« 6 » In the Matriztic School, my colleague Ximena Dávila Yáñez[1] and I think that much confusion has arisen with the not very careful use of the notion of *autopoiesis*, particularly as it is treated almost as if it were a synonym of self-organization. This is not the case with Urrestarazu's article, and I congratulate him for his care in being impeccable in this matter. Yet I would also like to add that Dávila and I want to emphasize that as living systems exist as *molecular autopoietic systems*, they occur in unity with the *ecological niche* that arises with them, and exist as *ecological organism-niche unities* as they operate as totalities.

« 7 » Although we do not usually see it in this way, we live immersed, so to say, in a flowing dynamic network of changing sensations in which from the moment we are conceived, we learned to abstract the sensory configurations that begin to guide the course of our living according to the manner of living that we learn-generate-create as we live. And in this network of sensations, what we distinguish is brought to existence as we distinguish it with what we do and name, much as a child in a sandy humid beach brings forth stars, triangles, flowers … with the moulds that he or she may happen to be playing with. So, names and words in general are not trivial artifices for indicating pre-existing conceptual or physical entities, they connote what we do and feel as we use them. Without our always being aware of what we are doing, names and, in fact, all words that we use, constantly orient our sensory-operational-relational living, both illuminating and obscuring it, according to the emotions that they evoke in us.

« 8 » Thus, in depth my question to Luhmann was: What would be conserved with the word *social* if we were to accept that *social systems are autopoietic systems*? Or, what would be lost from the psychic relational space of our daily living if we accept the claim that *social systems are autopoietic systems of communications*? After we give a name to something that we distinguish in our domain of living, whenever we later pronounce that name we bring forth into our present that something and the sensory-operational-relational domain that we are generating through it in our living.

« 9 » What would be added to our understanding of *social systems* and to how we now live our daily living if we were to find that that which we usually call a social system is an *autopoietic system*, besides the desire of getting out of *social systems* to avoid becoming robots that can only exist in them if all that they do is subordinated to their conservation, as Urrestarazu shows in his article? Maybe what is added is the awareness that if we are able to realize when a *social system* is about to become an *autopoietic system*, we can be wise enough to choose to live in such a way that it never occurs because we would know that whether that happens or not it would depend on us. I think that democracy is one attempt to live in that awareness so that we can avoid the temptation of the promised perfection of fundamentalist doctrines or theories that deny the possibility of reflecting about their fundaments in order to have the freedom of abandoning them.

« 10 » These were the reflections that I wanted to make, in addition to thanking Urrestarazu for his friendly reference to me. Thank you!

Humberto Maturana Romesín received a Ph.D. in Biology from Harvard University. He showed that living beings are molecular autopoietic systems, and that if one follows the consequences of the fact that living beings do not distinguish in their experience between perception and illusion, one can show that: language as a biological phenomenon occurs as a flow of living together in coordinations of coordinations of consensual behaviors; and cognition as a biological phenomenon occurs when an organism operates adequately to the circumstances of its living, conserving its autopoiesis as a consequence of the operational-relational coherences with its niche that are proper to it in the present of its living as a feature of the history of evolutionary structural drift to which it belongs.

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1| I mention my colleague because it is in our work together in the Matriztic School that we have reflected on these matters and find that we have to emphasize that living systems are molecular autopoietic systems, and that as such, they exist as totalities as organism-niche integrated ecological unities.

Author's Response

From Humans to Human Social Systems

Hugo Urrestarazu
Independent Researcher
hugo.urrestarazu/at/wanadoo.fr

> Upshot • Reflecting beyond the original intent of my paper, I respond to Luhmann-inspired commentaries by raising ontological-epistemological issues that stand before any attempt to build bridges between Maturana's and Luhmann's approaches to "autopoiesis." I propose to look at the social from a vantage point from which human actors and their social doings (communications, among others) appear as equally relevant objects of knowledge in sociological theory-building.

« 1 » I would like to express my gratification upon receiving so many discerning commentaries to my target article. Many of them address subjects that are well beyond the initial scope and intent of my paper, while being nonetheless highly relevant. This finding leads me to remind readers of my original aim in order to explain some seeming shortcomings (as noted by certain contributors). In addition, I shall provide further developments concerning some implications of this work that I did not envisage developing in the paper for reasons of keeping the overall focus as tight as possible.

« 2 » I will first address generally the mentioned limitations in the light of my original goals, and then, when I deal with the debate on the hypothetical "autopoiecity" of social systems, respond to the more challenging suggestions and opposing opinions provoked by my approach.

The goals of the target article

« 3 » The prime objective throughout my three preceding papers (Urrestarazu, 2011a, 2011b, 2012) was to provide a *thorough explanation* of the concept of autopoiesis, as it was originally proposed by Humberto Maturana and later worked out with the contribution of Francisco Varela and other collaborators. The need for such an explanatory effort appeared to me to be

a consequence of the widespread use of the term "autopoiesis" in disciplines other than biology, particularly in sociology. I felt that the specificities of the concept were not well understood in many essential details, and that the notion was thereby acquiring a confusion-prone "dilution" of its exact meaning

« 4 » So I set myself the personal goal of examining the question of whether "social systems" could possibly comply with the 6 VM&U rules. To do this, I needed a *framework for a generalized formulation* of the autopoietic machine concept, applicable to any kind of dynamic system. This entailed avoiding any explicit assumption about the kind of interaction mechanisms operating among components and environmental objects (e.g., systems should be seen as *causation structures* and their dynamics as *causation flows*). I then *attempted to find a fit* of the concrete case of social systems with this generalized conceptual structure.

« 5 » So, my aim was not to "define" *what kind of systems social systems could be*. Instead it was to investigate *if they could be tentatively construed* as circumscribable composite unities existing in an appropriate space where they could be subject to scrutiny *in terms of the requirements needed to ascertain their possible autopoietic nature*, as inferred from the said rules. Metaphorically speaking, I tried to drag and drop a generalized notion of "social system" into a straitjacket consisting of all the requirements imposed by the most general possible definition of an autopoietic system and see if it fitted in it and at what price.

« 6 » I conceive this approach as a valid *methodological exercise* in the attempt to unveil possible inconsistencies while merging conceptual structures of different origins. The *conceptual model of autopoietic system* "à la VM&U" constitutes an appropriate tool because it was conceived as a *falsifiable* theoretical proposition for observing systems.

The concept of social system

« 7 » There is no clear equivalent situation for the notion of "social system" as so many approaches are offered. Sticking to my approach, I had no other choice but to propose a tentative "definition" that was sufficiently coherent to fit with the premises needed to construe it as a *particular case of dynamic system*, at the very least. In doing this, I used a strict corpus of considerations based on observability, as I stated from the start when explaining what I understood as an *observational domain*. This is a term used throughout my work that refers to any domain of perceived phenomena in which human observers can perform sensorial and operational experiences throughout interactions with the observable entities under consideration. In this sense, observational domains are, for us, *physical domains*, where known physical laws apply and where our interactions with other entities should occur as phenomena pertaining to our own *biological domain* (i.e., perceived directly via our own sensory-motor capabilities, or indirectly, via biological effects resulting from the use of suitable transducers, see Urrestarazu 2011a: 307f).In particular, I assumed that dynamic systems (hence, autopoietic systems) correspond to observable manifestations of phenomena arising in our experience of living and interacting in such observational domains, which are part of our domain of existence.

« 8 » Consequently, the resulting "definition" of *social system* as proposed in this target article was inevitably "constrained" by my specific goal and inquiry methodology.

« 9 » I therefore make clear that this is not a definition of what I could perhaps elaborate if I became a sociologist and were able to construe freely and specifically on concepts concerning *human social systems* in particular. Instead, I proposed distinctions to address the most basic features of those observed natural dynamic systems, *seen* as composed of communicating agents and showing collectively coordinated behaviours, within a limited commonality of features shared with our human species' social behaviour in many respects.

« 10 » In particular, what appears to some commentators as "Urrestarazu's conception of communication" is in fact a provisional hypothetical construct elaborated *ad hoc* in order to be consistent with and applicable to the abovementioned framework. In particular, my aim was to *highlight* the importance of distinguishing behaviours determined mechanistically at the level of inter-agent social interactions (social domain) from behaviours determined within the non-intersecting internal domains of existence of agents themselves, i.e., the non-social structural determinations of agent's "psychic domains."

« 11 » Another recurrent subject of commentaries concerns my deliberate effort to not include in my "definitions" any reference to the semantic contents of communications. Not to speak about semiotics does not mean "neglecting" its relevance. I placed all considerations related to the semantics of communications carefully aside from my reasoning because I needed to focus essentially on all the aspects related to their mechanistic effects. Autopoietic systems as construed from Maturana and Varela's point of view must be seen as mechanistic systems. This does *not only* mean that their dynamics should be distinguished as determined by their structure.[1] More precisely, in the case of dynamic systems, mechanistic means that all the structural changes that they undergo while transitioning from one instantaneous state to another *are explainable* as outcomes of *only the relations* established between components and *not of the properties* of the components themselves. This is a subtle criterion of distinction that allows observers to distinguish a space of *selected determinations* that constitutes the domain in which the system-whole manifests itself as such to us as observers and is describable, circumscribable, and explainable at a *coherent level of granularity*.

« 12 » When we consider the semantic contents of communications, we cannot do so without referring to the *origin* of "meanings" and to their *observability*. For that, we need to dwell into the non-intersecting realm of agents' cognitive capabilities (i.e., self/alter-consciousness, language, memory). By this very fact we depart from the observational domain chosen to describe the encompassing social systemic-whole in which they participate as components. While explaining why I avoided referring to the role played by human sense-making in the constitution of human societies, I would not like to give the impression that I consid-

1| In fact, all distinguished phenomena, as we understand them in the Western scientific tradition, should be explainable in terms of structure-determined and causal outcomes of the operation of distinguished physical entities (the contrary would be to admit the occurrence of miracles).

er this role as negligible. On the contrary, I think that taking it into consideration from the start is essential to elicit to which class of dynamic systems *human* social systems could possibly be seen to belong. But this would be a goal for another essay.

« 13 » In this sense, many of my definitions should be understood as "provisional," because otherwise they appear insufficient and/or inappropriate, as pointed out by many commentators. However, I consider that provisional definitions are in no way a drawback in building useful understandings from my findings on the matter. Indeed, the generality of this *ad hoc* construct shows itself to be useful as a conceptual reference, or heuristics, for distinguishing precisely in *what crucial aspects* human social systems *differ* from other distinguishable natural social systems. Alternatively, it also offers the possibility of distinguishing the *partial mechanistic aspects* that participate in the emergence and manifestation of social systems of human origin based on languaging. In order to remain focused on my primary goal, in the target article I did not address this latter issue as I would have done otherwise if I had been set up to approach "the social" from observing social interactions among humans.

The history of autopoiesis

« 14 » Some commentators regretted the absence of an historical account of the concept of *autopoiesis*. I did not provide one because I feel that excellent presentations and discussions have been recently published by many authors. Instead, what I wanted to highlight – and this has been less discussed and analyzed in the available literature – was the *expounding power* of the model that Varela, Maturana and Uribe proposed in 1974, conceived as a compact and clearly defined abstract construct with its accompanying set of validation rules for its applicability. In my opinion, this basic set of operational distinctions inform us about the *delimited scope* of the concept of autopoiesis, even when consistently extended to a maximum level of generality. My proposed framework is intended to clarify how the VM&U's abstract model moves well beyond the stage of a general notion and becomes an operational scientific tool, apt to properly distinguish, observe and explain complex dynamic systems.

Luhmann's theory

« 15 » A great number of contributors focused on my commentary on Niklas Luhmann's theory and generated a wealth of comments and reflections based on interpretations of what they saw as a proposed personal fundamental "definition" of human social systems. On the contrary, my reference to Luhmann's work was meant to introduce *elements of comparison* that could, through contrast, throw more light on my own reasoning while explaining why dynamic systems interacting via communications and composed of agents provided with intentionality and consciousness capabilities could not be construed as *mechanistic* systems, and hence as autopoietic systems, as required by the VM&U rules. Referring to Luhmann's scheme was somewhat obligatory, precisely because he focuses on communication networks and supposes that they constitute autopoietic systems. The difference consisting in seeing communications as components of – not relations in – those networks needed to be highlighted because it constitutes a formal impediment to consistently applying the VM&U rules to them.

« 16 » In this sense, I mentioned that both approaches are formally incompatible "as is." I also *suggested* that *if* Luhmann's notion of "communication" could be expressed in terms of processes of collective behavioural patterns (abstract and *diachronically* distinguished CBP entities) *enacted by humans*, perhaps a conceptual bridge could be devised in order to distinguish a space (conceived as an observational domain) in which networks of "communications" could be properly *circumscribed* and an assessment of their "autopoiecity" as systemic-wholes could perhaps be obtained by applying the VM&U rules to real-size examples of social systems. But I should add that I conceive this as a purely theoretical possibility that would still need to be justified.

« 17 » **Diane Laflamme**'s view on the collision of both theoretical frameworks, Maturana's and Luhmann's, is nuanced. She relativized with respect to the collision between the two theoretical frameworks, by considering that my comment on Luhmann's theory does not dwell on it enough: "the possibility to establish bridges is […] impaired" because I briefly commented on Luhmann's theory of autopoiesis in communication systems, "but (did) not refer extensively to Luhmann's work." (Laflamme: Upshot). I agree and already explained the reasons above.

Ontological and epistemological aspects

« 18 » The Luhmann-centered commentaries made clear that there is a certain degree of incompatibility between my position and that of some commentators. One basic example is that they address knowledge about the social domain in terms of what social systems *are*, how they *are* and where their features *reside*, as if the notion of system was something externally given to us. I presume that that this can be traced back to Luhmann himself: **Loet Leydesdorff**, for example, cites Luhmann saying that he "assume[s] that *there are* systems" (§1).

« 19 » I argue that we can *distinguish* any system we want, that they are not imposed on us by any "*reality*" and that this is our human manner of building understandings about coherences that occur scattered diachronically along space and time in *our experiences* as observers. We do that all the time, according to what we happen to see or imagine or choose to take into consideration from a particular and situated *vantage* point.

« 20 » Discussing with Randall Whitaker our distinction of unities, he considered, for example, that a distinguished entity's organization is intrinsically interrelated with an observer's distinction of that entity, and hence to some extent contingent on that particular observer's *situated stance* (cognitive domain, circumstances of interaction with the entity, etc.):

> "[…] *organization* is not extrinsically or objectively *given* without regard to the observer's distinction-making actions in a particular situation. It's not *out there* to be found; it is to some extent *projected* onto the environment in the course of distinguishing unities." (private communication, his emphasis).

Since I concur with Whitaker's views I have troubles approaching Luhmann's vision from a common perspective; if I did, I would consequently need to reformulate it.

« 21 » Raivo Palmaru argues that I "*believe* that social systems *are* composed of agents" (§16), to which I respond that I believe *nothing specific* in this regard. On the contrary, what I believe is that *"no-thing" is* (*essere*) in one way or another, but that we can *see things* like this or that, according to a vantage point of arbitrary choice that needs to be intersubjectively validated on the basis of shared and coherent observational experiences.

« 22 » I consider the word "things" as a global name that refers to *objects of knowledge*, not to supposedly given external *objects of reality*. In some respects I endorse here Émile Durkheim's epistemological considerations while adopting his radical stand for sociological inquiry, in the sense that "social facts should be treated as things" (Durkheim 1988: 77). For him, a "thing" is any object of knowledge that is not naturally penetrable by our understanding and that we cannot conceptualize adequately as an idea by the simple process of intellectual analysis.

> "To treat facts of a certain order as *things* is therefore not to place them in this or that category of *reality*; it is to observe towards them a certain *attitude of mind*. It is to embark upon the study of them by adopting the principle that *one is entirely ignorant of what they are*, that their characteristic properties, like the unknown causes upon which they depend, cannot be discovered by even the most careful form of *introspection*." (ibid, my emphasis)

This means leaving open the door to the possibility that collectively shared observational experiences give rise to naturally grasped answers to our *all the time provisional hypothesis* in terms of "yes," "no," or "perhaps."

« 23 » In spite of my explicitly declared epistemological stand (see Urrestarazu 2011a: 310–312), Pascal Berger stands radically against what he sees as a "materialistic reduction" in my approach. I certainly reject any such materialistic reductionism on my side. It all depends on what he understands by "materialism" and by "reductionism" of course, but it would be erroneous to think that what in my words may appear as synonymous to "materiality" refers to *objects of reality*, pre-existing and externally given to observers as such. He would be dismally mistaken on my stand if he thought it was meant in this sense.

« 24 » Besides, in this context I consider it misleading to use the term "materialistic," in the sense of being opposed to "psychic," (this term is used profusely in Berger's commentary). This is because historically, "materialism" has been opposed rather to "idealism." A possibly better alternative might be the term "physically based." I argue that understanding autopoiesis entails a physically based attitude (and this has nothing to do with an *ontological physicalism* stating that there is nothing over and above the physical), because *autopoiesis* is a theory about physical objects *distinguished as coherences* perceived and enacted through biological experiences of observers and described by means of *abstractions in language* under the form of falsifiable hypothesis subject to intersubjective provisional verifications.

« 25 » This is also necessary for systems distinguished as composed by "process-like" entities. This is because to observe and describe them we need to *interact* with those processes in physical space on the basis of distinction criteria supported by our human sensory-motor perception (i.e., biological) capabilities. Recognizing and studying the physical bases and causation structures underlying the manifestation of higher order phenomena is not reductionism either; it is the only way we have at hand to grasp them as outcomes of our doings and sensorial experiences in whatever observational domain in which we are engaged.

« 26 » Athanasios Karafillidis's position seems clearly opposed to Maturana's ontology of observing when he states that "social systems observe themselves to make self-reproduction possible" (§10). By this, he conceives "social systems" not only as externally given for us, but also as intrinsically cognitive entities, where human observers would be "internalized into the system" and where "the system is an observer observing itself in order to determine its next operation" (ibid). Karafillidis regrets that "this has always been neglected by Humberto Maturana, and Urrestarazu is no exception" (ibid). For me, however, this is no neglect but a biologically founded refusal to depart from Maturana's claim that *an observer is a human being* who can make distinctions. The observer can specify that what she distinguishes as *entities different from herself* can be used for manipulations or descriptions in interactions with other observers. Also, "…everything said is said by an observer to another observer who can be himself or herself" (Maturana 1978: 32). In my opinion, it is difficult to see how we could bring together these opposed ontological conceptions of what the word *observer* connotes, unless Karafillidis was able to indicate that he is referring to something different while using the same name.

Methodological issues

« 27 » The abovementioned considerations are interrelated with the choice of methodologies for inquiry. The methodologies in the balance also need to be examined in depth according to the principle that…

> "a scientific discipline must always refer to its metalevel inquiring system, which is where the struggle among competing paradigms takes place; […] a discipline stagnates when it ignores its own epistemology and denies that it even exists." (van Gigch 1993: 257)

I do not mean to insinuate by this that Luhmann or his followers fall into this category, but to highlight the fact that if we cannot *explicitly* agree on a common onto-epistemological stand, inevitable disagreements will also occur when discussing practical ways of acquiring knowledge concerning human social systems in particular.

« 28 » One example of this is most evident in the case of Loet Leydesdorff's commentary when he argues that my

> "*perspective on Luhmann's theory of social autopoiesis* […] has remained meta-biological because Urrestarazu *foregrounds the agency of observers* who are engaged in *observable* 'languaging' instead of focusing on the *use of language* to improve interhuman communications about *expectations*." (§2, my emphasis)[2]

As I understand and translate Leydesdorff's language, he proposes the alternative of focusing on how observers use *their lan-*

2| In my target article I did not state any particular "perspective on Luhmann's theory," except to highlight the fact that it is formally incompatible with my conceptual approach.

guaging to approach an elucidation of the "expectations"[3] that humans experience and mobilize while establishing social relations.

« 29 » So, observers should not *observe the regularities* occurring in inter-individual languaging communications and subsequent actions (behaviours), and deduce from there how a network of communications operates to constitute a systemic-whole. According to **Leydesdorff**, they should instead "observe" how observers themselves communicate through languaging to bring forth, not only the constitution of a unity, but also the *nature of the expectations* as sources of communicative interactions that bring about a systemic-whole..

« 30 » This would be an invitation to delve into the *psychic domain of observers* in order to elucidate how the whole social communication structure emerges and operates as an outcome of similar psychic attitudes *attributed* to all individuals participating in a social system. This is tantamount to elucidating what I referred to as the possible *behavioural states* attributable to agents, a task that I decided to circumvent for the sake of properly applying the VM&U rules to a compatible, although incomplete construct of social systems.

« 31 » The question to pose is: how do observers "observe" the dynamics of "expectations" (or determine the *set of behavioural state variables* that could be attributable to agents) in the first place?

« 32 » In my opinion, this is not attainable other than by individual *introspection* followed by the *arbitrary attribution* of any personal findings to all individuals. This is something that could give rise to speculation among observers and/or to unverifiable conjectures. Introspection might be useful, but *if and only if* this inquiry method leads us to distinguish the *human observable doings* as correlated to hypothesized psychic states or processes. This would mean first distinguishing accurately the *observational domain* in which such slippery psychic phenomena could be intersubjectively grasped and our findings validated.

3| I interpret this to mean that "expectations" that give rise to communications and are shaped by these – through satisfaction or frustration – give rise to new expectations, and recursively so on and so forth.

Building cross-theoretical bridges?

« 33 » From the commentaries of many proponents of Luhmann's theory, I gather they seek to engage in a discussion where Luhmann's approach to "social autopoiesis" would be fully deployed in an interdisciplinary effort to place it at the same scientific level acquired by the biological autopoiesis paradigm.

« 34 » **Leydesdorff** states that my approach, seen as a "*formalization*[4] of this theory and the proposal of a "general theory of autopoiesis," *can also be used as a heuristic* in order to specify how the "social autopoiesis" in the communication of meaning might *differ* from the autopoiesis of life." He further states that "failure to comply with the VM&U rules opens research questions about systems that can interpenetrate each other's space reflexively" (§15).

« 35 » I see it as contradictory that my approach could plausibly become a heuristics for *specifying a "social autopoiesis"* construct for which boundedness, operational and organizational closure and even the mechanistic aspects of systems pertaining to this *different class of "autopoietic" entities* are denied as valid criteria for assessing their "autopoiecity."

« 36 » I think that these arguments reveal that Luhmann's notion of autopoiesis (as in **Leydesdorff**'s account) cannot be aligned with the abstractions condensed in VM&U's model and validation rules. In my view, Luhmann connotes more an ascription of self-emergence, self-organization, and self-maintenance to communication-based systems.

« 37 » For these reasons, I go along with the opinion that Luhmann's distinction of this *different* kind of system is sufficiently distinct to deserve the effort of coining a *new name rather than "autopoiesis"* to refer to its precise connotations. In my opinion, all refinements and adaptations introduced to nuance the notion of autopoiesis *should be named according to their specificity* instead of spreading as false synonyms that end up obscuring its original crisp and valuable signification. It has been argued repeatedly that if the concept is not fit as defined – including the six rules – to provide a complete account of some observed systemic phenomena, then the rules should be changed (in particular the component production rules). Following Varela, I advocate distinguishing and naming a *hierarchy of classes of autonomous systems*, where autopoietic systems are a particular case.

4| I clarify that I see my approach as a tentative explication, not a formalization of VM&U's already formalized model.

« 38 » Notwithstanding, **Laflamme** judges that both theories *seem* opposed and that this clash may perhaps "be better described as a clash between our present understandings about these theories" (§7). I consider this a flexible attitude, as she also thinks that from my approach, "there is no doubt that [Urrestarazu] could bring interesting insights into the study of systems made of distinctions" (§3). While this pushes me in a direction that I did not envisage initially, I now consider that, *in fine,* I should perhaps embark upon it in the future even though this would mean addressing the ontological and epistemological aspects that I mentioned above.

Misunderstandings

« 39 » **Alexander Kravchenko** stands against a supposed position of mine erroneously referred to in various paragraphs (i.e., "Urrestarazu's premise is that social systems are non-biological systems," Upshot, my emphasis). I want to clarify that I do not support such a stance. My only reference to the term "non-biological" can be found in my abstract where I state:

> "Identifying possible non-biological autopoietic systems is harder than merely assessing self-organization, existence of embodied boundaries and some observable autonomous behavioural capabilities."

Given that my approach does not rely on a specific choice concerning the nature of components and interaction mechanisms, it is conceivable in principle to include "non-biological" dynamic systems – if they were to exist – in an extended domain of applicability of the VM&U rules to assess any suspected "autopoiecity" on systems of any kind.

« 40 » What matters is to know whether an observed dynamics itself is sustained by biological interactions. Particularly, in the case of human or animal social systems,

their biological groundedness is not to be put into question. It would be misleading to suppose that their mechanistic features stem only from non-biological affordances.

« 41 » I agree with Kravchenko when he writes that

> "social systems are not *only* biological; as unities of interactions with the medium operating in the relational domain of social […] interactions, they establish a certain ecological niche […]" (§6, his emphasis)

However, I disagree when he adds "which *may not be characterized* in terms of physical space" (my emphasis). Why not? Not only social systems, but also human individuals, taken as unities of interaction with their medium, are observed as subject to perturbations or constraints of non-biological origin. Observers need to construe the notion of *ecological niche* as a physical (spatial-temporal) space in order to explain how the structural coupling between a distinguished unity and its medium does occur, for the very simple reason that they need to interact biologically (i.e., physically) with the unities and other phenomena distinguished in a particular observational domain. Otherwise they could not describe anything valuable that could be intersubjectively shared with other observers.

« 42 » Stephen Cowley and Vincenzo Raimondi argue that:

> "If Urrestarazu is correct that organizations attain degrees of autonomy, there is no reason to 'explain' the social by appealing to either autonomous agents that exploit social contingency or by emphasizing human kinds of heteronomy" (§8)

In my target article, the issue about autonomy appeared as a logical consequence of my effort to explain how, in spite of the impossibility of considering organizations as autopoietic unities, they could be construed as endowed with organizational closure (in Varela's terms) in *certain dimensions* of their operation. This attained result of my analysis is just that, a result. There is no reason to infer from there *intent to "explain"* the social. In the light of their interesting vision of a larger "Big Picture" for explaining the social, Cowley & Raimondi consider my mentioning of autonomy as a case of overemphasis on a feature that appears to be of lesser relevance in their matrix. To emphasize means highlighting a particular object of attention *among* others. But *I did not develop* specifically other aspects concerning human social systems in general or languaging in particular. Could I have indeed "overemphasized" autonomy? Besides, I said that organizational closure of specific social systems *needs to be assessed*, implying by this that we could fail to construe them as autonomous entities and thereby assuming implicitly that autonomy is not necessarily an *a priori* universal feature shown by all social systems.

« 43 » Athanasios Karafillidis may have misunderstood the full implications of my suggestion to distinguish Collective Behavioral Patterns (CBP) as interacting dynamic objects that could be seen as constituting an autopoietic system in a CBP abstract space. I considered that in *some* dynamic systems, recursive interactions between CBP processes may be distinguished and observed as occurring independently from the *production of agents* in physical space. However, Karafillidis mistakenly concludes that I considered these construed entities as components of *only* more general autonomous systems: "Urrestarazu confines [the] significance [of CBP entities] to autonomous systems" (§5, my emphasis).

« 44 » To clarify my position, let me reformulate what I said in §77:

1 | If we consider CBP entities as *components* of a network of interacting similar processes (e.g., a higher order emergent system), *and*
2 | if within a specific social domain we observe CBPs as processes participating in recursive processes of *production of other CBP processes* showing organizational closure, in formal compliance with VM&U Rules 5 and 6, *and*
3 | if observers can show that within this network all other VM&U Rules are complied with,
4 | then we could possibly conclude that such a CBP-based "social" system was *autopoietic* in a properly *distinguished CBP space* (e.g., a multi-dimensional relational space) without requiring that *the production of agents* complies with the said rules in three-dimensional physical space.

« 45 » Moreover, if observers are consistently capable of dealing with this CBP space as an *observational domain* where CBP processes are observed and described as outcomes of the observed behaviour of physical agents, this theoretical consideration would not be contradictory to the basic assumption that the notion of autopoiesis is a physically based abstract construct. So, in principle, I do not *confine* CBP networks to being seen exclusively as classes of non-autopoietic autonomous systems.

Other Luhmannian reactions

« 46 » Raf Vanderstraeten, while clearly expounding Luhmann's views and indicating conceptual interplays with Maturana and Varela's, makes an interesting point concerning the advantages of Luhmann's approach in considering human systems as composed of communications. In his final lines, he argues that "the rise of information and communication as a theoretical option also reflects the fact that communication networks have become more important in society" (§11). Clearly, Vanderstraeten aims at emphasizing the aptitude of the "conceptual innovations" in Luhmann's theory to address this concern.

« 47 » What in my view should always remain as "more important" is the place that humans occupy in our attempts to understand social phenomena. It is hard to see why from this vantage point we could not properly address the historical evolution and expansion of communication media among humans, going from the emergence of prehistorical proto-languages to the invention of sign and symbol systems, book printing and up to the present time, digital networking. What is of utmost importance is to elicit how the expansion of communication networks affects us and changes our traditional ways of being in society; what are its drawbacks and opportunities for our daily living and for our responsible involvement in the social construction of the world in which we want to live.

« 48 » How could we do that if we, humans and our doings (i.e., actions), fade formally away from our theories? If we theorize about the social, it is not for the sake of obtaining intellectual aesthetical satisfactions, but to understand ourselves ethically as a particular species endowed with capabilities

to shape the entire eco-system in which we live, both consciously and unconsciously, through our praxis.

Social autopoiesis as a "theoretical straitjacket"

« 49 » Karafillidis, while acknowledging that the existence of social autopoiesis is still an "unresolved and controversial issue" (§1), considers that applying the concept to social systems "revolves around the *determination* of components that realize social autopoiesis" (§2, my emphasis). In §49, §76, and §77 I discussed that this is theoretically possible, although not by "determination" but by an abstract *ascription* of the status of components to CBP process-like entities, as a possible example. Ascriptions are not "determined" from the outside of an observer's situated vantage point; they correspond to consistent entailments derived from an *arbitrary choice* concerning the observation and description of selected coherencies among some *observer related* phenomenal experiences. Observers decide to bring forth in language what they aim to distinguish from an explicit or implicit vantage point. Nothing forces us to "see" social systems as autopoietic unities: it is for observers to decide whether they wish or not to consider them as such, and then intersubjectively decide whether this was a consistent, reasonable and/or fruitful choice.

« 50 » So, is it necessary to deploy the autopoiesis concept in sociological research at all? Karafillidis admits that "Luhmann was well aware that [this] deployment […] could not work with humans as components" (§3). This is the reason why he opted to exclude human agents from his formalizing effort and concentrated on communications instead. Apart from observing that communication networks appear to us as self-emergent, self-organized and possibly organizationally closed unities, in my view there are no other reasons to consider them necessarily as autopoietic in VM&U's sense. Given our cognitive ability to "see" systems everywhere, would it not be a better alternative to ask ourselves what kind of abstract construct would provide better consensual coherent explanations for our intuitions about social phenomena? Understanding social systems concerns us as humans, and I prefer to choose a vantage point from which our human doings and perceptions appear as clearly related to the social phenomena by which we experience our different manners of living and participate in different specific social organizations.

« 51 » I am convinced that this vantage point may lead to inventing abstractions by which some Luhmannian concepts such as the "interpenetration" of different non-intersecting observational domains could be rigorously treated as valid operations of distinction without imposing on those abstract developments the straitjacket of autopoiecity. Karafillidis talks about a

> "currently emerging theory of social forms [that] treats systems as *one form of distinction* and assumes that world society is the only autopoietic social system." (§13, my emphasis)

While highlighting that it is indeed a matter of making appropriate distinctions, I do not see the need to construe the mentioned "forms" by including the premise of an autopoietic societal "background." Since for Karafillidis "these forms can be autonomous and operationally closed but need not be autopoietic" (ibid), his mentioning of autopoiesis could be considered superfluous and irrelevant.

« 52 » Although acknowledging my formal reasoning, John Stewart rejects my conclusion on the non-autopoiecity of social systems on the grounds that

> "human societies are not *heteropoietic* in [the] sense [of not being] built or fashioned by anything outside them […]; they are constituted by nothing other than the processes of their own historical development […]" (§1, my emphasis).

On my side, I argue that *autopoiesis is more than the opposite of heteropoiesis*, because it not only refers to the origin of a system (being built or not from outside), but *also to the ways by which they are seen to maintain their class identity* (being fashioned). Human social systems are indeed fashioned by humans: I see human societies of particular kinds (tribes, ethnic groups, civilizations, economic and political systems, etc.) emerging and disappearing as the result of expressions of human intervention, be they conscious or not. I think that historical developments cannot be conceived as the result of mere mechanistic effects of a *blind* social dynamics, but of the *intentions and doings* of humans, because humans are endowed with sufficient *autonomic* capabilities as to bring about and terminate particular social orders. These interventions are *allonomous* with regard to the system that encompasses human individuals at a given moment of history. We know from the history of foundations and upheavals, that an existing social order (or system) resists such creative or destructive interventions as if it was against something alien to itself. This being said in a metaphorical sense, because we also know that those who "resist" are also humans, with different intentions and attitudes.

« 53 » Therefore, I maintain that historical human social systems cannot be seen as autopoietic mechanistic machines but as something different that still awaits to be construed and named in terms of concepts and a terminology close enough to the sciences of dynamic systems.

Pragmatic implications of my approach

« 54 » Hugo Alrøe and Egon Noe think that neither my generalized VM&U-model-based approach to autopoiesis nor Luhmann's theory are sufficient to address completely a pragmatic concern of theirs. They agree on the need to explore a concept of social autopoiesis that is applicable beyond "human social systems"…

> "because we are interested in understanding 'heterogeneous' self-organizing systems, such as a farm enterprise that consists of a complex network of social, technical and biological relations." (§2)

Alrøe & Noe plead for developing an understanding of system closure that goes beyond communicative closure and self-reference in Luhmann's sense.

« 55 » I think that to construe a model of dynamic system reflecting the dynamics of "heterogeneous" self-organizing systems, such as a farm enterprise, is a problematic, complex, but solvable endeavour. From the start it is difficult to asses whether such a system is really "self-organizing" in terms of the sole interplay of interactions between heterogeneous components (social, technical and biological relations).

« 56 » This poses the question: what would happen in a farm as soon as participating humans ceased to take decisions upon contingent occurrence of perturbation events affecting "routine" activities? To seek an understanding of any possible "closure" that goes beyond communicative closure is in fact possible if farming processes could be distinguished that recursively reproduce the same farming processes that maintain the overall dynamics of farm activities in a stabilized manner without the need for human purposeful intervention.

« 57 » If that was the case, you would be facing a situation of systemic autonomy with regard to a certain set of potentially disrupting perturbations. Farm automation of certain dependencies between processes could improve the "degree of autonomy" of the farm system, despite its complexity; this degree could be measured by implementing adequate metrics within a suitable enterprise architecture framework approach.

« 58 » Pragmatically oriented technologies are available to this end, but most are based on static models that represent loosely defined inter-dependency relationships between system components (or "building blocks," in the jargon of architects). I propose to use dynamic instead of static models. They could be deployed operationally by using suitable dynamic modelling tools already available in the engineering of dynamic systems, by generalizing their scope of applicability. So, there is a chance that farmers could take longer leaves of absence during holidays and that scholars could seek funding opportunities for their applied research initiatives.

Ethical considerations

« 59 » I very much appreciate John Stewart's commentary because he points– with delicacy and wit – right to my core motivation in exposing my views on the social autopoiesis hypothesis. Namely, a motivation aimed at *developing awareness* of the potential dangers we incur with the temptation of inflicting thoughtless manipulations on our human organizations in order to empower them as highly autonomous systems.

« 60 » Basically, I believe that we are already far beyond the stage of potential dangers and temptations. One simple example: automated systems for decision-making are already in operation, as it is the case of financial brokering systems. Based on humanly conceived reckless rules, they perform automatic transactions that have already affected catastrophically the stability of wide sectors of Western countries' economies.

« 61 » Stewart stresses the point that the limitation of human agent's autonomy by the doings of states (law enforcement), civilized adaptation to social norms and other…

> "constraints are not just negative limitations; at the same time they open up possibilities for enacting whole areas of social life that would just not exist without them." (§3)

« 62 » In §46 of my target article I made an equivalent statement in the sense that an autonomous component could be so *finely tuned* to its subsuming unity that self-inhibiting its potential active autonomy would be the most effective/efficient condition for participating in the processes involved in maintaining the whole system's organization.

« 63 » But I also maintain that in the interplay between the degrees of natural *autonomy* and degrees of socially induced *heteronomy* attributable to human agents, a *suitable balance should be always sought* for ethical reasons (§99). What is the measure of this suitable balance? This is a political question that may find different answers depending on the position occupied by individuals, groups, classes or collectively organized humans in the ladder of power to act freely and seek successful satisfaction of all their needs.

« 64 » I am grateful to Humberto Maturana for addressing the following challenging implied question to me:

> "I do not fully understand, unless this is a philosophical habit, why he proposes a definition of social systems instead of asking himself what configuration of sensory-operational-relational coherences we connote when in daily life we speak of social relations… and social systems." (Maturana: §5)

I would like to clarify that I proposed "definitions" rather as a "habit of language" acquired in my education as a mathematically minded physicist. But, going to the core of his question, I want to acknowledge the utmost relevance of considering that any understanding of "the social" cannot be construed otherwise than by asking ourselves about what we experience in our daily life when we feel that we are part of a wider dimension of humanity, by being "connected" (or "disconnected") to it through our social relations.

« 65 » For me, this is not only a philosophical attitude, but a fundamental emotional need to make sense of my experienced manners of living, since I have personally lived both the highest possible levels of social connectedness and also the sudden and brutal irruption of its opposite. From the experiences of participating in a wide collective attempt to build a new social order in Chile – both Maturana's and my native country – and of becoming disconnected through political imprisonment and forced exile, I learned that in both cases my free will was involved, but only partially, along with the heteronomous determinations that resulted in me being connected or disconnected from what I felt was my "natural" historical-cultural social environment.

« 66 » This awareness also drives me to build an understanding of how the systemic outcomes of the intentions and doings of other humans affect us in our daily life so as to render us happy or miserable, free or constrained, aware or alienated, and understanding what is part of our responsibility in fostering or impeding these effects on us and on others. To do this we need to distinguish clearly what is entailed mechanistically by the operation of the social system in which we happen to live, from the implications stemming from human intentions and doings that engage our responsibility as individuals and/or groups.

« 67 » This understanding of the role of intentions and of the power to materialize them purposefully should not prevent us from fully understanding the mechanistic nature of some systemic phenomena – initiated by humans but running now autonomously. So, a theoretical construct proposing useful abstractions to understand and describe human social systems as networks of communications should be able to address both the purely mechanistic and the human sense-making and emotioning-related causes and outcomes of their dynamics.

« 68 » Humans fashion social systems in certain ways that also fashion our manners of living, but in the measure of our knowledge and of the increasing power of human technologies, *we also know that we know* that our species can consciously shape its becoming – for the better or for the worse. This highlights our responsibility in doing whatever we do, and particularly in producing theories to understand ourselves as a self-conscious species co-evolving with and within a global eco-system with limited resources. *We know* that our species is at a crossroads where foreseeable bifurcations show up, either towards mastering or being subdued by the expansion of our ecological footprint on Earth.

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Combined References

Abbott A. (2001) Time matters. On theory and method. University of Chicago Press, Chicago.

Alrøe H. F. & Noe E. (2012) Observing environments. Constructivist Foundations 8(1): 39–62. Available at http://www.univie.ac.at/constructivism/journal/8/1/039.alroe

Ashby W. R. (1981) Principles of the self-organizing System. In: Mechanisms of intelligence. Ross Ashby's writings on cybernetics. Edited by R. Conant. Intersystems, Seaside CA: 51–74. Originally published 1961.

Bateson G. (1972) Steps to an ecology of mind. Ballantine, New York.

Bateson G. (2000) Steps to an ecology of mind. With a new foreword by Mary Catherine Bateson. University of Chicago Press, Chicago.

Bruner J. (1996) The culture of education. Harvard University Press, Cambridge MA.

Campbell D. T. (1969) Variation and selective retention in socio-cultural evolution. General Systems XIV: 69–85.

Cowley S. J. (ed.) (2011a) Distributed language. John Benjamins, Philadelphia.

Cowley S. J. (2011b) Taking a language stance. Ecological Psychology 23(3): 185–209.

De Jaegher H. & Di Paolo E. (2007) Participatory sense-making: An enactive approach to social cognition. Phenomenology and the Cognitive Sciences 6: 485–507.

Deacon T. W. (1992) Brain-language coevolution. In: Hawkins J. A. & Gell-Mann M. (eds.) The evolution of human languages. Addison-Wesely, Redwoord City CA: 49–83.

Deacon T. W. (1997) The symbolic species: The co-evolution of language and the brain. W. W. Norton, New York.

Deacon T. W. (2009) Relaxed selection and the role of epigenesis in the evolution of language. In: Blumberg M. S., Freeman J. H. & Robinson S. R. (eds.) Oxford handbook of developmental behavioral neuroscience. Oxford University Press, New York: 730–752.

Durkheim E. (1988) Les règles de la méthode sociologique. Second edition. Edition Flammarion. Originally published in 1901. English translation: Durkheim E. (1982) The rules of sociological method, The Free Press, New York.

Foerster H. von (1960) On self-organizing systems and their environments. In: Yovits M. C. & Cameron S. (eds.) Self-organizing systems. Pergamon Press, London: 31–50. Reprinted in: Foerster H. von (2003) Understanding understanding: Essays on cybernetics and cognition. Springer, New York: 1–19.

Foerster H. von (2002) Der Anfang von Himmel und Erde hat keinen Namen. Kulturverlag Kadmos, Berlin.

Foerster H. von (2003) Understanding understanding. Essays on cybernetics and cognition. Springer, New York.

Fuchs P. (1997) Adressabilität als Grundbegriff der soziologischen Systemtheorie. Soziale Systeme 1: 57–79.

Glasersfeld E. von (1995) Radical constructivism: A way of knowing and learning. Falmer Press, London.

Goffman E. (1967) Interaction ritual. Essays on face-to-face behavior. Anchor Books, New York.

Habermas J. (1987) Excursus on Luhmann's appropriation of the philosophy of the subject through systems theory. In: The philosophical discourse of modernity: Twelve lectures. MIT Press, Cambridge MA: 368–385.

Hall W. P. (2005) Biological nature of knowledge in the learning organization. The Learning Organization 12(2): 169–188.

Hopkins J. & Fishwick P. A. (2001) Synthetic human agents for modeling and simulation. In: Proceedings of the IEEE 89(2): 131–147.

Husserl E. (1962) Die Krisis der Europäischen Wissenschaften und die Transzendentale Phänomenologie. Martinus Nijhoff, Den Haag. Originally published in 1935–1936.

Husserl E. (1973) Cartesianische Meditationen und Pariser Vorträge [Cartesian meditations and the Paris lectures]. Martinus Nijhoff, The Hague. Originally published in 1929. Available at http://ia600601.us.archive.org/10/items/CartesiamMeditations/

Husserl E. (1989) Ideas pertaining to a pure phenomenology and to a phenomenological philosophy. Second book: Studies in the phenomenology of constitution. Translated by R. Rojcewicz & A. Schuwer. Kluwer, Dordrecht.

Järvilehto T. (1998) The theory of the organism-environment system: I. Description of the theory. Integrative Physiological and Behavioral Science 33: 317–330.

Jennings R. E. & Thompson J. J. (2012) The biological centrality of talk. In: Kravchenko A. V. (ed.) Cognitive dynamics in linguistic interactions. Cambridge Scholars Publishing, Newcastle upon Tyne: 33–63.

Karafillidis A. (2010) Soziale Formen. Fortführung eines soziologischen Programms. Transcript, Bielefeld.

Karafillidis A. (2013) Socializing a calculus. The emergence of a theory of social forms and a sociological notation. Cybernetics & Human Knowing 20(3–4): 108–141.

Kravchenko A. V. (2007) Whence the autonomy? A reply to Harnad and Dror. Pragmatics & Cognition 15(3): 587–597.

Laflamme D. (2013) Moralized communication and social regulation. In: Febbrajo A. & Harste G. (eds.) Law and intersystemic communication. Ashgate, Farnham: 197–225.

Lettvin J. Y., Maturana H. R., McCulloch W. S. & Pitts W. H. (1959) What the frog's eye tells the frog's brain. Proceedings of the Institute of Radio Engineers (IRE) 47(11): 1940–1951.

Leydesdorff L. (2008) The communication of meaning in anticipatory systems: A simulation study of the dynamics of intentionality in social interactions. In: Dubois D. M. (ed.) Proceedings of the Eight International Conference on Computing Anticipatory Systems CASYS'07. Conference Proceedings Volume 1051. American Institute of Physics, Melville NY: pp. 33–49.

Leydesdorff L. (2010) The communication of meaning and the structuration of expectations: Giddens' "structuration theory" and

Luhmann's "self-organization." Journal of the American Society for Information Science and Technology 61(10): 2138–2150.

Leydesdorff L. (2012) Radical constructivism and radical constructedness: Luhmann's sociology of semantics, organizations, and self-organization. Constructivist Foundations 8(1): 85–92. Available at http://www.univie.ac.at/constructivism/journal/8/1/085.leydesdorff

Leydesdorff L. & Ahrweiler P. (in press) In search of a network theory of innovations: Relations, positions, and perspectives. Journal of the Association for Information Science and Technology.

Leydesdorff L. & Franse S. (2009) The communication of meaning in social systems. Systems Research and Behavioral Science 26(1): 109–117.

Leydesdorff L. & Ivanova I. A. (2014) Mutual redundancies in inter-human communication systems: Steps towards a calculus of processing meaning. Journal of the Association for Information Science and Technology 65(2): 386–399.

Limone A. & Bastías L. E. (2006) Autopoiesis and knowledge in the organization: Conceptual foundation for authentic knowledge management. Systems Research and Behavioral Science 23(1): 39–49.

Luhmann N. (1986) The autopoiesis of social systems. In: Geyer F. & van der Zouwen J. (eds.) Sociocybernetic Paradoxes. Observation, control and evolution of self-steering systems. Sage, London: 172–192.

Luhmann N. (1990a) Essays on self-reference. Columbia University Press, New York.

Luhmann N. (1990b) Meaning as sociology's basic concept. In: Essays on self-reference. Columbia University Press, New York: 21–79.

Luhmann N. (1994) Läßt unsere Gesellschaft Kommunikation mit Gott zu? In: Luhmann N. (eds.) Soziologische Aufklärung, Band 4: Beiträge zur funktionalen Differenzierung der Gesellschaft. Westdeutscher Verlag, Opladen: 227–253.

Luhmann N. (1995a) Intersubjektivität oder Kommunkation: Unterschiedliche Ausgangspunkte soziologischer Theoriebildung. Soziologische Aufklärung 6. Westdeutscher Verlag, Opladen: 169–188.

Luhmann N. (1995b) Social systems. Stanford University Press, Stanford CA. German original published in 1984 as: Soziale Systeme. Grundriß einer allgemeinen Theorie. Suhrkamp, Frankfurt.

Luhmann N. (1995c) Die Form "Person." Soziologische Aufklärung 6. Westdeutscher Verlag, Opladen: 142–154.

Luhmann N. (1997) Die Gesellschaft der Gesellschaft [The society of society]. Suhrkamp, Frankfurt am Main.

Luhmann N. (2002) How can the mind participate in communication? Chapter 8 in: Luhmann N., Theories of distinction: Redescribing the descriptions of modernity. Edited and Introduced by William Rasch. Stanford University Press, Stanford CA: 169–184.

Luhmann N. (2005a) The autopoiesis of social systems. In Seidl D. and Becker K. H. (eds.) Niklas Luhmann and Organization studies. Liber & Copenhagen Business School Press, Malmö: 64-82. Originally published in 1986.

Luhmann N. (2005b) The concept of autopoiesis. In: Seidl D. & Helge Becker K. H. (eds.) Niklas Luhmann and organization studies. Copenhagen Business School Press, Copenhagen: 54–63.

Luhmann N. (2012) Theory of society, Volume 1. Stanford University Press, Stanford. German original published in 1997.

Luhmann N. (2013a) Introduction to systems theory. Edited by Dirk Baecker. Translated by Peter Gilgen. Polity Press, Cambridge.

Luhmann N. (2013b) Theory of society. Volume 2. Stanford University Press, Stanford CA.

Lyon P. (2004) Autopoiesis and knowing: Reflections on Maturana's biogeneic explanation of cognition. Cybernetics and Human Knowing 11(4): 21–46.

Martin J. L. (2011) The explanation of social action. Oxford University Press, Oxford.

Maturana H. R. (1970) Biology of cognition. Biological Computer Laboratory Research Report BCL 9.0. University of Illinois, Urbana. Reprinted in: Maturana H. R. & Varela F. J. (1980) Autopoiesis and cognition: The realization of the living. Reidel, Dordrecht: 1–58. Available at http://www.enolagaia.com/M70–80BoC.html

Maturana H. R. (1978) Biology of language: The epistemology of reality. In: Miller G. E. & Lenneberg E. (eds.) Psychology and biology of language and thought: Essays in honor of Eric Lenneberg. Academic Press, New York NY: 27–63.

Maturana H. R. (1980) Biology of cognition. In: Maturana H. R. & Varela F. J., Autopoiesis and cognition: The realization of the living. Reidel, Boston: 5–58. Originally published in 1970 by the Biological Computer Laboratory (BCL) Research Report BCL 9.0. University of Illinois, Urbana. Available at http://www.enolagaia.com/M70–80BoC. html

Maturana H. R. (1981) Autopoiesis. In: Milan Zeleny (ed.) Autopoiesis: A theory of living organization. Elsevier North Holland, New York: 21–33.

Maturana H. R. (2000) The nature of the laws of nature. Systems Research and Behavioral Science 17: 459–468.

Maturana H. R. (2002) Autopoiesis, structural coupling and cognition: A history of these and other notions in the biology of cognition. Cybernetics & Human Knowing 9(3–4): 5–34.

Maturana H. R. & Varela F. J. (1980) Autopoiesis and cognition: The realization of the living. Reidel, Dordrecht.

Maturana H. R. & Varela F. J. (1987) The tree of knowledge: The biological roots of human understanding. Shambhala, Boston MA.

Maturana H. R. & Varela F. J. (1998) The tree of knowledge: The biological roots of human understanding. Revised edition. Shambala, Boston MA.

Maturana H. R. & Verden-Zöller G. (2008) The origins of humanness in the biology of love. Imprint academic, Exeter UK.

Mingers J. (1994) Self-producing systems: Implications and applications of autopoiesis. Plenum, New York.

Mitterer J. (1992) Das Jenseits der Philosophie. Wider das dualistische Erkenntnisprinzip [The beyond of philosophy: Against the dualistic principle of cognition]. Passagen, Vienna. Republished, with a new afterword, in 2011 by Velbrück Wissenschaft, Weilerswist.

Neumann M. & Cowley S. J. (2013) Human agency and the resources of reason. In: Cowley S. J. & Vallée-Tourangeau F. (eds.) Cognition Beyond the Brain: Computation, Interactivity and Human Artifice. Springer, Dordrecht: 13–30.

Noe E. & Alrøe H. F. (2006) Combining Luhmann and Actor-Network Theory to see farm enterprises as self-organizing systems. Cybernetics and Human Knowing 13(1): 34–48.

Noe E. & Alrøe H. F. (2012) Observing farming systems: Insights from social systems

theory. In: Darnhofer I., Gibbon D. & Dedieu B. (eds.) Farming systems research into the 21st century: The new dynamic. Springer, Dordrecht: 387–403.

Nöth W. (1990) Handbook of semiotics. Indiana University Press, Bloomington.

Palmaru R. (2012) Making sense and meaning. On the role of communication and culture in the reproduction of social systems. Constructivist Foundations 8(1): 63–75. Available at http://www.univie.ac.at/constructivism/journal/8/1/063.palmaru

Parsons T. (1937) The structure of social action. Free Press, New York.

Parsons T. (1968) Interaction. In: Sills D. L. & Merton R. K. (eds.) International encyclopedia of the social sciences. Volume 1. Macmillan, London: 429–441.

Parsons T. & Shils E. A. (1951) Toward a general theory of action. Harper and Row, New York.

Raimondi V. (2013) À la recherche de la matrice du langage: Des approches mentalistes de l'interaction sociale au languaging. Unpublished Ph.D dissertation. École des Hautes Études en Sciences Sociales, Paris.

Ross D. (2007) H. sapiens as ecologically special: What does language contribute? Language Sciences 29(5): 710–731.

Ruesch J. & Bateson G. (1987) Communication: The social matrix of psychiatry. W. W. Norton, New York. Originally published 1951.

Schmidt S. J. & Zurstiege G. (2007) Kommunikationswissenschaft. Systematik und Ziele [Communication science. Systematics and objectives]. Rowohlt, Reinbek bei Hamburg.

Schutz A. (1951) Making music together. Social Research 18(1): 76–97.

Shannon C. E. & Weaver W. (1949) The mathematical theory of communication. University of Illinois Press, Urbana.

Shapiro L. (2011) Embodied cognition. Routledge, New York.

Spencer Brown G. (1969) Laws of form. George Allen and Unwin, London.

Spencer Brown G. (1994) Laws of form. Limited Edition. Cognizer, Portland.

Stano P., Rampionia G., Carraraa P., Damianob L., Leonia L. & Luisi P. L. (2012), Semi-synthetic minimal cells as a tool for biochemical ICT. Biosystems 109(1): 24–34.

Steffensen S. V. (2011) Beyond mind: An extended ecology of languaging. In: Cowley S. J. (ed.) Distributed language. John Benjamins, Amsterdam/Philadelphia: 185–210.

Steiner P. & Stewart J. (2009) From autonomy to heteronomy (and back): The enaction of social life. Phenomenology and the Cognitive sciences 8(4): 527–550.

Thibault P. J. (2011) First-order languaging dynamics and second-order language: The distributed language view. Ecological Psychology 23(3):1–36.

Urrestarazu H. (2011a) Autopoietic systems: A generalized explanatory approach – Part 1. Constructivist Foundations 6(3): 307–324. Available at http://www.univie.ac.at/constructivism/journal/6/3/307.urrestarazu

Urrestarazu H. (2011b) Autopoietic systems: A generalized explanatory approach – Part 2. Constructivist Foundations 7(1): 48–67. Available at http://www.univie.ac.at/constructivism/journal/7/1/048.urrestarazu

Urrestarazu H. (2012) Autopoietic systems: A generalized explanatory approach – Part 3: The scale of description problem. Constructivist Foundations 7(3): 180–195. Available at http://www.univie.ac.at/constructivism/journal/7/3/180.urrestarazu

van Gigch J. P. (1993) Metamodeling: The epistemology of system science. Systems Practice 6(3): 251–258.

Vanderstraeten R. (2002) Parsons, Luhmann and the theorem of double contingency. Journal of Classical Sociology 2: 77–92.

Vanderstraeten R. (2012) Rewriting theory: From autopoiesis to communication. Systems Research & Behavioral Science 28: 377–386.

Varela F. J. (1979) Principles of biological autonomy. Elsevier North Holland, New York.

Varela F. J. (1981) Autonomy and autopoiesis. In: Roth G. & Schwegler H. (eds.) Self-organizing systems: An interdisciplinary approach. Campus Verlag, Frankfurt: 14–24.

Varela F. J. (1996) The early days of autopoiesis: Heinz and Chili. Systems Research 13: 407–416.

Varela F. J. & Goguen J. A. (1978) The arithmetic of closure. Journal of Cybernetics 8: 291–324.

Varela F. J., Maturana H. R. & Uribe R. (1974) Autopoiesis: The organization of living systems, its characterization and a model. BioSystems 5(4): 187–196.

White H. C. (1992) Identity and control. A structural theory of social action. Princeton University Press, Princeton.

White H. C., Fuhse J., Thiemann M. & Buchholz L. (2007) Networks and meanings: Styles and switchings. Soziale Systeme 13(1+2): 543–555.

Wittgenstein L. (1953) Philosophical investigations. Third Edition. English translation by G. E. M. Anscome. Macmillan, New York.

Ziemke T. (2012) The construction of embodied agency: The other side of the system-environment coin. Constructivist Foundations 8(1): 52–54. Available at http://www.univie.ac.at/constructivism/journal/8/1/052.ziemke