Nicolescu's Transdisciplinary Logic: Inclusivity and Complexity

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This paper recounts the two pillars of logic Basarab Nicolescu developed when he formulated the logic axiom of his transdisciplinary methodology: inclusive logic and complexity logic. The paper starts with a distinction between complexity and simplicity and frames transdisciplinary actors as a complex adaptive system (CAS). After explaining traditional classical linear logic and three laws of thought (i.e. exclusive logic) and their inability to deal with complexity, the discussion turns to both inclusive and complexity logic as understood by Nicolescu (who drew on Stéphane Lupasco, and Edgar Morin, respectively). Nicolescu knew he needed ways to both a) not exclude anything that might be integral to addressing a complex, wicked problem; and b) weave emergent ideas into something new, ways that he respectively called inclusive logic and complexity logic. Used together, richer communications and inquiry are now possible amongst diverse minds increasing chances of confidently addressing complex, normative and wicked problems.

Keywords: transdisciplinarity, complexity, simplexity, inclusive logic, complexity logic, classical logic

Introduction

Transdisciplinarity (TD) means simultaneously between, among and far beyond disciplinary knowing (Nicolescu, 2002). *KOME* (a journal of pure communication inquiry) is committed to transdisciplinarity and topics relevant for more than one special discipline of social sciences. Most communication (i.e. the transmission and exchange of information or meaning) depends on logic – reason, argumentation, judgement and inference (Dignum & Weigand, 1995). "Logic is an essential skill for anyone who wants to communicate effectively. By learning to think logically, we can improve our ability

to persuade, resolve conflict, and learn from others" (Wilensky, n.d.-b, para. 2). Logic improves communication and inquiry "by enabling us to structure our thoughts, express ideas coherently, and construct persuasive arguments" (Wilensky, n.d.-b, para. 4).

Transdisciplinarity deals with wicked problems that are normative in nature (i.e. what *should/ought* to be done). Transdisciplinarity also involves sets of interacting agents each of whom has an agenda that can be manipulated by self and others *by using logic* (Dignum & Weigand, 1995). In his challenge to exclusive, classical linear logic (to be discussed), Professor Basarab Nicolescu (a theoretical quantum physicist) formulated two pillars of transdisciplinary logic: inclusive logic and complexity logic. Indeed, Nicolescu (2007) intentionally framed his seminal approach as *a formulation,* which means a) methodically creating or preparing something; and b) then expressing it in a concise and systematic way (Stevenson, 2011). His approach is not a theory, conceptual framework, model, or philosophy – it is a methodology, a new way to create knowledge (Nicolescu, 1994).

Nicolescu's (1985, 2002, 2014) novel approach to transdisciplinarity draws on the new sciences of chaos theory, quantum physics and complexity theory. He presented the culmination of his work as a *methodology* with its own set of philosophical axioms (i.e. reality, knowledge and logic – not axiology) that can be used to create new knowledge. His approach joins the company of long-standing conventional research methodologies (i.e. empirical, interpretive and critical methodologies) that each have their version of the four philosophical axioms (McGregor, 2018a, 2018b).

As an inquiry delimitation, although Nicolescu formulated three axioms (eschewing axiology), my paper concerns only the logic axiom while respecting the unarguable interconnections among all axioms; reality, knowledge, logic and values are interrelated (Nicolescu, 1985, 2002, 2014). Nicolescu (1985, 2002, 2009) knew he needed a way to both a) not exclude anything that might be integral to addressing a complex, wicked problem; and b) weave emergent ideas into something new, ways that he respectively called inclusive logic and complexity logic. To that end, to aid in his formulation, he chose Lupasco's (1951) conceptualisation of *inclusive logic* and Morin's (1974, 1984, 2005, 2008) conceptualisation of *complexity logic* over other approaches.

After distinguishing between complexity and simplicity as they pertain to normative wicked problems, and framing TD actors as a complex adaptive system (CAS) engaged in intense communication and inquiry, I describe traditional classical logic and laws of thought and discuss their inability to deal with complexity (Liang, 2017; Nicolescu, 2014). The paper concludes with a detailed overview of inclusive and complexity logic as formulated by Nicolescu (1985, 2002, 2014).

Complexity and complex adaptive systems

Transdisciplinarity concerns the complexity of the issues humanity is facing and the messy dynamics of human thought around how to confront, communicate and address wicked problems (e.g. pandemics, alarming climate change, profound unsustainability and grinding poverty). Wicked connotes fearful, intolerably bad, relentlessly aggressive

and distressingly severe (Rittel & Webber, 1973). Problems are wicked when they are "highly resistant to resolution" (Australia Public Service Commission [APSC], 2007, p. 1).

To continue, wicked problems are triggered when "serious disagreements among stakeholders are combined with complexity and uncertainty [wherein] we have crossed a threshold" (Head, 2008, p. 103). *Complex* wicked problems are context and situation unique, hard to define and very unpredictable. Many disparate stakeholders (with varying points of view, perspectives, interests, resources and power) are vying for a voice in their problematisation and resolution (Rittel & Webber, 1973; Stuart, 2018). They all agree *something* must be done, but what *is* that something?

The dynamics of answering this question are the crux of transdisciplinarity because wicked problems are extremely inclusive in nature. Multilemmas (polycrises – an array of disastrous situations) like pandemics in concert with climate change do not exclude anyone in the bigger scheme of things. Because everyone is affected in some way, it is imperative that all voices are heard rather than most being excluded. This imperative clearly highlights the non-simple nature of humanity's peril and the need for inclusion and a respect for complexity and what it *really* means.

Complexity

To elaborate, lay notions of complexity have it as not simple – it is involved, dense and intricate (Anderson, 2014). But central to Nicolescu's (2002) TD methodology is the appreciation that complex is much more than not being simple (from Latin *simplus* 'comprising a single element; plain and uncomplicated in form, nature or design; not compound'). Complex is from Latin *complexus* 'plaited, interlaced strands, intertwined, surrounded, encompassed, embraced' (Harper, 2024) (see Figure 1, Microsoft Clipart used with permission). The opposite of complex is *not* simplicity (i.e. a few parts, or easy to understand). Instead, it is that which is *not woven*. Indeed, *noncomplex* means independent and not connected (Alvira, 2014).
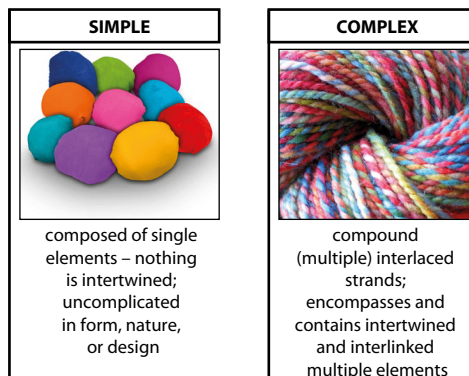

SIMPLE	COMPLEX
composed of single elements – nothing is intertwined; uncomplicated in form, nature, or design	compound (multiple) interlaced strands; encompasses and contains intertwined and interlinked multiple elements

Figure 1: Simple versus Complex
Source: Compiled by the author.

Complexity is thus nonlinear (no straight lines), meaning the interwoven strands are defined in relation to what they are connected to instead of defined by their individual characteristics (Alvira, 2014). Per Figure 1, the simple individual strands of colour are twisted together to create variegated yarns, which are then connected to each other to become a skein (bundle) of yarn. Those skeins are then used to knit a sweater. Linearity means the whole is *equal* to the sum of the parts (e.g. the cost of yarns used to make the sweater). But nonlinearity (i.e. things are defined in relation to what they are connected to) means the whole is *different from* the sum of all the parts (e.g. respectively, the sweater made from knitting different yarns). Some phenomena exhibit both properties. To illustrate, the cost of buying 10 stocks equates to the total cost of all of them added together (linear). But the variation (difference) in those 10 stock prices is often chaotic and tumultuous (nonlinear) (Alvira, 2014).

Complex adaptive systems and the edge of chaos

Herein, people engaged in TD work are conceived as a self-organising and self-regulating complex adaptive system (CAS) of many different actors and agents.

They are leaderless with no coordination, *yet* things still happen. Patterns emerge, *yet* no one was told or directed to make a pattern. They are governed by chance and randomness (stochastic), *yet* those involved trust that something will emerge. If any element of the system is altered, the whole system reacts and adapts. What is created has none of the traits of the contributing agents, *yet* they all created it (McGregor, 2020b, p. 3).

Their interaction and communication requires specific logic, so people can connect and *think* together in nonlinear fashion. CASs "are neither stable nor unstable [but] operate at the boundary between the two zones [...] on the edge of chaos" (Dann & Barclay, 2006, p. 22), which, in the new sciences, means order *is* emerging just not predictably.

The *edge of chaos* can be a space or a boundary. As a *space,* the very edge of chaos can be both a) physical (e.g. entering a region just hit by a tornado); and b) mental (i.e. people are at their highest level of adaptability and innovation – new order is ready to emerge). As a *boundary,* the edge of chaos refers to a place of emergence – a border where high turbulence and tensions exist with great potential (Liang, 2017). In a CAS, at the edge of chaos, people's ideas and thoughts can cross thresholds and transcend (i.e. climb up and over to a new space). In this process, both order and uncertainty can coexist as in a stock market. Many variables are constantly changing and moving toward some sort of temporary equilibrium, and they do so by themselves instead of being directed by an independent third party (Liang, 2017; McGregor, 2020b).

The ability to "maintain a balance between stability and turbulence [gives the system] dynamic stability" (Wang et al., 2015, p. 382). CASs that experience dynamic stability are "stable enough to maintain their structure, but sensitive enough to external changes that they can undergo rapid and unpredictable periods of change"

(Cleveland, 1994, p. 7). Good examples include stock markets, families, the Internet, weather systems, traffic flows, power grids and the human immune system.

In effect, Nicolescu (2002, 2014) called the edge of chaos the *zone of non-resistance* to others' Realities (i.e. the fecund included middle), which is mediated by the lubricating, mind-opening dynamic he called *the Hidden Third* (e.g. constituting art, drama, theatre, music, religion, the sacred and culture). This is the opposite of an outside third party controlling reorganisation; instead, in a CAS, the Hidden Third represents the unifying force operating in and emanating from the included middle where *two* or more contentious peoples and ideas are engaged, and each has a voice. Tensions and contradictions are natural and can be used to create something new. Morin (2005, p. 8) actually wondered whether the force that emerges among these relations is "a hidden force of nature, an intrinsic virtue" of complexity work.

Nicolescu (2014) was convinced that unique forms of logic are required to navigate the edge of chaos where new TD knowledge is both created from and contributes to complexity. These forms of logic are different from the long-standing traditional laws of thought (classical linear logic), which have governed human communications since Aristotle – for more than 2,000 years. Nicolescu (1985) formulated the new TD logic as inclusive logic and complexity logic, which are better understood when juxtaposed against exclusive logic (to be discussed). Inclusive logic deals with reconciling contradictory and antagonist ideas so new facts, thoughts and insights can emerge. People then use complexity logic to merge (weave) the emergent disparate strands of thinking into a complex new whole – new TD knowledge – to address the complex, wicked problem.

In short, inclusive means *including* integral elements whose absence would be notable, and complex means braiding those elements into something new to address the wicked problem (McGregor, 2018a). In that spirit, Nicolescu (2014) used the term *simplexity* to refer to the process of striving toward simple ends by way of complex means (simplexCT, 2013). Simplexity entails creating simplifying rules to reduce and improve one's understanding of complexity *without* altering the complexity of reality (Gélalian, 2018). Nicolescu commented that "in a paradoxical way, complexity is embedded in the very heart of simplicity" (2014, p. 100). "The new simplicity arises as an outcome from the process of many interdependent people working across many complex levels of Reality, achieved via simplexity" (McGregor, 2018a, p. 191).

Traditional laws of thought and exclusive logic

Rational human discourse is based on fundamental rules called *laws of thought*. Three traditional laws of thought constitute classical linear logic: the axioms of a) identity (A); b) contradiction (non-A); and c) the excluded middle or exclusive logic (Hamilton, 1859; Russell, 1912). These three laws (i.e. rules of logical thought and reasoning) are commonly represented as A, non-A and the absence of a third **T** state that is simultaneously A and non-A (see Table 1).

Table 1:

Comparison of Classical Linear Logic and Contemporary Nonlinear Logic

Classical Linear Logic (Simplicity and Duality) *Logic of the Excluded Middle* Reinforces Tension between A an Non-A	Contemporary Nonlinear Logic (Complexity and Nondualism) *Logic of the Included Middle* Frees Tension between A and Non-A
Axiom of Identity: A is A. - Everything is itself. - Whatever is, is.	*Axiom of Identity:* A is A. - Everything is itself. - Whatever is, is.
Axiom of Contradiction: A is not non-A. - No thing having a given quality also has the negative of that quality. - Nothing can both be and not be (e.g., be true and false at the same time).	*Axiom of Contradiction:* A is not non-A. - No thing having a given quality also has the negative of that quality. - Nothing can both be and not be (e.g., be true and false at the same time).
Axiom of the Excluded Middle (Third): There exists <u>no</u> third term **T** that is at the same time A and non-A. This **T** cannot exist in contradiction. No reconciling third possibility is logically foreseeable. - Everything must <u>either</u> be <u>or</u> not be – dualistic (either mind or body). - Everything <u>either</u> has a given quality <u>or</u> has the negative of that quality (e.g., it is either this or the other but not both).	*Axiom of Included Middle (Third):* There exists a third term **T** that is at the same time A and non-A. This **T** can coexist in contradiction, because when A is actualized, non-A is potentialized without either disappearing entirely – a reconcilable third is logically foreseeable. - Things can remain distinct without being separate (mind and body) – nondualistic. - Things can (a) <u>both</u> be this one <u>and</u> the other one or (b) <u>both</u> be <u>neither</u> this one <u>nor</u> the other one.

Source: McGregor, 2020c.

Classical linear logic is predicated on linearity, simplicity and duality (Hamilton, 1859; Russell, 1912). Respectively, linearity (straight lines) refers to sequentialism and one dimensionality (Liang, 2017). Simplicity means uncomplicated, not compound (few parts), and easy to understand (Anderson, 2014). Dualism (i.e. divided into two opposing aspects) reflects *either/or thinking.* Again, respectively, things happen in a logical order or sequence, are relatively easy to comprehend and there is no room for gray areas or contradictions. Dualistic thinking means something cannot be both A and non-A at the same time (e.g. cannot simultaneously be true [A] *and* false [non-A]) (Nicolescu, 2002, 2014).

Nicolescu (2002, 2014) acknowledged *exclusive logic* and found it lacking. Exclude is from Latin *excludere* 'to debar from admission or participation; prevent from entering or sharing; to hinder' (Harper, 2024). When applying exclusive logic when communicating, people reason, for example, that there is no possibility for anything to be right and wrong at the same time (i.e. the logic of the *excluded* third). Even hinting at such a thing is illogical.

To illustrate, based on the premise that the body and mind are two separate things (dualism), Western medicine focuses on the body (empirical science and controlled experiments) with no room for the mind (spirituality or intuition). In his justification for transdisciplinarity, Nicolescu (2014) viewed this distinction as the huge divide between, respectively, technoscience and spirituality. While respecting them and their role in

human communications, he blamed the classical laws of thought and exclusive logic for truncating human thought vis-à-vis complexity and complex, wicked problems.

To continue, exclusive logic assumes that ambiguity (i.e. unclear, undecided) cannot be tolerated. There is no middle ground (i.e. a standpoint or area midway between extreme or opposing positions) – thus the moniker the excluded *middle*: things *either* are, *or* they are not. From a TD stance, this logic assumes that knowledge cannot evolve *if* there are ambiguities or contradictions (Nicolescu, 2014). He held that this assumption is not necessarily wrong but is harmful, as it rules out too many ideas that may be fundamental (integral) to addressing complex, wicked problems. Worse, the potential to generate something new by using inclusive logic to resolve tensions between antagonistic ideas and contradictions is negated (Nicolescu, 2002). The creation of new TD knowledge is thus compromised, and wicked problems wreak havoc. Witness the lingering Covid-19 global pandemic, wherein resolutions to save humanity were compromised by seemingly intractable and non-reconcilable disparate perspectives (Al-Rodhan, 2021).

Transdisciplinary Logic

"Very few would try to maintain that [traditional logic] is adequate as a basis for understanding [...] everyday reasoning" (Smith, 2017, para. 5). Nicolescu (1985, 2002, 2014) formulated transdisciplinarity to offset his perceived inadequacy of classical laws of thought and linear logic when it comes to complexity and TD CAS dynamics. Specifically, he took issue with the third element of linear logic's triadic structure – the excluded middle **T** (see Table 1). "Even Aristotle considered the law of the excluded middle somewhat shaky" (Rohmann, 1999, p. 236).

Inclusive Logic

Nicolescu (2014) was convinced that the traditional laws of thought were "no longer valid in the quantum world" (p. 126). Thus, as part of his TD approach, Nicolescu (1985, 2000, 2002, 2009) formulated *inclusive logic* by drawing on Romanian philosopher Stéphane Lupasco's (1951) work related to the same construct. In classical logic, the **T** state cannot exist because contradictions are not accommodated. Something is either one thing or another but not both. Lupasco (1951) conceived instead that the **T** state *can* exist. It is neither *actual* nor *potential* but a resolution of the two contradictory elements at a higher level of reality or complexity than when the logical reasoning, communication and thought processes started (see Table 1).

For clarification, Nicolescu's (2002) ontology axiom comprises two levels of Reality: *TD Subject,* internal flow of perspectives and consciousness, and *TD Object,* external flow of facts and information. Movement among these realities to higher levels of complexity to create TD knowledge (epistemology) is mediated and lubricated by mind- and spirit-opening modalities such as culture, art, spirituality and religion (called the *Hidden*

Third). Richer details about his ontology axiom can be found at McGregor (2011) and Nicolescu (2009, 2016).

The adjective inclusive is from Latin *inclus* 'to enclose (contain, surround); to insert' (Harper, 2024). Inclusive logic holds that at the same time contradictions exist (A and non-A), a third **T** state *can* simultaneously co-exist (Nicolescu, 2002, 2104). This means that contradictions around ideas, thoughts, interests, perspectives and solutions are brought together and *can* coexist at the same table, *but* they do not merge, they do not exclude each other, and they never disappear (Desbois, 2012). Instead, while communicating about and addressing TD problems, any opposing ideas "cancel each other out" (Desbois, 2012, p. 95) thereby enabling the new **T** state to emerge. This idiom means that "both opposing ideas are equal to each other in force or importance but are opposite to each other and thus have no effect" ("Cancel each other," 2023). Any potential influence they may have had on addressing the problem is reduced because neither gains an advantage nor becomes privileged. They are equal but opposite.

But – and this *is* significant – the mere fact they *were* brought together to sit at the same table is why something new was created that would *not* have happened otherwise. Their juxtaposition in the new **T** state was made possible using logic that is conducive to inclusion (i.e. included, involved, added, taken in and encompassed). This logic holds that disparate people who do not normally work together concede something new can and will emerge from their reasoning, communication and thought processes, something bigger than themselves. This could be construed as TD altruism (i.e. temporary selflessness and a concern for humanity) (Blazer, 2011). This conciliation is temporary with the potential to become permanent (McGregor, 2017).

To continue, the struggle between opposites and contradictions during TD collaboratory work does not result in the two aspects being separated; they can remain distinct (clearly identifiable) without being separate (disconnected) (Desbois, 2012). They are connected by virtue of being on the table at the same time for consideration. When you think of it, they actually are inseparable because one cannot exist without the other – the existence of one idea means its opposite must also exist, which is very different from it is *either* one *or* the other (dualism) (Nicolescu, 2014) (see Table 1). Clear evidence of inclusive logic's ability to yield a temporary resolution of tensions is when a contradiction is resolved at a higher level of complexity than when the collaborative communication, thinking, reasoning and inferences started (Nicolescu, 2014).

As an example, consider a situation where Indigenous lands will be destroyed if corporate engineers build a dam. While the Elders are adamantly against the dam, the government (who sympathises with them) wants the dam because it will generate electrical power for the nation, including Indigenous peoples. Inclusive logic assumes they can reach a 'meeting of the minds', so the complexity of the situation can be respected and accommodated. This will require tense and contentious dialogue informed by all stakeholders and shaped by inclusive logic, which holds that people will not leave anything off the table because they assume something new can emerge *if* everyone keeps an open mind and nothing is excluded or privileged.

As a further caveat, I intentionally focused on Nicolescu's (2014) inclusive logic and his concern for noncontradictory rather than the overall constructs of contradictions

and inconsistencies per se, which are an inherent part of logic. Transdisciplinary scholars interested in these constructs may want to explore possible synergy between Nicolescu's inclusive logic and paraconsistent logic, which deals with inconsistencies in a discriminating way. Paraconsistent logic can also be applied in situations where people hold opposing views (Fisher, 2007). But instead of excluding things, "paraconsistent logic accommodates inconsistency in a controlled way that treats inconsistent information as potentially informative" (Priest & Tanaka, 2022, para. 2).

When formulating his approach to inclusive logic, Nicolescu (2002) also drew on the quantum notion of *cyberspace time* (CST) (see McGregor & Gibbs, 2020). Mihalache (2002) explained that CST is a way to capture the phenomenon of a previously nonexisting space that emerges in the process of its development via communication (like when people are addressing a wicked problem and have a temporary, eye-opening meeting of the minds). CST "is an aggregation of places (sites), not a space waiting to be filled" (Mihalache, 2002, p. 293). Nicolescu (2002) thus considered CST a connecting principle bridging people's a) subjective perceptions and consciousness; and b) objective facts, information, evidence and statistics (i.e. TD Subject and TD Object, respectively) via inclusive logic.

This bridge helps make people's disparate contributions to the wicked problem more evident and amenable, as they communicate with each other intending for something new to emerge (Nicolescu, 2002). Per Table 1, Nicolescu (2014) posited that the actualisation of A (one idea) leads to the potentialisation of non-A (contradictory idea) and to a new **T** (third) state where contradictions can be temporarily reconciled. During this TD problem addressing process, people are "linked by a relationship of contradiction" (Nicolescu, 2014, p. 132), which can be mediated by using both the logic of the included middle and complexity logic.

Paradoxes (contradictions and inconsistencies) are part of TD work and tied to inclusive logic (Nicolescu, 2014). Paradoxes serve "to arrest attention and provoke fresh thought" by contrasting two normally unassociated ideas to create a provocative idea (Editors of Encyclopedia Britannica, 2020, para. 1) (e.g. 'Less is more'). Recognising that logic involves paradoxes (Cantini & Bruni, 2017), Nicolescu (2014) drew on the *quantum paradox phenomenon* when formulating inclusive logic. This paradox holds that each particle (A and B) is in an uncertain state; each is in multiple states at the same time *until* measured or observed (called *superposition*) (Nicolescu, 2014; Rouse, 2020). Particle A's state becomes certain *when* it is measured or observed. Because particles A and B are quantumly entangled, when A is measured, B knows what its state is *supposed* to be (Jones, 2019). This paradox is evident in Schrodinger's (1935) cat thought experiment.

Although this quantum process cannot be observed with the human eye, the consequences *can* be measured (Rouse, 2020) – much like the process that unfolds within the included middle using inclusive logic cannot be *seen,* but the results can. Activities and thoughts of TD stakeholders are in an uncertain state, until they are not. Until things change, many possibilities exist. Once they *do* change, something different exists – because actualised A helped potentialised non-A to emerge (Brenner, 2011). Inclusive logic is very relevant to addressing TD problems because with complexity,

paradoxes "are widespread in contrast with the rigid logic of binary oppositions" (Marzocca, 2014, para. 7).

Complexity Logic

If the role of classical logic is to prevent or remove contradictions in reasoning and thinking (Landauer & Rowlands, 2001), then the role of complexity logic is to acknowledge and accommodate contradictions in reasoning and thinking (see Table 1). Indeed, "complexity has its own logic" (Desbois, 2012, p. 94), which lets people creatively and coherently cross and connect different ways of knowing and perceiving (Nicolescu, 2000). Inclusive logic temporarily reconciles contradictions inherent in multiple actors, *and* complexity logic allows for their different ways of knowing and melded perspectives to be woven into new TD knowledge (Nicolescu, 2002, 2014).

To formulate the logic of complexity, Nicolescu (1985, 2002, 2005, 2008, 2014) drew heavily on Edgar Morin's work on complexity thinking, especially Morin's notion of *generalised complexity,* which Morin equated with "the generalized interdependence of everything and everyone" (Morin, 2005, p. 21). That is, when confronting complexity, people cannot create new knowledge *unless* they "try to comprehend the *relations between* [emphasis added] the whole and the parts" (Morin, 2005, p. 6) instead of the characteristics of the parts and of the whole (i.e. nonlinearity as previously explained).

To continue, Morin (1974) believed complexity logic entails thinking about opposites at the same time (i.e. holding both in your mind while you think) instead of just describing each one and setting it aside assuming they cannot occupy the mind at the same time because they push against each other. The application of complexity logic "takes place in the force field where the tension between differences is upheld, brought together and kept apart at the same time [thereby giving] the 'logic of complexity' a paradoxical character" (Preiser, 2012, p. 201).

Assuming complexity cannot be reduced to simplicity but that simplicity can be used to understand complexity, Nicolescu (2005, 2014) formulated three types of complexity: a) *horizontal* (within a single Reality, [e.g. economics]); b) *transversal* (across different aspects of a single Reality [e.g. different types of economics: classical, ecological, feminist, and behavioural]); and c) *vertical* (crossing several levels of Reality [e.g. economics, historical, social and political]). Max-Neef (2005) suggested that as people engage with these different types of complexities, they gain glimpses within that "generate reciprocal enrichment that may facilitate the understanding of complexity" (p. 15). In effect, they get to peek into each other's thinking and gain a deeper appreciation for how complex things *really* are.

In his formulation of complexity logic, Nicolescu (2010) further distinguished between *simplexus* (within one fold) and *complexus* (many folds, intertwined and knotted) (see Gélalian, 2018). Nicolescu (2010) equated each type of complexity or level of Reality as simplexus and then proposed, without explaining it, the term *transcomplexity* for their unification. Luna and Alfonzo (2016) later clarified that, with transcomplexity, people can break away from restrictive dominant ontological visions (e.g. traditional laws

of thought, see Table 1). Transcomplexity thus pertains to multiple worldviews, multiple visions, and argumentative and propositional reciprocities (i.e. exchanging things for mutual benefit) (Bravo et al., 2020). With the logic of complexity, people can both a) have their models of the world, truths and knowledge; *and* b) challenge them, so they can reveal their limits, re-evaluate them with each usage, and reinvent them, if necessary. This process leads to transcomplexity – a state beyond the original levels of complexity (Preiser, 2012).

As with inclusive logic, Nicolescu also drew on CST to formulate complexity logic. Instead of viewing spacetime as smooth, CST views it as "*quantum foam* to describe the turbulence [and tension therein]" (Nicolescu, 2014, p. 67). "Dimensions unfurl and furl back in on themselves [...]. They blink in and out of existence like the bubbles in a freshly poured beer" (NASA Science Casts, 2015, 1:27–1:38; see also Wilczek, 2010). Instead of linearly (smoothly) moving through the problem-solving process, complexity logic has people moving through a complex and turbulent space comprising a mass of constantly reforming miniscule bubbles (i.e. foam).

Because CST is presumed to comprise many small, ever-changing regions, each of space, time and cyber connections (while communicating) fluctuate in a foam-like manner (Wilczek, 2010). These small bubbles of foam could represent the diverse mindsets within the TD CAS vying for a voice during complex communications and interactions. These interactions (i.e. voices coming and going over time) merit a *logic of complexity* because interpenetrating viewpoints generate inherent tensions that must be thought about using a different logic than linearity (Cillier & Nicolescu, 2012). "All views on the problem must be *included* and any contradictory positions must be temporarily reconciled so strategic and innovative solutions to the problem can be formulated, agreed to and implemented" (McGregor, 2018a, p. 194).

Conclusion

Effectively and efficaciously addressing complex, wicked problems is an incredibly inclusive and complex process requiring inclusive logic and complexity logic. Appreciating this truth, Nicolescu turned to Lupasco's (1951) notion of the included middle (inclusive logic and the **T** state), and Morin's (2005) theory of generalised complexity. Through these lines of thought, Nicolescu (2002, 2014) articulated the logic axiom of his uniquely formulated TD methodology for addressing complex, wicked problems.

Address is the correct verb because complex TD problems cannot be completely *solved;* they can only be addressed (Stuart, 2018), which entails directing attention and resources to them to better understand them thereby preparing people to *begin* to deal with them (Anderson, 2014). Both types of TD logic are needed to communicate about, reason through and address problems that are inclusive, complex and wicked (Desbois, 2012; Liang, 2017; Nicolescu, 2002, 2014). Leaving out (excluding) people, ideas and perspectives because they might be antagonistic, or contradictory is not tenable. Too much is missed. Too much is at stake when facing complex polycrises.

The classical laws of thought (see Table 1) predicated on linearity, simplicity and dualism are not enough anymore. Basarab Nicolescu realised this and ruminated then formulated accordingly. When he first published his seminal work, Nicolescu (1985, 2002) was considered vanguard and a rebel – he was *way* ahead of his time. He himself commented on "the problem of formulating a new 'quantum logic'" (Nicolescu, 2014, p. 122) and "the visceral fear of introducing the idea of the included third" (p. 123). Fortunately, people can now access his leading-edge formulations of inclusivity and complexity logic – and the world will be better for it. Richer communications and inquiry are now possible amongst diverse minds increasing chances of confidently addressing complex, normative and wicked problems.

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