. *Apes, man, language*. New York: Penguin Books.
Lotman, Juri. 1990. *Universe of the mind: A semiotic theory of culture*. London: I.B. Tauris.
MacLarnon, Ann. 2012. The anatomical and physiological basis of human speech production: Adaptations and exaptations. In Kathleen R. Gibson & Maggie Tallerman (eds.), *The Oxford handbook of language evolution*, 224–235. Oxford: Oxford University Press.
Magnani, Lorenzo. 2022. *Eco-cognitive computationalism: Cognitive domestication of ignorant entities*. Cham: Springer.
Martinelli, Dario & Kristian Bankov. 2008. Bankov's razor versus Martinelli's canon. A confrontation around biosemiotics. *Biosemiotics* 1. 397–418.
McLuhan, Marshall. 1994 [1964]. *Understanding media: The extensions of man*. Cambridge, MA: The MIT Press.
Mills, Kathy A. 2016. *Literacy theories for the digital age: Social, critical, multimodal, spatial, material and sensory lenses*. Bristol: Multilingual matters.
Miller, James R. 2017. *Residential schools and reconciliation: Canada confronts its history*. Toronto: University of Toronto Press.
Milloy, John S. 1999. *A national crime: The Canadian government and the residential school system, 1879–1986*. Winnipeg: University of Manitoba Press.
Nelson, Melissa K. & Daniel Shilling (eds.). 2018. *Traditional ecological knowledge: Learning from Indigenous practices for environmental sustainability*. Cambridge University Press.
Olteanu, Alin. 2019. *Multiculturalism as multimodal communication: A semiotic perspective*. Cham: Springer.
Olteanu, Alin. 2021. A proposal for a biosemiotic approach to digitalization: Literacy as modeling competence. In Elena Pagni & Richard Theisen Simanke (eds.), *Biosemiotics and evolution: The natural foundations of meaning and symbolism*, 65–85. Cham: Springer.
Olteanu, Alin. 2022. Translation from a contemporary media perspective: Avoiding culturalism and monolingualism. *Social Semiotics* 32(1). 143–161.
Olteanu, Alin & Andrew Stables. 2018. Learning and adaptation from a semiotic perspective. *Sign Systems Studies* 46(4). 409–434.
Olteanu, Alin & Arianna Ciula. 2022 (in press). Digital humanities and semiotics. In Jamin Pelkey & Paul Cobley (eds.), *Bloomsbury semiotics volume 4: Semiotic movements*. London: Bloomsbury.
Olteanu, Alin & Cary Campbell. 2018. A short introduction to edusemiotics. *Chinese Semiotic Studies* 14(2). 245–260.
Olteanu, Alin & Cary Campbell. 2022 (in press). Biosemiotic systems theory: An embodied and ecological approach to culture. In Claudio Higuera & Juan R. Coca (eds.), *Biosocial world. Biosemiotics and biosociology*. Valladolid: University of Valladolid Press.

Peirce, Charles S. 1931–1935, 1958. In Arthur W. Burks, Charles Hartshorne & Paul Weiss (eds.), *The collected papers of Charles Sanders Peirce*. Cambridge: Belknap. [= CP].

Peirce, Charles S. 1998 [1893–1913]. *The essential Peirce: Selected philosophical writings: Volume 2*. The Peirce Edition Project. Bloomington: Indiana University Press. [= EP II].

Petersen, Eva B. 2018. 'Data found us': A critique of some new materialist tropes in educational research. *Research in Education* 101(1). 5–16.

Petrilli, Susan. 2014. *Sign studies and semioethics: Communication, translation and values*. Berlin: De Gruyter Mouton.

Petrilli, Susan. 2022. The law challenged and the critique of identity with Emmanuel Levinas. *International Journal for the Semiotics of Law – Revue international de Sémiotique juridique* 35. 31–69.

Petrilli, Susan & Augusto Ponzio. 2005. *Semiotics unbounded: Interpretative routes through the open network of signs*. Toronto: University of Toronto Press.

Petrilli, Susan & Augusto Ponzio. 2019. Identity and alterity of the text in translation: A semioethic approach. *International Journal of Semiotics and Visual Rhetoric* 3(1). 46–65.

Rifkin, Jeremy. 2011. *The third industrial revolution: how lateral power is transforming energy, the economy, and the world*. New York: Palgrave Macmillan.

Rodríguez-Higuera, Claudio. 2019. Everything seems so settled here: The conceivability of post-Peircean biosemiotics. *Sign Systems Studies* 47(3/4). 420–435.

Rouvroy, Antoinette. 2013. The end(s) of critique: Data behaviourism and due process. In Mireille Hildebrandt & Katja de Vries (eds.), *Privacy, due process and the computational turn: The philosophy of law meets the philosophy of technology*, 143–167. London: Routledge.

Saussure, Ferdinand de. 1959 [1916]. In Charles Bally, Albert Sechehaye & Albert Reidlinger (eds.), *Course in general linguistics* [*Course de linguistique générale*]. Wade Baskin (trans). New York: The Philosophical Library.

Sebeok, Thomas A. 1965. Animal communication. *Science* 147(3661). 1006–1014.

Sebeok, Thomas A. 1968. A selected and annotated guide to the literature of zoosemiotics and its background. *Social Science Information* 7(5). 103–117.

Sebeok, Thomas A. 1986. The problem of the origin of language in an evolutionary frame. *Language Sciences* 8(2). 169–176.

Sebeok, Thomas A. 1991. *A sign is just a sign: Advances in semiotics*. Bloomington: Indiana University Press.

Sebeok, Thomas A. 2001a [1994]. *Signs: An introduction to semiotics*. Toronto: University of Toronto Press.

Sebeok, Thomas A. 2001b. *Global semiotics*. Bloomington: Indiana University Press.

Sebeok, Thomas A. & Marcel Danesi. 2000. *The forms of meaning: Modelling systems theory and semiotic analysis*. Berlin: Mouton de Gruyter.

Simpson, L. B. 2014. Land as pedagogy: Nishnaabeg intelligence and rebellious transformation. *Decolonization: Indigeneity, Education & Society* 3(3). 1–25.

Smythe, Suzanne, Cher Hill, Margaret MacDonald, Diane Dagenais, Nathalie Sinclair & Kelleen Toohey. 2017. *Disrupting boundaries in education and research*. Cambridge: Cambridge University Press.

Stables, Andrew. 2012. *Be(com)ing human: Semiosis and the myth of reason*. Rotterdam: Sense publishers.

Stjernfelt, Frederik. 2007. *Diagrammatology: Investigations on the borderlines of phenomenology, ontology and semiotics*. Dordrecht: Springer.

Stjernfelt, Frederik. 2011. What is culturalism? The anatomy of a contemporary disease in academia and politics. *Lexia. Rivista Semiotica* 5(6). 369–400.
Stjernfelt, Frederik. 2012. Liberal multiculturalism as political philosophy. *The Monist* 95(1). 49–71.
Stjernfelt, Frederik. 2014. *Natural propositions: The actuality of Peirce's doctrine of dicisigns*. Boston: Docent Press.
Stjernfelt, Frederik. 2022. *Sheets, diagrams, and realism in Peirce*. Berlin: de Gruyter.
Said, Edward. 1993 [1994]. *Culture and imperialism*. London: Chatto & Windus.
Sastre, Ezequiel M. C. 2018. Signs of culture? A critical transdisciplinary approach to the study of animal cultures. *Crossways Journal* 2(2).
Tomlinson, Gary. 2015. *A million years of music: The emergence of human modernity*. Cambridge, USA: MIT Press.
Tomlinson, Gary. 2018. *Culture and the course of human evolution*. Chicago: University of Chicago Press.
Taylor, Affrica. 2017. Beyond stewardship: Common world pedagogies for the Anthropocene. *Environmental Education Research* 23(10). 1448–1461.
Taylor, Carol & Christina Hughes (eds.). 2016. *Posthuman research practices in education*. London: Palgrave MacMillan.
Taylor, Affrica & Veronica Pacini-Ketchabaw. 2018. *The common worlds of children and animals: Relational ethics for entangled lives* (Routledge Spaces of Childhood and Youth). London: Routledge.
Ulmer, Jasmine. 2017. Posthumanism as research methodology: Inquiry in the Anthropocene. *International Journal of Qualitative Studies in Education* 30(9). 832–848.
Wagner, Gunter & Gary Tomlinson. 2022. Extending the explanatory scope of evolutionary theory: The origination of historical kinds in biology and culture. *Philosophy, Theory, and Practice in Biology* 14. 1.
Wilson, Edward O. 1998 [1975]. *Sociobiology. The abridged edition*. Cambridge, MA: The Belknap Press of Harvard University Press.
Wulf, Andrea. 2015. *The invention of Nature: Alexander von Humboldt's New World*. New York: Alfred A. Knopf.

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