



WHY IS
SMALL
SO POWERFUL?

by Keith Wiebe Gordon
featuring Mr. Big



the **power of small**
A LOCAL ALTERNATIVE



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Almost 800 years ago, in a small village tucked away in a remote corner of India, a bumbling and absent-minded scholar named Gopal stumbles upon an ancient manuscript buried deep within the stacks of a forgotten library.

As Gopal dusts off the yellowed pages, he comes across the Vaisheshika Sutras, written by Kanada, one of India's greatest thinkers. Unknown to Gopal, he has stumbled upon a groundbreaking revelation lost in his country for centuries.

Completely oblivious to the historical significance of Kanada's text, Gopal begins to study the Sutras as he would any other piece of literature, with a comically misinformed and haphazard approach. As he reads about Kanada's theory of atoms, Gopal chuckles and dismisses the concept as the ramblings of an eccentric ancient thinker. He puts Kanada's

text on his bookshelf and forgets about it.

One day, while indulging in his peculiar hobby of watching ants build huge colonies from the Indian soil using the very smallest of actions, Gopal suddenly wonders if there is more to the ancient ideas of Kanada than he first thought.

The next day, Gopal takes Kanada's ancient text off his bookshelf and carefully wraps it in his packsack. Gopal has decided to go on a long journey to find out if other scholars in faraway places can shed any light on his discovery.



Hi! My name is Mr. Big. Sorry to interrupt you, but I need to make sure you don't get tricked by all this fake power of small stuff. I mean, who believes small is good? And this Gopal story, really? It sounds totally made up if you ask me. Stay cool. Stay big. Talk later.

After a long and perilous sojourn, Gopal reaches Baghdad and discovers the House of Wisdom, a library which contains a vast collection of manuscripts and books from various cultures and civilizations. Gopal introduces himself to the resident scholars and slowly unwraps the ancient

writings of Kanada and his theory of atoms.

After a quiet reading of the text by one of the older scholars in the House of Wisdom familiar with the ancient languages of India, the sage locks eyes with Gopal, and stares at him for what seems like an eternity. Suddenly the Baghdad scholar exclaims, "Your Kanada's theories on atoms predate the same atomic theories recorded by the Greek philosopher Democritus by hundreds of years!"

When Gopal is shown the writings of Democritus and compares them to the writings of Kanada, while remembering his observations of the tiny actions of ants, his mind is flooded with a profound understanding of the significance of small things. He realizes the groundbreaking nature of Kanada's teachings and the implications it holds for people in India to understand the power of small.

Gopal returns to his hometown and with an air of self-importance, he calls for a scholarly meeting in the local speaking hall so he can share his newfound revelation with the scientific community.

When he finishes his long story about how he has observed ants creating large colonies through small actions, and how he found the writings of Kanada, and then went on a long journey to Baghdad, and that the sage from the House of Wisdom told him the writings of Kanada were an amazing discovery, Gopal notices the bewildered looks on the faces of the scientists in his Indian hometown. They find his claims of an ancient Indian sage proposing atomic theory

both hilarious and preposterous.

Laughter fills the auditorium as Gopal desperately tries to explain the profound significance of Kanada's ideas amidst the waves of amusement.



Hmm. I, for one, think everything can be fully understood just by taking it apart to look at the parts. Like the tiny brains of these power of small types. Look inside their heads and tell me what you see, just a bunch of straw.

* * * * *

While Gopal is a fictional character created by this article for teaching purposes, the ancient atomic theories found in the writings of Kanada and Democritus more than 2,500 years ago, and the subsequent rediscovery of their theories in the Golden Age of Islam, are not fictional.

There is nothing new about historical cycles that require

humans to rediscover what was known by the ancients in both indigenous and academic cultures. For much of the modern era, humans collectively forgot about the power of small and became convinced that size matters and that big is beautiful in the midst of reductionist thinking that arrogantly purports that everything can be understood by mechanically examining the parts.

In the modern era, big, top-down, human ideas have shaped global approaches to economic, environmental, and sociological systems and have created a world where people and nations aspire to possess more and obtain power by the theory that might makes right.

This article is written to explain how the power of small has been re-discovered in the modern era through atomic theory and quantum physics and new understandings of how individual agents in emergent systems form a complex whole that cannot be reduced to an understanding of the individual parts in the system.

The world of small can seem mysterious but through a study of complex adaptive systems and a probabilistic understanding of the small actions of microstates, we can better understand the world around us and how to be better stewards of our planet and the sociological systems that impact our lives.

Who are the Modern Day Gopals?

In 1827 Robert Brown, a botanist, made the observation that later became known as Brownian motion while studying pollen grains suspended in water under a microscope. He noticed that the pollen grains exhibited irregular, jiggling movements, seemingly without any external force or cause. At the time of Brown's experiments in the early 19th century, the nature of what is now commonly known as Brownian motion was not well understood, and its connection to the kinetic behavior of molecules was not recognized. Brown himself did not know enough to provide a detailed explanation or theory to explain the ob-

served phenomenon.

In 1905, Albert Einstein mathematically explained Brownian motion, providing a theoretical framework for the phenomenon. Einstein's explanation described the random motion of particles suspended in a fluid as a result of the



Seriously? Modern day Gopals? The article is reaching a new low. Who cares about atoms anyway? If you want to waste your time staring into a microscope have fun. My idea of a good time is a sports bar and a few beers.

continuous bombardment of molecules on the particles. This work was instrumental in confirming the existence of atoms and molecules and establishing their constant movement. Brownian motion supported the atomic theory of matter and contributed to our understanding of the microscopic world.

A contemporary of Einstein, Ludwig Boltzmann, was an

Austrian physicist who made significant contributions to the field of statistical mechanics and the atomic theory of matter. He developed mathematical equations and statistical interpretations that explained the behavior of gases and the concept of entropy.

Tragically, Boltzmann's life was marked by personal struggles, including bouts of depression and challenges to his work by his colleagues. In 1906, before he could fully comprehend the implications of Albert Einstein's proofs on Brownian motion and its support of his own pioneering theories, Boltzmann died by suicide.

Proponents of communities in the 21st century are, in many ways, pioneers in their own field and may not always find immediate support for their discoveries, or even understand the discoveries themselves.

Much can be learned by advocates of community-based organizations in the 21st century from the 19th century and early 20th century pioneers of the outgrowth of atomic theory; namely, quantum physics. Many of the pioneers of quantum theories, and their attempt to understand the strange behavior of microstates, lived in a world of uncertainty and opposition.

Like our fictional character, Gopal, many thinkers in the modern era such as Brown and Boltzmann, have discovered different aspects of the significance of the microscopic world which at first were often bewildering to the founders, or challenged by the public domain. It is helpful to

know that pioneers in any field are rarely alone.

Max Planck, who won the Nobel prize for physics in 1918, formulated quantum theory but was at first criticized by his colleagues because he challenged classical understandings of physics.

Likewise, Niels Bohr, who was a key figure in the development of quantum mechanics, faced opposition after he theorized that an atom's electrons occupied discrete ener-



Ahh, could it be that these quantum egg heads were doubted for good reasons? Have you ever taken a closer look at their theories? Science fiction if you ask me. Good for a laugh!

gy states.

Werner Heisenberg's uncertainty principle and matrix mechanics faced organized resistance by a group of his peers for many years.

Erwin Schrödinger, who is now commonly known for his thought experiment called Schrödinger's cat, developed a wave equation which described the behavior of quantum particles, but initially encountered resistance and skepticism.

Paul Dirac, the British mathematician who is buried next to Isaac Newton at Westminster Abbey, formulated relativistic quantum mechanics, including the discovery of the positron, but faced many challenges due to his departure from classical notions.

More recently, physicists such as Richard Feynman and John Bell were challenged for their mid-20th century theories regarding the interplay between individual components within a system and the emergence of collective behavior of the system as a whole. In some ways, these men can be seen as pioneers of concepts behind the theory of complex adaptive systems (also known as complexity) which followed.

While the Power of Small and its application to community-based organizations is not tied to atomic theory or quantum physics, it can draw direct insights from the study of complex adaptive systems. These studies aim to understand the complex dynamics and emergent properties, including the behavior of agents-based systems.

By exploring the interplay of agents within a system, these theories shed light on self-organization, patterns, and the macro effects that emerge from micro-level behavior.

These theories offer conceptual tools for understanding how small-scale actions and initiatives can have profound impacts on larger systems, providing valuable perspectives for alternative community development.

An acceptance of the understanding of complex adaptive



Oh my! Let me get this straight. The Santa Fe Institute was started by some dude who had just helped make an atomic bomb at nearby Los Alamos? How could that be a good thing? Maybe I am missing something with these small thinkers. How can this end well?

systems is now common in the study and applications of physics, biology, economics, computer science, and philosophy. However, the same can't be said for social systems and political policy which lag behind in the understanding of complexity and are missing out on a deeper awareness of the positive impacts it could have on the planet's ecological well-being and human development.

From an academic perspective, the work of community-

based organizations and their understanding of complex systems can be classified as the studies of a sociological modeling of emergence. These studies await pioneers who are willing to stand on the shoulders of the giants who came before them.

What are Complex Adaptive Systems?

A study of the Santa Fe Institute is a helpful introduction to complex adaptive systems.

The Santa Fe Institute is one of the world's leading thinktanks and is dedicated to interdisciplinary research. The institute is located in Santa Fe, New Mexico and was founded in 1984 with the goal of studying complex systems and fostering multidisciplinary collaboration.

There is a link between the Santa Fe Institute and the Los Alamos National Laboratory located nearby because of the physicist Murray Gell-Mann, a renowned Nobel laureate who made significant contributions to the field of particle physics.

Gell-Mann worked at Los Alamos National Laboratory during the early stages of his career, where he was involved in research related to nuclear physics and the development of the atomic bomb. Alongside other notable scientists and researchers, Gell-Mann recognized the need for an interdisciplinary research institution that could address complex scientific questions and foster collaborations across various fields.

Today, the Santa Fe Institute brings together scientists from various fields, including physics, biology, economics, computer science, and the social sciences. Researchers at the Santa Fe Institute investigate a wide range of complex phenomena, such as the dynamics of ecosystems, the emergence of social structures, the behavior of financial markets, and the principles underlying biological systems. At the Santa Fe Institute, scientists utilize computational



Okay this is getting ridiculous. What good is a complex adaptive system? Give me a simple rigid dictatorship any day. At least you know who is in charge. Long live the power of big!

modeling, mathematical analysis, and empirical research to better understand the fundamental principles that govern complex systems. The institute emphasizes a cross-disciplinary approach, encouraging collaboration and the exchange of ideas between researchers from different disciplines.

By studying complex systems and uncovering the underlying principles that drive them, the Santa Fe Institute aims to advance scientific knowledge, contribute to policymaking, and provide insights into the dynamics of complex systems in nature, society, and technology. This involves modeling and understanding the behavior of individual agents and their interactions within a larger system. Each agent within the system follows certain rules or behaviors, and through their interactions collective patterns and emergent properties emerge.

In this framework, emergence refers to the phenomenon where complex and unexpected behaviors or structures emerge at the system level as a result of interactions among the individual agents. These emergent properties are not explicitly programmed or controlled but arise from the bottom-up interactions and dynamics of the agents.

The Santa Fe Institute's work on complex adaptive systems focuses on studying how local interactions and the adaptation of individual agents can lead to the emergence of global properties and behaviors. By understanding the rules and mechanisms governing the behavior of agents, researchers can simulate and analyze the dynamics of the system and explore the emergence of patterns, self-organization, and other collective phenomena. This approach allows researchers to explore how simple rules and interactions at the individual level can give rise to sophisticated and unpredictable behavior at the systems level.

The Santa Fe Institute represents how the aspects of sci-

ence connected to the power of small can help our planet, in contrast to the Los Alamos Laboratory which, in its earliest years, represented the destructive .

What are the Properties of Complex Adaptive Systems?

Complex adaptive systems possess several distinct properties that set them apart from simple or linear systems. One of their key features is emergence, which refers to the phenomenon where system-level patterns and behaviors emerge from the interactions and relationships among their components.

These emergent properties cannot be fully explained by the behavior of individual components alone but result from the collective behavior of the system as a whole. Complex adaptive systems also exhibit self-organization, meaning they have the ability to spontaneously create order and patterns without external control or direction. Through self-



Okay, let me give you a little clap for getting to the end of this nonsense. Take a lesson from Mr. Big, if you think small you are going

organization, these systems can dynamically adapt their structure, behavior, or relationships in response to changes in the environment or internal conditions. This adaptability allows them to navigate complex and changing circumstances.

Another important property of complex adaptive systems is their inherent ability to adapt. These systems possess mechanisms for learning, feedback loops, and the capacity to modify their behavior or structure based on feedback from the environment or internal processes. This adaptation enables complex adaptive systems to respond and adjust to changing conditions, improving their chances of survival and success.

Additionally, these systems often exhibit non-linear dynamics, where small changes or inputs can lead to disproportionately large and non-proportional effects or outcomes. The relationship between cause and effect is not necessarily linear or predictable in complex adaptive systems, and small perturbations can have significant and far-reaching consequences.

Complex adaptive systems are characterized by their interconnectedness. They are composed of multiple interconnected components or agents that interact and influence each other. These interactions can occur through direct connections or indirect influences, forming networks of relationships that shape the system's behavior and evolution. Feedback loops play a crucial role in complex adaptive systems as well. Positive feedback loops amplify or rein-

force certain behaviors or patterns, while negative feedback loops regulate or dampen them. The presence of feedback mechanisms contributes to system stability, resilience, and the generation of emergent behavior.

Complex adaptive systems exist in a state of non-equilibrium, meaning they are far from static or equilibrium states. They are characterized by continuous flows of energy, information, and resources, and they operate far from a steady-state condition. Finally, complex adaptive systems are often sensitive to initial conditions, a phenomenon commonly referred to as the butterfly effect. Small changes in the system's initial state or inputs can have significant impacts on its future behavior and outcomes. This sensitivity to initial conditions highlights the importance of understanding the intricacies and interdependencies within complex adaptive systems.

The Power of Small

Understanding complex adaptive systems can be highly beneficial for community-based organizations. By modeling communities as agent-based systems, community planners and organizers can simulate and analyze how individual agents (community members) interact and influence the overall dynamics. This helps in designing cost-effective community structures and better interactions that promote cooperation, resource sharing, resilience, and better program outcomes.

Concepts related to complexity, such as agent-based systems and systems thinking, have practical applications in various domains, including environmentally responsible affordable housing, sustainable villages, holistic healthcare, and social enterprise. By modeling these concepts as agent-based systems, community-based organizations can gain valuable insights and design approaches that promote desirable emergent behaviors and outcomes.

In the realm of affordable housing, agent-based modeling can help analyze the interactions between various stakeholders such as residents, investors, policymakers, and developers. By simulating the behavior of these agents, researchers can identify optimal strategies for allocating resources, implementing fair housing policies, and creating sustainable communities that meet the needs of residents while considering affordability and social equity.

In the context of sustainable villages, agent-based systems can facilitate the design and planning of self-sufficient and environmentally conscious communities. By modeling the interactions between individuals, infrastructure, and resources, researchers can explore different scenarios to optimize energy usage, waste management, and resource distribution. This can inform decisions related to renewable energy systems, sustainable agriculture, village-based small business, and community-based governance structures.

Holistic healthcare can benefit from agent-based systems by modeling the interactions between healthy diets, exer-

cise, stress-reduced lifestyles, and support networks. By simulating the dynamics of these agents, researchers can identify strategies for improving healthcare access, and preventative health practices.

In the realm of social enterprise, agent-based systems can support the development and evaluation of socially responsible business models. By modeling the behavior of agents representing entrepreneurs, consumers, and community members, researchers can explore the impact of different business strategies, pricing models, and community engagement efforts.

In all these applications, agent-based systems provide a powerful tool for understanding the dynamics of complex social systems, optimizing resource allocation, and fostering bottom-up, emergent behaviors that align with the goals of community-based organization at a local level. By utilizing the modeling of complex adaptive systems, researchers and practitioners can contribute to the design, improvement, and implementation of real-life solutions that address societal challenges in effective ways.