

KAMMA AND CHAOS THEORY (COMPLEXITY SCIENCE)

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Abstract

Exposure to kamma and chaos theory is followed by an attempt to identify similarities between them such as: **continuous causality** (interdependent coexistence present in open systems) - a common factor in chaos theory and Buddhism (explains Buddhist rebirth); Buddhist **proximate paths** or **actions** that yield very different effects and chaos theory **proximate initial conditions** giving very different results; Buddhist **31 abodes of beings** at various levels and chaos theory **attractors**; the **middle path** in Buddhism and in chaos theory the **edge of chaos** being the most desirable resting level.

INTRODUCTION

Buddha's teaching is based on the understanding of kamma, causality consisting of the twelve-fold chain (*Paticca Samuppada*) that explains rebirth. At the heart of causality is coexistence and interdependence of phenomena. Kamma leads to or alleviates dukkha (stress) via cause and effect. Understanding kamma and acting in accordance with it can lead to enlightenment.

Kamma describes the origin of personality, a unique combination of components such as forces, values, beliefs and reactions, caused in the past but not fixed. Personality based on volition can change by practices like learning, effort, behaviour and meditation.

Recent developments in science such as relativity theory, quantum physics and chaos theory or complexity science had drastically modified the concept of causality. Newton's deterministic cause and effect laws or **discontinuous causality** had been replaced by **continuous causality** (interdependent coexistence present in open systems).

Einstein's relativity theory says that temporal succession of events is modified by observer motion, which has light velocity as the limit. It also proves existence of zones of causality that are determined by light speed.

Special theory of relativity says time is not independent of the universe. It is **elastic and dependent on observer motion**. The faster the observer moves the

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slower the time; at 99% speed of light the time slows down by a factor of seven. General theory of relativity says gravity slows time. Thus the light velocity as limitation of observer motion is not as simple as it seems. Buddhism tells us that the concept of **time, like space, does not have inherent existence**. It is a relative truth (**panatti**) in the world of phenomena of experience.

A classic example that demonstrates elasticity of time is Einstein's thought experiment involving three observers all in different states of motion, observing lightning strike both ends of a train going through a station at high speed. The three observers are at the level of the middle of the train, in three different places. A is on the platform, B is on the train, and C is on another train going in the opposite direction.

The three observers will see the two lightning strikes differently. A will see the two lightning strikes simultaneously. B sitting in the middle of the train is moving towards light coming from the front end strike and hence B will see the front end strike first. The rear end strike will be seen a fraction of a second later, as it needs extra time to catch up with B. By the same reasoning C will see the rear end strike first followed by the front end strike. Thus which strike "occurs" first depends on observer motion. If a causal event is assumed, the cause and the effect will be seen to be dependent on the observer motion, which is absurd. Thus the two strikes cannot have a causal link.

From this, rules concerning causal linking of events evolved. For two events to be causally linked information must be passed between them and light must be able

to travel between them in the time that separates the two events. For two events NOT to be causally linked they must be sufficiently far apart in space or near enough in time, so light cannot travel between them in the time that separates them. If time separation is big enough for light to travel between the two events, causality principle is followed. Thus if event y is preceded by event x in a long enough interval, x comes before y for all observers.

Quantum theory tells us that matter is governed by uncertainty rules. Probability is used. It says there is a single global reality. **Global coexistence and interdependence** of phenomena is at the heart of causality. Effect in global systems has many causes, including consciousness. Hence linear deterministic causality analysis is impossible.

Quantum systems are described by wave functions . Consider two quantum systems. Before interacting and separating they are described by TWO independent wave functions. They are two independent systems. After interaction and separation only ONE global wave function describes them, showing that they coexist and are interdependent.

Chaos Theory (Complexity Science) states that cause and effect relationships are nonlinear. Nonlinear differential equations are used to describe complex realities. A more detailed account of Chaos Theory follows below.

The aim of this presentation is an attempt to identify kamma and chaos theory similarities such as: **continuous causality** (interdependent coexistence in open systems), which is a common factor in chaos theory and Buddhism (explains re-

birth); Buddhist **proximate paths** or actions that lead to very different effects and chaos theory **proximate initial conditions** giving very different results; Buddhist **abode of beings** at various levels and chaos theory **attractors**; the **middle path** in Buddhism and in chaos theory the **edge of chaos**, being the most desirable resting level.

Chaos Theory

Chaotic behavior is observed in electrical circuits, lasers, oscillating chemical reactions, fluid dynamics, and mechanical and magneto-mechanical devices, etc. Natural chaotic behaviour are seen in the solar system - satellite dynamics; celestial bodies' magnetic field - time evolution; ecology - population growth; neurons - action potential dynamics; and molecules - molecular vibrations. Everyday examples include weather and climate.

Systems with Mathematical Chaos

Dynamical systems are highly sensitive to initial conditions. This is known as the **Butterfly Effect**. Arbitrarily small changes in initial conditions lead to an exponential growth giving vastly different results (**attractors** in the language of chaos theory). A butterfly fluttering its wings in a certain country giving rise to a storm or a clear blue sky in a far distant land is an example of the butterfly effect of physical events. Hatred or ambition leading

to world wars is an example of the butterfly effect of mental events.

Linear systems are not chaotic. Non-linear systems are chaotic. It is most interesting when chaos occurs on an attractor. Orbits of a large set of initial conditions converge to this chaotic region called an **attractor**.

Most motion has simple attractors such as points and circle - like curves (Limit cycles). Chaotic motion has strange attractors with great detail and complexity. For example the three-dimensional model of the Lorenz weather system (Lorenz attractor). Another example is the point attractors in 2D phase space shown in figure 1. A ball at a hill crest can roll into any of several valleys (attractors) depending on slight differences in initial position (initial condition).

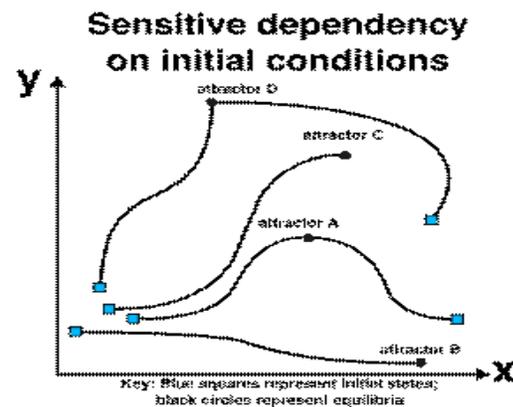


Figure 1. Point attractors in 2D phase space

Complexity Science

Non linear equation behaviour was studied by a new breed of mathematicians. They discovered new universal mathematic laws. Chaotic theory was renamed as complexity science, which identified that simultaneous presence of imposition and variation are normal in nature. Eg: a soccer game. There are rules (imposition) but many outcomes are possible (variation).

Life components (atoms, molecules) obey physics and chemistry laws. But life (biologic systems) is governed by living laws. Another example, atom components like fundamental particles (quarks, leptons, force carriers) and subatomic particles (neutron, proton, electron) obey the classical mechanical laws, but the quantum atomic structure obeys quantum mechanical laws, described by the Schrodinger equation. $H = E$ and $\text{Probability} = \int \int \int 2d$. Orbits of electron probability clouds are the attractors. Changes in initial conditions (absorption / emission of energy, ΔE) make the electron "jump" to different orbits or different attractors.

The most desirable resting level is at the edge of chaos where mingling of fixed and fluid states occur resulting in optimal use of energy (adaptation). Rigidly ordered systems such as dictatorships cannot withstand external changes, they finally disintegrate. Highly chaotic systems invite anarchy (fall of Rome). But at the chaos edge, there is enough order for self perpetuation and enough complexity for new combinations (example - democracy).

Previously the world is viewed as the result of much simple linear behaviours or many simple linear differential equations.

Currently chaos theory views the world as a manifestation of a few very complex non linear differential equations.

Basics of Kamma

Man is not a special creation, endowed with an immortal principle (soul). He is not a mere chance combination of chemicals, not an accident in the cosmos. Between the two opposites lies the Buddhist truth - KAMMA.

Every being is a result of kamma that works through physical processes. It is a law of moral causation involving intentional (volitional) action: mental, verbal, or physical.

What causes inequality in mankind? Is it purely accidental? No it is due to heredity, environment, and kamma. The difference is the result of past actions, both proximate and remote, coupled with present actions. Causality relationship is nonlinear.

Kamma difference is the chief cause of twenty four factors. Kamma is just one of five laws (*niyamas*) operating in physical and mental realms (Others are *utu, bija, dhamma, citta*).

If the present life is totally conditioned by past actions then kamma is fatalism, determinism or predestination. This is **discontinuous causality. Such a fatalistic doctrine - is NOT the Buddhist law of kamma.**

Reaping of kamma effect in this life and future lives is influenced by present and past deeds. Thus kamma is **nonlinear**; it is **continuous causality** - interdependent coexistence in open systems where there is

interaction between system components themselves and also with the environment.

There is no unchanging entity, no actor apart from action, no perceiver apart from perception, and no conscious subject behind consciousness.

Then, who does kamma? Who experiences the effect? The doer is **volition** or **will** (*cetana*). The **reaper** is **feeling** (*vedana*). Apart from these pure mental states (*suddhadhamma*) there is no-one else sowing and reaping.

It is stated in the Dhammapada that “one cannot escape from an evil deed”. But not many are aware that we are not bound to pay all our past kamma debts. Otherwise emancipation will be impossible, and eternal recurrence will persist.

The present is not totally what we were; the future is not absolutely what we are; the present is the offspring of the past and the present of the future. But the present does not always truly reflect the past or the future.

As mentioned before, effect in global systems has many causes including consciousness; and two types of causes may be identified - substantial cause (like seed being cause of flower) and cooperative cause (like sun and water). Working of kamma is complex. Kamma is seemingly random but a structure exists.

Causes of kamma are **ignorance** (*avijja*) - not knowing things as they truly are. It causes activities (*avijja paccaya sankhara - Paticca Samuppada*) and **craving** (*tanha*).

Kamma is not freedom or determinism. It is a dynamic fusion of the two, a result of uniting choice and necessity. The “opposites”

mingle in varying degrees at various times and places - **coexisting complexity**. The universe is not truly as mechanical as a clock and not totally as formless as a mist.

Personal life is both choice and necessity; disarray of life is illusory. Some event cannot be traced directly to a proximate past. “Storms of ancient origins can affect”. But even in a storm there is a downdraft of coherence. Storms die and reintegrate with nature. Thus even in bad times, people can go along good fields.

When does kamma affect? It depends on the kamma type. “*Nanekhanika*” kamma: do now - affect later. “*Thahazata*” kamma: do now - affect now. “*Ditthadhamma-waynirana*” kamma: immediate effect caused by dana to Buddha or arahats on their arising from deep meditation.

In the sequential development of consciousness (*vinanna*), repetitions (*javana*) occur seven times with increased intensity at each time. The first *javana* affects this life. If it is not expressed in this life it becomes “ahoti” kamma - washed out, cannot affect anymore. The seventh *javana* is the most intense and affects proximate future life. The middle five javanas can affect anytime from the third proximate life throughout one’s entire existence, until extinguished by attaining *nibbana*.

An alternative classification of kamma identifies four types: “*Garukamma*” - heavy kamma such as attaining jhana or harming triple gems. “*Atanakkamma*” - actions done close to death. “*Aseinna-kamma*” - regularly done habitual kamma. “*Kattaka-kamma*” - random kamma - actions done here and there.

Kamma and Chaos Theory

The **Mechanical Model of Reality** considers reality as gross macroscopic items. Cause and effect interlock according to set rules - Newton's deterministic cause and effect laws - **Discontinuous Causality**. Examples are: billiard balls on a game table that behave within table boundary limits; the concept that current life is predetermined by actions in the past life; linear (straight line) graph $y = mx + c$ (in figure 2, set x as 2 and y is **fixed** at 20). Thus scientists thought that simple mathematic laws can describe the universe. For example, two bodies orbiting each other are described by Newtonian mechanics, using linear differential equations.

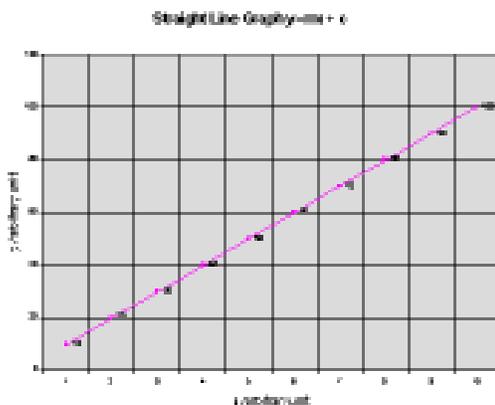


Figure 2. A linear graph

But on extending to two, three or more orbiting bodies (many bodied) nonlinear differential equations became necessary. The solutions are extremely difficult. However with the advent of computers, Lorenz discovered that the **physical world has zones of rules**, called **attractors**. The **31 abodes**

or levels of existence may be identified as 31 different attractors. Moving to the edge of a zone invites attraction by another zone. New behaviour appears when a new level of organization is reached. New rules take over and appearance and behaviour are altered. This signifies the **changing of abodes**.

Attractor systems never repeat and are not periodic, but they stay within a defined range of values (**Lorenz attractors**). Pattern less in a short time period; but pattern is apparent in a long time frame. For example earth temperature stays between -60 C and 45 C ranges.

Chaos theory extends causal thinking by realizing cause and effect relationship is nonlinear. It considers **continuous causality**. Consequently explanations became closer to reality.

Buddha's teaching is based on **open-ended time and space**. It describes the world of variation and order governed by universal laws. Even genetics is caused not fated. At the heart of kamma is the coexistence and interdependence of phenomena. Thus causal relationship is nonlinear. It is **continuous causality**, which is present in open systems.

Thus both Buddhism and chaos theory recognize that cause and effect relationships are nonlinear. Both accept the **continuous causality** concept, which is **interdependent coexistence** - a characteristic of open systems where there is interaction between system components among themselves and also with the environment.

Choices remain our own among world events and each choice instantly travel along lines of cause and effect. We act within the

world flux and kamma draws out the implications. Indeterminacy and choice exists but our actions organize the preexisting disarray into magnetic fields of effects, just like non-linear equations in Chaos theory that are variable yet have solvable outcomes.

But predicting the exact outcome in the next moment is impossible. Our actions are in a dynamic world, just like a ball on a billiard table with many balls already whizzing in multiple directions. "The fate of a specific ball depends on its own force and direction and those of others that collide with it. Impact of our life occurs within a dense matrix of others with their own actions, interactions and vectors". This again shows that cause and effect relationship is nonlinear.

Chaos theory also points out that complexity is not anarchy: the ricocheting ball may be steered. It may collide but it can resume direction. Both kamma and non-linear equations describe variable but lawful coherent processes. Even in a hailstorm world, we can still walk the path. Renewed and recurrent practice gives direction to life. Even when skidding on ice, there is still control if there is no panic. Brake intermittently and steer into the skid.

"Antagonistic" pairs like linearity and fluidity, determinism and free-will, couple and uncouple coexist. These pairs can come from the same non-linear equation that can shape and contain phenomena. We shape ongoing lifetimes. Implications of antecedent insights exist for each moment.

Buddha's reality and chaos theory is based on **unending space-time continuum**. There is no creation locus point. The universe is uniform and not geocen-

tric. Each point in the universe is the centre. Many worlds exist and each is the centre.

This is clearer if one considers the four mathematic processes of infinity shown below, where N denotes infinity.

$N + N = N$; $N - N = N$; $N \times N = N$ and $N/N = N$. Take a one dimensional picture of the universe. You are at the centre as infinity is on your left and right sides. Moving left by any degree ($N - N$) results in infinity on your left side [$N - N = N$]. You still have infinity on both sides. Hence you are still at the centre of the universe. The same results if you move right. Hence every point in the unending space-time continuum is the centre of the universe.

The causal universe has no origin and no end. There is ongoing influence, no absolute boundaries exist. There are no real limits that define "I". Pulse waves of effect caused by our actions roll outward in time-space.

Buddha preached *anatta*: there is no enduring permanent self, no unique and final boundary around "me". The only existence is a transient and local expression of laws and choices in a seamless universe. There is NO ME! There is no enduring self (*anatta*). However due to different antecedents individuality is present. Two persons can have proximate paths giving different consequences. But similar paths do not exist.

Operations of forces that mold "me" occur before and after "me" until spent. This fluid change is an inherent property of all natural bodies including worlds and true equations. This earth/universe is a temporary space shape, within wider cycles of order and change.

Small perturbations in non-linear equations yield very different future behaviour ie. different attractors give different results - an attractor may draw one to truth while another to security. Results of non-linear equations that are confined within a zone can suddenly exit that outcome band to a next level with new organization levels and new laws - **Buddhist rebirth - changing of abodes.**

Tiny perturbations in initial conditions can be magnified by time, space and impinging variables into huge effects - the **Butterfly Effect**. Thus one moment of clarity can change a life! Seeing impermanence (*anicca*) may neutralize a strong attractor pull. Any moment of meditation can become the last orbit around greed, anger, delusion (*loba, dosa, moha*) evolving into a first orbit in a new mental level - *Four Arahat Stages*.

Mingling of fixed (organized) and fluid states that result in optimal energy use and adaptation occur at the edge of chaos. It is the most desirable resting level. It is said that **“The most stable systems include modulated instability (stability / instability combination)”**. Buddha taught to live at the edge of chaos. Undisciplined daily life leads to chaos. Rigid inflexibility leads to religious orthodoxy, political tyranny. Between these two is Buddha’s **Middle Path**.

Non linear equations have graphs consisting of smooth arrays. They can suddenly expand into random scatter dots and just as suddenly re-cohere. It is recurrent aggregation, dissolution and re-aggregation. It reflects **Buddhist rebirth**.

This comes from the same equation that has different forms in different re-

gions under its own influence. The implication is that one law can manifest in many forms, expressing the relations in different contexts.

Forces initiated by volitions (kamma) yield a long variously appearing trajectory: visibly coherent forms (bodies) appear at times, while no visible form is observed at others. The original volition is expressed via many possibilities. Like rebirth (reappearance of previous life) and reappearance of new worlds in a vast flux of time-space continuum.

If phenomena are considered to be concrete and independent entities then problems on causality arise. So does cause and effect exist inherently?

Considering the only possible four types of causality: a thing can be born (1) from itself (2) from something else (3) from itself and something else (4) neither from itself nor from something else, the Buddhist conclusion is

“Seemingly cause and effect relationship is possible only if neither cause nor effect exists independently and permanently”

“Phenomena non-reality is precondition for their appearance, which evolve according to causality laws based on interdependent phenomena with no inherent existence”

“Because everything is emptiness, everything can exist”

CONCLUSION

The universe has continuous causality; it is causally communicating and in-

terlocking. Cause and effect relationship is nonlinear.

Kamma and non linear equations describe variable but lawful coherent processes. Attractors may draw one to truth and another to security. This also reflects rebirth in various levels of the 31 different abodes, which may be identified as 31 attractors.

Arbitrarily small perturbations result in very different future behaviour of different attractors. The Butterfly Effect expresses huge effects caused by the magnification of tiny differences in initial conditions. One moment of clarity changes a life!

The edge of chaos is the most desirable resting level. "The most stable systems include modulated instability". Undisciplined daily life induces chaos. Rigid inflexibility begets religious orthodoxy and political tyranny. Buddha's Middle Path is between the two.

Non linear equations have graphs that consist of smooth arrays, which suddenly expand into random scatter dots and suddenly re-cohere. This linked recurrence is common and shows aggregation, dis-aggregation and re-aggregation, which supports the Buddhist concept of rebirth.

Aggregates (minds and bodies) are expressions that molded past bodies and cause future bodies. Chaos theory allows understanding of our bodies: conglomerates of particle aggregates that dissolve and may re-aggregate according to laws we activated and set.

Our world is not the limit. Everything is in a state of flux. Many horizons exist but there are no finalities. Many other worlds exist. While creating our future

we influence the future of many worlds. Iterations of old laws create new universes at every moment.

These laws governing us also allow attaining liberation from round of rebirths (*samsara*). They are cosmic laws. Significance of life is not dependent on any single incident that occurred at a certain space-time locus. At the heart of causality are phenomena that coexist and are interdependent.

Inherently existing objects cannot have cause and cannot depend on anything else. Things seemingly happen in the world of appearances (*panatti* - relative truth) only because cause and effect have no intrinsic existence.

Chaos theory helps understand the world as Buddha taught. It provides a scientific model but no further. Morality and meditation, not mathematics, shapes destiny!

The secret of understanding reality is union of emptiness and appearances. When things are empty they appear; when they appear they are empty. "I see a space" - but how can space be seen? Examine what this means! True understanding needs direct contemplation!

May this Dhamma dana be a solid support for attaining *Nibbana* in this very life! May you all be peaceful and be liberated from *samsara*!

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