Opinion

Climate change and social transformations: is it time for a quantum leap?

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Climate change is recognized as an urgent societal problem with widespread implications for both natural and human systems, and transforming society at the rate and scale that is mandated by the 2015 Paris Agreement remains a major challenge. Do we need to be open to new paradigms for social change? In this opinion piece, I draw attention to the emerging field of quantum social theory and consider its implications for climate change responses. Quantum social theory considers how concepts, methods and understandings from quantum physics relate to societal issues, and it provides a physically based, holistic perspective on conscious and intentional transformations to sustainability. It is distinct from other social theories in that it raises deep metaphysical and ontological questions about what is *really* real. I explore the methodological, metaphorical and meaningful significance of quantum social theory for understandings of social change. Quantum concepts such as entanglement, complementarity, uncertainty, and superposition provide a strong basis for recognizing and promoting *people* as the solution to climate change.

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INTRODUCTION

> A lost number in the equation. A simple, understandable miscalculation. And what if, on the basis of that, the world as we know it changed its matter of fact? Let me get it right: What if we got it wrong? (Lemn Sissay, What if?)[1]

What if we really *have* got it wrong? Lemn Sissay's powerful and thought-provoking poem questions not only our definition of progress and our approach to development in a changing climate, but also our capacity to listen: 'What if the message carried in the wind was saying something?'[1] His call for reflection is not questioning the reality of climate change, but rather challenging the assumptions underlying current responses to global environmental challenges. Of particular interest to climate change research is Sissay's contention, later in the poem, that 'It's the small things that make great change.'[1]

This poem makes me wonder whether we are currently underestimating our capacity to transform society at the rate and scale that is called for by climate change science and mandated by the 2015 Paris Agreement under the United Nations Framework Convention on Climate Change. Are the possibilities for transformations to sustainability greater than we think? Do we need to be open to new paradigms for social change? A paradigm, or 'the world view underlying the theories and methodology of a scientific subject,'[2] represents the deepest set of beliefs about the way that the world works, and it can be a powerful leverage point for systems change.[3]

The worldview or paradigm that underlies much of the current thinking on climate change

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mitigation is based on the assumptions of classical physics, where agents are discrete individuals or self-interested states that interact through local causation, with little or no role for subjectivity, consciousness, intentionality, and free will. Whether in relation to rational choice theory, game theory, or approaches to global commons and public goods problems, the social world in which climate change responses are deliberated, negotiated, and enacted is ultimately deterministic. If humans are as predictable as matter and material, is there any hope for social change through individual and collective agency?

In this opinion piece, I consider what a quantum paradigm might offer to understandings of climate change responses. Quantum mechanics refers to a set of ideas developed to better explain and describe processes at atomic and subatomic scales. It is, however, also relevant to macroscale phenomena, including transistors, lasers, LED lights, as well as many features of the universe. Drawing attention to an emerging field of quantum social theory, which considers how concepts, methods, and understandings from quantum physics relate to societal issues, I reflect on its significance for social transformations. Quantum social theory supports or reinforces many of the understandings of relationships between social structures and human agency described by social scientists. However, it also provides a physically based, holistic perspective on conscious and intentional actions by 'entangled' individuals who can collectively influence systems and structures that appear stable or entrenched. Interpreted through a social lens, quantum concepts such as entanglement, complementarity, uncertainty, and superposition provide a strong basis for recognizing and promoting *people* as the solution to climate change.

There are admittedly diverse opinions on quantum theory's relevance at the scale of society, including considerable skepticism. However, I will argue that if we take climate change seriously, we should also take quantum social theory seriously—at least enough to engage in discussions and debates about its significance. Why? Because we know that paradigms and worldviews influence the way problems are framed and addressed, and that social theories are enacted and 'performed' through social actions. Currently the role of individuals is trivialized, limited to changes in behavior or consumption patterns, or to traditional expressions of political agency (e.g., by voting or supporting leaders).[4] If anything, quantum social theory shows that people matter more than they think through an entangled, collective impact.

If we have got it wrong, we risk underestimating the potential for humans to respond effectively to systemic problems, which can limit successful adaptation to climate change. Without questioning the classical underpinnings of social science, we are likely to continue along rational, deterministic trajectories that prioritize technical responses over adaptive changes. Quantum social theory allows us to explore the full range of possibilities and potentials available when people consciously and actively engage with transformations to sustainability.

CLIMATE CHANGE AND SOCIAL TRANSFORMATIONS

Climate change calls for collaborative responses at an unprecedented rate and scale to decrease the likelihood of severe, pervasive, and irreversible impacts on people and ecosystems.[5] Most agree that this includes drastic reductions in global greenhouse gas emissions, which are largely attributable to the burning of fossil fuels and deforestation. In terms of IPCC emissions scenarios, the challenge can be represented as a shift from the current trajectory leading to a global warming of 2.6–4.8°C to one that is compatible with warming of less than 2°C by 2100.[5] This shift represents a dramatic deviation from business as usual—metaphorically, a quantum leap—and implies transformations in energy, transport, agriculture, production, consumption, and many other systems associated with today's carbon-intensive economy and society. Reductions in greenhouse gas emissions alone, however, are not sufficient to ensure a secure future for humanity. There is also a need to adapt to current and anticipated impacts as well as reduce the factors contributing to risk, vulnerability, and human insecurity.

Although climate change is recognized as an urgent problem with widespread consequences for both natural and human systems, societal responses are lagging far behind the drivers and dynamics of climate change. Recent scientific papers and assessments show that there are limited opportunities for avoiding dangerous climate change, at least not without first 'overshooting' the targets, then relying on bioenergy and carbon capture and storage to recover.[5] The limitations are often associated with a range of factors that influence social structures and systems, including constellations of power, politics, interests, values, behaviors, and human needs.[6] With the observed impacts of climate change becoming increasingly visible, many are dismissing the 2°C target as unrealistic, focusing instead on adaptation, disaster risk management, or geoengineering.

To counter this narrative, there are increasing calls for deep transformations in economic, social, technological, and political systems.[5,7] Whether discussed in terms of climate-resilient pathways for sustainable development, a safe operating space for humanity, or planetary stewardship, these responses involve deliberate actions and intentionality; that is, a commitment to changing the behaviors, structures, and systems that contribute to what many consider to be undesirable and potentially dangerous outcomes, including increased temperatures and climate extremes, rising sea levels, food and water insecurity, and other environmental and social impacts.[5,8] Importantly, behaviors, structures, and systems are influenced by individual and shared beliefs, identities, norms, values, and worldviews, which can be linked to different theories of social change. Frank Geels, for example, identifies and compares seven foundational theories of change and considers how they relate to transitions to sustainability.[9] His comparison is accompanied by a call for reflexivity about differences in underlying assumptions, as well as greater attention to the causal mechanisms associated with different theories and approaches to sustainability

Paradigms play an important role in understandings of social change, including explanations of causal mechanisms. The positivist social sciences implicitly or explicitly assume that the macro world behaves according to the laws of classical Newtonian physics, which are generally characterized by materialism and determinism.[10] Many alternatives to understanding change have been offered by social scientists, including feminist approaches, post-structuralism, critical realism, actor network theory, and social practice theory. These alternatives present a formidable critique of positivist science, yet have had little impact on policies and institutionalized responses to climate change. In fact, epistemological divisions between the natural and social sciences makes interdisciplinary and transdisciplinary research difficult, and this has long been a stumbling block for collaborative and integrated global change research.[11]

Quantum social theory introduces a perspective that can contribute insights on social transformation from both naturalistic and interpretivist perspectives.[10] It challenges some of the basic assumptions about the physical and social world, potentially (re) introducing personal experience into physical science.[12] It is distinct from other social theories in that it raises deep metaphysical and ontological questions about what is *really* real. Quantum theory or mechanics, considered the most successful theory in physics for describing molecular, atomic, and subatomic-scale systems, has raised such questions since it was developed over a century ago. Quantum mechanics recognizes that elements can exist as both waves and particles, and it relates the collapse of the wave function to measurements. Quantum entanglement describes particles that interact nonlocally without communicating. These particles cannot be described separately, and instead must considered as one system, at least until measurement is made. The probability of observing different outcomes in experiments can be predicted by a mathematical formalism known as Schrödinger's equation.[13]

The idea that quantum phenomena, characterized by nonlinearity, nonlocality, and potentiality, are relevant to macroscale systems has traditionally been dismissed, if not ridiculed. This is because quantum coherence apparently cannot be maintained in contexts that favor random scattering, vibration, and motion.[13] Nonetheless, recent research in quantum biology suggests that some processes, such as photosynthesis, bird navigation, and sense of smell, are quantum rather than classical, and that relatively small numbers of highly ordered particles can make a difference through processes such as quantum tunneling.[13] In other words, it is increasingly argued that 'the division between the quantum and classical worlds appears *not* to be fundamental' (Ref 14, p. 43, italics added).

A QUANTUM SOCIAL WORLD?

What are the implications of quantum theory for society? This question is drawing increasing interest and attention, particularly as technologies such as quantum computing and quantum cryptography develop. For example, a transdisciplinary dialogue on the societal implications of quantum theory has been initiated through 'Project Q: Peace and Security in a Quantum Age.'[15] This dialogue embraces quantum social theory, which can be described as an emerging field of research that considers the wider, macroscale social implications of quantum theory. As with quantum theory itself, there are numerous interpretations of quantum social theory, and no consensus as to its significance. Some interpretations include the conjecture that we live in a world where quantum effects such as entanglement are relevant not only at the molecular, atomic and subatomic scales, but also in biological systems and potentially social systems. [10,16] Other interpretations make no such claim, yet still argue that the implications of quantum theory are important for social research.[17,18]

There are three interpretations of quantum social theory that may be relevant to understanding and enabling social transformations in a changing climate. The first approach involves the use of 'quantum-like' statistical models to study probabilistic-dynamical systems. In *Quantum Social Science*, Emmanuel Haven and Andrei Khrennikov describe its goal as the investigation of economics, finance, psychology, sociology, and other domains of inquiry with the help of formal models and concepts used in quantum physics.[18] The fields of quantum interactions and quantum information theory have successfully applied quantum formalisms and quantum-like models to the fields of cognition and decision-making processes.[15] Quantum decision-making recognizes that judgments and decisions are influenced by context, and that entangled systems cannot, in theory, be modeled as separate systems.[18]

Importantly, this statistical approach does not assume that quantum physical effects are really part of the social world. Although it applies quantum mathematics to social and cognitive phenomena, it considers that these phenomena are based on classical information processing consistent with the neuronal paradigm of neurophysiology and cognitive science.[18] It draws attention to quantum theory as a statistical theory, recognizing that the interference of probabilities is a basic statistical feature of quantum theory.[18–20] Quantum formalisms are merely considered a more effective way of processing incomplete information and accounting for the interference of probabilities in macroscopic quantum systems.

A second approach to quantum social theory is presented by Karen Barad in *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*.[17] Barad's 'agential realism' is derived from quantum measurements and the inseparability of objects and subjects, which she refers to as 'agencies of observation.' Building on Niels Bohr's work and the Copenhagen Interpretation of quantum physics, agential realism recognizes our participation within nature and considers phenomena to be constitutive of reality. Drawing on feminist theory, Barad sees objectivity as contextual and embodied, simultaneously material and cultural, with boundaries that are not fixed and a future that is radically open.[17,21,22] Agential realism challenges commonly held notions of identity, agency, and causality.

Barad's agential realism rejects the metaphysics of individualism and instead rethinks causality in terms of intra-actions, which she defines as nonarbitrary and nondeterministic causal enactments, or the process through which matter 'becomes.'[17] In dissolving the subject–object dichotomy, humans become part of the larger material configuration of the world: 'Matter is a dynamic intra-active becoming that never sits still—an ongoing reconfiguring that exceeds any linear conception of dynamics in which effect follows cause end-on-end, and in which the global is a straightforward emanation outward of the local' (Ref 17, p. 170). Through entanglements, Barad's interpretation of quantum social theory allows a much larger space for agency, and her ontology recognizes a vitally alive universe. Barad does not, however, argue to the effect that 'the quantum theory of the micro world is analogous to situations that interest in the macro world—be they political, spiritual, psychological, or even those encountered in science studies' (Ref 17, p. 70). Her focus is instead on rigorously examining the real consequences, creative possibilities and responsibilities associated with our intra-actions within and as part of the world.[17,21]

A third approach to quantum social science is Alexander Wendt's quantum consciousness hypothesis.[10,23,24] In *Quantum Mind and Social Science: Unifying Physical and Social Ontology*, Wendt discusses how and why metaphysical assumptions of the classical worldview (which include materialism, determinism, locality, and atomism) are challenged by a quantum social science that emphasizes nonlocality, indeterminism, and holism. He challenges the assumption that quantum effects are irrelevant to the macro scale and considers how social life would be explained from a quantum perspective, that is, viewing humans as 'walking wave functions' of potentiality and possibility that intra-act through quantum characteristics, rather than as discrete individuals that interact classically.[10]

Wendt, an international relations systems theorist, makes this realist claim based on a review and assessment of a wide body of literature on the philosophy of mind and philosophy of science. Unlike the other approaches, Wendt's theory *does* consider quantum physics to be potentially a macroscale phenomenon. Drawing on insights from quantum brain theory (suggesting quantum coherence in the brain) and panpsychism (considering consciousness as an attribute of matter at the elementary level), Wendt's ontology recognizes the fundamental significance of consciousness and free will, both of which have been ignored or deliberately excluded from the natural sciences and most positivist social sciences.[10] Wendt challenges understandings of classical human beings as completely material, where (1) mental states are nothing more than brain states; (2) individuals are completely separable, independent, and well-defined at the micro level (i.e., in a given state); (3) individuals respond only to local causal forces; and (4) behaviors

are completely determined by internal and external causes, rather than by free will.[10] This classical, Newtonian model of humans omits subjectivity altogether, leaving no place for experience, meaning, and purpose. Wendt's quantum social theory accommodates subjectivity within a naturalistic worldview, allowing the social sciences to make sense of human activities without resorting to the dualism and determinism associated with models of classical physics.[10]

Similar to Barad's agential realism, Wendt argues that human beings are not fully separable, but rather entangled and intra-acting, and that these intra-actions collapse shared wave functions into practices, materializing (i.e., bringing into being) both agents and social structures.[10,17] Although social structures are external to individuals, they are, according to Wendt (Ref 10, p. 208) 'internal to human beings collectively.' Consistent with Anthony Giddens' structuration theory,[25] Wendt's quantum social ontology is ultimately process-oriented, rather than agent- or structure-centric:

> [S]ocial structures are not actual realities existing somehow above us in space, but potential realities constituted by inherently non-local shared wave functions. In this way, quantum theory underwrites a 'flat' rather than stratified social ontology, in which individuals are the only real realities. While that might seem to vindicate individualism, the holism and non-locality of quantum theory belies that conclusion. (Ref 10, p. 33)

Quantum theory thus challenges the vertical discourse of 'bottom–up and top–down' in favor of a horizontal discourse of 'inside–out' and 'outside–in' (Ref 24, p. 283). This is consistent with a flat ontology, or what Sallie Marston et al. refer to as 'geography without scale.'[26] Quantum social theory legitimates intersubjective meanings, discourse, culture, and ideas, justifying both intentional and structural explanations. In a quantum social world, we are not agents, but *agency*: 'someone who is never in a state of Being but always of Becoming' (Ref 17, p. 365). How we collapse or 'perform' our wave function thus makes a difference. As Barad (Ref 17, p. 394) puts it, '[o]ur (intra)actions matter—each one reconfigures the world in its becoming.'

In summary, quantum social theory supports a holistic, nondualistic worldview that emphasizes non-local entanglements, where consciousness and free will can influence structures and systems, both of which exist in a quantum world of potentiality. The idea that quantum theory can contribute to alternative understandings of the social world is by no means new, yet it has not been taken seriously in the social sciences.[16,27] In an article published in 1994, William Peterman considered the implications of quantum theory for geography, suggesting that it might provide a better way of describing and understanding social space by including the contextual dimensions of meaning and values, potentially bridging positivist and humanistic approaches to geography.[27] The article generated critical commentaries for its lack of application and alleged misuse of a metaphor. In responding to commentaries, Peterman defended an alternative scientific basis for geography, pointing out that quantum theory, similar to Alfred North Whitehead's process philosophy, describes 'a world in which change, interconnections, and creative uncertainty dominate' (Ref 28, p. 222).

Quantum social theories have more recently been applied to both urban and globalization studies. For example, Caleb Rosado explores how 'context contributes to content' in urban areas, and considers the role that the holistic worldview associated with quantum physics plays in urban transformations, in comparison to a fragmented worldview.[29] In looking at the politics of global development and social justice, Ann El Khoury explores how ontological shifts and alternate and pluralistic ways of knowing can help people assert human agency, reclaim space, and convert heterodox visions of the future into plural enactments of possibilities.[30]

QUANTUM SOCIAL THEORY AND SOCIAL TRANSFORMATIONS

In what ways can quantum social theory contribute to better understandings of social transformations within the context of climate change? The answer clearly depends on interpretations of both quantum mechanics *and* quantum social theory. Here, I present some initial thoughts, focusing on the methodological, metaphorical and meaningful significance for understandings of social change.

Methodological Significance

Whether in relation to mitigation or adaptation, responses to climate change are closely tied to human decision-making processes and to negotiations among parties with diverse interests, both of which are influenced by subjective perceptions. The mathematical interpretation of quantum social science advocated by Haven and Khrennikov challenges some of the methodologies used to study social phenomena.[18] For example, quantum models of decision-making may be able to better explain and

predict decisions, including preference reversals, in comparison to methods based on expected utility theory.[18,31–33] As another example, quantum game theory is considered interesting because of the close connection between game theory and the theory of quantum communication.[34] In exploring the quantization of nonzero sum games, Jens Eisert et al. show that novel features emerge when classical games like the Prisoner's Dilemma are explored using quantum methodologies.[34] In fact, by allowing for quantum strategies and entanglement, the Prisoner's Dilemma ceases to be a dilemma.

Q Methodology, used in psychological and social scientific research to assess subjective viewpoints, is also related to quantum physics, with the factor analysis representing the mathematical equivalent of the matrix model of quantum mechanics.[35] Q methodology has been used in a number of studies of subjective attitudes and beliefs related to climate change.[36,37] Methods that accommodate subjectivity (including critical reflexivity) and allow for nonrational outcomes (e.g., based on transcendent values or altruism) may contribute to a wider range of scenarios that include opportunities for unexpected responses to climate change. For example, quantum methodologies might challenge the classical assumptions of socioeconomic scenarios used in integrated assessment models, such as in shared socioeconomic pathways and shared climate policy assumptions.

Metaphorical Significance

The metaphorical significance of quantum social theory's holistic perspective cannot be underestimated. One of the features of quantum theory is that the observer and observed are not separate, but part of a single system.[17] This single system idea is consistent with the framing of Earth systems science, which sees humans as part of a large, integrated system.[38] From the perspective of quantum social theory, humans can and do consciously and intentionally transform this system through their intra-actions. In a sense, the physical is social. Metaphorically, quantum social science has implications for collaboration; it may involve nonlocal connections related to shared language and meaning[10] and thus extend beyond collaboration in a classical sense, that is, focused on personal, organizational, or cultural skills or traits conducive to joining individuals together to tackle social issues.[39]

Quantum metaphors can potentially empower individuals and groups through a transformed sense of agency, enabling them to influence what are currently represented as classically 'linear' pathways in radical, nonlinear ways. Reflecting on the implications of quantum theory for climate change, physicist Shohini Ghose reminds us that 'nature has shown us that you can take the smallest amounts—trace elements of matter—and they can actually make huge impacts and change the planet. So can *we* be those trace elements and make tiny actions that collectively change the world?'[40] In other words, quantum social science metaphorically draws attention to the possibility for individuals to contribute to collective impact and a quantum leap to sustainability.

Meaningful Significance

Perhaps most important, quantum social theory legitimates subjectivity within climate change science. Theoretically speaking, there is no room for subjectivity in classical physics and behaviorism, where consciousness and intentionality are not considered to be important and where even the existence of free will remains subject to passionate philosophical debate.[10] Positivism has explicitly or implicitly influenced many analyses of climate change responses, at the same time imposing a sense of illegitimacy on social science approaches that do take subjectivity seriously. If sustainability is indeed a choice that depends on human responses to climate change, consciousness and free will must be taken into consideration. Yet, there is no scientific agreement as to whether consciousness really exists, and if so, what it actually is.[41]

Wendt's interpretation of quantum social theory considers consciousness as decoherence or collapse of a quantum wave function into a defined reality, resulting in the everyday world that we perceive and experience.[10] He argues that the subjective manifestation of wave function collapse in the moment is neither individual nor collective, but the outcome of dynamic relationships between the two.[10] As a quantum phenomenon, consciousness has implications for understandings of social life, including relationships between individuals and groups and between structure and agency. More important, it helps to understand how shared meanings shape the future, and why the *experience* of agency is not causally determined, but free and full of potential.[10]

Wendt's argument is speculative, based on a thought experiment that presupposes quantum coherence in the brain. Nonetheless, his theory introduces a physical basis for a holistic, interconnected view of society, where free will and agency are considered fundamental aspects of the social world. Quantum human beings are, according to Wendt, vitally alive. Through cognition, will and experience, humans can

deliberately reflect upon and transform the decisions and structures that shape the future.[10] This may potentially relate to generative visions of quantum mechanics such as quantum-Bayesianism (QBism), which considers how beliefs and experiences guide agents in their interactions with the world.[42]

Although quantum mechanics is the most effective theory of physics, its metaphysical implications have been difficult to grasp, thus it is not surprising that it has been regarded as distinct from classical physics and hence irrelevant to social life and insignificant to social transformations. Yet as Jim Al-Khalili and JohnJoe McFadden (Ref 13, p. 295) ironically point out, 'Quantum mechanics is normal. It is the world that it describes that is weird.' Quantum social theory shows that the distinction between the quantum and classical world may itself be a construction, with quantum reality offering new possibilities for both understanding and enacting change. The significance of quantum social science is nicely summarized by El Khoury:

> Quantum theory reflects, and eventually tries to incorporate the existence of paradox and incommensurability in our physical experience. It may also help make conceptual space for multiple ways of operating in the same space, with no singular or hegemonic 'way' possessing sole spatial sovereignty. It has informed a newly probabilistic social science where reality and the representation of reality (or its performance and construction) incorporate potentiality, not simply actuality. Through a quantum-influenced philosophical realism, it is easier to imagine how what is not yet or in potentia inhabits reality. Reality is open and unfinished rather than closed and fixed, and has both an ideational and a material basis. (Ref 30, p. 207)

The quantum nature of society does not make human behavior more predictable, but instead allows for an indeterminate, spontaneous vital force to influence the future through collective purposiveness.[24] Quantum social theory introduces meaning into what might otherwise be considered a meaningless world. In Barad's words, '[t]he world and its possibilities for becoming are remade with each moment' (Ref 17, p. 396).

CONCLUSION

In this opinion piece, I have drawn attention to an emerging field of research that is both intriguing and provocative—one that asks us to directly engage with the assumptions, beliefs, and paradigms that have led to a convergence of interrelated global crises. Yet many will ask, why should we bother with quantum social science, particularly if the social sciences and humanities are already saying many of the same things? I suggest three reasons:

First, given the serious nature of climate change and its implications for social–ecological systems, it may be helpful to keep an open-mind to alternative paradigms, allowing for curiosity and exploration rather than the safety of certitude: '[T]o recognize multiplicity is to enlarge rather than fracture the world.' (Ref 30, p. 219). Although fragmentation and division can be convenient and useful for thinking about the practical, technical, and functional aspects of problems, quantum physicist David Bohm emphasizes that the larger whole itself cannot be fully perceived and understood through fragmented thinking.[43]

Second, in the world of global change research, nonpositivist perspectives from the social sciences and humanities are often marginalized. Quantum social theory supports areas of research (e.g., posthumanism, new materialism, biosemantics, panpsychism, and others) that could potentially incorporate subjectivity and meaning into studies of the Earth System. Being aware of human impacts on the environment is important, but arguably insufficient if it does not activate both reflection and engagement. If anything, quantum social theory provides the scientific backbone for what Andreas Weber (Ref 44, p. 11) refers to as a shift from an Enlightenment paradigm to an 'Enlivenment paradigm,' or a cultural worldview that emphasizes the importance of 'lived experience, embodied meaning, material exchange, and subjectivity' as key to addressing complex problems like climate change. Quantum social theory challenges us to recognize that life matters, subjective meaning matters, and we matter.

Third, quantum social theory is important because theories tend to be self-fulfilling: 'If human agents regard a given premise as true, they will act accordingly and reproduce that reality; structure and agency are continuously co-constructed' (Ref 30, p. 183). Quantum social theory, with its nonlocal, nondeterministic, and participatory approach to change, may appear strange and counterintuitive in relation to classical understandings of society. Yet by taking subjectivity seriously, a social science based on quantum physics arguably conforms better to how we experience the world relative to a social science based on classical physics.[10] Furthermore, as we teach students about complex, interacting, and urgent global problems, there is good reason to

provide them with an expanded set of theoretical and methodological tools with which to address them.

In conclusion, given that current responses to climate change are incommensurate with the risks that we are facing, and considering that deterministic, materialistic and individualistic approaches appear inadequate to the challenge at hand, it may be time for a new approach. A quantum leap is not a causal trajectory, but an actualization of possibility. Quantum theory poses deep metaphysical questions that challenge rational understandings of the world.[45] By continually asking ourselves, 'what if we got it wrong?' we are likely to become more aware of not only the role and significance of subjectivity, meaning, and collective human agency, but also the possibilities and potentials for transformative social change. Quantum social theory draws attention to people as the solution to climate change which, referring back to Sissay's poem, compels us to change our 'matter of fact.'

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