On Emptiness and Nonseparability:

Different Languages for Similar Concepts

Chelsea Cooper

Chelsea-cooper@mocs.utc.edu

5930 Mt. Carmel Rd.

Covington, TN 38019

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The aim of this piece is to appreciate how science can fit into a larger conception of life, and how seemingly distinct realms of inquiry can enrich and fulfill one another. The Buddhist view of ultimate reality potentially resolves discomforting contradictions between the traditional Western view of objective reality and recent discoveries in science, specifically quantum physics. Physics has historically centered its pursuits around the metaphysical bias of atomism and the existence of an objective reality, without perhaps always critically examining the source of said bias. If science is to maintain its progression, it might need to entertain alternate metaphysical stances to view seemingly contradictory data from a perspective that may reduce some of the paradoxes. The closer we delve into the smallest materials of existence, the more it seems that reality eludes our conceptual grasp. Nagarjuna, as the intellectual founder of the *Madhyamaka* School, could help to further the scientific vision with his metaphysical notion of emptiness (*sunyata*) at the heart of reality. I intend to compare some of his poetic insights to the technical notion of nonseparability in subatomic particles. In this attempt, I will highlight the atomic and objective theory of reality that has flourished in the West. I will also discuss the notions of impermanence, interdependence, and a general overview of dependent arising as described in many Buddhist philosophical texts.

To understand the parallels between subatomic theory and Buddhism, it is important to understand the Buddhist framework, which varies widely from the Western philosophical tradition. Although there are many sects and schools of thought in Buddhism, many, such as various Mahayana schools, believe the concept of emptiness to be of utmost importance in understanding reality. Some scholars, such as David Kalupahana, have argued that this doctrine can be found in the earliest of Buddhist teachings, which the exalted philosopher Nagarjuna merely came to emphasize. Others have seen Nagarjuna as a “second Buddha,” expounding on

ideas that the Buddha could not teach during his time because his listeners would not have been able to understand the abstract nuances of such a doctrine. In any case, most will agree that Nagarjuna's philosophical texts served as a starting point for the Madhyamaka School.

The Madhyamaka School places specific emphasis on the concept of emptiness in its teachings and can be seen as the "middle way" between two extreme views – eternalism and annihilationism (or Indian nihilism). The former of these views asserts that something, such as life, can be eternal, while the latter simply espouses the idea that there is no life after death. The middle path between these extremes can be called "dependent arising," or "dependent origination," which can be seen as an exposition of the Second Noble Truth; that is, the principal cause of suffering is attachment, which is perpetuated due to ignorance of the fundamental law of change. If nothing is eternal, there is nothing to which one can be attached that will not change. Dependent origination is a multilayered doctrine with complexities which are outside the scope of this paper. However, in its simplest form, it explains that all phenomena arise because of a number of causal factors. It is visualized as twelve links that form a wheel, indicating the lack of a beginning or end. There are various interpretations of these links and dependent-arising itself, but a basic understanding will do for our purposes. Essentially, causes and effects are interdependent, and therefore, they are unable to be isolated. To express this notion, Nagarjuna states in *The Philosophy of the Middle Way (Mulamadhyamakakarika)* that, "It is not proper to assume that there is first becoming when the last has ceased. Nor is it proper to assume that there is first becoming when the last has not ceased" (Kalupahana, 300). This seems to mean that it is not proper to assume there is a first becoming at all, indicating the interdependence of cause and effect. Neither can be said to have existed first. Jeffery Hopkins, a scholar in Tibetan language and religion, explains that, "The term 'dependent-arising' not only refers to a *process* of

production and of coming into existence, but also to these *things* which are produced and come into existence" (Hopkins, 164). Therefore, all phenomena are dependently-arising, including emptiness. In many cases then, Buddhist practitioners do not simply equate emptiness with dependent-arising, but Madhyamikas can find a certain synonymity in their refutation of inherent existence (or *svabhava)*.

How can dependent-arising be seen as non-synonymous by some schools but synonymous in Madhyamaka? The answer to this lies in the concept of emptiness itself. Many see dependent-arising as a reason for asserting inherent existence, but for the Madhyamikan, in order for a phenomenon to be dependently-arising, it is necessarily devoid of inherent existence. "For, he has realized that what inherently exists does not rely on anything and he has realized that inherent existence and dependent-arising are contradictory" (Hopkins, 71). To understand this, it is important to discuss fully the meaning of emptiness in the Madhyamaka tradition. Nagarjuna describes it thus – "Because of the perception of change, the absence of self-nature of existents is [recognized]. Because of the emptiness of existents, there is no existent without self-nature" (Kalupahana, 220). In this way, the perception of change found in dependent-arising confirms the lack of substantive existence of phenomena. Emptiness can be understood in a limited way as a lack of inherent or substantive existence. However, true understanding of emptiness cannot be rationally explained or described, as it requires an experience of pure Suchness (*tathata*). Buddhism stresses the importance of non-discursive thought in the endeavor to experience reality, pure and without existents. Norman Fischer, a Soto Zen Roshi, describes emptiness as being nearly impossible to refute because it neither confirms nor denies anything. He says, "Appearances remain valid as appearance, and there is no reality beyond appearances, other than the emptiness of the very appearances" (Fischer, 168). Although this cannot explain

exactly what emptiness *is*, it provides guidance to what emptiness is *not*: appearance. That is, emptiness is the lack of conventional reality – it is the absence of how things seem to be. In other words, phenomena don't exist as independent, solidly real entities. Emptiness is the realization of reality beyond perception, constantly present, yet obscured beneath the illusion of objective reality.

The idea of interdependence is also related to emptiness in that it is an essential component in the doctrine of dependent origination. Interdependence incorporates the idea that things only exist in relationship to others, an idea also called mutual causality. In other words, phenomena arise together in a mutually interdependent web of cause and effect. Nothing can exist independently of the whole, for it would be causeless and immutable. The whole and the parts are mutually interdependent, and require each other to exist. Rather than the idea that "things" exist prior to relationships, the concept of interdependence posits that the characteristics of a phenomena are defined through relationships alone. Although objects do exist, it is only a conventional reality or a relative truth, rather than a mirror image of ultimate reality. Impermanence is related to interdependence in that because reality exists in terms of its relationships, it is necessarily always changing. The ever-changing nature of phenomena means that any state is transient or impermanent because it is constantly becoming the next state. All conditioned phenomena are inconstant, unsteady, and in a constant flux. From this insight, the natural progression is that the distinction between "self" and "other" is also a purely conventional truth. For, the self is itself one of these phenomena that are impermanent and without independent existence. This divisiveness between self and other perpetuates suffering in that one clings to the notion of the ego. Emptiness, along with its correlates (interdependence and impermanence) does not create a nihilistic view of void or nothingness; rather, emptiness is the

absence of autonomous or permanent existence. The ultimate understanding of emptiness is supposed to lead to boundless compassion for sentient beings through the understanding of our ultimate interconnectedness. On interconnectedness, Nagarjuna said, "Someone is made known by something. Something is made known by someone. How could there be someone without something and something without someone?" (Kalupahana, 190).

At this point, the Buddhist notion of emptiness has been sufficiently described to allow the reader to understand parallels in the following discussion of subatomic particles. For many individuals raised within a Western philosophical framework, the notion of the atom will be quite familiar. It has been described as the fundamental building block of all matter – eternal, passive, immutable, and self-existent. It has been the goal of many scientists to discover this hypothetical substance which has formed the basis of so many philosophical notions. It seems to have been introduced into Western thought in the sixth century B.C.E., with the Greek philosophers Democritus and Leucippus. However, this revolutionary idea remained in the shadow of the Aristotelian notion of the four elements as the essential components of matter, until the early 1800s when John Dalton performed experiments that seemed to suggest the existence of an elementary particle. From there, scientists began the long struggle to find a particle so small that it could not be divided, from J.J. Thomson and Ernest Rutherford up to Niels Bohr, Louis de Broglie, and George Thomson. By the time that science had advanced up to these latter individuals, the notion of a basic building block of matter had become a quite complicated concept.

The atom was found to exist as a cloud of negatively-charged electrons surrounding a dense nucleus, itself composed of both protons (positively charged) and neutrally charged neutrons (the collection of protons and neutrons are referred to as nucleons). The electrons orbit

the nucleus at fixed energy levels, which are simultaneously attracted to protons and repelled by other electrons. Coupled with the strong nuclear force which holds protons and neutrons together, this maintains the atom as a relatively stable particle. The standard theory of quantum physics holds that the "indivisible" particles that compose protons and neutrons are quarks. However, quarks most often exist in sets of three, and can seemingly never exist independently. "According to Bohr and Heisenberg… the "atom" concept is simply an image that helps physicists put together diverse observations of the particle world into a coherent and logical scheme" (Ricard, 84). The multiplicity of divisions in the atom concept calls into question its status as a fundamental building block. One might argue, however, that this merely shifts the intrinsic matter to a smaller level, such as quarks.

Quarks are elementary particles that, among other things, form the components of the nucleus – namely protons and neutrons, which are two types of hadrons. Quarks need to exist in sets of three to create a hadron, and correspondingly, each individual quark has a fraction of a charge that adds up to the appropriate charge for the created, composite particle. This is currently theoretical, as physicists have not yet been able to isolate a particle with a fractional charge. Most quarks live for only a miniscule fraction of a second, and thus are highly impermanent. Quarks are classified in terms of their "flavor" and "color." The first family contains quarks of flavor "up" or "down," the second contains "strange" or "charmed", while the third contains "bottom" and "top." All the flavors may then be classified as "yellow, red, and blue". Quarks within the same family regularly change flavors and can even change families if their electric charge is altered. Furthermore, changes in these states of the quarks lead to changes in the hadrons they form. Thus, the state of a quark is not permanent in that it is neither immutable (because of regular change) nor eternal. Additionally, for every quark there is a corresponding

antiquark. It is for this reason that a quark can never exist independently. When an experimenter attempts to free one of the three quarks from its hadron, energy is added to the strong nuclear force which is then liberated when the quark is freed. Because of the interchangeability of energy and matter (as introduced by Einstein's famous $E=mc^2$ equation), this energy creates a quark/antiquark pair which facilitates two things. First, the new quark produced immediately replaces the freed quark in the hadron, restoring stability. Meanwhile, the antiquark combines with the recently freed quark to create a particle called a meson. If the quark can transform into another particle so readily, it would seem to lose its identity as a quark during its becoming. This, along with its readiness to change states and ephemeral quality, calls into question whether it can truly be considered an intrinsically indivisible building block of matter. The famous physicist Erwin Schrodinger had this to say, "It is better not to view a particle as a permanent entity, but rather an instantaneous event. Sometimes these events link together to create the illusion of permanent entities" (qtd. in Ricard, 85).

Another concept that calls into question the existence of an indivisible, independent particle is the notion of wave/particle duality. This was established experimentally by Thomas Young, an English physicist, in his well-known "Double Slit Experiment" of 1801. Young set up this experiment by shining light of a single wavelength through a screen with one narrow slit so that it appeared from a single source. From there, this light was shown onto a screen with two narrow slits, which further projected onto a solid screen with photographic paper that would capture the pattern of light. If light behaves as a particle, the experimenters expected that there would be two bright spots linear to the slits with darkness in the center between them. Indeed, if only one slit is opened, one bright band of light is precisely what is perceived. Young found, however, that when both slits were open, an interference pattern emerged from waves interfering

with other waves. This appeared as alternating strips of light and dark on the photographic screen, with light appearing where the crests of waves added up to create the bright strips. The troughs and crests of waves also added so as to cancel one another out to create the dark bands. So, it would seem definitively that light exhibits wave-like behavior. However, when a photon (a light packet) hits the screen, it exhibits a bright dot of light in only one place even though it is propagated through the area in between the slits and screen as a wave. When it hits the screen, an interaction occurs as if the wave had a definite position, and thus occurs as a particle. If the intensity of the light was low enough so that photons could proceed one by one, it would seem that they would be forced to go through one slit or the other and no interference pattern would emerge. Experiments confirm that this is not the case, though, and an interference pattern continues to emerge with singular photons. Wave particle duality is not restricted solely to light, as electrons were subsequently found to exhibit the same nature. Eventually, it was determined that all particles, energy and matter alike, exhibit wave-nature and particle-nature depending on the role of the observer and the apparatus used to measure the property.

So what does it mean to say that all matter and energy exhibit wave-particle duality? Waves spread out in all directions throughout space, and have no fixed location or trajectory as a particle does. According to the Copenhagen interpretation, the wave-state collapses into the particle state upon observation, creating a reality in which “atoms form a world of potentials and possibilities, rather than things and facts” (qtd. in Ricard, 83). As stated previously, the status of a particle into its wave or particle form depends on the role of the observer and the tool used to measure its current property. An object may behave both as a particle and a wave, but never both simultaneously. It is this fact that led to Heisenberg’s Uncertainty Principle, which states that it is impossible to determine both the position and momentum of a particle simultaneously because

the measurement of position necessarily disturbs the momentum. The addition of sine waves of different wavelengths creates a resultant wave that is localized. The uncertainty of its position can be minimized by increasing the number of waves at different wavelengths. The position of the particle is where the wave amplitude is the greatest. However, this resultant wave contains several waves of different wavelengths, and it is unclear which wavelength should be used for the determination of momentum. A pure sine wave has only one wavelength and thus has a precise momentum. However, sine waves continue in all directions and are not localized at all. So, when you choose to observe one or the other, you necessarily exclude determination of the other property. Moreover, an object cannot even have both an exact position and momentum at the same time due to the dual nature of particles and waves. This is truly a fatal blow to the atomic universe in that a reliance on purely indivisible particles excludes their nature as waves that are, in a sense, omnipresent. This is best summed up by Heisenberg himself who said, "The world thus appears as a complicated tissue of events, in which connections of different kinds alternate or overlap or combine, and thereby determine the texture of the whole." (qtd. in Capra, 139).

This brings us much closer to Nagarjuna's notion of ultimate reality. Suchness here has been equated with omnipresent waves that transform into packets of energy called particles, which themselves are reducible. Upon reaching the smallest discernible level – quarks- we find a nonseparability that occurs, but does not remain constant. That is, though quarks seem to maintain their essential structure, the energy used to create these subatomic states varies with every moment. Though one might find a sort of indestructibility in this description, one can certainly dispute the claim of immutability. The Buddhist notion of impermanence is clearly demonstrated by the example of quarks, while wave-particle duality is reminiscent of the

discussion of interdependence. The wave and particle are interconnected in such a way that they must both exist, and yet, cannot be measured in both forms simultaneously. They are, thus, 'empty' of inherent form as necessarily either particle or wave. Matter has been reduced to forces, which consist of the interexchange of particles, and energy, neither which resemble the world of atoms so fervently sought by Western science. This reduction is not only based on Einstein's famous equation that demonstrated the interchangeability of energy and matter, but also on relativity theory. In a relativistic description of particles, the forces, such as attraction and repulsion, between said particles are understood as the actual exchange of other particles. Language, here, works to my detriment, as it has for many Buddhists and physicists alike. In describing emptiness through physical terms, it is necessary to rely on 'visually represented objects' like particles to describe phenomena such as forces. As can be seen from the aforementioned points, however, the term 'particle' here can only refer to momentary and transient relationships. Fritjof Capra explains, "Both force and matter are now seen to have their common origin in the dynamic patterns which we call particles" (Capra, 80). While these discoveries may complicate the dogmatic assertion of independent objects of existence, it must be conceded that the door is open for the notion of emptiness and dependent-arising.

> *Some philosophers have gone farther and concluded that nothing, including matter and mind, intrinsically exists. If we trace the history of this line of thought back, it seems to have been first formulated in Oriental thought by Siddhartha Gautama over two thousand five hundred years ago. There is no nihilism in this concept, no denial of reality or existence, but rather a profound view of the very nature of existence. If things do not exist in absolute terms, but do nevertheless exist, then their nature must be sought in the relationships that bring them together. Only these relationships between objects exist, and not the objects themselves. Objects are relationships… will the physics of the future succeed in making an equation of what is now a purely philosophical vision?*
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> - Laurent Nottale, physicist (qtd. in Ricard, 87-8)

Although emptiness seems a conceivable notion to some, others have posited the idea of string theory to reify the myth of an indivisible particle. The aim of this theory is to unify general relativity and quantum mechanics, as well as the four fundamental forces – electromagnetism, the gravitational force, and the strong and weak nuclear forces – that govern the universe, specifically with the intent to devise a theory of quantum gravity. In string theory, quarks are no longer the fundamental particle; rather they and all other particles are merely manifestations of infinitesimally small vibrating strings. The length of these has been calculated to about 10^{-35} meters (Planck length), which is beyond anything currently observable by physicists. String theory holds that particles of matter and light transmit forces that bring together the world's phenomena so that they can interact and change. However, none of these particles are discrete entities because they are achieved by various manifestations of the strings, which can change particle types at different frequencies. The vibration of the string determines all the properties of the particle, including its mass, electric charge, and spin. They appear to replace quarks as basic entities, but they can appear either as strings or waves. Strings can join up, move, and interact, but can never measure less than Planck length. Also, they can form loops individually or with other strings; they can have free ends as well. Essentially, the entire universe is composed of these strings, as superstring specialist Brian Greene put it, "Perhaps there really is no notion of a separation between strings and the universe they inhabit. The latter really is a reflection of the former." Greene continues, "The string is like a chameleon. It can 'look' like a particle since all that a particle is (according to String Theory) is the pattern of vibration of its internal string." (qtd. in Ricard, 108-9) So, although strings seem to replace quarks as the indivisible building block of life, the string itself seems to have no immutable properties nor do they seem to be

separable from the universe. This last attempt to find a basic building block is disputed by many quantum physicists and has been unconfirmed by experimental evidence.

Science is silent on providing wisdom on how we should live, yet this is a struggle that every individual must work through. Science should be seen as an instrument that is intrinsically neither good nor bad, but may be used for either. Scientists, like all individuals, have an ethical responsibility to consider the ramifications of their discoveries with an eye of compassion and benevolence. If science is not guided by consciously ethical motivation, its effects could produce great harm to humanity and our world. Scientific discoveries inevitably affect the way we view the world and thusly our behavior. To have a beneficial, lasting contribution, the behavior that one encourages must be firmly rooted in a desire to limit suffering, rather than increase it. One cannot deny the importance of scientific inquiry, but at the same time, it must be tempered with altruism and empathy if it is to promote the survival of all the sentient beings that inhabit this world. Many values that affect the human experience, such as creativity, ethics, and spirituality, seem to lie outside the scope of the scientific method, yet they must be observed and contemplated through experience. In this way, spirituality may be able to complement science when it comes to certain areas such as ethics. In Buddhism, realization of the nature of reality leads to a renunciation of attachment, which functions to transform the energy of desire into awareness, understanding, and compassion for all living things. Shabkar, a Tibetan hermit, summed it up nicely: “With compassion, one has all the teachings, / Without compassion, one has none of them. / Even those who meditate on emptiness / Need compassion as its essence.” (qtd. in Ricard, 273) The same could be said for science in that without compassion as its basis, the fruits of labor are as nothing, or worse in some cases (such as the atomic bomb and biological warfare).

No one escapes the question of the nature of ultimate reality. It plagues theologians, scientists, students, and people who just want to find the key to personal happiness. The awareness of our mortality and the integration of a smorgasbord of races, religions, cultures, and opinions are ever present in our daily lives and encourage us to contemplate various conceptions of reality. This is not a topic that can be glossed over as we encourage single-mindedness on only a very small part of the whole. The parts and the whole seem to be inseparable, and to understand one, the other must be present as well. We must continually integrate evolving knowledge of the small segments of reality we can discern into a picture of a larger whole so that we may behave with an awareness of the results of our actions. Science is an offshoot of philosophy and thus must remain intimately connected to its parent state, the whole of which it is a part. I believe the vision found in Buddhism, especially Nagarjuna's Madhyamaka School, provides an adequate framework for a conception of reality as interrelated and, hence, empty. Perhaps more importantly, the ethical dimension would provide a structure to scientific endeavors that has been lacking due to the non-quantifiability of morality. Buddhism offers an empirical approach to the inner dimension of existence that has been too long ignored in scientific pursuits.

Freed from all defects, adorned
With all virtues, become
The sustenance of all sentient
Beings and be omniscient.

These doctrines were not taught
Merely to help kings,
But with the wish in any way
To help other sentient beings.

- Nagarjuna*, The Precious Garland*

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