"Life Is a Verb": Inflections of Artificial Life in Cultural Context

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Abstract This review essay surveys recent literature in the history of science, literary theory, anthropology, and art criticism dedicated to exploring how the artificial life enterprise has been inflected by—and might also reshape—existing social, historical, cognitive, and cultural frames of thought and action. The piece works through various possible interpretations of Kevin Kelly's phrase "life is a verb," in order to track recent shifts in cultural studies of artificial life from an aesthetic of critique to an aesthetic of conversation, discerning in the process different styles of translating between the concerns of the humanities, social sciences, natural sciences, and sciences of the artificial.

Keywords
Life, history, cultural critique, aesthetics, emergence, translation

> **verb** a. OF. (also mod.F.) verbe or ad. L. verbum word, verb (whence also It., Sp., Pg. verbo).] **1.** *Gram.* **a.** That part of speech by which an assertion is made, or which serves to connect a subject with a predicate. For the numerous kinds of verbs distinguished by special epithets see the adjs. active, auxiliary, deponent, desiderative, frequentative, etc.[1]

In *Out of control: The new biology of machines*, Kevin Kelly, examining attempts by artificial life scientists to define life, arrives at the conclusion that "life is a verb, not a noun" [27, p. 347]. The phrase summarizes his observation that, for many practitioners in the field, life has become not just a property or a collection of properties, but a *process*, an unfolding of activity. Just as the word *verb*, originally meaning "word," has traveled toward a more specific reference to terms that denote doing, being, and becoming, so *life* has moved away from its reference to a static object toward indicating trajectories of dynamic, vital action. Indeed, the organizing tension in artificial life between what Christopher Langton once called *life-as-we-know-it* and *life-as-it-could-be* might be framed in terms of an itinerary of verbs from the present tense transitivity of *as-we-know-it* to the modal compound conditional mood of *could-be* [30]. If life is a verb, it has many conjugations, and it has been one of the signature promises of artificial life as a genre of theoretical biology to spell out its many possible forms.

In this piece, I consider some ways vitality has been parsed in artificial life (particularly in its "classic" forms in the late twentieth century) and use this consideration as a platform for surveying recent texts in history of science, literary theory, anthropology, and art criticism that have sought to explore how the artificial life enterprise has been inflected by—and might also reshape—existing social, historical, cognitive, and cultural contexts. I argue that scientific and humanistic traditions of thinking about artificial life, which have historically run on separate theoretical and epistemological tracks—with artificial life thinkers hewing closely to an ethos of empiricism toward artificial worlds and agents, and humanists offering cultural contextualizations or critiques of artificial life efforts—

1 All definitions are from the *Oxford English Dictionary*, 3rd ed.

have lately begun to recombine, as scholars have found terms such as "life," "emergence," and "agent" to demand cross-disciplinary discussion and, perhaps, redefinition (think only, on the life–computer-sciences side of the conversation, of this journal's hospitality to perspectives from social science—e.g., [23, 32, 37]—and media art [6]). In what follows, I track the trajectory of this move from an *aesthetic of critique* to an *aesthetic of conversation* as it has manifested in recent literature on artificial life from historical, social, cultural, and aesthetic quarters of inquiry. I conclude by discerning two modes through which artificial life–humanities conversations are being opened. The first mode works through what I will call *direct translation* (in which artificial life terms are aligned with those in the humanities). The second engages in what I will term *allopoietic translation* (in which artificial life terms are employed to produce an efflorescence of meanings pertaining to and productive of new, unexpected contexts of usage[2]). I organize this review somewhat playfully, around grammatical terms—headings I think provide ways into considering "life as a verb" both in artificial life and in this secondary literature. Though I have written this piece as an essay with an argumentative arc, I mean the text also to have something of the structure of a hypertext, with readers invited to make links, to generate new grammatical combinations, across the various subheads offered here.

> **mood 2. a.** *Gram.* Any one of the several groups of forms in the conjugation of a verb which serve to indicate the function in which the verb is used, i.e. whether it expresses a predication, a command, a wish, or the like; that quality of a verb which depends on the question to which of these groups its form belongs.

In " 'Artificial societies' and social science," the anthropologist J. Stephen Lansing assesses work on social modeling in artificial life, calling for a theoretically grounded framework for understanding the limits and possibilities of computer simulation as a tool for social scientists to employ in modeling social systems [32]. Lansing suggests that the construction of nonlinear models of heterogeneous actors is the practice through which "the significance of artificial societies as a genuine methodological innovation become[s] apparent" [32, p. 282].[3] Artificial life tools have promise for limning the outlines of possible explanation in the life and social sciences, the conditional mood of *life-as-it-could-be*. But Lansing also cautions that "[i]f our 'toy models' serve only to reify and naturalize the conventional social science wisdom, then they are indeed a Medusan mirror, freezing the victim by the monster's glance" [32, p. 289]. We do not want to move into a wishful mood or worse, the imperative mood: *life-as-it-should-be*. It is important to distinguish models and their corresponding semantic statuses as, variously—to take the grammatical meaning of "mood"—*predications*, *commands*, or even *wishes*. I here explore some moods of artificial life work, reviewing a species of scholarship complementary to that surveyed by Lansing, a variety that seeks to understand how sociocultural forces inflect and are inflected by the production of artificial life artifacts and concepts. To begin this review, it will be useful to return to a fundamental form of the verb: the conjugation.

> **conjugation 3.** *Grammar.* **a.** A connected scheme of all the inflexional forms belonging to a verb; a division of the verbs of any language according to the general differences of inflexion.

2 *Allopoiesis*, an entity's production of something outside or beyond itself, will be familiar to readers conversant with Francisco Varela's notion of *autopoiesis*, an organism's continual production of the conditions of its own self-identity. See Doyle [9] for a discussion of allopoietic systems. The combining form *-poiesis*, fittingly for my usage in connection with translation, shares etymological history with *poetry*; both words point back to the ancient Greek for "to make, create, produce."

3 A recent issue of *Artificial Life* was dedicated to modeling social worlds [23] ranging from those of hunter-gatherers [37] to those of the artificial life research community itself [35].

With the notion of life as a verb before us, we can with some ease imagine a classification of artificial life artifacts by their conjugations. Let me take some classic artificial life systems as touchstones. Tom Ray's Tierra system, which Ray argues hosts the earliest stages of "living systems" exemplary of "new natural evolutions in artificial media," may be read as a scripting of life in the future imperfect tense, a definite activity that is in a futural, continuing, but not completed, state: *life-as-it-will-be-unfolding* [36] ("unfolding," of course, is one of the founding meanings of "evolution"). Karl Sims, who claims that his creations "evolve" but remains agnostic about whether they are in fact "alive," gives us life in the preterite present: *life-as-it-may-be* [43]. Roboticists such as Rodney Brooks, meanwhile, creating artifacts in the three-dimensional world that we humans ourselves inhabit, deliver an active transitive: *life-as-we-make-it* [4]. Brooks's robots, in contrast to Ray's digital creations, are materially fixed once they are built and cannot therefore unfold in the evolutionary sense, phylogenetically. Francisco Varela's autopoietic view of vitality might be said to arrive in the present imperfect as *life-as-it-is-becoming* [51]. Varela's model of life demands the dynamic maintenance of self-specification, a dance between being and becoming, a view he saw as in dialogue with phenomenological notions of *becoming* (due to Heidegger and Husserl and also Zen Buddhism; see [41]).

We could continue in this vein, discerning a range of verbal inflections of the relation of artificial life to "life" (and generating, in the process, a lively debate about how to taxonomize the artifacts of artificial life beyond the usual software, hardware, and wetware or "strong" and "weak" designations). So doing might extend the family of what the rhetorician Richard Doyle in his 1997 book *On beyond living: Rhetorical transformations of the life sciences* calls the "rhetorical softwares" that enable people to see computers as capable of harboring or doubling vitality [8]. In the final chapter of that book, "Emergent power: Vitality and theology in artificial life" (which originated as a presentation at Artificial Life III in June 1992, in Santa Fe [7]), Doyle argues that such interpretative moves as describing life as "information processing" or as a process about which one might have visual intuition ("I know it when I see it") make use of "rhetorical softwares" that permit vitality to materialize on the screen for those persons who subscribe to the relevant symbolic framework. Understandings of life as a verb, we might say, depend on how one describes its root, infinitive form. Is life a code? Is it behavior? Is it the capacity to produce emotional response or persuade an observer? Is it some combination of those things? The polyphony of possibilities leads Doyle to conclude that artificial life opens up an array of ways of thinking of life—including the counterintuitive possibility that there is no unitary ontological or epistemological center to life itself: "[W]hat makes possible the substitution of the signs of life for life," he writes, "is the reproducibility of 'lifelike behavior,' a reproducibility that ultimately points to the fact that A-Life organisms are themselves reproductions, simulations cut off from any 'essence' of life" [8, p. 122]. The contribution of Doyle's *On beyond living* to epistemological discussions in artificial life is to provide both an empirical assessment of the plurality of ways of modeling "life" in artificial life and a diagnosis of the field as a science that transforms how we think about empirical verification (or, as Claus Emmeche [10, pp. 156–166], has put it, artificial life is in some ways the first "postmodern" science, in that it lets a variety of paradigms as well as relationships to the "real" prosper). Doyle's work alerts us to the possibility that we are speaking, to invoke another grammatical category, of different *tenses* of life; that is, different things that "life" has been, may be, and may yet become.

> **tense 2. a.** *Gram.* Any one of the different forms or modifications (or word-groups) in the conjugation of a verb which indicate the different times (*past*, *present*, or *future*) at which the action or state denoted by it is viewed as happening or existing, and also (by extension) the different nature of such action or state, as continuing (*imperfect*) or completed (*perfect*); also *abstr.* that quality of a verb which depends on the expression of such differences.

With an eye to the past, some scholars have begun to examine whether artificial life might have a legible philosophical and technical prehistory prior to its official naming in 1987 [54]. Unlike

Langton's field-founding, invitingly expansive account of the origin of artificial life [30], which gathered a variety of early attempts to mimic vitality into an unbroken centuries-long lineage, such histories have been keen to locate antecedent ideas and artifacts in denser historical context, arguing that "life" has not been a stable, transhistorical signifier. Thus, the historian of science Jessica Riskin has recently revisited Vaucanson's famous mechanical duck, inquiring into which portions of this automaton's construction—its ingestion, digestion, elimination—might prefigure present artificial life attempts at modeling or imitation and which might not [39]. She finds that the duck inaugurated an era in which technological devices were asked not only to represent, but also to *simulate* phenomena associated with living beings. Somewhat distinctively from today's artificial life practice, however, the material of which the digestive system of the duck was made—rubber—was considered an important variable (as, indeed, was its putative fecal matter); Vaucanson and his contemporaries felt that similitude of process should be accompanied by, even accomplished *through*, similarity in material, not just likeness in form. The textures and substances of what Riskin calls "eighteenth-century wetware" were important to such simulations in a way that has not been the case for in silico artificial life models like Tom Ray's Tierra, which offers an informational universe in which the material substrate is not the central concern [40, 36].

As any artificial life scientist knows, of course, Vaucanson's duck was a hoax—the corn and grain it "consumed" did not in fact travel from bill to butt; edible input and excremental output were entirely unrelated, partitioned, their supposed connection declared rather than demonstrated. But, as Riskin argues, Vaucanson only claimed to be offering a *partial* representation of a process and indeed, was not fully persuaded that digestion *could* be fully replicated. In that claim, we can hear anticipations of those scientists in artificial life who claim that their models are suggestive representations rather than full body doubles of living systems (see, e.g., [11], [43], and also much work on genetic algorithms as models rather than materializations of life[4]). Riskin writes, "I find the most striking feature of Vaucanson's automata to have been their simultaneous enactment of both the sameness and the incomparability of life and machinery" [40, p. 610]. The dialectic between similarity and difference, she argues, "represents a historical moment, one in which we are still living. Its contradictory convictions derive from a combination that emerged in the early eighteenth century and remains with us: first, a widely held materialist theory of animal life and, second, the inability of this theory to explain the core phenomenon of animal life, consciousness" [40, p. 612]. In Riskin's fresh interpretation of Vaucanson's automaton duck, we find philosophical dilemmas that continue to bedevil artificial life, and we see them placed in the historical frame of the post-Cartesian Enlightenment era. The lesson artificial life practitioners might take away from Riskin's important work on ALife in the *past tense* is this: "The story of the origins of modern artificial life lies, not in a changeless quest emerging from timeless human impulses, but rather in the experimenters', philosophers', and critics' continually shifting understandings of the boundary between intelligent and rote, animate and mechanical, human and nonhuman" [39, p. 99]. Those shifting understandings, to anticipate an argument a few sections down, are now themselves being recontoured as social scientists and humanists grapple with the implications of artificial life formulations.

But to stay in the recent present tense for the time being: in their history of Lindenmayer systems—logical systems that have been used to model plant growth—the anthropologist Christopher Kelty and the historian Hannah Landecker examine recent accounts of animation in artificial life, attending to the way *time* is imagined in such systems [28]. They argue that Lindenmayer systems not only posit a theory of life, but build that theory into the very model meant to explore it, in the bargain importing a very particular model of temporality: "it is only via the process of programming a machine to calculate an L-system that one can claim to *see* a 'theory' over time" [p. 48]. The point is subtle and important: many artificial life systems are not mainly "alternative

4 Holland, inventor of genetic algorithms, in his book *Hidden order* offers a description of simulations as partial models: "The modeler (cartoonist) must decide which features to make salient (exaggerate), and which features to eliminate (avoid) in order to answer the questions (make the political point)" [24, p. 11].

worlds" in which to do empirical science, but are rather theories in motion. And there are nontrivial implications of exactly how they are put in motion—that is, in the medium of digital computers:

> Time, in the L-system, progresses as a series of discrete steps, and cells are assumed to go through time together, as it were, neither faster nor slower than one another. Though this interpretation is meant to capture the centrality of time to the living organism, there is but one time image at work in the language of L-systems: that of the regular pulse of the computer chip.…[5] That an L-system is (or models, or represents) a biological organism is only *one among many interpretations*. An L-system is by itself a *thing:* a logical machine that is observed to unfold in time [p. 51, 52].

Kelty and Landecker's work demonstrates that if life is a verb for artificial life, then the formal language and set of algorithms in which it is phrased, and the machine system in which it is concretized, may be key to making sense of it. So, while "the actual implementation, the software, is perceived as technical and secondary to the formal presentation and does not appear in many publications," L-systems cannot in fact model the motion of life without the discrete imagination of time upon which they rely. Not just "rhetorical software," then, but software itself as a kind of rhetoric.

In a fusion of art history with the history of science, the new-media scholar Mitchell Whitelaw in his 2004 *Metacreation* argues that artificial life scientists' visualization practices are preceded by traditions not just in science, but also in the visual arts, from Renaissance painting to the abstract expressionism of artists such as Paul Klee, who, like many artificial life scientists of today, were concerned with combining "organic idealism with formalist thought" ([53, p. 14]; see also [4]). Whitelaw takes seriously the aesthetic appeal of artificial life simulations and argues that the field opens up new ways to think about the entwined histories of science and visual arts. But he also presses the reader to think of artificial life in the *future tense*—and in so doing hints at the ways artificial life science and art may learn from one another; his work takes onboard the challenge of using concepts like emergence to rethink art as well as ideas from aesthetics to rethink the objects and possibilities of artificial life. The bulk of Whitelaw's book is dedicated to exploring new genres of computer art inspired by artificial life, and he argues that these are brokering transformations in the way many of us see art and artistic agency. He examines, for instance, how practitioners rethink the creative process as they enter into what they script as "collaborations" with machines, especially machines they imbue with agentive properties akin to those of "natural selection." *Metacreation* guides its readers through a gallery of artificial life art, which Whitelaw organizes into three broad categories: "breeders," "cybernatures," and "hardware."

Programmers in Whitelaw's "breeder" school, such as Sims, use genetic programming to create generations of model organisms. They selectively "breed" populations of artificial life "creatures," acting as sorts of farmer-deities cultivating artificial gardens. For Whitelaw, they are akin to nineteenth-century Romantics who saw in nature a sublime beauty from which humans might learn, and that humans might try to emulate in their works. Those researchers involved in fashioning what Whitelaw calls "cybernatures," meanwhile, hope to draw attention to the messy, negotiated, and contested boundaries between the "inside" and "outside" of the computer, and between the "natural" and "artificial." The artist and engineer Natalie Jeremijenko, to take one of Whitelaw's selected artists, has in her piece *OneTrees* juxtaposed Lindenmayer systems with an installation piece involving one hundred cloned trees, in order to contrast "idealized computer models of… algorithmic trees and actual complex growth phenomena" and to investigate our cultural investments in organismic uniqueness [25]. As viewers are presented with genetically identical trees that nonetheless are phenotypically very different, Jeremijenko's piece of artificial life art prompts them to examine just how far the metaphor of the genetic program can and cannot go. In *OneTrees*, she

5 The actual mechanism of the computer clock is less important here than the fact that it operates in a discrete rather than analog fashion.

also cleverly calibrates the "growth" of L-system trees to environmental sensors, thereby puncturing the separation between real and artificial, placing the sort of hermetically sealed L-systems discussed by Kelty and Landecker into an ecological loop that uses artificial life tools to prompt a conversation about the boundaries between natural growth and algorithmic generation. One of Whitelaw's examples of artificial life art in "hardware," Kenneth Rinaldo's Autopoiesis, is a collection of robotic arms made of grapevines, vines reorganized to hang into a gallery space and respond to museumgoers' movements. Here, what is interrogated is not only the boundaries between natural and artificial objects, but also the kinds of social habits that might emerge when humans interact with machines programmed to respond to their casual, everyday motions.

Whitelaw's discussion of the future of artificial life art ends with a discussion of emergence. He builds inventively upon the philosopher Peter Cariani's definition of emergence [5] as that which deviates from or exceeds an observer's model of a system's behavior. This definition, he points out, is epistemological—that is, relative to an observational and interpretative frame. Whitelaw finds that many artificial life art pieces do indeed surprise at first glance, but also maintains that such surprise can often be diffused by appealing to a more complete model of the system in question, often at another level or in a deeper mathematical or algorithmic register. Unless and until artificial life systems are able to evolve "new sensors, new perceptual categories, or new meanings," he argues, we will have only "syntactically adaptive," and not "semantically adaptive" systems (p. 220, and compare the roboticist Tim Smithers [45, p. 147], who argues that simulation systems can only model "syntactically," not "dynamically and continuously"). Where Whitelaw does see true emergence is in the production of *art* as such—in the generation of an experience in which the interpretation of an object is not finally derivable from its technical specifications, but is generative of additional meanings. "[A]rt itself," he writes, "[is] an open system rife with emergence" (p. 227). His description of the impulse behind artificial life art is instructive: "Inasmuch as it is driven by a desire for absolute emergence, endless excess, a-life art is a *metacreative* endeavor: it wants to create creation, variation, otherness. If a-life science is about knowing and understanding, a-life art is very basically about making and becoming, becoming-other, and becoming-unknown" (p. 226). In other words, artificial life art is about trying to deliver on the full meaning of life as a verb, as a process open to becoming something other than it was when it began. An example of ALife art answering to this description for Whitelaw is Jeremijenko's *OneTrees*, which poses unbounded questions about how to think about identity, programs, and genes—questions that open into conversations about landscapes, ecologies, and even the politics of planting trees in public space. Whitelaw's future tense shows us that while artificial life epistemologies are rooted in philosophical and aesthetic traditions, they might also yet have a hand in reconfiguring them, especially when they are joined with artistic practice.

> **person VI 8.** *Gram.* Each of the three classes of personal pronouns, and corresponding distinctions in verbs, denoting or indicating respectively the person speaking (*first person*), the person spoken to (*second person*), and the person or thing spoken of (*third person*); each of the different forms or inflexions expressing these distinctions.

Let me move briefly into the first person. Whereas Lansing's concern was with how we can ground–truth simulation, the issue at the heart of many social analyses of artificial life has been how we should grapple with the human, cultural perspectives from which research is pursued. Thus, my own 1998 book, *Silicon second nature: Culturing artificial life in a digital world*, posed this question: If artificial life is "life" crafted not by nature but by culture, does it matter which cultures create it? [19].[6] I sought in that text to represent what anthropologists call "the native's point of view" (a first person), but also to locate artificial life in a specific cultural context (a third person). To speak in anthropological terms, I aimed, for people outside artificial life, to make this strange scientific world familiar, and tried, for artificial life

6 Lansing is not persuaded that my analyses are specific enough to computational models. For a debate between Lansing and me on modeling in social sciences, see [20], [31], and [21].

initiates, to make their familiar world strange. I described artificial life models as "looking-glass worlds" in order to suggest that the "digital organisms" across the threshold of the computer screen both reflect and reverse researchers' culturally acquired images of existing life. In my ethnographic research, centered at the Santa Fe Institute in the 1990s, I found that as researchers programmed alternative universes, many described themselves as unitary gods populating their cyberspace creations and as digital Darwins exploring frontiers full with elementary creatures—descriptions that I argued repeated familiar Judeo-Christian origin stories and called upon dominant Euro-American representations of gender, kinship, and primitivity.[7] I also found that in some cases, as Alison Adam has put it in her book *Artificial knowing: Gender and the thinking machine*, artificial life constructions of self-replicating genetic-computer codes could be seen as "sociobiology in computer clothing" [1, p. 151]. One key argument of mine—that computers become worlds capable of harboring life when researchers make choices about which features of biology are essential and amenable to digital representation (and which are not)—also followed the book by the philosopher of computing Brain Cantwell Smith, *On the origin of objects* [44], in asking how ontologies in simulation are created in practice. What is it that allows Harvey [13], for example, to speak of artificial life agents as "creatures from another world"? I argued that computers become "worlds" in part because of researchers' inheritance of ideas about reality as law-governed, a view put into quite literal operation in simulation. Why are the programs within these "worlds" "virtual organisms" at all [52]? I argued that researchers took literally the metaphor of the genetic code in order to claim that computer code might generate vitality. In this sense, my analysis operated within an *aesthetic of critique*. At the same time, however, I also became interested in how artificial life was not simply a practice that reproduced old stories in new software, but also pressed us to make explicit the cultural and philosophical commitments packed into definitions of vitality. *Silicon second nature* juxtaposed different views within the artificial life community (particularly, those dominant at the Santa Fe Institute with those advanced by followers of Varela) to prime an *aesthetic of conversation*, to call attention to the many possible inflections of "life" that might become available in a broad discussion about what might count as synthetic vitality.

One key scholar with whom *Silicon second nature* was in dialogue was the anthropologist Lars Risan, who was interested, in his ethnography of artificial life researchers at Sussex, in how programmers shift the boundaries between self, interface, and model in practices of building and interpreting simulations of living things [38]. He argued that the boundary between self and simulation is porous, with the interface only fully consolidated when programmers feel they have finished programming their simulations. Risan's focus on the interface has proven prescient, since many attempts to trade ideas between artificial life and the social sciences, arts, and humanities have focused on this site of meaning-making as a resource for generating alternative interpretations and narrations.

> **gender 2.** *Gram.* Each of the three (or in some languages two) grammatical 'kinds', corresponding more or less to distinctions of sex (or absence of sex) in the objects denoted, into which substantives are discriminated according to the nature of the modification they require in words syntactically associated with them.

The literary theorist N. Katherine Hayles has argued that artificial life simulations must be narrated to make sense, and that such storytelling often employs themes from researchers' cultural worlds—gender, for example: writing of Dawkins' Blind Watchmaker program, Hayles suggests that Dawkins'

7 To my knowledge, no anthropological work has been done on artificial life cross-culturally, though some informal thinking in this area has been undertaken. At the Artificial Life V conference in Nara, Japan, in 1996, for example, the philosopher Brian Keeley and the historian of science Osamu Sakura led a panel entitled "What is Life? West and East." One moment in the discussion turned on notions of "ch'i," loosely translatable as "life energy," a concept in currency in Chinese medicine and in Japanese popular thought. Whether ch'i might be modeled in artificial life artifacts was not settled in this discussion (which I attended as part of my anthropological fieldwork, and which, as far as I know, was never published). On the matter of non-western perspectives borrowed into artificial life, we might look to the work of Varela, who has called upon Zen Buddhist ideas about being and becoming in his work on cognition and life. On artificial life scientists' ideas about "culture," see [22, 47].

claim to produce ever-fitter generations of cybercreatures works in part because the Watchmaker embeds symbolism of a "male programmer mating with a female program to create progeny whose biomorphic diversity surpasses the father's imagination" [14, p. 125]. *Silicon second nature* makes similar arguments for Tom Ray's Tierra, maintaining that this Artificial Life artifact repeats, even as it refigures, traditions that have seminal male potency (symbolized by the figure of the "seed") animating fertile female ground—a tradition for which Aristotle's *Generation of animals*, the Pygmalion tale, Fritz Lang's *Metropolis*, and Al Pacino's film *Simone* are just a few data points (see also Alison Adam's *Artificial knowing* for an analysis of gender and procreation narratives in Artificial Life [1]).[8] The scholar of psychoanalysis Sherry Turkle, in *Life on the screen*, analyzes how simulations function as evocative objects for people in an age in which we no longer need or care to understand how machines work in order to interact with them, and she is interested in the gendered dimensions of how women and men have variously encountered simulation technology [50]. The title of Turkle's earlier book, on artificial intelligence, *The second self*, inspired my own "silicon second nature," my phrase for the space researchers create in silico and for the dispositions they cultivate as they view their own lives through the lens of the artificial [49]. It is worth recalling that one of Turkle's starting points was Simone de Beauvoir's 1949 *The second sex*, which argued that "woman is not born, but made," a maxim that highlights the artificiality—or, better, abstractness—of categories we often take as natural, like gender, and indeed, life itself (it is worth mentioning that Kevin Kelly organizes his thesis about Artificial Life in *Out of control* around a distinction between the born and the made). The nineteenth-century feminist Charlotte Perkins Gilman also pronounced that "life is a verb, not a noun," an adage that spoke to her social reform efforts, aimed at broadening life opportunities for women.

The feminist question in artificial life is taken on extensively by Sarah Kember, who in her 2003 *Cyberfeminism and artificial life* employs a twenty-first-century feminist lens to examine how both gender and life are undergoing revision in the way they are "not born, but made" in the digital, virtual age [29]. As she puts it, "Biology no longer occupies a territory that can consistently and reliably be named 'nature', and feminism does not preside over a pure, abstract extrapolation of nurture called 'culture' " (pp. 175–176). Writing of "evolving feminism in Alife environments," Kember is interested in the possibilities that views of vitality-in-the-making offer for transforming the registers in which one can act as a feminist, as a person committed to challenging the naturalization of gender inequality. Here, she extends and critiques the work of Adam, arguing that when gender becomes comprehensible as something made (constructed), new ways of fashioning selves become possible (think only of the rise of the transgender movement). For Kember, the figure of the *cyborg*—the cybernetic organism, the mixture of the natural and the artificial, looped together in a feedback system (first employed as an object to think with about our highly technologized social order by Donna Haraway [12])—rewrites how we might think about nature and culture, about life and artifice, and therefore about the relation between sex and gender. Kember's work exemplifies one of the ways that scholars in the humanities are finding epistemic possibilities in the questions that artificial life presents about what is "natural."

> **number IV. 16.** *Gram.* The property in words of denoting that one, two or more persons or things are spoken of; the special form of a word by which this is expressed.

And so, the latest efforts in the cultural study of artificial life move toward a conversational treatment of the relation between artificial life science and culture, working through a mélange of artificial life theories and methods to generate concepts for the future of the humanities. Simon

8 Hayles has in this journal critiqued my call to look at the heterosexual slant of many ALife models of reproduction, suggesting that a program including homosexual desire would be "far more complex than any existing simulation" [18, p. 426]. Insofar as I consider what such a model might look like, the discussion derives from conversation with a scientist who suggested that one could write a simple procedure to program virtual critters to inherit mate preferences from opposite sex parents. This would, my interlocutor proposed, complicate the sex-linked inheritance often at the heart of sexual selection models. Hayles writes that I "never explicitly entertain . . . the argument of what such modeling would accomplish in a scientific sense" (p. 426). I did not need to; my informant did it for me.

Penny was among the first to put his finger on the shared *interactive* logics of artificial life, artificial selection, artistic production, and cultural action [34]. In his article "The Darwin machine: Artificial life and interactive art," Penny examines the tension between rationalism and intuition that animates attempts to create and interpret lifelike artifacts, whether in science or in art. "The interface," he writes (in an observation that resonates with Risan), "is the zone of translation." It is this zone that humanities scholars have found a productive location from which to engage artificial life formulations. And it is here that the conversation can be parsed into two styles: those animated by *direct translation* and those motored by *allopoietic translation*. Let me take these in turn.

Hayles, in her "Simulating narratives" [17], argues that meditating upon virtual creatures, looking at their images through an interface, can lead one to think about oneself as a system of distributed cognition, made up of a multiplicity of agents. This, to quote the subtitle of her article, is "what virtual creatures can teach us." Artificial life formulae, in this argument, can reformat our own self-understandings. The comparative literature scholar John Johnston [26], in his article "A future for autonomous agents," makes the humanities–artificial life convergence more explicit, seeing an alignment between artificial life notions of the "agent" and definitions of the "agent" in literary analyses of narrative, "where it [has] designated a type of function that initiated, sustained, or relayed a sequence of actions" (p. 485). With the poststructuralist questioning of the "subject" (the self-present human actor of liberal individualism—an actor that, in the wake of theorists such as Foucault, is now frequently understood to be a social, cultural, and historical product rather than a preexisting entity), Johnston suggests, the "agent" has been advanced to theorize modes of action that no longer require such anchoring conceits as "free will" or "consciousness." Johnston claims that kindred notions of agency find articulation in the work of people like Rodney Brooks, who has forwarded arguments in favor of "intelligence without reason" and "intelligence without representation." Johnston sees here a congenial meeting point for artificial life and literary theory. Both Hayles and Johnston, then, espy a direct translation between artificial life and humanist concerns (Hayles might say *posthumanist* concerns, in line with a discarding of the "subject" in favor of the "agent" [16]).

But there is another kind of hybrid discourse out there, one that, unlike those of Hayles and Johnston, combines artificial life and humanistic ideas without thereby making them identical to one another. Hayles and Johnston see a one-to-one translation between ideas about the "agent" in narrative and artificial life theory[9]; they meditate less upon the *disjunctures*, or multiple possible translations, people might make between artificial life "agents" and human "agents." But there is more than one lesson that "virtual creatures can teach us," more than one avenue to follow in thinking about artificial agents. One scholar who has gone a step further than Hayles and Johnston on this score is the Cornell roboticist and cultural theorist Phoebe Sengers, who has sought to bring a critical commitment to her construction of relational robots; she has challenged the very idea of the "agent" not only interpretatively, but also concretely, in machines. Sengers uses "cultural analysis to evaluate the cultural meaning of current systems, and then [to] develop new systems which express different meanings" [42]. She has been concerned to argue that artificial agents can only make sense if they operate within a narrative frame—one that must be actively fashioned by programmers, that

9 In another example of translational flattening, Johnston compares the philosophers Gilles Deleuze and Félix Guattari's notion of "nonorganic life" with artificial life. Johnston begins by taking on board Deleuze and Guattari's idea of the "machinic phylum," which they define as "a life proper to matter, a vital state of matter as such . . . matter in movement, in flux, in variation, matter as a conveyer of singularities and traits of expression" (Deleuze and Guattari, quoted in Johnston [26, p. 479]). Deleuze and Guattari, Johnston reports, tell a story of how this "phylum" was "first made visible by nomad metallurgists, who extracted metals and ores from the earth in order to fabricate weapons and tools. Eventually it came to constitute a technological lineage comprehending different lines of variation—evident, for example, in the differences between saber and sword" (p. 480). Johnston then argues that artificial life scientists are the heirs to this metallurgic tradition, artisans of new forms of nonorganic life, forms that are employing humans to bring themselves into evolutionary being. A key problem here is that Johnston takes Deleuze and Guattari's provocative philosophical fable as history, both natural and social, leading him to tell just the sort of "changeless quest" tale critiqued by Riskin [39]. For another critique of this kind of approach, see Ansell Pearson's *Viroid life* [3], which emphasizes the differences between Deleuzian notions of the machinic phylum and the "dubious neo-Larmarckism" and "ridiculous anthropomorphism" (p. 149) that often sneaks into tales of artificial life as the agent of its own creation (Kevin Kelly's formulations are particularly worrisome to Ansell Pearson). See Terranova [48] for a critique of the posthuman, and Anderson [2] for an idiosyncratic take on artificial life as toys, tools, and trash.

cannot arrive on its own (in other words, Hayles's ideas about "what virtual creatures can teach us" cannot exist without first buying into a whole set of narrative conventions [that they exist in a virtual realm, that they are "creatures"][10]). What renders robots designed with Brooks's subsumption architecture unconvincing, Sengers maintains, is the fact that their actions do not have a narrative center, an interpretative frame that would allow learning and acting across domains of action. She has provocatively suggested an architecture she calls the Expressivator, which would take explicit account of the interpretation-laden interaction that users will have with artificial agents. Sarah Kember, summarizing Sengers's work, puts it this way: "An agent is not a 'pristine testing-ground' for theories of mind and matter—not a creation, but a construction of life" [29, p. 194].

Or lives. Richard Doyle, in his latest monograph, *Wetwares: Experiments in postvital living*, offers a recipe book for thinking about how "life" only emerges as such in relationships; not artificial life, then, so much as *artificial lives* [9]. Doyle tells us that the Online Hacker Jargon File defines "wetware" as "Human beings (programmers, operators, administrators) attached to a computer system, as opposed to the system's hardware or software." In a key chapter, Doyle develops a rhetorical device he calls the "ALife ribotype," which he describes as a kind of translatory apparatus that turns computer code into persuasive lifelike performance. Steering clear of the language of genotype (which often glides too close to a simplistic determinism) and of phenotype (which only looks at the surfaces of artificial life performances—images on the screen, for instance), Doyle's ribotype (the ribosome is that organelle that transmogrifies geno- into phenotype) directs our attention to the *plural* relationships and translations—technical, emotional, professional—*between* scientists and the machines that they encounter as if they were alive. Doyle's frame echoes a sentence of Whitelaw's: "the best we can hope for is a proliferation of possible lives, aesthetics, agencies, systems, and critiques." Whitelaw calls for "[e]xperiments in utopian ecoengineering [coexisting] with wailing, thrashing a-life underworlds" [53, p. 237]. These experiments are experiments not just in translation, but in *translations*, in multiple conjugations. I call these *allopoietic translations* and alongside Doyle's, I would number the work of Jeremijenko, Whitelaw, Sengers, and Kember. Each translates artificial life for a different purpose—to think about the politics of nature, the interpretative possibilities of art, the responsibility of roboticists to the users of their tools, or the instability of gender in the machine age, to list just a few. These translations exceed their source material.

> **aspect 9. b.** *Gram.* …, a verbal category of which the function is to express action or being in respect of its inception, duration, or completion, etc.; by extension applied to such forms in other languages.

All the efforts I have examined in this piece press us to take seriously artificial life's charter, articulated by Chris Langton, to examine *life-as-it-could-be* [30]. Gestures toward other ways of thinking about life have been a hallmark of sociology, anthropology, and cultural studies. Most recent articulations of the anthropological endeavor see this as part of the project of cultural critique, the object of which has been to show that taken-for-granted practices are contingent and might be other than they are [33]. As an anthropologist and as a member of the same scientific culture as many artificial life researchers, I see artificial life as a promising terrain through which to think about new visions of life, nature, and our human relationship to it. All of the writings reviewed above join artificial life researchers in a common project of critiquing aspects of received knowledge—and more importantly, in intervening in the inception, duration, or completion of the project—in the making of artificial life as a verb.

10 In this recent work, Hayles appears to have put aside her earlier attentiveness to how analogy, metaphor, and narrative preconstitute the objects that appear in so-called virtual worlds. Here she is on Tierra in a piece from 1995, one that reads differently from her later work: "[T]he interpretation of the program through biological analogies is so deeply bound up with its logic and structure that it would be virtually impossible to understand the program without them. These analogies are not like icing on a cake, which you can scrape off and still have the cake. Nor are they clothes you can remove and still have the figure. The biological analogies do not embellish the story; in an important sense, they constitute it" [15, p. 421].

I second an argument advanced by Hayles in this journal that cultural studies have much to contribute to artificial life and vice versa. If C. P. Snow [46] sought to encourage scientists and humanists—his "two cultures"—to meet halfway, these efforts can make an intervention that generates productive diffraction patterns between the many cultures of scientists that participate in artificial life: from neo-Darwinian to autopoietically inclined biologists, from computer scientists who follow von Neumann to those who employ phenomenology, from biochemists who see vitality as an abstract grammar to those who demand that life needs water, from anthropologists who simulate culture to those who study the culture of simulation. If life is a verb, it has not only many conjugations, but also many translations.

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