

Chapter 2

Systems Research and the Systemic Yoyo Model

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To prepare the theoretical foundation for the rest of this book, this chapter introduces the basics of systems thinking, the systemic yoyo model, and some elementary properties of this model. Then, for the completeness of this book, this chapter also glances through the theoretical and empirical justifications on why each and every system can be seen as a rotational yoyo.

The rest of this chapter is organized as follows: Section 2.1 provides an overview of systems science and why it can be seen as the second dimension of knowledge. Section 2.2 looks at the systemic yoyo model and some of its properties. Section 2.3 considers the laws of state of motion. Section 2.4 lists some of the theoretical justifications of the model. Section 2.5 provides a few empirical justifications.

2.1 Systems Science and the Second Dimension of Knowledge

2.1.1 *Systems Science and Its Importance*

Since 1924 when von Bertalanffy pointed out that the fundamental character of living things is its organization, the customary investigation of individual parts and processes cannot provide a complete explanation of the phenomenon of life, this holistic view of nature and social events has spread over all the corners of science and technology (Lin and Forrest 2011). Accompanying this realization of the holistic nature, in the past 80 some years, studies in systems science and systems thinking have brought forward brand-new understandings and discoveries to some of the major unsettled problems in the conventional science (Lin 1999; Klir 1985). Due to these studies of wholes, parts, and their relationships, a forest of interdisciplinary explorations has appeared, revealing the overall development trend in modern science and technology of synthesizing all areas of knowledge into a few major blocks, and the boundaries of conventional disciplines have become blurred (“Mathematical Sciences,” 1985). Underlying this trend, we can see the united effort of studying similar problems in different scientific fields on the basis of wholeness and parts and of understanding the world in which we live by employing the point of view of interconnectedness. As tested in the past 80 plus years, the concept of systems has been widely accepted by the entire spectrum of science and technology (Blauberg et al. 1977; Klir 2001).

2.1.2 *A Two-Dimensional Spectrum of Knowledge*

Similar to how numbers are theoretically abstracted, systems can also be proposed out of any and every object, event, and process. For instance, behind collections of objects, say, apples, there is a set of numbers such as 0 (apple), 1 (apple), 2 (apples), 3 (apples), etc., and behind each organization, such as a regional economy, there is an abstract, theoretical system within which the relevant whole, component parts, and the related interconnectedness are emphasized. And, it is because these interconnected whole and parts, the totality is known as an economy. In other words, when internal structures can be ignored, numbers can be very useful; otherwise, the world consists of dominant systems (or structures or organizations).

Historically speaking, on top of numbers and quantities, traditional science has been developed, and along with systemhood comes the systems science. That jointly gives rise to a two-dimensional spectrum of knowledge, where the classical science, which is classified by the thinghood it studies, constitutes the first dimension and the systems science, which investigates structures and organizations, forms the genuine second dimension (Klir 2001). That is, systems thinking focuses on those properties of systems and associated problems that emanate from the

general notion of structures and organizations, while the division of the classical science has been done largely on properties of particular objects. Therefore, systems research naturally transcends all the disciplines of the classical science and becomes a force making the existing disciplinary boundaries totally irrelevant and superficial.

The importance of this supplementary second dimension of knowledge cannot be in any way overemphasized. For example, when studying dynamics in an n -dimensional space, there are difficulties that cannot be resolved within the given space without getting help from a higher-dimensional space. In particular, when a one-dimensional flow is stopped by a blockage located over a fixed interval, the movement of the flow has to cease. However, if the flow is located in a two-dimensional space, instead of being completely stopped, the one-dimensional blockage would only create a local (minor) irregularity in the otherwise linear movement of the flow (that is how nonlinearity appears (Lin 2008)). Additionally, if one desires to peek into the internal structure of the one-dimensional blockage, he can simply take advantage of the second dimension by looking into the blockage from either above or below the blockage. That is, when an extra dimension is available, science will gain additional strength in terms of solving more problems that have been challenging the very survival of the mankind.

2.1.3 The Systemic Yoyo Model

Even though systems research holds such a strong promise as what is described in the previous subsection, the systems movement has suffered a great deal in the past 80 some years of development due to the reason that this new science does not have its own particular speaking language and thinking logic. Conclusions of systems research, produced in this period of time, are drawn either on ordinary language discussions or by utilizing the conventional mathematical methods, making many believe that systems thinking is nothing but a clever way of rearranging conventional ideas. In other words, due to the lack of an adequate tool for reasoning and an adequate language for speaking, systems research has been treated with less significance than they were thought initially since the 1970s when several publications criticized how systems enthusiasts derived their results without sufficient rigorous means (Berlinski 1976; Lilienfeld 1978), even though most of the results turned out to be correct if seen through our 20–20 hindsight.

Considering the importance of the Cartesian coordinate system in modern science (Kline 1972), Wu and Lin (2002) realize that the concepts of (sizeless and volumeless) points and numbers are bridged beautifully together within the Cartesian coordinate system so that this system plays the role of intuition and playground for modern science to evolve; and within this system, important concepts and results of modern mathematics and science are established. Recognizing the lack of such an intuition and playground for systems science, on the basis of the blown-up theory (Wu and Lin 2002), the yoyo model in Fig. 2.1 is formally

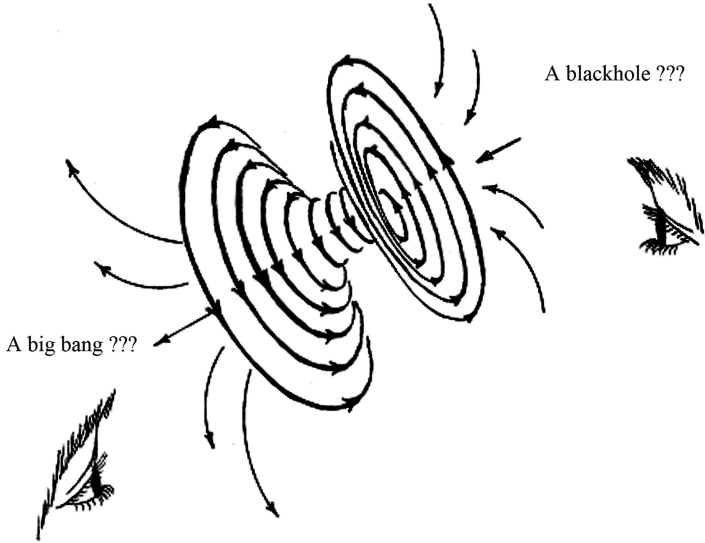
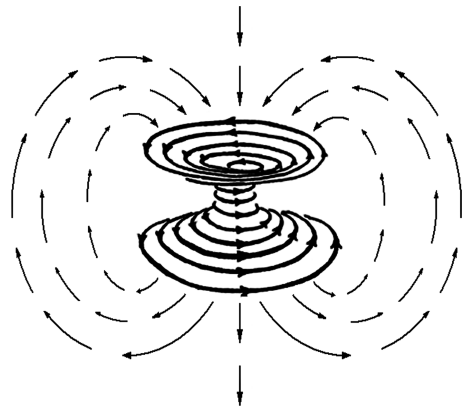


Fig. 2.1 Eddy motion model of a general system

Fig. 2.2 The distribution of a meridian field



introduced by Lin (2007) in order to establish the badly needed intuition and playground for systems science.

In particular, on the basis of the blown-up theory and the discussion on whether or not the world can be seen from the viewpoint of systems (Lin 1988a; Lin et al. 1990), the concepts of black holes, big bangs, and converging and diverging eddy motions are coined together in the model shown in Figs. 2.1 and 2.2. This model was established by Wu and Lin (2002) for each object and every system imaginable. In other words, each system or object considered in a study is a multidimensional entity that spins about its either visible or invisible axis. If we fathom such a

spinning entity in our three-dimensional space, we will have a structure as shown in Fig. 2.1. The side of black hole sucks in all things, such as materials, information, energy, profit, etc. After funneling through the short narrow neck, all things are spit out in the form of a big bang. Some of the materials, spit out from the end of big bang, never return to the other side and some will (Fig. 2.2a). For the sake of convenience of communication, such a structure as shown in Fig. 2.1 is referred to as a (Chinese) yoyo due to its general shape. More specifically, what this systemic model says is that each physical or intellectual entity in the universe, be it a tangible or intangible object, a living being, an organization, a culture, a civilization, etc., can all be seen as a kind of realization of a certain multidimensional spinning yoyo with either an invisible or visible spin field around it. It stays in a constant spinning motion as depicted in Fig. 2.1. If it does stop its spinning, it will no longer exist as an identifiable system. What Fig. 2.2b shows is that due to the interactions between the eddy field, which spins perpendicularly to the axis of spin, of the model, and the meridian field, which rotates parallel to axis of spin, all the materials that actually return to the black-hole side travel along a spiral trajectory.

To show this yoyo model can indeed, as expected, play the role of intuition and playground for systems researchers, this model has been successfully applied in the investigation of Newtonian physics of motion, the concept of energy, economics, finance, history, foundations of mathematics, small-probability disastrous weather forecasting, civilization, business organizations, and the mind, among others (Lin 2009; Lin and Forrest 2011; Forrest 2013, 2014; Forrest and Tao 2014; Ying and Forrest 2015).

At this junction, as an example, let us look at how a workplace can be investigated theoretically as such a spinning structure. In fact, each social entity is an objectively existing system that is made up of objects, such as people and other physical elements, and some specific relations between the objects. It is these relations that make the objects emerge as an organic whole and a social system. For example, let us look at a university of higher education. Without the specific setup of the organizational whole (relationships), the people, the buildings, the equipment, etc. will not emerge as a university (system). Now, what the systemic yoyo model says is that each imaginable system, which is defined as the totality of some objects and some relationships between the objects (Lin 1999), possesses the systemic yoyo's rotational structure so that each chosen social system, as a specific system involving people, has its own specific multidimensional systemic yoyo structure with a rotational field.

To this end, there are many different ways for us to see why each social entity spins about an invisible axis. In particular, let us imagine an organization, say a business entity. As it is well known in management science, each firm has its own particular organizational culture. Differences in organizational cultures lead to varied levels of productivity. Now, the basic components of an organizational culture change over time. These changes constitute the evolution of the firm and are caused by inventing and importing ideas from other organizations and consequently modifying or eliminating some of the existing ones. The concept of spin beneath the systemic yoyo structure of the firm comes from what ideas to invent,

which external ideas to import, and which existing ones to eliminate. If idea A will likely make the firm more prosperous with higher level of productivity, while idea B will likely make the firm stay as it has been, then these ideas will form a spin in the organizational culture. Specifically, some members of the firm might like additional productivity so that their personal goals can be materialized in the process of creating the extra productivity, while some other members might like to keep things as they have been so that what they have occupied, such as income, prestige, social status, etc., will not be adversely affected. These two groups will fight against each other to push for their agendas so that theoretically ideas A and B are actually “spin” around each other. For one moment, A is ahead; for the next moment, B is leading. And at yet another moment, no side is ahead when the power struggle might have very well reached an equilibrium state. In this particular incidence, the abstract axis of spin is invisible, because no one is willing to openly admit his underlying purpose for pushing for a specific idea (either A or B or other ones).

As for the concept of black hole in a social organization, it can be seen relatively clearly, because each social organization is an input-output system, no matter whether the organization is seen materially, holistically, or spiritually. The input mechanism will be naturally the “black hole,” while outputs of the organization the “big bang.” Again, when the organization is seen from different angles, the meanings of “black hole” and “big bang” are different. But, together these different “black holes” and “big bangs” make the organization alive. Without the totality of “black holes” and that of “big bangs,” no organization can be physically and holistically standing. Other than intuition, to this end the existing literature on civilizations, business entities, and individual humans does readily testify.

From this example, a careful reader might have sensed the fact that in this systemic yoyo model, we look at each system, be it a human organization, a physical entity, or an abstract intellectual being, as a whole that is made up of the “physical” body, its internal structure, and its interactions with the environment. This whole, according to the systemic yoyo model, is a high-dimensional spin field. Considering the fact that the body is the carrier of all other (such as cultural, philosophical, spiritual, psychological, etc.) aspects of the system, in theory the body of the system is a pool of fluid realized through the researcher’s sensing organs in the three-dimensional space. The word “fluid” here is an abstract term totaling the flows of energy, information, materials, money, etc., circulating within the inside of, going into, and giving off from the body. And in all published references we have searched, these flows are studied widely in natural and social sciences using continuous functions, which in physics and mathematics mean flows of fluids and are widely known as flow functions. On the other hand, it has been shown and concluded in Lin (2008) and Lin and Forrest (2011) that the universe is a huge ocean of eddies, which changes and evolves constantly. That is, the totality of the physically existing world can be legitimately studied as fluids, their mechanism of internal working, and their interactions with each other.

2.2 Properties of Systemic Yoyos

2.2.1 *The Field Structure*

Because each yoyo spins as in Fig. 2.1, other than the eddy field, which is perpendicular to the axis of rotation as shown in Fig. 2.1, there also exists a meridian field accompanying each yoyo (see Fig. 2.2). The invisible meridians go into the center of the black hole, through the narrow neck, and then out the big bang. They travel through the space and return to the center of the black hole. Somehow, we can imagine that these meridians help to hold different layers of the eddy field of the yoyo structure together. For the convenience of our communication, for any given yoyo structure, the black-hole side will be referred to as the south pole of the structure and the big bang side the north pole.

In this model, the word “spin” is used to capture the concept of angular momentum or the presence of angular momentum intrinsic to a body as opposed to orbital angular momentum of angular momentum, that is, the movement of the object about an external point. For example, the spin of the earth stands for the earth’s daily rotation about its polar axis. The orbital angular momentum of the earth is about the earth’s annual movement around the sun. In general, a two-dimensional object spins around a center (or a point), while a three-dimensional object rotates around a line called an axis.

Mathematically, a spin of a rigid body around a point or axis is followed by a second spin around the same point (respectively, axis), and then a third spin results. The inverse of a spin is also a spin. Thus, all possible spins around a point (respectively, axis) form a group of mathematics. However, a spin around a point or axis and a spin around a different point (respectively, axis) may result in something other than a rotation, such as a translation. In astronomy, spin (or rotation) is a commonly observed phenomenon. Stars, planets, and galaxies all spin around on their axes. In social science areas, spin appears in the study of many topics. An old saying goes as things always “go around and come around.” The theory and practice of public relations heavily involve the concept of spin, where a person, such as a politician, or an organization, such as a publicly traded company, signifies his often biased favor of an event or situation. In quantum mechanics, spin is particularly important for systems at atomic length scales, such as individual atoms, protons, or electrons (Griffiths 2004).

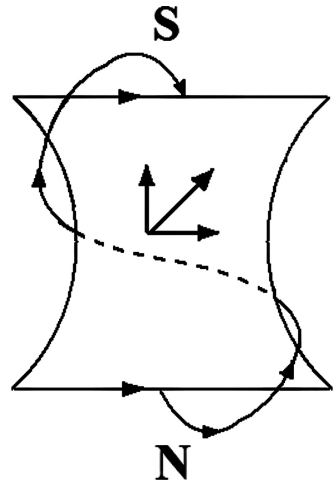
Because systems are of various kinds and scales, the universe can be seen as an ocean of eddy pools of different sizes, where each pool spins about its visible or invisible center or axis. At this junction, one good example in our three-dimensional physical space is the spinning field of air in a tornado. In the solenoidal structure, at the same time when the air within the tornado spins about the eye in the center, the systemic yoyo structure continuously sucks in and spits out air. In the spinning solenoidal field, the tornado takes in air and other materials, such as water or water vapor on the bottom, and lifts up everything it took in into the sky, and then it continuously spays out the air and water from the top of the spinning field. At the

same time, the tornado also breathes in and out with air in all horizontal directions and elevations. If the amounts of air and water taken in by the tornado are greater than those given out, then the tornado will grow larger with increasing effect on everything along its path. That is the initial stage of formation of the tornado. If the opposite holds true, then the tornado is in its process of dying out. If the amounts of air and water that are taken in and given out reach an equilibrium, then the tornado can last for at least a while. In general, each tornado (or a systemic yoyo) experiences a period of stable existence after its initial formation and before its disappearance. Similarly, for the general systemic yoyo model, it also constantly takes in and spits out materials. For the convenience of our discussion in this book, we assume that the spinning of the yoyo structures follows the left-hand rule 1 below.

Left-Hand Rule 1. When holding our left hand, the four fingers represent the spinning direction of the eddy plane, and the thumb points to the north pole direction along which the yoyo structure sucks in and spits out materials at its center (the narrow neck). (Note: it can be seen that in the physical world, systemic yoyos do not have to comply with this left-hand rule.)

As influenced by the eddy spin, the meridian directional movement of materials in the yoyo structure is actually slanted instead of being perfectly vertical. In Fig. 2.3, the horizontal vector stands for the direction of spin on the yoyo surface toward the reader and the vertical vector the direction of the meridian field, which is opposite of that in which the yoyo structure sucks in and spits out materials. Other than breathing in and out materials from the black-hole (the south pole) and big bang (the north pole) sides, the yoyo structure also takes in and gives out materials in all horizontal directions and elevations, just as in the case of tornadoes discussed earlier.

Fig. 2.3 Slanted meridians of a yoyo structure



2.2.2 *The Quark Structure of Systemic Yoyos*

The so-called three-jet event of the particle physics is an event with many particles in a final state that appear to be clustered in three jets, each of which consists of particles that travel in roughly the same direction. One can draw three cones from the interaction point, corresponding to the jets (Fig. 2.4), and most particles created in the reaction appear to belong to one of these cones. These three-jet events are currently the most direct available evidence for the existence of gluons, the elementary particles that cause quarks to interact and are indirectly responsible for the binding of protons and neutrons together in atomic nuclei (Brandelik et al. 1979). Because jets are ordinarily produced when quarks hadronize, the process of the formation of hadrons out of quarks and gluons, and quarks are produced only in pairs, an additional particle is required to explain such events as the three jets that contain an odd number of jets. Quantum chromodynamics indicates that this needed particle of the three-jet events is a particularly energetic gluon, radiated by one of the quarks, which hadronizes much as a quark does. What is particularly interesting about these events is their consistency with the Lund string model. And, what is predicted out of this model is precisely what is observed.

Now, let us make use of this laboratory observation to study the structure of systemic yoyos. To this end, let us borrow the term “quark structure” from Chen (2007). Because out of the several hundreds of different microscopic particles, other than protons, neutrons, electrons, and several others, most only exist momentarily, it is a common phenomenon for general systemic yoyos to be created and to disappear constantly in the physical microscopic world. All microscopic systemic yoyos can be classified (Chen 2007, p. 41) into two classes using the number of quarks involved. One class contains two-quark yoyos, such as electrons; π -, κ -, η -mesons; and others; and the other class three-quark yoyos, including protons; neutrons; Λ -, Σ -, Ω -, Ξ (Xi) baryons; etc. Here, electrons are commonly seen as without any quark. However, Chen (2007) showed that yes, they have two quarks. Currently, no laboratory experiment has produced zero-quark or n -quark particles, for natural number $n \geq 4$.

Fig. 2.4 A “snapshot” a three-jet event

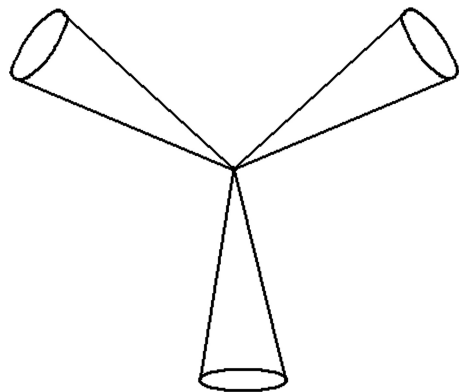


Fig. 2.5 The quark structure of a proton P

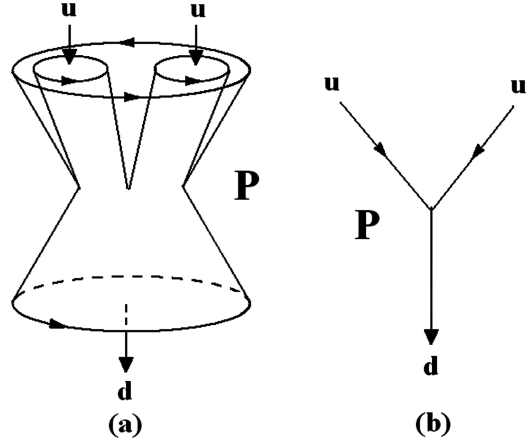
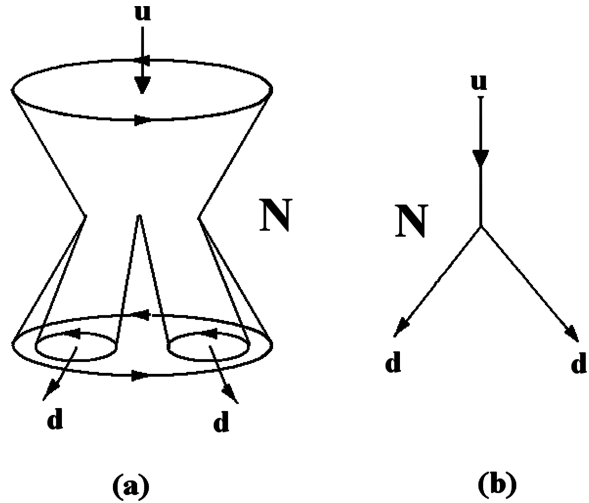


Fig. 2.6 The quark structure of a neutron N



Following Chen (2007), each spinning yoyo, as shown in Fig. 2.1, is seen as a two-quark structure, where we imagine the yoyo is cut through its waist horizontally in the middle, then the top half is defined as an absorbing quark and the bottom half a spurting quark. Now, let us study three-quark yoyos by looking at a proton P and a neutron N. At this junction, the three-jet events are employed as the evidence for the structure of three-quark yoyos, where there are two absorbing and one spurting quark in the eddy field. The proton P has two absorbing u-quarks and one spurting d-quark (Fig. 2.5), while the neutron N has two spurting d-quarks and one absorbing u-quark (Fig. 2.6). In these figures, the graphs (b) are the simplified flow charts with the line segments indicating the imaginary axes of rotation of each local spinning column. Here, in Fig. 2.5, the absorbing u-quarks stand for local spinning pools, while together they also travel along in the larger eddy field in

which they are part of. Similarly in Fig. 2.6, the spurting d-quarks are regional spinning pools. At the same time when they spin individually, they also travel along in the large yoyo structure of the neutron N. In all these cases, the spinning directions of these u- and d-quarks are the same except that each u-quark spins convergently (inwardly) and each d-quark divergently (outwardly).

Different yoyo structures have different numbers of absorbing u-quarks and d-quarks. And, the u-quarks and d-quarks in different yoyos are different due to variations in their mass, size, spinning speed and direction, and the speed of absorbing and spurting materials. This end is well supported by the discovery of quarks of various flavors, two spin states (up and down), positive and negative charges, and colors. That is, the existence of a great variety of quarks has been firmly established.

Hide (1953) used two concentric cylinders with a liquid placed in the ring-shaped region between the cylinders. He placed the container on a rotating turntable subjected to heating near the periphery and cooling at the center. The turntable generally rotated counterclockwise, as does the earth when viewed from above the north pole. Even though everything in the experiment was arranged with perfect symmetry about the axis of rotation, such as no impurities added in the liquid and the bottom of the container is flat, Hide observed the flow patterns as shown in Fig. 2.7. Briefly, with fixed heating, a transition from circular symmetry (Fig. 2.7a) to asymmetries (Fig. 2.7b, then Fig. 2.7c) would take place as the rotation increased past a critical value. With sufficiently rapid but fixed rate of rotation, a similar transition would occur when the heating reached a critical strength, while another transition back to symmetry would occur when the heating reached a still higher critical strength. Also, in stage Fig. 2.7c, a chain of identical eddy motions would appear. As they travel along, they would alter their shapes in unison in a regular periodic fashion, and after many rotations of the turntable, they would regain their original shape and then repeat the cycle. Fultz and his colleagues (1959) conducted another dishpan experiment without the inner cylinder, producing similar results.

Now, if we fit Fultz's dishpan experiment to the discussion above by imagining both the top and the bottom of each yoyo as a spinning dish of fluids, then the patterns as observed in the dishpan experiment suggest that in theory, there could exist such a yoyo structure that it has n u-quarks and m d-quarks, where $n \geq 1$ and $m \geq 1$ are arbitrary natural numbers, and each of these quarks spins individually and along with each other in the overall spinning pool of the yoyo structure.

From Lin (2007, 2008), it can be seen that due to uneven distribution of forces, either internal or external to the yoyo structure, the quark structure of the spinning yoyo changes, leading to different states in the development of the yoyo. This end can be well seen theoretically and has been well supported by laboratory experiments, where, for example, protons and neutrons can be transformed into each other. When a yoyo undergoes changes and becomes a new yoyo, the attributes of the original yoyo in general will be altered. For example, when a two-quark yoyo is split into two new yoyos under an external force, the total mass of the new yoyos might be greater or smaller than that of the original yoyo. And, in one spinning yoyo, no matter how many u-quarks (or d-quarks) exist, although these quarks spin

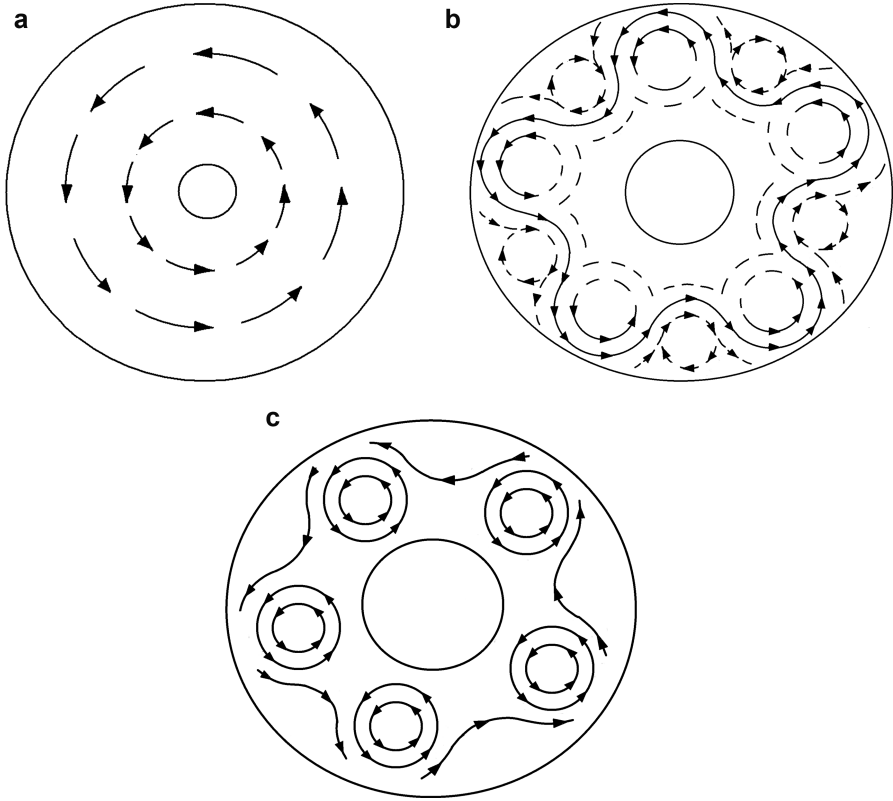


Fig. 2.7 Patterns observed in Hide's dishpan experiment. (a) Symmetric flow at the upper surface. (b) Asymmetric flow at the upper surface. (c) Asymmetric circular flow at the upper surface

individually, they also spin in the same direction and at the same angular speed. Here, the angular speeds of u-quarks and d-quarks do not have to be the same, which is different of what is observed in the dishpan experiment, because in this experiment everything is arranged with perfect symmetry, such as the flat bottom of the dish and perfectly round periphery.

2.3 Laws on State of Motion

Based on the discovery (Wu and Lin 2002) that spins are the fundamental evolutionary feature and characteristic of materials, in this section, we will study the figurative analysis method of the systemic yoyo model and how to apply it to establish laws on state of motion by generalizing Newton's laws of motion. More specifically, after introducing the new figurative analysis method, we will have a chance to generalize all the three laws of motion so that external forces are no

longer required for these laws to work. As what is known, these laws are one of the reasons why physics is an “exact” science. And, in the rest of this book, we will show that these generalized forms of the original laws of mechanics will be equally applicable to social sciences and humanity areas as their classic forms in natural science. The presentation in this section is based on Lin (2007).

2.3.1 *The First Law on State of Motion*

Newton’s first law says an object will continue in its state of motion unless compelled to change by a force impressed upon it. This property of objects, their natural resistance to changes in their state of motion, is called inertia. Based on the theory of blown-ups, one has to address two questions not settled by Newton in his first law: If a force truly impresses on the object, the force must be from the outside of the object. Then, where can such a force be from? How can such natural resistance of objects to changes be considered natural?

It is because uneven densities of materials create twisting forces that fields of spinning currents are naturally formed. This end provides an answer to the first question. Based on the yoyo model (Fig. 2.1), the said external force comes from the spin field of the yoyo structure of another object, which is another level higher than the object of our concern. These forces from this new spin field push the object of concern away from its original spin field into a new spin field. Because if there is not such a forced traveling, the said object will continue its original movement in its original spin field. That is why Newton called its tendency to stay in its course of movement as its resistance to changes in its state of motion and as natural. Based on this discussion and the yoyo model (Fig. 2.1) developed for each and every object and system in the universe, Newton’s first law of mechanics can be rewritten in a general term as follows:

The First Law on State of Motion *Each imaginable and existing entity in the universe is a spinning yoyo of a certain dimension. Located on the outskirts of the yoyo is a spin field. Without being affected by another yoyo structure, each particle in the said entity’s yoyo structure continues its movement in its orbital state of motion.*

Because for Newton’s first law to hold true, one needs an external force, when people asked Newton where such an initial force could be from, he answered (jokingly?): “It was from God. He waved a bat and provided the very first blow to all things he created” (Kline 1972). If such an initial blow is called the first push, then the yoyo model in Fig. 2.1 and the stirring forces naturally existing in each “yoyo” created by uneven densities of materials’ structures will be called the second stir.

2.3.2 The Second Law on State of Motion

Newton's second law of motion says that when a force does act on an object, the object's velocity will change and the object will accelerate. More precisely, what is claimed is that its acceleration $\vec{a}$ will be directly proportional to the magnitude of the total (or net) force $\vec{F}_{\text{net}}$ and inversely proportional to the object's mass m . In symbols, the second law is written:

$$\vec{F}_{\text{net}} = m\vec{a} = m \frac{d\vec{v}}{dt} \quad (2.1)$$

Even though Eq. (2.1) has been one of the most important equations in mechanics, when one ponders over this equation long enough, he has to ask the following questions: What is a force? Where are forces from and how do forces act on other objects?

To answer these questions, let us apply Einstein's concept of "uneven time and space" of materials' evolution (Einstein 1997). So, we can assume

$$\vec{F} = -\nabla S(t, x, y, z), \quad (2.2)$$

where $S = S(t, x, y, z)$ stands for the time-space distribution of the external acting object (a yoyo structure). Let $\rho = \rho(t, x, y, z)$ be the density of the object being acted upon. Then, Eq. (2.1) can be rewritten as follows for a unit mass of the object being acted upon:

$$\frac{d\vec{v}}{dt} = -\frac{1}{\rho(t, x, y, z)} \nabla S(t, x, y, z). \quad (2.3)$$

If $S(t, x, y, z)$ is not a constant, or if the structure of the acting object is not even, Eq. (2.3) can be rewritten as

$$\frac{d(\nabla x \times \vec{v})}{dt} = -\nabla x \times \left[\frac{1}{\rho} \nabla S \right] \neq 0 \quad (2.4)$$

and it represents an eddy motion due to the nonlinearity involved. That is, when the concept of uneven structures is employed, Newton's second law actually indicates that a force, acting on an object, is in fact the attraction or gravitation from the acting object. It is created within the acting object by the unevenness of its internal structure.

By combining this new understanding of Newton's second law with the yoyo model, we get the models on how an object m is acted upon by another object M (see Figs. 2.8 and 2.9).

Now, by summarizing what can be observed in these figures, Newton's second law can be generalized as follows.

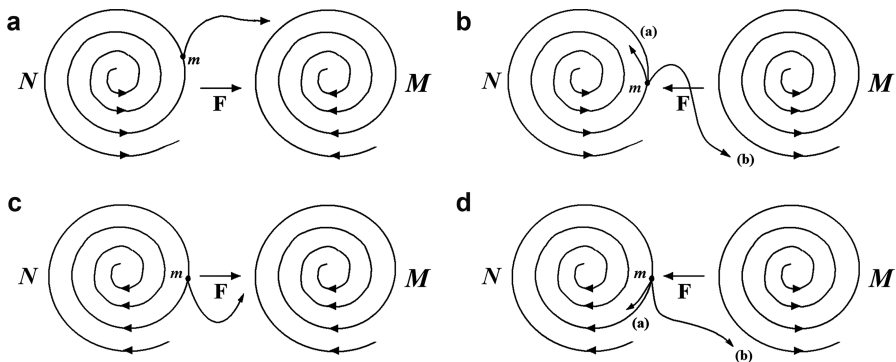


Fig. 2.8 Acting and reacting models with yoyo structures of harmonic spinning patterns. (a) Object m is located in a diverging eddy and pulled by a converging eddy M . (b) Object m is located in a diverging eddy and pulled or pushed by a diverging eddy M . (c) Object m is located in a converging eddy and pulled by a converging eddy M . (d) Object m is located in a converging eddy and pulled or pushed by a diverging eddy M

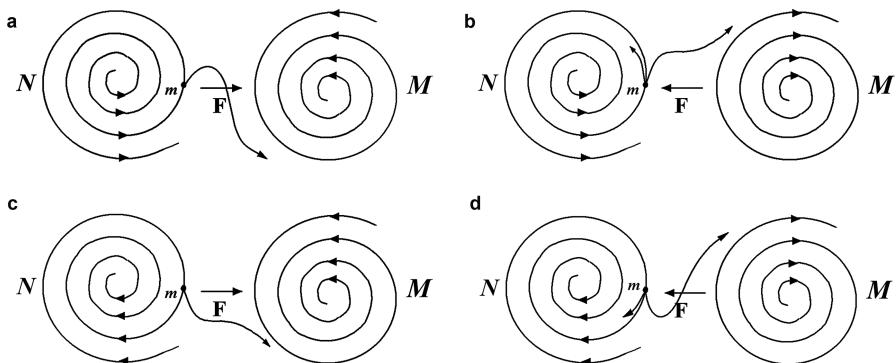


Fig. 2.9 Acting and reacting models with yoyo structures of inharmonic spinning patterns. (a) Object m is located in a diverging eddy and pulled by a converging eddy M . (b) Object m is located in a diverging eddy and pushed or pulled by a diverging eddy M . (c) Object m is located in a converging eddy and pulled by a converging eddy M . (d) Object m is located in a converging eddy and pushed or pulled by a diverging eddy M

The Second Law on State of Motion When a constantly spinning yoyo structure M does affect an object m , which is located in the spin field of another object N , the velocity of the object m will change and the object will accelerate. More specifically, the object m experiences an acceleration $\vec{a}$ toward the center of M such that the magnitude of $\vec{a}$ is given by

$$a = \frac{v^2}{r} \quad (2.5)$$

where r is the distance between the object m and the center of M and v the speed of any object in the spin field of M about distance r away from the center of M . And, the magnitude of the net pulling force $\vec{F}_{\text{net}}$ that M exerts on m is given by

$$F_{\text{net}} = ma = m \frac{v^2}{r} \quad (2.6)$$

2.3.3 The 3rd and 4th Laws on State of Motion

Newton's third law is commonly known as that to every action, there is an equal, but opposite, reaction. More precisely, if object A exerts a force on object B, then object B exerts a force back on object A, equal in strength but in the opposite direction. These two forces, $\vec{F}_{A\text{-on-}B}$ and $\vec{F}_{B\text{-on-}A}$, are called an action/reaction pair.

Similar to what has been done earlier, if we analyze the situation in two different angles: two eddy motions act and react to each other's spin field, and two, one spinning yoyo is acted upon by an eddy flow of a higher level and scale, then for the first situation, where two eddy motions act and react to each other's spin field, we have the diagrams in Fig. 2.10.

For objects N and M with harmonic spin fields, we have the diagrams in Fig. 2.11.

Based on the analysis of these graphs, Newton's third law can be generalized for the case of two eddy motions acting and reacting to each other's spin fields as follows:

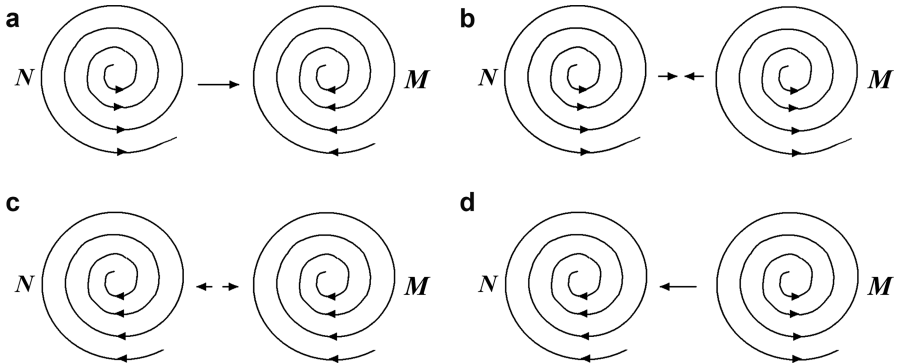


Fig. 2.10 Same scale acting and reacting spinning yoyos of the harmonic pattern. (a) N diverges and M converges. (b) Both N and M diverge. (c) Both N and M converge. (d) N converges and M diverges

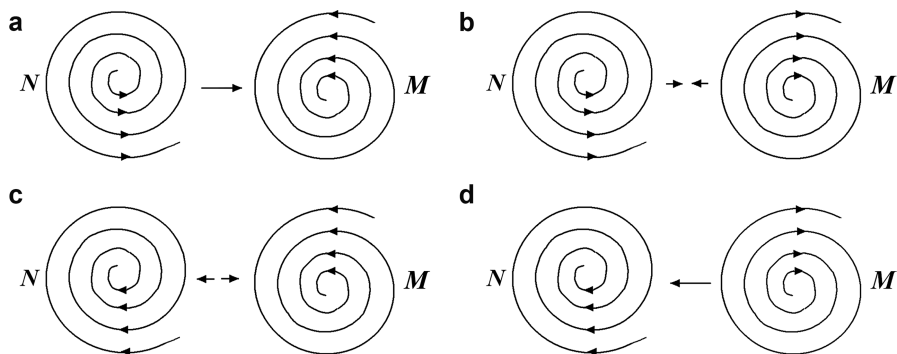


Fig. 2.11 Same scale acting and reacting spinning yoyos of inharmonic patterns. (a) N diverges and M converges. (b) Both N and M diverge. (c) Both N and M converge. (d) N converges and M diverges

The Third Law on State of Motion *When the spin fields of two yoyo structures N and M act and react on each other, their interaction falls in one of the six scenarios as shown in Figs. 2.10a–c and 2.11a–c. And, the following are true:*

1. *For the cases in (a) of Figs. 2.10 and 2.11, if both N and M are relatively stable temporarily, then their action and reaction are roughly equal but in opposite directions during the temporary stability. In terms of the whole evolution involved, the divergent spin field (N) exerts more action on the convergent field (M) than M 's reaction peacefully in the case of Fig. 2.10a and violently in the case of Fig. 2.11a.*
2. *For the cases (b) in Figs. 2.10 and 2.11, there are permanent equal, but opposite, actions and reactions with the interaction more violent in the case of Fig. 2.10b than in the case of Fig. 2.11b.*
3. *For the cases in (c) of Figs. 2.10 and 2.11, there is a permanent mutual attraction. However, for the former case, the violent attraction may pull the two spin fields together and have the tendency to become one spin field. For the latter case, the peaceful attraction is balanced off by their opposite spinning directions. And, the spin fields will coexist permanently.*

That is to say, Newton's third law holds true temporarily for cases (a), permanently for cases (b), and partially for cases (c) in Figs. 2.10 and 2.11.

If we look at Newton's third law from the second angle, one spinning yoyo m is acted upon by an eddy flow M of a higher level and scale. If we assume m is a particle in a higher-level eddy flow N before it is acted upon on by M , then we are looking at situations as depicted in Figs. 2.8 and 2.9. Jointly, we have what is shown in Fig. 2.12, where the sub-eddies created in Fig. 2.12a are both converging, since the spin fields of N and M are suppliers for them and sources of forces for their spins. Sub-eddies in Fig. 2.12b are only spinning currents. They serve as middle stop before supplying to the spin field of M . Sub-eddies in Fig. 2.12c are diverging.

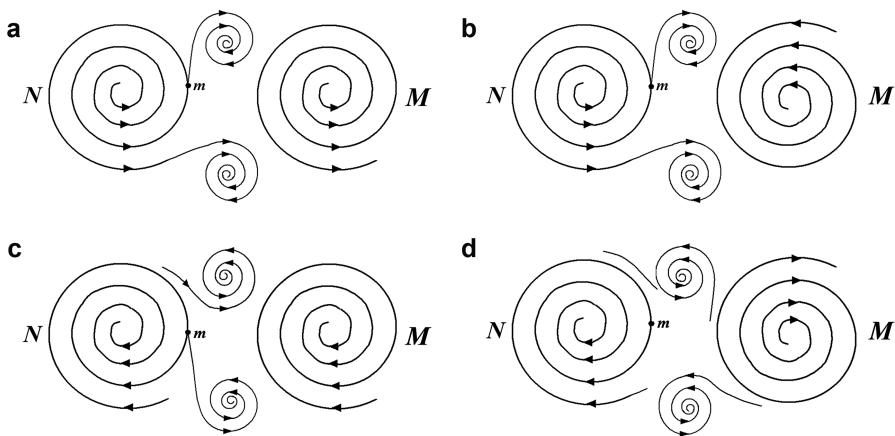


Fig. 2.12 Object m might be thrown into a sub-eddy created by the spin fields of N and M jointly. (a) Object m is situated as in Fig. 2.8b. (b) Object m is situated as in Fig. 2.9a. (c) Object m is situated as in Fig. 2.8c. (d) Object m is situated as in Fig. 2.9d

And, sub-eddies in Fig. 2.12d are only spinning currents similar to those in Fig. 2.12b.

That is, based on our analysis on the scenario that one object m , situated in a spin field N , is acted upon by an eddy flow M of a higher level and scale, we can generalize Newton's third law to the following form:

The Fourth Law on State of Motion *When the spin field M acts on an object m , rotating in the spin field N , the object m experiences equal, but opposite, action and reaction, if it is either thrown out of the spin field N and not accepted by that of M (Figs. 2.8a, d and 2.9b, c) or trapped in a sub-eddy motion created jointly by the spin fields of N and M (Figs. 2.8b, c and 2.9a, d). In all other possibilities, the object m does not experience equal and opposite action and reaction from N and M .*

2.3.4 Validity of Figurative Analysis

In the previous three subsections, we have heavily relied on the analysis of shapes and dynamic graphs. To any scientific mind produced out of the current formal education system, he/she will very well question the validity of such a method of reasoning naturally. To address this concern, let us start with the concept of equal quantitative effects. For detailed and thorough study of this concept, please consult with Wu and Lin (2002) and Lin (1998).

By equal quantitative effects, it means the eddy effects with nonuniform vortical vectorities existing naturally in systems of equal quantitative movements due to the unevenness of materials. Here, by equal quantitative movements, it means such movements that quasi-equal acting and reacting objects are involved or two or more

quasi-equal mutual constraints are concerned with. What is significant about equal quantitative effects is that they can easily throw calculations of equations into computational uncertainty. For example, if two quantities x and y are roughly equal, then $x - y$ becomes a computational uncertainty involving large quantities with infinitesimal increments. This end is closely related to the second crisis in the foundations of mathematics.

Based on recent studies in chaos (Lorenz 1993), it is known that for nonlinear equation systems, which always represent equal quantitative movements (Wu and Lin 2002), minor changes in their initial values lead to dramatic changes in their solutions. Such extreme volatility existing in the solutions can be easily caused by changes of a digit many places after the decimal point. Such a digit place far away from the decimal point in general is no longer practically meaningful. That is, when equal quantitative effects are involved, we face with either the situation where no equation can be reasonably established or the situation that the established equation cannot be solved with valid and meaningful solution.

That is, the concept of equal quantitative effects has computationally declared that equations are not eternal and that there does not exist any equation under equal quantitative effects. That is why OuYang (Lin 1998) introduced the methodological method of “abstracting numbers (quantities) back into shapes (figurative structures).” Of course, the idea of abstracting numbers back to shapes is mainly about how to describe and make use of the formality of eddy irregularities. These irregularities are very different of all the regularized mathematical quantifications of structures.

Because the currently available variable mathematics is entirely about regularized computational schemes, there must be the problem of disagreement between the variable mathematics and irregularities of objective materials’ evolutions and the problem that distinct physical properties are quantified and abstracted into indistinguishable numbers. Such incapability of modern mathematics has been shown time and time again in areas of practical forecastings and predictions. For example, since theoretical studies cannot yield any meaningful and effective method to foretell drastic weather changes, especially about small or zero probability disastrous weather systems, (in fact, the study of chaos theory indicates that weather patterns are chaotic and unpredictable. A little butterfly fluttering its tiny wings in Australia can drastically change the weather patterns in North America (Gleick 1987)); the technique of live report has been widely employed. However, in the area of financial market predictions, it has not been so lucky that the technique of live report can possibly applied as effectively. Due to equal quantitative effects, the movements of prices in the financial marketplace have been truly chaotic when viewed from the contemporary scientific point of view.

That is, the introduction of the concept of equal quantitative effects has made the epistemology of natural sciences gone from solids to fluids and completed the unification of natural and social sciences. More specifically, after we have generalized Newton’s laws of motion, which have been the foundations on which physics is made into an “exact” science, in the previous three subsections, these new laws

can be readily employed to study social systems, such as military conflicts, political struggles, economic competitions, etc.

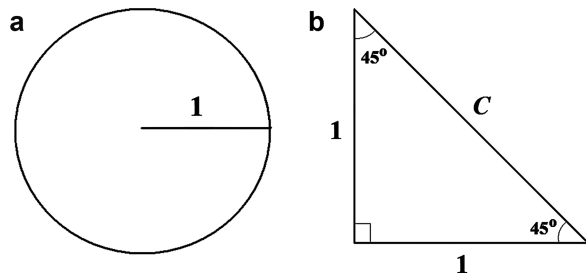
Since we have briefly discussed about the concept of equal quantitative effects and inevitable failures of current variable mathematics under the influence of such effects, then how about figurative analysis?

As for the usage of graphs in our daily lives, it goes back as far as our recorded history can go. For example, any written language consists of an array of graphic figures. In terms of figurative analysis, one early work is the book, named *Yi Ching* (or the *Book of Changes*, as known in English (Wilhalm and Baynes 1967)). For now, no one knows exactly when this book was written and who wrote it. All known is that the book has been around since about 3000 years ago. In that book, the concept of Yin and Yang was first introduced and graphic figures are used to describe supposedly all matters and events in the world. When Leibniz (a founder of calculus) had a hand on that book, he introduced the binary number system and base p number system in modern mathematics (Kline 1972). Later on, Bool furthered this work and laid down the foundation for the modern computer technology to appear.

In our modern days, figures and figurative analysis are readily seen in many aspects of our lives. One good example is the number π . Since we cannot write out this number in the traditional fashion (in either the decimal form or the fraction form), we simply use a figure π to indicate it. The same idea is employed to write all irrational numbers. In the area of weather forecasting, figurative analysis is used each and every day in terms of weather maps. In terms of studies of financial markets, a big part of the technical analysis is developed on graphs. So, this part of technical analysis can also be seen as an example of figurative analysis.

From the recognition of equal quantitative effects and the realization of the importance of figurative analysis, OuYang invented and materialized a practical way to “abstract numbers back into shapes” so that the forecasting of many disastrous small or zero probability weather systems becomes possible. For detailed discussion about this end, please consult with Appendix D in Wu and Lin (2002) and Lin (1998). To simplify the matter, let us see how to abstract numbers π and $\sqrt{2}$ back into shapes with their inherent structures kept. In Fig. 2.13a, the exact value of π is represented using the area of a circle of radius 1. And, the precise value of $\sqrt{2}$ is

Fig. 2.13 Representing π and $\sqrt{2}$ figuratively and precisely. (a) The area of the circle is π . (b) The length of c is $\sqrt{2}$



given in Fig. 2.13b by employing the special right triangle. By applying these simple graphs, the meaning, the precise values, and their inherent structures of π and $\sqrt{2}$ are presented once for all.

2.4 Theoretical Justifications

This section looks at the theoretical foundation on why such an intuition as the yoyo model of general systems holds for each and every system that is either tangible or imaginable.

2.4.1 *Blown-Ups: Moments of Transition in Evolutions*

When we study the nature and treat everything we see as a system (Klir 2001), then one fact we can easily see is that many systems in nature evolve in concert. When one thing changes, many other seemingly unrelated things alter their states of existence accordingly. That is why we propose OuYang et al. (2009) to look at the evolution of a system or event of our concern as a whole. That is, when developments and changes naturally existing in the natural environment are seen as a whole, we have the concept of whole evolutions. And, in whole evolutions, other than continuities, as well studied in modern mathematics and science, what seems to be more important and more common is discontinuity, with which transitional changes (or blown-ups) occur. These blown-ups reflect not only the singular transitional characteristics of the whole evolutions of nonlinear equations but also the changes of old structures being replaced by new structures. By borrowing the form of calculus, we can write the concept of blown-ups as follows: For a given (mathematical or symbolic) model, which truthfully describes the physical situation of our concern, if its solution $u = u(t; t_0, u_0)$, where t stands for time and u_0 the initial state of the system, satisfies

$$\lim_{t \rightarrow t_0} |u| = +\infty, \quad (2.7)$$

and at the same time moment when $t \rightarrow t_0$, the underlying physical system also goes through a transitional change, then the solution $u = u(t; t_0, u_0)$ is called a blown-up solution and the relevant physical movement expresses a blown-up. For nonlinear models in independent variables of time (t) and space (x , x and y , or x , y , and z), the concept of blown-ups is defined similarly, where blown-ups in the model and the underlying physical system can appear in time or in space or in both.

2.4.2 Mathematical Properties of Blown-Ups

To help us understand the mathematical characteristics of blown-ups, let us look at the following constant-coefficient equation:

$$\dot{u} = a_0 + a_1 u + \dots + a_{n-1} u^{n-1} + u^n = F, \quad (2.8)$$

where u is the state variable, and $a_0, a_1, \dots, a_{n-1}$ are constants. Based on the fundamental theorem of algebra, let us assume that Eq. (2.8) can be written as

$$\dot{u} = F = (u - u_1)^{p_1} \dots (u - u_r)^{p_r} (u^2 + b_1 u + c_1)^{q_1} \dots (u^2 + b_m u + c_m)^{q_m}, \quad (2.9)$$

where p_i and $q_j, i = 1, 2, \dots, r$ and $j = 1, 2, \dots, m$, are positive whole numbers and $n = \sum_{i=1}^r p_i + 2 \sum_{j=1}^m q_j, \Delta = b_j^2 - 4c_j < 0, j = 1, 2, \dots, m$. Without loss of generality, assume that $u_1 \geq u_2 \geq \dots \geq u_r$, then the blown-up properties of the solution of Eq. (2.9) are given in the following theorem.

Theorem 2.1 The condition under which the solution of an initial value problem of Eq. (2.8) contains blown-ups is given by

1. When $u_i, i = 1, 2, \dots, r$, does not exist, that is, $F = 0$ does not have any real solution
2. If $F = 0$ does have real solutions $u_i, i = 1, 2, \dots, r$, satisfying $u_1 \geq u_2 \geq \dots \geq u_r$
 - (a) When n is an even number, if $u > u_1$, then u contains blown-up(s).
 - (b) When n is an odd number, whether $u > u_1$ or $u < u_r$, there always exist blown-ups.

A detailed proof of this theorem can be found in Wu and Lin (2002, pp. 65–66) and is omitted here. And for higher-order nonlinear evolution systems, please consult with Lin (2008).

2.4.3 The Problem of Quantitative Infinity

One of the features of blown-ups is the quantitative infinity ∞ , which stands for indeterminacy mathematically. So, a natural question is how to comprehend this mathematical symbol ∞ , which in applications causes instabilities and calculation spills that have stopped each and every working computer.

To address the previous question, let us look at the mapping relation of the Riemann ball, which is well studied in complex functions (Fig. 2.14). This so-called Riemann ball, a curved or curvature space, illustrates the relationship between the infinity on the plane and the north pole N of the ball. Such a mapping relation connects $-\infty$ and $+\infty$ through a blown-up. Or in other words, when a dynamic point x_i travels through the north pole N on the sphere, the corresponding image x'_i

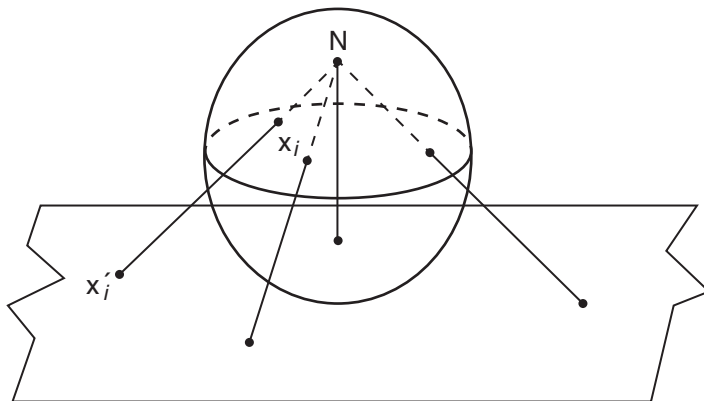


Fig. 2.14 The Riemann ball – relationship between planar infinity and three-dimensional north pole

on the plane of the point x_i shows up as a reversal change from $-\infty$ to $+\infty$ through a blown-up. So, treating the planar points $\pm\infty$ as indeterminacy can only be a product of the thinking logic of a narrow or low dimensional observ-control, since, speaking generally, these points stand implicitly for direction changes of one dynamic point on the sphere at the polar point N. Or speaking differently, the phenomenon of directionless, as shown by blown-ups of a lower dimensional space, represents exactly a direction change of movement in a higher-dimensional curvature space. Therefore, the concept of blown-ups can specifically represent implicit transformations of spatial dynamics. That is, through blown-ups, problems of indeterminacy of a narrow observ-control in a distorted space are transformed into determinant situations of a more general observ-control system in a curvature space. This discussion shows that the traditional view of singularities as meaningless indeterminacies has not only revealed the obstacles of the thinking logic of the narrow observ-control (in this case, the Euclidean space) but also the careless omissions of spatial properties of dynamic implicit transformations (bridging the Euclidean space to a general curvature space).

Summarizing what has been discussed above in this section, we can see that nonlinearity, speaking mathematically, stands (mostly) for singularities in Euclidean spaces, the imaginary plane discussed above. In terms of physics, nonlinearity represents eddy motions, the movements on curvature spaces, the Riemann ball above. Such motions are a problem about structural evolutions, which are a natural consequence of uneven evolutions of materials. So, nonlinearity accidentally describes discontinuous singular evolutionary characteristics of eddy motions (in curvature spaces) from the angle of a special, narrow observ-control system, the Euclidean spaces.

2.4.4 *Equal Quantitative Effects*

Another important concept studied in the blown-up theory is that of equal quantitative effects. Even though this concept was initially proposed in the study of fluid motions, it essentially represents the fundamental and universal characteristics of all movements of materials. What is more important is that this concept reveals the fact that nonlinearity is originated from the figurative structures of materials instead of nonstructural quantities of the materials.

The so-called equal quantitative effects stand for the eddy effects with nonuniform vortical vectorities existing naturally in systems of equal quantitative movements due to the unevenness of materials. And, by equal quantitative movements, it is meant to be the movements with quasi-equal acting and reacting objects or under two or more quasi-equal mutual constraints. For example, the relative movements of two or more planets of approximately equal masses are considered equal quantitative movements. In the microcosmic world, an often seen equal quantitative movement is the mutual interference between the particles to be measured and the equipment used to make the measurement. Many phenomena in daily lives can also be considered equal quantitative effects, including such events as wars, politics, economies, chess games, races, plays, etc.

Comparing to the concept of equal quantitative effects, the Aristotelian and Newtonian framework of separate objects and forces is about unequal quantitative movements established on the assumption of particles. On the other hand, equal quantitative movements are mainly characterized by the kind of measurement uncertainty that when I observe an object, the object is constrained by me. When an object is observed by another object, the two objects cannot really be separated apart. At this junction, it can be seen that the Su-Shi Principle of Xuemou Wu's panrelativity theory (1990), Bohr (N. Bohr, 1885–1962) principle and the relativity principle about microcosmic motions, von Neumann's principle of program storage, etc. all fall into the uncertainty model of equal quantitative movements with separate objects and forces.

What is practically important and theoretically significant is that eddy motions are confirmed not only by daily observations of surrounding natural phenomena but also by laboratory studies from as small as atomic structures to as huge as nebular structures of the universe. At the same time, eddy motions show up in mathematics as nonlinear evolutions. The corresponding linear models can only describe straight-line-like spraying currents and wave motions of the morphological changes of reciprocating currents. What is interesting here is that wave motions and spraying currents are local characteristics of eddy movements. This fact is very well shown by the fact that linearities are special cases of nonlinearities. Please note that we do not mean that linearities are approximations of nonlinearities.

The birth-death exchanges and the nonuniformity of vortical vectorities of eddy evolutions naturally explain where and how quantitative irregularities, complexities, and multiplicities of materials' evolutions, when seen from the current narrow observ-control system, come from. Evidently, if the irregularity of eddies comes

from the unevenness of materials' internal structures and if the world is seen at the height of structural evolutions of materials, then the world is simple. And, it is so simple that there are only two forms of motions. One is clockwise rotation, and the other counterclockwise rotation. The vortical vectority in the structures of materials has very intelligently resolved the Tao of Yin and Yang of the *Book of Changes* of the eastern mystery (Wilhalm and Baynes 1967) and has been very practically implemented in the common form of motion of all materials in the universe. That is when the concept of invisible organizations of the blown-up system comes from.

The concept of equal quantitative effects not only possesses a wide range of applications but also represents an important omission of modern science, developed in the past 300 plus years. Evidently, not only are equal quantitative effects more general than the mechanic system of particles with further reaching significance, but also have they directly pointed to some of the fundamental problems existing in modern science.

In order for us to intuitively see why equal quantitative effects are so difficult for modern science to handle by using the theories established in the past 300 plus years, let us first look at why all materials in the universe are in rotational movements. According to Einstein's uneven space and time, we can assume that all materials have uneven structures. Out of these uneven structures, there naturally exist gradients. With gradients, there will appear forces. Combined with uneven arms of forces, the carrying materials will have to rotate in the form of moments of forces. That is exactly what the ancient Chinese Lao Tzu (English and Feng 1972) said: "Under the heaven, there is nothing more than the Tao of images," instead of Newtonian doctrine of particles (under the heaven, there is such a Tao that is not about images but sizeless and volumeless particles). The former stands for an evolution problem of rotational movements under stirring forces. Since structural unevenness is an innate character of materials, that is why it is named second stir, considering that the phrase of first push was used first in history (OuYang et al. 2000). What needs to be noted is that the phrases of first push and second stir do not mean that the first push is prior to the second stir.

Now, we can imagine that the natural world and/or the universe be composed of entirely with eddy currents, where eddies exist in different sizes and scales and interact with each other. That is, the universe is a huge ocean of eddies, which change and evolve constantly. One of the most important characteristics of spinning fluids, including spinning solids, is the difference between the structural properties of inwardly and outwardly spinning pools and the discontinuity between these pools. Due to the stirs in the form of moments of forces, in the discontinuous zones, there exist sub-eddies and sub-sub-eddies (Fig. 2.15, where sub-eddies are created naturally by the large eddies M and N). Their twist-ups (the sub-eddies) contain highly condensed amounts of materials and energies. Or in other words, the traditional frontal lines and surfaces (in meteorology) are not simply expansions of particles without any structure. Instead, they represent twist-up zones concentrated with irregularly structured materials and energies (this is where the so-called small-probability events appear and small-probability information is observed and collected, so such information (event) should also be called irregular information (and

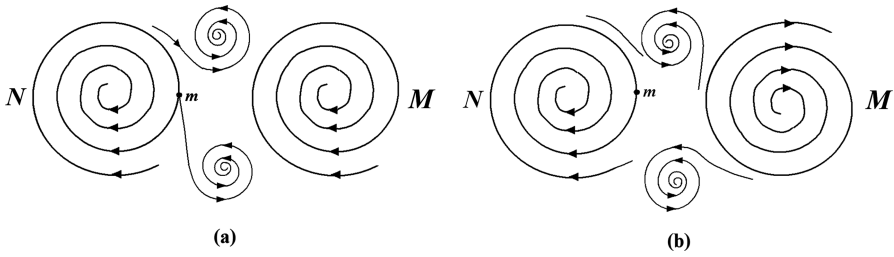
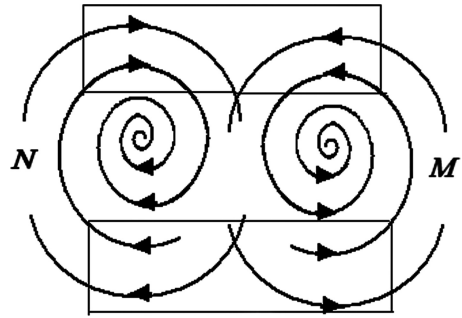


Fig. 2.15 Appearance of sub-eddies

Fig. 2.16 Structural representation of equal quantitative effects



event)). In terms of basic energies, these twist-up zones cannot be formed by only the pushes of external forces and cannot be adequately described by using mathematical forms of separate objects and forces. Since evolution is about changes in materials' structures, it cannot be simply represented by different speeds of movements. Instead, it is mainly about transformations of rotations in the form of moments of forces ignited by irregularities. The enclosed areas in Fig. 2.16 stand for the potential places for equal quantitative effects to appear, where the combined pushing or pulling is small in absolute terms. However, it is generally difficult to predict what will come out of the power struggles. In general, what comes out of the power struggle tends to be drastic and unpredictable by using the theories and methodologies of modern science.

2.5 Empirical Justifications

Continuing on what was done in the previous sections, we will in this section study several empirical evidences and observations that underline the existence of the yoyo structure behind each and every system, which either tangibly exists or is intellectually imaginable.

2.5.1 Bjerknes' Circulation Theorem

Based on the previous discussions, it is found that nonlinearity accidentally describes discontinuous singular evolutionary characteristics of eddy motions (in curvature spaces) from the angle of a special, narrow observ-control system, the Euclidean spaces (the imaginary plane). To support this end, let us now look at the Bjerknes' Circulation Theorem (1898).

At the end of the nineteenth century, V. Bjerknes (1898) (Hess 1959) discovered the eddy effects due to changes in the density of the media in the movements of the atmosphere and ocean. He consequently established the well-known circulation theorem, which was later named after him. Let us look at this theorem briefly.

By a circulation, it is meant to be a closed contour in a fluid. Mathematically, each circulation Γ is defined as the line integral about the contour of the component of the velocity vector locally tangent to the contour. In symbols, if $\vec{V}$ stands for the speed of a moving fluid, S an arbitrary closed curve, $\delta\vec{r}$ the vector difference of two neighboring points of the curve S (Fig. 2.17), then a circulation Γ is defined as follows:

$$\Gamma = \oint_S \vec{V} \delta\vec{r}. \quad (2.10)$$

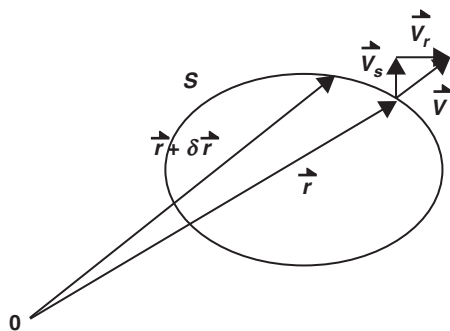
Through some very clever manipulations, we can produce the following well-known Bjerknes' Circulation Theorem:

$$\frac{d\vec{V}}{dt} = \iint_{\sigma} \nabla \left(\frac{1}{\rho} \right) \times (-\nabla p) \cdot \delta\sigma - 2\Omega \frac{d\sigma}{dt}, \quad (2.11)$$

where $\vec{V}$ stands for the velocity of the circulation, σ the projection area on the equator plane of the area enclosed by the closed curve S , p the atmospheric pressure, ρ the density of the atmosphere, and Ω the earth's rotational angular speed.

The left-hand side of Eq. (2.11) represents the acceleration of the moving fluid, which according to Newton's second law of motion is equivalent to the force acting on the fluid. On the right-hand side, the first term is called a solenoid term in

Fig. 2.17 The definition of a closed circulation



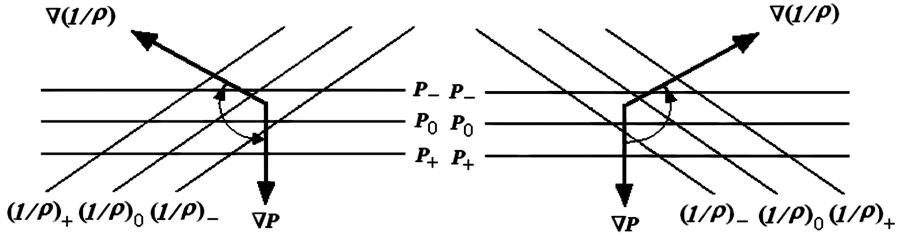


Fig. 2.18 A diagram for solenoid circulations

meteorology. It is originated from the interaction of the p - and ρ -planes due to uneven density ρ so that a twisting force is created. Consequently, materials' movements must be rotations with the rotating direction determined by the equal p - and ρ -plane distributions (Fig. 2.18). The second term in Eq. (2.11) comes from the rotation of the earth. In short, when a force is acting on a fluid, a rotation is created.

2.5.2 Conservation of Informational Infrastructure

Some branches of modern science were made "exact" by introducing various laws of conservation, even though, at the times when they were proposed, there might not have been any "theoretical or mathematical" foundations for these laws. Walking along the similar lines, Lin (1995) developed a theoretical foundation for some laws of conservation, such as the laws of conservation of matter-energy, of fundamental particles, etc., on the basis of general systems theory. By addressing some problems related to the discussions in Lin (1995), Lin and Fan (1997) systematically showed that human understanding of nature can be very much limited by our sensing organs, even though our constant attempts do help us get closer to the true state of the nature.

To form the heuristic foundation of the conservation law of informational infrastructure, let us first look at the intuitive understanding of the concept of general systems. From a practical point of view, a system is what is distinguished as a system (Klir 1985). From a mathematical point of view, a system is defined as follows (Lin 1987): S is a (general) system, provided that S is an ordered pair (M, R) of sets, where M is the set of objects of the system S and R a set of some relations on the set M . The sets M and R are called the object set and the relation set of the system S , respectively. (For those readers who are sophisticated enough in mathematics, for each relation r in R , it implies that there exists an ordinal number $n = n(r)$, a function of r , such that r is a subset of the Cartesian product of n copies of the set M .) The idea of using an ordered pair of sets to define the general system is to create the convenience of comparing systems. In particular, when two systems S_1 and S_2 are given, by writing each of these systems as an ordered pair (M_i, R_i) , $i = 1$,

2, we can make use of the known facts of mathematics to show that $S_1 = S_2$, if, and only if $M_1 = M_2$ and $R_1 = R_2$. When two systems S_1 and S_2 are not equal, then with their ordered pair structures, we can readily investigate their comparisons, such as how and when they are similar, congruent, or one is structurally less than the other, and other properties between systems. For more details about this end, please consult with Lin (1999).

By combining these two understandings of general systems, we can intuitively see the following: Each thing that can be imagined in human minds is a system according to Klir's definition so that this thing would look the same as that of an ordered pair (M, R) according to Lin's definition. Furthermore, relations in R can be about some information of the system, its spatial structure, its theoretical structure, etc. That is, there should exist a law of conservation that reflects the uniformity of all tangible and imaginable things with respect to:

1. The content of information
2. Spatial structures
3. Various forms of movements, etc.

Based on this intuition of (general) systems and by looking at the available data from particle physics, field theory, astronomy, celestial mechanics, geo-physics, and meteorology, it is shown that between the macrocosm and the microcosm, between the electromagnetic interactions of atomic scale and the strong interactions of Quark's scale, between the central celestial body and the circling celestial bodies of celestial systems, between and among the large, medium, small, and micro-scales of the earth atmosphere, there exist laws of conservation of products of spatial physical quantities. In particular, it can be conjectured that there might be a more general law of conservation in terms of structure, in which the informational infrastructure, including time, space, mass, energy, etc., is approximately equal to a constant. In symbols, this conjecture can be written as follows:

$$AT \times BS \times CM \times DE = a \quad (2.12)$$

or more generally,

$$AT^\alpha \times BS^\beta \times CM^\gamma \times DE^\epsilon = a, \quad (2.13)$$

where $\alpha, \beta, \gamma, \epsilon$, and a are constants and T, S, M, E and A, B, C, D are, respectively, time, space, mass, energy, and their coefficients. These two formulas can be applied to various conservative systems of the universal, macroscopic, and microscopic levels. The constants $\alpha, \beta, \gamma, \epsilon$ and a are determined by the initial state and properties of the natural system of interest.

In Eq. (2.12), when two (or one) terms of choice are fixed, the other two (or three) terms will vary inversely. For example, under the conditions of low speed and the macrocosm, all the coefficients A, B, C , and D equal 1. In this case, when two terms are fixed, the other two terms will be inversely proportional. This end satisfies all principles and various laws of conservation in the classical

mechanics, including the laws of conservation of mass, momentum, energy, moment of momentum, etc. So, the varieties of mass and energy in this case are reflected mainly in changes in mass density and energy density. In the classical mechanics, when time and mass are fixed, the effect of a force of a fixed magnitude becomes the effect of an awl when the cross section of the force is getting smaller. When the space and mass are kept unchanged, the same force of a fixed magnitude can have an impulsive effect, since the shorter the time the force acts the greater density the energy release will be. When time and energy are kept the same, the size of working space and the mass density are inversely proportional. When the mass is kept fixed, shrinking acting time and working space at the same time can cause the released energy density reaching a very high level.

Under the conditions of relativity theory, that is, under the conditions of high speeds and great amounts of masses, the coefficients in Eq. (2.12) are no longer equal to 1, and Eq. (2.13) becomes more appropriate, and the constants A, B, C, D , and a and the exponents α, β, γ , and ε satisfy relevant equations in relativity theory. When time and space are fixed, the mass and energy can be transformed back and forth according to the well-known mass-energy relation:

$$E = mc^2.$$

When traveling at a speed close to that of light, the length of a pole will shrink when the pole is traveling in the direction of the pole and any clock in motion will become slower. When the mass is sufficiently great, light and gravitation deflection can be caused. When a celestial system evolves to its old age, gravitation collapse will appear and a black hole will be formed. We can imagine based on Eq. (2.12) that when our earth evolves sufficiently long, say a billion or trillion years, the relativity effects would also appear. More specifically speaking, in such a great time measurement, the creep deformation of rocks could increase and solids and fluids would have almost no difference so that solids could be treated as fluids. When a universe shrinks to a single point with the mass density infinitely high, a universe explosion of extremely high energy density could appear in a very short time period. So, a new universe is created!

If the previous law of conservation of informational infrastructure holds true, (all the empirical data seem to suggest so), its theoretical and practical significance is obvious. The hypothesis of the law contains the following facts:

1. Multiplications of relevant physical quantities in either the universal scale or the microscopic scale approximately equal a fixed constant.
2. Multiplications of either electromagnetic interactions or strong interactions approximately equal a fixed constant.

In the widest domain of human knowledge of our modern time, this law of conservation deeply reveals the structural unification of different layers of the universe so that it might provide a clue for the unification of the four basic forces in physics. This law of conservation can be a new evidence for the big bang theory.

It supports the model for the infinite universe with border and the oscillation model for the evolution of the universe, where the universe evolves as follows:

... $\rightarrow$ explosion $\rightarrow$ shrinking $\rightarrow$ explosion $\rightarrow$ shrinking $\rightarrow$...

It also supports the hypothesis that there exist universes “outside of our universe.” The truthfulness of this proposed law of conservation is limited to the range of “our universe,” with its conservation constant being determined by the structural states of the initial moment of “our universe.”

All specific examples analyzed in establishing this law show that to a certain degree, the proposed law of conservation indeed holds true. That is, there indeed exists some kind of uniformity in terms of time, space, mass, and energy among different natural systems of various scales under either macroscopic or microscopic conditions or relativity conditions. Therefore, there might be a need to reconsider some classical theoretical systems so that our understanding about nature can be deepened. For example, under the time and space conditions of the earth’s atmosphere, the traditional view in atmospheric dynamics is that since the vertical velocity of each atmospheric huge scale system is much smaller than its horizontal velocity, the vertical velocity is ignored. As a matter of fact (Ren and Nio 1994), since the atmospheric density difference in the vertical direction is far greater than that in the horizontal direction and since the gradient force of atmospheric pressure to move the atmospheric system 10 m vertically is equivalent to that of moving the system 200 km horizontally, the vertical velocity should not be ignored. The law of conservation of informational infrastructure, which holds true for all scales used in the earth’s atmosphere, might provide conditions for a unified atmospheric dynamics applicable to all atmospheric systems of various scales. As a second example, in the situation of our earth where time and mass do not change, in terms of geological time measurements (sufficiently long time), can we imagine the force, which causes the earth’s crust movements? Does it have to be as great as what is believed currently?

As for applications of science and technology, tremendous successes have been made in the macroscopic and microscopic levels, such as shrinking working spatial sectors, shortening the time length for energy releasing, and sacrificing partial masses (say, the usage of nuclear energy). However, the law of conservation of informational infrastructure might very well further the width and depth of applications of science and technology. For example, this law of conservation can provide a theory and thinking logic for us to study the movement evolution of the earth’s structure, the source of forces or structural information which leads to successful predictions of major earthquakes, and to find the mechanisms for the formation of torrential rains and for the arrival of earthquakes (Ren 1996).

Philosophically speaking, the law of conservation of informational infrastructure indicates that in the same way as mass, energy is also a characteristic of physical entities. Time and space can be seen as the forms of existence of physical entities with motion as their basic characteristics. This law of conservation connects time, space, mass, and motion closely into an inseparable whole. So, time, space, mass,

and energy can be seen as attributes of physical entities. With this understanding, the concept of mass is generalized and the wholeness of the world is further proved and the thoughts of never diminishing mass and never diminishing universes are evidenced.

2.5.3 Silent Human Communications

In this subsection, we will look at how the systemic yoyo model is manifested in different areas of life by briefly visiting relevant experimental and clinical evidences. All the omitted details can be found in the relevant references.

Based on the systemic yoyo model, each human being is a three-dimensional realization of a spinning yoyo structure of a certain dimension higher than three. To illustrate this end, let us consider two simple and easy-to-repeat experiments.

Experiment #1: Feel the Vibe

Let us imagine we go to a sport event, say a swim meet. Assume that the area of competition contains a pool of the Olympic size and along one long side of the pool there are about 200 seats available for spectators to watch the swim meet. The pool area is enclosed with a roof and walls all around the space.

Now, let us physically enter the pool area. What we find is that as soon as we enter the enclosed area of competition, we immediately fall into a boiling pot of screaming and jumping spectators, cheering for their favorite swimmers competing in the pool. Now, let us pick a seat a distance away from the pool deck anywhere in the seating area. After we settle down in our seat, let us purposelessly pick a voluntary helper standing or walking on the pool deck for whatever reason, either for her beauty or for his strange look or body posture, and stare at him intensively. Here is what will happen next:

Magically enough, before long, our stare will be felt by the person from quite a good distance; he/she will turn around and locate us in no time out of the reasonably sized and boiling audience.

By using the systemic yoyo model, we can provide one explanation for why this happens and how the silent communication takes place. In particular, each side, the person being stared at and us, is a high-dimensional spinning yoyo. Even though we are separated by space and possibly by informational noise, the stare of one party on the other has directed that party's spin field of the yoyo structure into the spin field of the yoyo structure of the other party. Even though the later party initially did not know the forthcoming stare, when her/his spin field is interrupted by the sudden intrusion of another unexpected spin field, the person surely senses the exact direction and location where the intrusion is from. That is the underlying mechanism for the silent communication to be established.

When this experiment is done in a large auditorium where the person being stared at is on the stage, the afore-described phenomenon does not occur. It is because when many spin fields interfere the field of a same person, these interfering

fields actually destroy their originally organized flows of materials and energy so that the person who is being stared at can only feel the overwhelming pressure from the entire audience instead of from individual persons.

This easily repeatable experiment in fact has been numerously conducted by some of the high school students in our region. When these students eat out in a restaurant and after they run out of topics to gossip about, they play the game they call “feel the vibe.” What they do is to stare as a group at a randomly chosen guest of the restaurant to see how long it takes the guest to feel their stares. As described in the situation of swim meet earlier, the chosen guest can almost always feel the stares immediately and can locate the intruders in no time.

Experiment #2: She Does Not Like Me!

In this case, let us look at the situation of human relationship. When an individual A has a good impression about another individual B, magically, individual B also has a similar and almost identical impression about A. When A does not like B and describes B as a dishonest person with various undesirable traits, it has been clinically proven in psychology that what A describes about B is exactly who A is himself (Hendrix 2001).

Once again, the underlying mechanism for such a quiet and unspoken evaluation of each other is based on the fact that each human being stands for a high-dimensional spinning yoyo and its rotational field. Our feelings toward each other are formed through the interactions of our invisible yoyo structures and their spin fields. So, when person A feels good about another person B, it generally means that their underlying yoyo structures possess the same or very similar attributes, such as spinning in the same direction, both being either divergent or convergent at the same time, both having similar intensities of spin, etc. When person A does not like B and lists many undesirable traits B possesses, it fundamentally stands for the situation that the underlying yoyo fields of A and B are fighting against each other in terms of either opposite spinning directions, or different degrees of convergence, or in terms of other attributes. For a more in depth analysis along a line similar to this one, please consult with Part 4: The Systemic Yoyo Model: Its Applications in Human Mind, of this book.

Such quiet and unspoken evaluations of one another can be seen in any working environment. For instance, let us consider a work situation where quality is not and cannot be quantitatively measured, such as a teaching institution in the United States. When one teacher does not perform well in his line of work, he generally uses the concept of quality loudly in day-to-day settings in order to cover up his own deficiency in quality. When one does not have honesty, he tends to use the term honesty all the time. It is exactly as what Lao Tzu (exact time unknown, Chap. 1) said over 2000 years ago: “The one who speaks of integrity all the time does not have integrity.”

When we tried to repeat this experiment with local high school students, what is found is that when two students A and B, who used to be very good friends, turned away from each other, we ask A why she does not like B anymore. The answer is exactly what we expect: “Because she does not like me anymore!”

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