Systems Research and Behavioral Science
Syst. Res (2011)
Published online in Wiley Online Library
(wileyonlinelibrary.com) **DOI**: 10.1002/sres.1116

■ *Research Article*

From Second-order Cybernetics to Enactive Cognitive Science: Varela's Turn From Epistemology to Phenomenology

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Varela is well known in the systems sciences for his work on second-order cybernetics, biology of cognition and especially autopoietic theory. His concern during this period was to find an appropriate epistemological foundation for the self-reference inherent in life and mind. In his later years, Varela began to develop the so-called 'enactive' approach to cognitive science, which sets itself apart from other sciences by promoting a careful consideration of concrete experiential insights. His final efforts were thus dedicated to finding a pragmatic phenomenological foundation for life and mind. It is argued that Varela's experiential turn—from epistemology to phenomenology—can be seen as a natural progression that builds on many ideas that were already implicit in second-order cybernetics and biology of cognition. It is also suggested that the rigorous study of conscious experience may enable us to refine our theories and systemic concepts of life, mind and sociality. Copyright © 2011 John Wiley & Sons, Ltd.

Keywords Varela; autopoiesis; cognitive science; enactive approach; phenomenology

INTRODUCTION

The aim of this paper is to trace the historical reasons for Varela's 'experiential turn', starting from some ideas of the first generation of cybernetics, continuing through the development of second-order cybernetics and the biology of cognition, up to his final contributions to the development of a phenomenological pragmatics in the cognitive sciences.[1] Of course, given Varela's deep and wide-ranging scientific involvements, which extended across many different disciplines with their own unique histories, an extensive scholarly effort will be necessary to fully analyse

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[1] The term 'phenomenology' has different meanings in different fields. It is sometimes used to describe the defining characteristics of a phenomenon, and in the autopoietic tradition it is often used to denote the cognitive implications of autopoietic theory. However, here we will follow Varela's convention and use the term in the way originating with Edmund Husserl, namely to denote the systematic study of the structures, qualities and dynamics of first-person experience (Gallagher and Zahavi, 2008).

Received 28 February 2011
Accepted 26 August 2011

and clarify the extent of his life's work. Here, we can only make a partial and selective contribution to this outstanding project. Existing studies in this area have shown that it is indeed possible to give a coherent interpretation of Varela's work, which takes us from the early days of autopoiesis to his later fascination with neurophenomenology (Rudrauf *et al*., 2003; Thompson, 2004, 2007). This paper complements this finding and takes it further by placing Varela's final focus on phenomenology into a wider context.

The Work of Francisco Varela

Francisco Varela (1946–2001) had a highly productive career that spanned many areas of research and that resulted in a number of influential involvements in a variety of disciplines. Some of Varela's most widely recognized contributions were made at the beginning of his career during his extensive collaborations with Humberto Maturana, namely, on developing a new 'biology of cognition' grounded in a systemic view of biological autonomy (Maturana and Varela, 1980 [1973]). Most famously, during this very fruitful time, Varela and Maturana conceived of an operational definition of the phenomenon of life on the basis an organism's metabolic self-production. On this view, a spatially bounded and continual process of regenerating the necessary conditions of their material existence is what essentially characterizes every member of the class of living beings. They coined the term *autopoiesis* to refer to the systemic organization of this process of material self-production.

Another one of Varela's major achievements during this period is that he generalized the concept of autopoiesis to other domains in the form of the notion of autonomy (operationally defined as 'organizational closure', which can be thought of as a type of network self-production), and he made important contributions to the mathematical formalization of self-reference specifically for this purpose (Varela, 1979). He then became focused on applying these ideas in order to evoke a shift in perspective in the context of immunology, especially by making use of complex systems and network theory (Coutinho, 2003).

Finally, from the late 1980s to the end of his life, Varela's major achievement was to instigate the beginnings of a paradigm shift in the cognitive sciences (Varela *et al*., 1991). He brought together the organism-centred philosophy of his early work, with the complex systems theory of his immunology period (which he now applied in the context of neuroscience) and combined it with a concern for a practical and rigorous study of subjective and intersubjective experience. He called this new paradigm the 'enactive' approach and referred to its novel method of integrating experimental neuroscience, complex systems analysis and first-person experiential research as 'neurophenomenology' (Varela, 1999). Most of his final publications addressed the problem of how to establish a phenomenologically aware science of consciousness.

The Impact of Francisco Varela

Varela was clearly a highly influential scientist in many areas. However, it also needs to be said that, despite his many impressive insights and successes, his research still remains largely unknown in biology. Autopoietic theory has never managed to break into the mainstream. Of course, the concept of autopoiesis has had a huge impact on developments in various areas of systems thinking, especially as applied to the social sciences (Luhmann, 2002). However, the vast majority of researchers working in the sciences of life and mind are still oblivious to the existence of this concept.

In contrast, other fields that also have historical roots in the early cybernetics era, such as artificial intelligence, cognitive science, control theory, information theory, and computational approaches to biology, have by now managed to become part of some of the most prestigious areas of engineering and the natural sciences. In other words, cybernetics has given rise to some remarkably successful traditions, and yet some other kinds of cybernetics-based approaches, in which Varela was involved, are still struggling for recognition. The reasons for this divergent state of affairs are fascinating and complex (Froese, 2010). What is important in the current context is that, thanks to the growing popularity of the enactive approach, there is now an increasing interest in

the concept of autopoiesis in the cognitive sciences (Thompson, 2007).

However, this is not simply a return to traditional autopoietic theory, because the renewed interest in the concept of autopoiesis is driven by the maturation of Varela's phenomenological insights. What sets this new context apart from the cybernetic context in which the autopoietic tradition first originated is that the customary concern with universal principles and abstract theorems has been replaced with a focus on what Varela (1995) liked to call the 're-enchantment of the concrete' (Froese and Stewart, 2010). On this view, a proper understanding of the phenomenon of life must take into account the *concrete living body*, including its material and thermodynamic properties, and the *concrete lived body*, including its first-person phenomenological or experiential properties (Hanna and Thompson, 2003). It is this double requirement of the concrete living and lived body that is motivating the renewed interest in the notion of autopoiesis and which at the same time is challenging its traditional formulation and interpretation (Froese and Stewart, 2010).

To some proponents of the autopoietic tradition, this attempt to rethink the essential tenets of autopoietic theory on the basis of insights from experiential research may appear as a misguided effort to modify a perfectly self-consistent theory. This paper will develop two complementary responses to this objection. On the one hand, it will follow Maturana and Varela in arguing that a theory must be measured not only in terms of its logical consistency but also in terms of how well it fits with our personal experience. But this requires a careful examination of our experience. On the other hand, and following on from this point, it will be argued that the seeds for the current shift in perspective to phenomenology were already dormant in the early cybernetics era and have been slowly maturing in the post-cybernetic developments. It is hoped that this historical analysis will thereby help to open up a vantage point from which it is possible to motivate phenomenologically grounded reappraisals of systemic concepts in other areas of cybernetically inspired approaches to life, mind and sociality.

EXPERIENCE: THE MISSING BACKGROUND

Our aim is to better understand how Varela's experiential turn fits into the intellectual landscape of the 20th century. There are a few words of caution before we begin: given the limited scope of a single research article, we will be forced to make some significant abstractions and simplifications. For instance, we cannot address in sufficient detail the rise and fall of the first generation of cybernetics nor the historical developments that culminated in today's mainstream biology and cognitive science.[2]

Instead, we will try to weave a historical narrative that is centred on the ideas of some of the most influential thinkers who were contemporary with the young Varela, and we will only focus on those ideas that notably paved the way for Varela's decision to incorporate practical experiential research into the cognitive sciences. Consequently, the intellectual trace that we will uncover is rather narrow, but it serves our specific purpose well and it opens up fresh perspectives for future research.

Cybernetics Rediscovers the Role of the Observer

We begin our historical analysis with a brief reminder of the decisive event that gave birth to the intellectual landscape of Western modernity. In the 17th century, the great thinker René Descartes, after reflecting deeply about the certainties and uncertainties of conscious experience, severs reality into two metaphysically independent realms: mind and matter. This may sound like pure philosophy, but we should not forget that Descartes was also a key figure for the scientific revolution. His idea of mind–matter dualism can therefore also be understood as a pragmatic proposal of methodological independence: 'Let's keep the observer out of the observed!' And indeed, the majority of scientists has happily obliged ever since. In fact, they eventually radicalized his dictum of observer independence to such an extent that the

[2] The interested reader is referred to Dupuy (2009) and Husbands *et al.* (2008) for more information on the early cybernetics, as well as to Rose (2005) for biology and Boden (2006) for cognitive science.

DOI: 10.1002/sres

original dualism became a victim of its own scientific success. The mind–matter dualism has collapsed under the authoritative weight of objectivity into the material half alone, thereby forming an impoverished materialist monism. Today, this doctrine of reductive materialism has become so ingrained in our mainstream science and culture that it is commonly no longer even recognized as one possible philosophical position among other valid possibilities. Nevertheless, occasionally the spectre of subjectivity arises from the dualist rubble, causing fear and havoc among hardnosed scientists until it is once more contained behind the bars of observer independence.

A prominent example of this kind of upheaval and temporary resolution is the final drama of the cybernetics era (Dupuy, 2009). In its heyday, it confidently asserted itself in opposition to introspectionist psychology by advocating a subjectless materialist monism. For instance, subjective goal-directedness and purpose were assumed to be synonymous with negative feedback systems (e.g. Rosenblueth, Wiener, and Bigelow, 1943), and mental intentionality was equated with propositional logic implemented by a neural network (e.g. McCulloch and Pitts, 1943). But then, just when the triumphant victory of a subjectless materialist monism appeared to be imminent, the active role of the observer resurfaced once again (Froese, 2010). This observer dependence is nicely illustrated by Ross Ashby's attempt to formalize the notion of a system's organization in terms of the constraints between its variables.

> The "constraint" is thus a *relation* between observer and thing; the properties of any particular constraint will depend on both the real thing and on *the observer*. It follows that a substantial part of the theory of organization will be concerned with *properties that are not intrinsic to the thing but are relational between the observer and thing*. (Ashby, 1962: 258)

For the early cybernetics movement, this constructive effect of the observer was an unfortunate nuisance. It stood in the way of gaining epistemic access to the real world in way that the natural sciences were presumed to achieve. Accordingly, for Ashby (1962: 257) 'organization theory has a peculiarity not found in the more objective sciences of physics and chemistry'. Thus, just at the moment when it seemed that the cybernetics era had succeeded in eliminating the subjective observer from science by turning the subject into just another cybernetic system, it was found that all systems are in fact formally dependent on the observer.

This dilemma about the role of the observer had several consequences. It is perhaps only a small exaggeration to say that the growing awareness of the active role of the observer in relation to the constitution of observed systems, which was long ignored by cybernetics and at times even explicitly suppressed (von Foerster and Bröcker, 2002, pp. 164–165; Varela, 1987: 219), helped to bring the prestigious movement to its end. Many researchers pushed the tradition aside like an unresolved trauma and instead began to regroup anew under the banners of artificial intelligence and cognitive science, as well as computationalism more generally (Froese, 2010). For example, it is remarkable that mainstream discussions of the historical origins of cognitive science often lack a reference to the cybernetics era altogether (e.g. Thagard, 2010).

We cannot go into a detailed analysis of this historical reorientation here, but it is worth briefly noting that it is essentially the doctrine of representationalism by which these new disciplines try to keep the spectre of subjectivity at bay. For if observation is assumed to be a linear process that simply creates an mental copy, correspondence map or some other kind of internal representation of external reality, then reality's independent objectivity is faithfully preserved in our knowledge, and thus a system's dependence on the observer is no longer an issue.

However, a small group of scientists questioned whether there was any validity to this metaphysical assumption about the observer's relationship to ultimate reality. Instead, they saw an opportunity in the cybernetic rediscovery of the observer to develop a new kind of cybernetics that takes the potentially constructive effects of the observer into account within the scientific framework—a second-order cybernetics. In other words, in the second-order generation

of cybernetics, the potential role of the observer was not marginalized in an *a priori* manner in terms of a questionable belief in an epistemologically convenient metaphysics. Rather, the internal consistency of science was maintained by means of a recursive application of the standard scientific method.

Uncovering the Experiential Background

It was Heinz von Foerster who played a crucial role in keeping many of the insights of the original cybernetics era alive for the next wave of research (Varela, 1996a). His particular approach, which he referred to as 'second-order cybernetics' in order to acknowledge the role of the observer (von Foerster, 1979), was a considerable inspiration for many developments that took place on the margins of the mainstream sciences of mind. It greatly influenced the establishment of von Glasersfeld's (1995) radical constructivism as well as Maturana and Varela's (1987) biology of cognition.

Radical constructivism is guided by an observer-centred epistemology that follows the philosophical tradition of Vico, Hume and Kant (von Glasersfeld, 1984). In many respects, it is the flipside of the early cybernetics movement. Instead of a materialist stance, which conceives of an observer as constructed by the observed world, it adopted a radical idealist or intellectualist stance, which treats the observed world as constructed by an observer. However, as von Foerster liked to remind us, the direct negation of one nonsensical position will only lead us to another, equally nonsensical position. And, indeed, radical constructivism has its own set of challenges and serious problems, in particular, the persistent threat of being locked up in solipsistic fantasy.[3]

To be fair, von Glasersfeld has often emphasized that he is *not* trying to deny that something *might* exist outside of what is, for him at least, the limit of the rationally conceivable, although he insists that the question of existence (ontology, rather than epistemology) is mere speculation that belongs to the domain of the mystics. But this split between pure rationality and irrational mysticism surely presents us with a false dichotomy: it neglects entirely the brute fact of our existence and our daily praxis of living, which in its contingency is neither fully rationally justifiable nor identical with some mystical awareness—it just is a given state of affairs. The concrete experiential background of our lifeworld remains hidden from von Glasersfeld because, according to his radically intellectualist view, we must always first conceive, and thereby create, the world before we can decide to participate in it.

We can begin to find the beginnings of an experiential breakthrough in von Foerster's work. This difference in perspective is expressed in his lifelong practice as a magician and, in the context of his published work, in his fascination with Carlos Castaneda's anthropological tales of initiation into the mysterious practices of Yaqui shamanism (e.g. Castaneda, 1968). At a number of occasions during his academic career, von Foerster uses a specific passage of Castaneda's narrative as a pedagogical tool in order to make his audience more aware of an insight that will increasingly occupy him toward the end of his life (von Foerster and Bröcker, 2002). He is specifically concerned with our cultural tendency to let our theoretical explanations overshadow the immediacy of lived experience:

> It is interesting to note that something that cannot be explained – that is, for which we cannot show a cause or for which do not have a reason – we do not wish to see. In other words, something that cannot be explained cannot be seen. This is driven home again and again by Don Juan, a Yaqui Indian, Carlos Castaneda's mentor. (von Foerster, 1979)

Perhaps we can rephrase this anecdote in terms of von Foerster's favourite philosopher, namely, Wittgenstein (1961 [1921]) who famously wrote: '*The limits of my language* mean the limits of my world' (§5.6). This may sound similar to the ideals of radical constructivism, but this is not

[3] It would take us beyond the scope of this paper to evaluate radical constructivism. As a starting point, the interested reader is referred to the target article by von Glasersfeld (2008) and the response by Di Paolo (2008). See also the commentary by Boden (2010). From the perspective developed in this paper, we could say in brief that radical constructivism suffers from a lack of phenomenological insight into the problem of concrete intersubjectivity and our pre-existing situatedness in a shared lifeworld.

DOI: 10.1002/sres

the case. At the end of his *Tractatus*, Wittgenstein calls upon the reader that 'He must surmount these propositions; then he sees the world rightly' (§6.54). In other words, the prison of the intellect must be broken. Similarly, von Foerster is interested in raising our awareness about the limits of rationality. Even more importantly, he follows Wittgenstein and goes beyond radical constructivism by trying to make us realize that *the limits of reason do not necessarily have to coincide with the limits of our experience*. For instance, after one of von Foerster's talks about constructivist epistemology, there was an open discussion round. Karl Pribram, a famous neuroscientist who was sympathetic to his general argument, wanted to know: if 'reality' is indeed a fiction constructed by an observer, then how is it possible that he observes unexpected events in his lab? Von Foerster responded with the story of Don Juan, the Yaqui shaman, and then said: 'You were surprised because you abandoned your preoccupation with explanations. Therefore, you could see. I hope you will continue to be surprised' (von Foerster, 1984).

To be sure, the notion of abandoning preoccupation with explanations may sound like scientific heresy, and it is not difficult to see why von Glasersfeld tried to distance his theories from such 'mysticism'. However, we must be careful not to misunderstand von Foerster's remarks as in fact advocating an unscientific attitude. On the contrary, he is trying to prevent us from getting dogmatically trapped by the intellectual pull of our theories. He is pointing to the difficulty of keeping an open mind toward new and unexpected experiences, some of which may enable us to change our mind and our theories. Von Foerster is keen to preserve an opening for the felt immediacy of our experiential situation by raising awareness of our habitual tendency to unreflectively switch from the level of direct experience to the level of mediated explanation.[4]

[4] Of course, this opening is quite difficult to accomplish in practice. Von Foerster himself occasionally slips into being a physicist when talking about our experiential world. For example, he claims that we primarily experience the *noises*, which we produce in our vocal tracts, thereby creating the 'magical' problem of explaining how they can be heard as meaningful speech (von Foerster & Bröcker, 2002, p. 337). But, as Heidegger (2010 [1927], ¶ 34) once observed: 'What we "first" hear is never noises or complexes of sounds, but the cracking wagon, the motor-cycle. [...] It requires a very artificial and complicated frame of mind to "hear" a "pure noise".'

Intellectual argumentation is certainly important, but an abstract level of discourse is only secondary to our situatedness. The important point is that *we already participate in the world before we can decide to reflect upon it*. There is more to our concrete existence than any theory about intellectual activity can capture, a theme that Varela will further explicate in some of his earliest work (Varela, 1976).

From Epistemic Isolation to Experiential Interaction

Cybernetics had tried to explain the subjective observer away. Conversely, radical constructivism was an unsuitable starting point for Varela's experiential turn because its observer was caught up in a circle of reflection. To prevent the excesses of radical constructivism and the early cybernetics, namely, observer maximization and observer minimization, what is needed is a way of understanding the relationship between the observer and the observed in a mutually non-reductive manner that is grounded in our pre-reflective existence. And even though von Foerster had realized the importance of establishing a discourse that can direct our awareness to the pre-reflective dimension of experience, unfortunately he never developed the implication of his insight more systematically. Most importantly, the mutually non-reductive relationship needs to be theorized in a way that also manages to avoid the explanatory gap, which has plagued Descartes' metaphysical mind–matter dualism.

Maturana and Varela's (1980 [1973], 1987) work on the biology of cognition resulted in a remarkable solution to this problem by defining the observer operationally. For them, observing behaviour is constituted by, and yet irreducible to, the level of its underlying component processes. This is a difficult topic, and we can only indicate the overall shape of their proposal here. In effect, the distinction between 'self' and 'other' is already inherent within the operations of an autopoietic system itself; that is, it is a system which is self-defined or whose being is its own doing. Thus, although it is the observer who makes the system available to our knowledge by distinguishing it as

DOI: 10.1002/sres

a system, the autopoietic organization of the distinguished system makes the system appear to the observer as being in fact self-distinguishing. In other words, having a self-producing organization marks the observed system as having its origin located outside of the constructive activity of its observer. Autopoiesis therefore has the effect of attributing the autopoietic system with a degree of self-generated autonomy.

Although Maturana and Varela's sources are not always explicitly cited, it is clear that they were drawing on the systemic insights from the early cybernetics era, especially the work of Ashby (Froese and Stewart, 2010). Moreover, with the generous help of von Foerster, they were building on the developments of second-order cybernetics as well (Varela, 1996a). This original conception of autopoiesis was therefore rooted in the earlier work of cybernetics and systems thinking. At the same time, it is clear that the concept of autopoiesis was a revolutionary proposal in many respects. In stark contrast to the pervasive tendency in mainstream biology to reduce the organism to the function of its genes or to its negligible role in population statistics, autopoietic theory made it possible to recognize the existence of the biological individual as a phenomenon in its own right. Moreover, in contradistinction to radical constructivism, the autopoietic system's property of self-distinction ensures that it cannot be fully absorbed into the constituting activity of the observer's intellect. Thus, given the notion of autopoiesis, it is possible to give a non-reductive account of the relationship between the observer and the observed, thereby opening a middle way between the poles of radical constructivism and the early generation of cybernetics.

Most importantly, Maturana and Varela's middle way between the two extremes of full observer dependence and full observer independence provided them with a new vantage point from which to realize that we are always already experientially situated and embodied. It is beyond the scope of this analysis to trace the full account offered by the biology of cognition from the origins of autopoiesis to the emergence of observers (Maturana and Varela, 1987), but it eventually turns back on itself:

> We human beings operate as observers, that is, we make distinctions in language. Furthermore, if we are asked to explain what we do, we usually say that in our discourse we denote or connote with our arguments entities that exist independently from us. Or, if we accept that what we distinguish depends on what we do, as modern physics does, we operate under the implicit assumption that, as observers, we are endowed with rationality, and that this need not or cannot be explained. Yet, if we reflect upon our experience as observers, we discover that whatever we do as such happens to us. In other words, *we discover that our experience is that we find ourselves observing, talking or acting, and that any explanation or description of what we do is secondary to our experience of finding ourselves in the doing of what we do*. (Maturana, 1988; emphasis added)

This statement describes a profound existential insight. Although it may appear that Maturana's realization is simply another version of the proposition, well known from radical constructivist and second-order cybernetics, that 'our knowing depends on our doing', it arrives at this conclusion by different means, namely, experiential discovery and not just rational deduction. It supports the epistemological claim that 'we have no valid basis for describing an observer-independent reality', and yet the experiential insight offers a different interpretation of the active role of the observer, which takes into account our experiential situatedness. We can refer to these two possible options as 'isolationist' and 'interactionist' interpretations:

(1) An isolationist interpretation: We say that the epistemological claim is valid because it is an isolated observer who constructs reality by making distinctions (conceptual or otherwise). On this view, it is impossible for us to say anything about an observer-independent reality because, as the agnosticism of radical constructivism forces us to conclude, our intellect is *rationally isolated* from what might be going on in such an independent world. Unsurprisingly, this is von Glasersfeld's (1990) interpretation of Maturana's position.

DOI: 10.1002/sres

(2) An interactionist interpretation: We can also say that the epistemological claim is valid because all descriptions and explanations that we provide are secondary to our ongoing praxis of living. On this view, it is impossible to say anything about an observer-independent reality because, as Maturana (1988) has reminded us, we are always already *practically involved* in what is going on around us. On this view, our doing and knowing are indeed inseparable, but the locus of this activity is not an intellectual vacuum, but rather the domain of experiencing that precedes reflection (epistemological or otherwise).

For Maturana, the pre-reflective praxis of living is both the ultimate condition of the possibility of explaining and the most fundamental explanatory problem. The basis of our epistemic activity is not isolated conceptual construction but reciprocal embodied interaction (Maturana, 1978). Most importantly, Maturana suggests that it is precisely because of this mutual involvement of experiencing and explaining that we can try to validate explanations at all, namely, in terms of the coherence they afford to our praxis of living (experiencing). In the case of the explanatory framework proposed by the biology of cognition, we are therefore presented with a notion of mutual involvement between the pre-reflective and reflective level, which is illustrated in Figure 1.

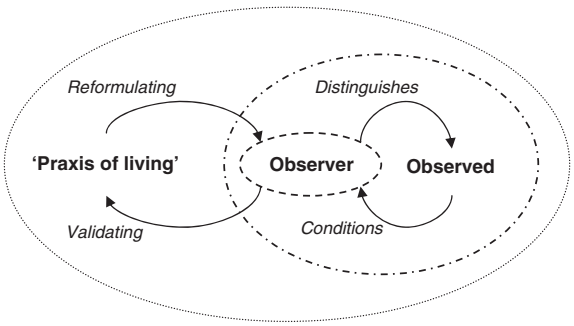

Figure 1 According to the biology of cognition, we can take the perspective of a reflective observer by reformulating observed phenomena in language. As observers, we can then explain our own presence as an observer within the larger context of that which is being observed. But our pre-reflective experience also shows that this process of explaining takes place within our already ongoing 'praxis of living' and that any explanation must be validated in relation to this praxis before it is accepted as valid

What are some of the consequences of the interactionist interpretation? First of all, it is important to emphasize that some of the essential epistemological insights of the radical constructivist position, for example, the active role of the observer and that knowledge is about adequate 'fit' and not a representational 'match' (von Glasersfeld, 1995), are preserved. The crucial difference is that the interactionist interpretation accepts on the basis of our lived experience that we are always already engaged within a world. It encourages us to become aware of the artificial confines of our theoretical discourse and to examine the existential situation within which it is being formulated.[5]

Second, there is the question of the existence and role of others. In the biology of cognition, our pre-theoretical situation is characterized as an ongoing 'praxis of living', and this includes 'languaging' with other observers (Maturana, 1978). Accordingly, Varela (1979) talks of an 'observer-community' rather than of a single observer so as to emphasize that the observer is not an isolated biological individual. Once we are aware that our pre-reflective situatedness involves others and that it is only possible to formulate a theory, including a theory of the observer, because of this pre-existing sociocultural background, then our theories have to take this condition of possibility into account. In other words, experiential insight prevents any reduction or isolation of the role of the observer: 'The successor to objectivism is not subjectivism, by way of negation, but rather the full appreciation of participation, which is a move beyond either of them' (Varela, 1979, p. 276).

Thus, while the first generation of cybernetics had culminated in the realization that knowledge of a system is essentially *observer dependent*, the second generation of cybernetics, which tried to systematically develop this insight into a cybernetic theory of the observer, culminated in the awareness that the observer is essentially

[5] It is in this sense that we must also understand Edmund Husserl's phenomenological credo 'back to things themselves', namely not as an appeal to engage in metaphysics (for that, again, would involve theoretical reflection) but as a return to our immediate 'lived' experience (from the German: *erlebte*) that is always already presupposed by our act of explaining.

DOI: 10.1002/sres

situation dependent. It turns out that the *theoretical attitude*, in which we distinguish between either an active or passive 'observer' relating to an either dependent or independent 'observed', is itself an intellectual accomplishment that depends on an ongoing praxis of living that is situated within a socio-cultural context. Furthermore, it is only by means of adopting an *experiential attitude* that our pre-reflective participation in the world becomes an accessible insight.

VARELA'S EXPERIENTIAL TURN

The subjective experience of life was never far away from Varela's concerns. Already in high school, he became acquainted with Sartre's existentialism, and he continued to pursue his interest in the European phenomenological tradition of Husserl, Heidegger and Merleau-Ponty during his undergraduate degree (Varela, 1996a). He was aware that the biology of cognition was incomplete in this respect:

> My mind is still a different affair which is not exhausted by that description; there is a residue left, a remnant that we may call the experience of the mind, the sense of self. [...] As long as there is such a remnant in the mind's description of minds, this sense of self that evades any descriptive net, the Mind–Body relation is still a problem. (Varela, 1976: 66)

It would take another 20 years before this particular aspect of the mind–body problem would become popularized as the 'hard problem' of consciousness science (Chalmers, 1996), which in turn prompted Varela to formulate a pragmatic remedy in the form of 'neurophenomenology' (Varela, 1996b). With this approach, which is unique in its insistence on the need for disciplined experiential practice, Varela finally fleshed out an insight that had remained in the background of the biology of cognition, namely, that 'a change in experience (being) is as necessary as change in understanding if any suturing the mind–body dualisms is to come about' (Varela, 1976: 67).

Given Varela's longstanding concern for how to facilitate a transformation of life's experiential background, we can see why he disapproved of any attempts to totalize the systemic framework, especially when it was used to reductively explain domains that were directly related to human life such as social phenomena. We can also begin to appreciate why he dedicated that last decade of his life to introducing experiential methodologies into the cognitive sciences. And, as we will see, these final efforts led him to revise some of the central tenets of the biology of cognition.

The Situatedness of Embodied Life

For Varela, the insight into the situation dependence of the observer/system dyad puts clear limitations on the scope of the biology of cognition and systemic explanation in general. An illustrative expression of this conviction can be found in his attempt to establish a mutual circulation between the biology of cognition on the one hand and family therapy on the other. Dissatisfied with what he calls the 'extreme application' of systemic ideas to the life of the family, he formulates an alternative approach that he provocatively calls the *Observer-in/System-out Principle*. Arguably, this principle can be taken as representative of his stance in general:

> Once we bring the describer/observer fully into the picture, then the very notion of a system founders. For a system to exist as a stable description, the human actions that are entailed in the description must slip unnoticed into the background. [...]
>
> *Corollary*: The whole gamut of notions necessary for a stable description (for example, eigenbehavior—stable patterns in natural systems; rules of generation; and natural drift) are, *ipso facto*, in question. (Varela, 1989: 5)

In other words, although systemic approaches to family therapy have tried to ground and stabilize their human practice in terms of the concepts of cybernetics and biology of cognition, Varela points out that these systemic concepts are themselves dependent on situated human practice. The best we can do is therefore to establish a circulation that links the domains in a mutually

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informing and constraining manner, but which at the same time recognizes and respects their individual peculiarities. In particular, Varela worries that an extreme application of abstract system principles to human life has the effect of overshadowing the concrete details of experiential embodiment:

> Therapy is possible only to the extent that we have some common spaces with others (we, together, *are* that common space) in order to provide some basis on which to proceed. But that basis is not universal, transcendental, guaranteed, verifiable, or grounded. By proceeding on the basis of the path created by our own actions, we literally and materially contribute to the embodiment of a form of life that has no fixity and no hidden or underlying significance. But it certainly does have, in every case, a detailed coherence and texture. (Varela, 1989: 7)

In this paragraph, Varela is preempting much of what will be the focus of his final years of research. There is a jump from the groundlessness entailed by the middle way of the biology of cognition into the concreteness of our lived situation; a 'clearing' is achieved that enables the coherence and texture of our moment-to-moment existence to come into view. In fact, a whole new domain of investigation has opened up before us, namely, phenomenology, the study of phenomena as they appear in experience.

From Experimental Epistemology to Phenomenological Pragmatics

Varela's change of direction from cybernetics to phenomenology might be difficult to accept for researchers in systems thinking, but, arguably, it actually follows from the principles of cybernetics. So far, we have focused on tracing the progression of ideas and theories that eventually led to Varela's experiential turn, but another progression can be discerned in the methodology that is employed.

Already during the beginning of the cybernetics era, there was a strong sense that intellectual activity alone was not sufficient for a proper science of the mind and that practical realization in an artefact was required in order to demonstrate that the ideas were indeed valid and to generate a concrete basis for further reflection. This was expressed nicely in Warren McCulloch's notion of 'experimental epistemology', with Ashby's construction of the 'homeostat' being a paradigmatic example. Similarly, Varela and Maturana were not satisfied with a theory of autopoiesis on its own and continued McCulloch's tradition by practically demonstrating the validity of their concept by implementing a model of autopoiesis in a computer (Varela, Maturana, and Uribe, 1974).

This model was a revolutionary piece of work in itself. It can be considered as one of the early forerunners of the field of Artificial Life, a field that Varela later helped to establish in Europe (Bourgine and Varela, 1992) and would continue to stimulate with his ideas (Varela, 1995). Indeed, he helped to give rise to a continuing tradition of implementing autopoiesis in virtual (McMullin, 2004) as well as chemical media (Luisi, 2003). But his interest in experimental epistemology was not limited to artificial systems alone; it extended to include the role of human interaction:

> We would like to conduct (for the first time) a full exploration of the possibility of man-made autonomous systems capable of a prolonged and rich history of structural coupling with humans, in such a way that a common structural drift is created together wherein a shared world of meaning and action can be brought forth. (Varela, 1987: 222)

We can see here the way in which Varela hoped to connect traditional experimental epistemology with a practical concern for human experience. We could go further and suggest that, in a sense, the methodological basis of Varela's experiential turn can be seen as a continuation of 'experimental epistemology', except that the domain of the practical insight has been generalized to become what we could call an experimental phenomenology or, to use Varela's term, a *phenomenological pragmatics*.

From the beginning, Varela (1976) was aware that a practical element is necessary in the study of consciousness. Although scholarly interest in the relevant literature can certainly be a good

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source of inspiration, by itself it is not sufficient to constitute a research programme in cognitive science (Varela, 1996b). At best, such scholarship can provide us with convenient starting points that lead to further investigation. What is required is a pragmatic methodology that enables us to consistently gain access to the required experiences so that we can systematically analyse, describe and validate them (Varela and Shear, 1999). In other words, it is not enough to abstractly reflect about life and mind; theories have to be supported by the practical realization of concrete experiences. To be sure, there are essential differences between these two kinds of methods, but they share enough structural similarities to be usefully brought together (Froese and Gallagher, 2010). In fact, this kind of experiential inquiry could provide the contemporary heirs of second-order cybernetics, radical constructivism and biology of cognition, all of which are explicitly interested in studying the process of observing, with a much-needed methodological basis.

However, Varela faced a serious practical problem. At the time it appeared to him that Western traditions, including Husserl's phenomenology, did not provide an adequate methodology that could be used to consistently validate experiential insights. Varela and colleagues accordingly decided to turn toward a consideration of the practices of meditative traditions, especially of Buddhism (Thompson, 2007: 413–417). Buddhist spiritual traditions, which since their origins have been devising and testing methods of experiential inquiry for millennia, deeply resonated with Varela because they necessarily involve an element of personal commitment and practice (Hayward and Varela, 1992). A few years later, Varela discovered that Husserl's phenomenology had in fact methodological insights to offer after all (Varela and Shear, 1999; Roy *et al*. 1999). He therefore began to extract the essential common features of these traditions in order to lay the foundations for a unified methodological and theoretical basis for a phenomenological pragmatics (Depraz, *et al*. 2003).

This practical phenomenological approach is central to Varela's enactive approach to the cognitive sciences (Varela, Thompson, and Rosch, 1991) and, in particular, to his research programme of *neurophenomenology* (Varela, 1996b). We will have more to say about the enactive approach in the succeeding discussions. The aim of neurophenomenology is to establish a mutually informing dialogue between phenomenology and the cognitive sciences, for instance, by actively involving subjects who are trained in phenomenological practice. Trained subjects can actively participate in the process of realizing an experiment in the neuroscience of consciousness, for example, by devising their own experiential categories (Lutz, 2002). Even untrained subjects can become aware of the details of their experience through carefully guided interviews (Petitmengin, 2006). In general, the aim of this research programme is to develop a science in which insights into our lived situation are explicitly taken into account (Bitbol, 2002).

Thus, on the basis of a disciplined investigation of the first-person perspective, we can begin to ask a new set of questions (Zahavi, 2005): What does experience consist in and what are its essential characteristics? How does it change over time? What are the best methods of becoming aware of our experience? What kinds of criteria should we use to systematically evaluate the descriptions produced by its reformulation into language? How do we turn them into 'data' for a science of consciousness? How does this data relate to more traditional experimental data? Each of these questions entails a whole new area of research unto its own. Indeed, a thorough investigation would have to include a consideration of existential analysis, synchronic (static) phenomenology, diachronic (genetic) phenomenology and intersubjective verification of the resulting verbal reports. In particular, Varela's insistence on the need for a mutual circulation with the 'hard' sciences continues to be a serious challenge (Froese *et al*., 2011a,b).

The enactive Approach: Life, Mind, and Sociality

It was precisely with this unorthodox mixture of the biology of cognition, existential phenomenology and Buddhism that the *enactive* approach to cognitive science was first conceived by Varela and colleagues (Varela *et al*., 1991). In this seminal book, the enactive approach is presented as a human experience-centred alternative to the

DOI: 10.1002/sres

computational theory of mind in the cognitive sciences. The notion of autopoiesis had notably slipped into the background of the discussion, and the focus was instead on complementing the sciences of mind with a rigorous examination of our experiential situatedness. In addition to drawing inspiration from Buddhist psychology, Varela and colleagues also considered key insights from the existing phenomenological tradition in continental philosophy, especially Heidegger's existential analytic of 'being-in-the-world' and Merleau-Ponty's phenomenology of embodiment and motor intentionality.

The reason for Varela's fascination with phenomenology, which had until then been almost entirely absent from cognitive science, should be clear by now. This tradition had already made significant advances in revealing the worldly and bodily context in which we are always already embedded and embodied before we decide to adopt a scientific attitude and enter into a theoretical discourse (Thompson, 2007). Moreover, the enactive approach has made use of these phenomenological foundations to rethink the cybernetic theories of life and mind (e.g. Froese and Stewart, 2010; Froese and Di Paolo, 2011). In order to give an indication of how experiential research has impacted on these theories, we can consider the problem of mind–body dualism once more.

The enactive approach addresses the mind–body problem in terms of the phenomenon of life as a whole (Weber and Varela, 2002). One particularly attractive proposal by Hanna and Thompson (2003) is to see lived embodiment (the lived body or '*Leib*', as Husserl would say) as the missing piece. They argue that what we normally consider to be our mind and body, namely, a reflective consciousness and physical object (or '*Körper*'), respectively, are actually linked by our embodiment. In other words, our body is not just any physical object; it is alive and thus characterized by a biological organization. And this living body is not just external to our mind; we also experience our body from the 'inside', or more precisely, as Merleau-Ponty would say, we live through it. The first piece of this proposal, the living body, is provided by the biology of cognition, but the bridge also requires a second piece, the lived body, which is derived from phenomenology. Both traditions need each other in order for this biophenomenological solution to the mind–body problem to work (Figure 2).

This particular approach to the mind–body problem is conceptually attractive, because the notions of living (biological) embodiment and lived (experiential) embodiment both refer to a common conceptual denominator: the phenomenon of life (Jonas, 2001 [1966]). Nevertheless, the success of this framework cannot be based on conceptual niceties alone. Although autopoiesis plays a role in characterizing the properties of the living body, the framework also depends on personal experiential insight into one's embodiment, because otherwise the notion of the lived body will remain vacuous.

This example also provides an illustration of how the experiential turn has begun to affect the theoretical framework in which system thinking is being applied. In his last paper on autopoiesis (Weber and Varela, 2002), Varela makes use of the experiential insight into embodiment to reverse his earlier stance in biology of cognition, which had banished teleology, purpose and meaning outside of the biological body. Instead, he argues that the precarious existence of a living being, as expressed through its autopoiesis, is the

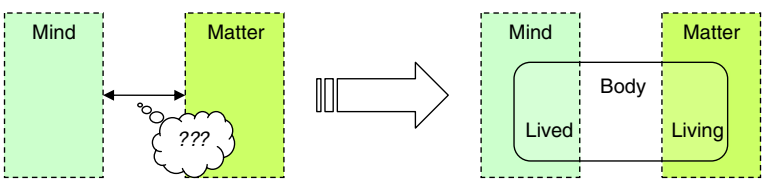

Figure 2 The enactive approach proposes to resolve the mind–body problem by building a bridge between two aspects of embodiment that have been neglected by mainstream cognitive science (i) by insisting on the autonomous organization of the living body, and (ii) by recovering our pre-reflective experience of the lived body

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DOI: 10.1002/sres

source of its intrinsic teleology and sense-making activity. This has turned out be a very fruitful transformation of the concept of autopoiesis, which is being further developed in a variety of directions as part of the enactive approach to cognitive science (Stewart, Gapenne, and Di Paolo, 2010).

Another ongoing research project is to investigate how this view of life, as living and lived, can be scaled up to human cognition (Froese and Di Paolo, 2009). One proposal is to look more carefully at the enabling role of sociality in the realization of human faculties. This idea is supported by recent work in the enactive approach to social interaction, which argues that the interaction process itself can extend the agency of the interactors (De Jaegher and Froese, 2009). Precisely how this influence from the 'global' level of mutual interaction to the 'local' level of an agent's action takes place is investigated from a phenomenological perspective, as well as from a dynamical systems perspective (Froese, 2011). These tentative beginnings to address the social dimension of life and mind are promising, but more work still needs to be carried out in order to go beyond dyadic interaction and to address the contribution of socio-cultural factors, especially language and technology (Steiner and Stewart, 2009). It is here that researchers involved in the humanities can lend their expertise to the enactive cause, especially considering the importance of understanding how different social systems impact on the phenomenology of those who are interacting within them.

CONCLUSION

Throughout this article, we have tried to emphasize the continuity that flows from the original cybernetics era, through the traditions of second-order cybernetics and the biology of cognition, all the way to the enactive approach in the cognitive sciences and Varela's neurophenomenology. The purpose of emphasizing historical continuity in this manner was to demonstrate that we could make sense of the progression of ideas leading up to Varela's experiential turn. Perhaps this historical bridge from the systemic to the phenomenological will inspire other researchers to consider enriching their work by circulating between abstract mathematics and concrete existence.

At the same time, this sense of continuity should not leave us blind to the fact that the historical progression was punctuated by a number of profound transitions, which are indicative of qualitative leaps. The development of the foundations of the biology of cognition can be considered as one example: 'The mature concept of autopoiesis did have, as we have seen, clear roots, but between an idea and its roots exists a crucial jump' (Varela, 1996a: 413). Another notable qualitative leap took us from Maturana's theoretical acknowledgment of the background praxis of living to Varela's attempt to establish the foundations of a phenomenological pragmatics.

To be sure, we could point to other discontinuities in the progression, and even the pursuit of understanding origins is itself a complex historical process that has to deal with various intricate circularities (Dupuy and Varela, 1992). Furthermore, although we can make sense of these qualitative jumps in retrospect, it is a different question altogether of how we can generate and stabilize the next ones in the present. But this historical analysis may have given us a clue. If we follow the progression from the early cybernetics to Varela's experiential turn, then we realize that the source of creativity is ambiguously situated in the circulation between concrete experience and abstract knowledge. As scientists, we learn to habitually work on our knowledge, but we often neglect to cultivate our experiential insights. However, this attitude will no longer do, especially in a world that is increasingly more reliant on science. It is no use turning back, and the sensible way forward is 'an expansion of experience, a redressing of the balance between knowledge and being' (Varela, 1976: 67).

ACKNOWLEDGEMENTS

Tom Froese would like to thank Michel Bitbol and three anonymous reviewers for their helpful comments on an earlier version of this article. Froese's research was financially supported by a

Grant-in-Aid provided by the Japanese Society for the Promotion of Science (JSPS).

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