



Tree of Knowledge

Humberto R. Maturana , Francisco J. Varela

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"Knowing how we know" is the subject of this book. Its authors present a new view of cognition that has important social and ethical implications, for, they assert, the only world we humans can have is the one we create together through the actions of our coexistence. Written for a general audience as well as for students, scholars, and scientists and abundantly illustrated with examples from biology, linguistics, and new social and cultural phenomena, this revised edition includes a new afterword by Dr. Varela, in which he discusses the effect the book has had in the years since its first publication.

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From Reader Review Tree of Knowledge for online ebook

Nick says

“All doing is knowing and all knowing is doing” (27)

“all knowing is an action by the knower” (34)

“Everything said is said by someone.”

Unities: A unity (entity, object) is brought forth by an act of distinction. Conversely, each time we refer to a unity in our descriptions, we are implying the operation of distinction that defines it and makes it possible. (40)

“Our proposition is that living beings are characterized in that, literally, they are continually self-producing. We indicate this process when we call that organization that defines them an autopoietic organization.” (43)

“Thus, autopoietic unities specify biological phenomenology as the phenomenology proper of those unities with features distinct from physical phenomenology. This is so, not because autopoietic unities go against any aspect of physical phenomenology – since their molecular components must fulfil all physical laws – but because the phenomena they generate in functioning as autopoietic unities depend on their organization and the way this organization comes about, and not on the physical nature of their components (which only determine the space of their existence).” (51) = physical+biological!!

“Ontogeny is the history of structural change in a unity without loss of organization in that unity. This ongoing structural change occurs in the unity from moment to moment, either as a change triggered by interactions coming from the environment in which it exists or as a result of its internal dynamics. As regards its continuous interactions with the environment, the cell unity classifies them and sees them in accordance with its structure at every instant. The overall result is that the ontogenetic transformation of a unity ceases only with its disintegration.” (74)

“In describing autopoietic unity as having a particular structure, it will become clear to us that the interactions (as long as they are recurrent) between unity and environment will consist of reciprocal perturbations. In these interactions, the structure of the environment only triggers structural changes in the autopoietic unities (it does not specify or direct them) and vice versa for the environment. The result will be a history of mutual congruent changes as long as the autopoietic unity and its containing environment do not disintegrate: there will be a structural coupling.” (75) cos all changes in either unity or enviro depend on their respective structures.

Structural dynamics allow observation, from which predictions can be made – those predictions can be limited by

1. ability to observe all relevant factors
2. comprehension / conceptual
3. changes to the system as a result of observation

animal and human behaviour often seems unpredictable. Why? 1-3? Does nervous system limit predictions? (cf. study on free-will flies).

Awe are all a product of our history. “Strictly speaking, nothing is an accident. Our experience, however, is

one of creative freedom; and in the way we see things, the behavior of higher animals seems unpredictable.” (124) This is a result of “the very operation of the nervous system with all the richness of the realms of structural coupling that its presence makes possible.” (124)

“This is like walking on the razor’s edge. On one side there is a trap: the impossibility of understanding cognitive phenomena if we assume a world of objects that informs us because there is no mechanism that makes that “information” possible. On the other side there is another trap: the chaos and arbitrariness of nonobjectivity, where everything seems possible.” (133)

If we take a representationist perspective “it blinds us to the possibility of realizing how the nervous system functions from moment to moment as a definite system with operational closure” (133) cf.

“absolute cognitive solitude or solipsism, the classic philosophic tradition which held that only one’s interior life exists.” (134) a trap because “it does not allow us to explain how there is a due proportion or commensurability between the operation of the organism and its world.” (134)

Solve the problem? Avoid both traps.

Both perspectives help to understand the unity, the environment and their interactions, but both are perceived by observers. They are aspects / viewpoints / observations; Nothing else.

“Behavior is not something that the living being does in itself (for in it there are only structural changes) but something we point to.” (138)

Chemotaxis: flagellum &c. move to area where greatest concentration of nutrients.

Elementary nervous system – sensory surface, motor surface, system of coordination between surfaces i.e. neurons e.g. hydra. Where neurons meet neurons or other cells we find a synapse.

Humans have c.1011 neurons, each connected to a multitude of neurons and cells – the combinations are staggering (see Edelman)

When a hand is withdrawn in pain, externally it looks as though this behaviour is a direct result of the stimuli causing pain. However, the hand is only withdrawn as a result of the neuronal system re-establishing equilibrium. It is the neuronal system that causes the hand to withdraw. The external pain is a trigger only. This can be easily demonstrated. “But from the standpoint of the operation of the nervous system as such..., what occurs is only the constant maintenance of certain relations between sensory and motor elements that were temporarily perturbed by outside pressure.” (164)

“the operation of the nervous system is wholly consistent with its forming part of an autonomous unity in which every state of activity leads to another state of activity in the same unity, because its operation is circular, or in operational closure. The nervous system, therefore, by its very architecture does not violate but enriches the operational closure that defines the autonomous nature of the living being. We begin to see clearly the ways in which every process of cognition is necessarily based on the operational closure of its nervous system; hence it follows that all knowing is doing as sensory-effector correlations in the realm of structural coupling in which the nervous system exists.

Michael says

Not a Thing, is for Certain!

José Luis says

The authors present a unified theory of cognition and concept formation, that can be extended to explain knowledge, knowing, social interactions. The basic concept is autopoiesis, "Our proposition is that living beings are characterized in that, literally, they continually self-producing. We indicate this process when we call the organizations that defines them an autopoietic organization. " (page 43). Then on page 48, "We are proposing that the mechanism that makes living beings autonomous systems is autopoiesis. This characterizes them as autonomous systems." The book is easy reading, although the concepts are not easily understandable, it is necessary some background.

Funda Guzer says

Kitabın bölümlerinin devamlılığı ve şekillerde anlatım okumada kolaylık sağlar. Çeviri çok başarılı. Bilgiye farklı bakış açısı.

DJ says

Interested in cybernetics, theoretical biology, and philosophy but still find Dan Brown novels to require mental gymnastics? Put on your philosophical training wheels and give "Tree of Knowledge" a spin! A mixture of dated scientific ideas, profound frameworks for thinking about living organisms, and unnecessarily complicated jargon, ToK is essentially the children's menu version of Maturana and Varela's Autopoiesis and Cognition papers on living organisms, communication, and consciousness.

I highly recommend reading ToK *before* Autopoiesis and Cognition and possibly even foregoing Autopoiesis and Cognition altogether. ToK is not only more clearly written but is laden with examples, something lacking in the uncompromisingly sterile Autopoiesis and Cognition.

The rest of this review is a summary of the deep and profound wisdom I gleaned from the Chileans, so you may want to skip it if you haven't read the book yet.

ToK's more gentle approach (along with post-reading conversations with a Chilean economist and Italian physicist) helped clear up a question I had after Autopoiesis and Cognition: if a unity is so deeply coupled with its environment, how does one uniquely define its morphological boundaries? It may seem obvious to look at me, carve a 2D surface over my skin, and call me a closed system, but give me a week without a consistent supply of low-entropy energy and I'll quickly succumb to the second law of thermodynamics. The key trick is this: *unique boundaries there are not*. "Everything said is said by an observer." An observer selects the features by which a unity will be defined through their shared domain of interactions. Different observers (and even the same observer at different times with different goals) will have different domains of interactions and will define a unity in a different way. For example, a given university may be a set of assets and liabilities, a collection of students, a football team, a physical space, or some combination of these things, depending on who you ask.

Some more notes:

Referring to a unity implies an act of distinction.

Replication, copy, and reproduction can be distinguished by the amount of historicity in each process.

Replication (repeated generation) is ahistorical. Copy (creation from a mold) is historical if iterated.

Reproduction (the fracture of a unity to create two unities of the same class), however, is necessarily historical.

Heredity and variation are strongly complementary features. Heredity is the preservation of structure in a historical series of unities. Variation are the differences of structure in that series. Different components of a unity may exhibit different degrees of heredity and variation.

Unities may couple via inclusion (think organelles) or recurrent coupling with the maintenance of individual identities (individual humans).

The environment does not *instruct* an organism; it only *triggers* internal dynamics. To phrase it differently, the space of possible reactions to an environment is defined in the internal structure of an organism; the environment does not inject behavioral commands into an organism in any way. To phrase it differently yet again, environmental stimuli modulate, they do not control. *Environmental input is imply one more "voice" in the "conversation" of internal dynamics.*

Organisms must exhibit variance of the time scale of their environment (and in a complementary "direction") in order to adapt (remain coupled).

Adaptation in response to a single change in the environment affects the organism in a global way. A small change in structure may occur to accommodate one new feature of the environment, but through an internal domino effect, alter the way an organism interacts with other features.

The simplest neural systems allow detection of correlations between inputs on a sensory surface.

A nervous system expands our possible behaviors by inserting a network with a huge range of possible patterns between our sensory and motor surfaces.

zynphull says

This is the best book I've read probably since I began to read. Undoubtedly, it is at least the conceptual cherry in the proverbial intellectual cake I've been cooking for at least the past two years as I reflected upon and studied about justice, political philosophy, sociology, anthropology, psychology, as well as, most notably recently, systems theory, complexity and cognitive science.

Through existing we "put forth a world" that is a result not of direct contact with "objective external reality" (thus not a representational mind) nor a fantasy of our imagination (thus not a solipsistic dreamland). We experience reality as autonomous unities in "structural coupling" with the environment which, for each of us, include other beings as well.

The main takeaway of this view, for myself, lies in short in its ability to present incredible insights into human cognition and behavior while making it clear how they are absolutely incompatible with traditional notions of 'objectivity vs. subjectivity', free will/agency, 'nature vs. nurture', certainty, reason, and education. To accept it as credible (and the core of this theory is all but incredible - indeed, once one "creeds" it, it is impossible to dispel of one's mind without being aware one is refusing to think > and that is 'knowing how we know'); to accept it as credible is to necessarily accept a most drastic notion of equality: one's view of the world is unique, a result of one's own social/nurtural (ontogenic) history and one's biological/natural (philogenic) history. That means we are equal in our uniqueness of limitation. The world we perceive and think about cannot be any other than the one we put forth through our own cognition. Thus, the world a 21st century American woman perceives and lives in, though 'objectively' the same, is filled with values, notions

(or lack thereof) of right, wrong, old, new, roles, goals, that are for the most part wildly different than the ones through which, say, a native Mongolian in the 15th century perceived.

It is not just that we are different because we learned different things. Our brains quite literally are unable to perceive (or rather, should I say 'produce'?) the same meanings in reality. We are who we are born, but also (and _that_ is why we disagree so much everywhere) who we become as we live - one is indissociable from another. Autonomy/freedom is only perceived as a phenomenon through our social coupling, and such social coupling only comes about through our biological/embodied reality, from whence we can never escape, for it is who we are, and to escape it would mean to be something else.

I could spend hours talking about it, but that might be mostly pointless - it is usually easier for one to read the book itself, and besides what I took away from it is not a result of the book by itself and my 'interpretation' of it, but rather -in fashion with the book itself- of my past experiences, that have helped shape my awareness of such ideas.

But please, do read this.

It is highly accessible, requires no prior understanding of its subjects (beyond basic high school biology), and will enable you, if you give yourself into it, to become someone new - or, rather, to be more aware of what you are, and what you are not.

The following passage from the last chapter of the book helps illustrate my amazement a little, and will close this review:

"The knowledge of knowledge compels. It compels us to adopt an attitude of permanent vigilance against the temptation of certainty. It compels us to realize that the world everyone sees is not **the** world but **a** world which we bring forth with others. It compels us to see that the world will be different only if we live differently. It compels us because, when we know that we know, we cannot deny (to ourselves or to others) that we know.

That is why everything we said in this book, through our knowledge of our knowledge, implies an ethics that we cannot evade, an ethics that has its reference point in the awareness of the biological and social structure of human beings, an ethics that springs from human reflection and puts human reflection right at the core as a constitutive social phenomenon. If we know that our world is necessarily the world we bring forth with others, every time we are in conflict with another human being **with whom we want to remain in coexistence**, we cannot affirm what for us is certain (an absolute truth) because that would negate the other person. If we want to coexist with the other person, we must see that **his certainty - however undesirable it may seem to us - is as legitimate and valid as our own** because, like our own, that certainty expresses his conservation of structural coupling in a domain of existence - however undesirable it may seem to us. Hence, the only possibility for coexistence is to opt for a broader perspective, a domain of existence in which both parties fit in the bringing forth of a common world. A conflict is always a mutual negation. It can never be solved in the domain where it takes place if the disputants are 'certain.' A conflict can go away only if we move to another domain where coexistence takes place. The knowledge of this knowledge constitutes the social imperative for a human-centered ethics."

Fernando Kaiowá says

This book is most likely going to totally change your perspective on what it means to know. Extremely well structured and well explained. I find it amazing how the authors are able to fit so many different topics into a meaningful cascade of concepts and theories that fits perfectly to their main conclusions, of cognitive processes as circular biological, social and linguistic phenomena inherent of living beings. The two biologists go well beyond their original disciplines, delving into philosophy, spirituality and psychology, as examples of overlapping domains in this such essential but overlooked (perhaps due to its complexity) concept of cognition. Indispensable!

Joe Raimondo says

Unpacking all the ideas and thinking in this book would take a lifetime. Essentially, the book discusses autopoiesis -- a process that the authors posit is universal by which objects in the physical world (living and non-living) incorporate information from their environment into themselves.

Andrew says

This book succeeds at using a relatively accessible framework and accessible language to lead the reader through what are quite challenging and perhaps counter-intuitive ideas about autopoiesis and cognition. For that, I'd definitely recommend it to anyone at all with more than a cursory interest in science, thought or society.

Magi says

This is the book that inspired me to give up fighting what I saw as mainstream unenlightened biological determinism in psychology, and enrol as a mature age student in psychology while a single parent of four. The language is difficult and challenging and the concepts complex, it took me many attempts to get it, but worth the effort. A classic, an all time favorite. I read it twenty years ago, after having the privilege of attending a workshop with the author, a delightful shaman of a man. His ultimate message is that human beings are biologically programmed for love, and that love and relationship in language is what makes us human.

Abailart says

This book came out of a series of lectures given by the writers as a contribution to a decision in 1980 by the Organization of American States to research the many difficulties confronted in social communication and knowledge transfer.

It begins by unmasking the 'temptation of certainty' in all branches of knowledge and proceeds thence to present 'a coherent formulation of the foundation of communication as the biological being of man.'

Clearly illustrated with diagrams, pictures and blocks of key points, the concluding chapter sums up the enterprise:

We began with the features of our experience common to our shared social life. From that starting point we moved on to cellular autopoiesis, the organization of metacellularity and their behavioral domains, the operational closure of the nervous system, the linguistic domains, and language. Along the way, we put together the building blocks of an explanatory system capable of showing how the phenomena proper to living beings arise. We came to see how social phenomena founded on a linguistic coupling give rise to language and how language, from our daily experience of cognition, enables us to explain its origin. The beginning is the end.

We have thus completed the task we set for ourselves, namely, that a theory of knowledge ought to show how knowing generates the explanation of knowing. This situation is very different from what we usually find, where the phenomenon of explaining and the phenomenon explained belong to different domains.

This quotation and the entire final chapter can be found at <http://www.mindfire.ca/The%20Tree%20o....> I've read that and am working through the book which, as well as anything else, is a useful primer for a layperson on cell formation, reproduction, evolutionary 'drift' and this will form the basis of a progression to more human behavioural and sociolinguistic phenomena with this biological base.

Moana Avvenenti says

Utterly confused and lost (partially in translation).

David says

"Humm... I'm going to bring my cabbages to someone who understands my needs."

Ricardo Roman says

El Árbol de Conocimiento, escrito por Humberto Maturana y por el inolvidable biólogo y maestro budista Francisco Varela, fue un libro que me marcó hace años, cuando comenzaba a conocer esta cultura de estudios y comprensión de la mente y el conocimiento. El conocimiento como forma de hacer, partiendo de formas de vida simples hasta el conocimiento humano y la formación de sistemas.

Es un libro que logra superar la visión reduccionista y mecánica de la mente como máquina de información, y poner la conexión con el cuerpo que conoce haciendo en su medio como adaptaciones prácticas.

Junto con el Conocer y El Cuerpo Presente de Francisco Varela, son trabajos que me dieron una nueva comprensión de mi propio aprendizaje, pensamiento y mi acercamiento a mi trabajo como desarrollo de transformaciones de visiones y prácticas sociales, laborales y corporativas, partiendo por la transformación de los individuos, lo que también me va transformando en el caminar de esos procesos.

Martin Hassman says

Podobný popis zařínající buňkou a končící nervovou soustavou, lověka, lingvistikou a sociologií jsem ještě neviděl. A přitom jsem opakovaně měl pocit, zda nečtu nějakou knihu o Zenu. Kniha se nachází někde mezi biologií, filosofií a spiritualitou. Přišla mi zbytečně dlouhá, řada biologického uvažování byla středověká a já tak dost přeskakoval. Dobrá k přemýšlení. Obsahuje řadu zajímavých poznatků i neobvyklých pohledů.

Oliver Hodson says

I like reading these technical books but I can never quite hang on to enough of the wow moments and 'penny drops' to keep it in my consciousness or communicate it to others properly but I'll give it a go.

I think the big concept is autopoiesis, which is that in living things there is an internal unity and divider between the living thing and the environment. This condition gives rise to possibilities of interaction, that in many lineages give rise to behaviour, and in some language, and in currently one circumstance knowledge of the actions the organism is doing (as well as much action that is structural and uncontrolled by the consciousness- especially our cellular goings on that give rise to that ability to know).

Another big idea here is the idea that adaptation is a conserved feature of living things. I like how this places competition and 'selection' (which the book also teases out nicely) in a broader context, and makes adaptation, rather than competition, the compelling feature of life.

Sooo... In the end we happen, with our consciousness and we are obliged to bring it forth in a way that allows others to share it. This is because allowing others to share in it allows both us and them to retain knowledge and to retain their adaptation to the environment.

I am a Christian, so I guess it probably sits well with me to have a moral system encouraging relationship, 'being in the now', and supporting altruism seemingly spring out of nature. I am not saying this justifies anything of my faith (which I really don't know how to justify) but it does sit well. Aside from that, I can see the power of the systematic and scientifically framed discussion of the origins, limitations, and possibilities of cognition and think this is an awesome book.

Mahipal Lunia says

One of those rare books that are a bit hard to read but ones that change one's outlook to life

Everardo Araújo says

Mesmo sem o declarar, o autor propõe uma discussão epistemológica - seria mesmo a epistemologia o "inferno" da filosofia? - sobre os fundamentos biológicos e sociais do conhecimento. Pelo que pude perceber, sua teoria do conhecimento se centra na percepção de que o pensar é pensado por alguém, o que muitas

vezes é esquecido pela epistemologia dominante. Seu ponto de vista converge para as extrapolações epistemológicas da mecânica quântica e de uma teoria social do conhecimento de sabor marxista. Valeu a leitura e merece uma nova futura leitura.

Darin Stevenson says

This book introduces an extremely complex topic 'autopoeisis'... which, simply rendered means... something like... intensely relational co-self-mergence into being, sensing and existence. But my definition pales.

This describes an entirely new direction in understanding living symmetries and relational hypersystems. Our minds, ideas, and life on Earth are explicit examples of such systems.

Astonishing, and requires a few readings over years to get the ideas clearly. If -realized- they turn minds into prodigy. This, however, is much more rare.

Donna Barthule says

I purposefully read this book three times in order to better comprehend as much as possible. If you are interested in cybernetics, whole systems, evolution, epistemology, or any related discipline then this book would be at home on your bookshelf. If you are at all interested in how we "work" .. we human beings, read this book, and whatever else you can find by Maturana and his protege Varela. Make a label for your bookshelf: Neurophilosophy, Etc. Put this book there after you've done reading it.

"When one puts objectivity in parenthesis, all views, all verses in the multiverse are equally valid. Understanding this, you lose the passion for changing the other. One of the results is that you look apathetic to people. Now, those who do not live with objectivity in parentheses have a passion for changing the other. So they have this passion and you do not. For example, at the university where I work, people may say, 'Humberto is not really interested in anything,' because I don't have the passion in the same sense that the person that has objectivity without parentheses. And I think that this is the main difficulty. To other people you may seem too tolerant. However, if the others also put objectivity in parentheses, you discover that disagreements can only be solved by entering a domain of co-inspiration, in which things are done together because the participants want to do them. With objectivity in parentheses, it is easy to do things together because one is not denying the other in the process of doing them."

Humberto Maturana - Interview 1985.
