A METHODOLOGY FOR THE INTEGRATION OF ANCIENT AND MODERN SYSTEM THEORIES --THE PORTAL FOR THE 2000YRS OLD TAICHI YIN-YANG SYSTEM THEORY

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ABSTRACT

System and control theories actually started thousands of years ago in many traditional cultures. In the Chinese culture, these theories appeared in many well-known classics including the I Ching book of changes, Tao De Ching of Lao-Tsu's Toaism, the Ten Wings of Confucius's annotation on I Ching, Taichi classic of Taichi exercise, the Noble Eightfold Path meditation technique of Buddha, the Yellow Emperor's Medicine Classic of Traditional Chinese Medicine and more. These classics guided the development of culture until the end of the Qing dynasty where many wars were fought and people were confused with the sudden influence of western culture. Even the practitioners of Toaism, Confucius, Taichi exercise, meditation, and Traditional Chinese Medicine question the truthfulness of these ancient theories. And they tried to adopt modern scientific theories to replace the ancient ones.

In the last few decades, some of the believers of the classics tried to illustrate these theories in terms of modern system and control theories. However, it is believed that the key essence of the link between the ancient and the modern theories are not clearly defined and illustrated. Without such a link, it is impossible for modern scientist to get the benefit of these ancient practical theories. A gateway or platform for the integration between these ancient theories and the integration with modern theories is urgently required. The integration of all theories in all areas, the search for "The Theory of Everything" is the hope of many leading scientists in different areas of research. It is believed that the essence of these ancient theories would be able to provide insights and new inspirations for the search of Unity of the universe.

Our research has been concentrated on the search of this missing link. In these papers, we present the result of our research in developing an integrated representation of these ancient theories in terms of modern system and control theories. The Good & Evil Yin-Yang chart has been developed for representing the state of the Taichi Yin-

Yang system. The generalization of these theories has been researched and a methodology has been developed for the integration of these ancient theories with modern scientific theories. This methodology enables the practical application of these ancient system and control theories in modern areas of interest, including areas in physical, social and biological sciences.

We hope that modern professional engineers and scientists can be the witness of the scientific and logical foundation of these ancient system and control theories. They are hard science instead of just "interesting" abstract philosophies.

Keywords: Ancient and Modern, Control System Theory, Differentiation & Integration, Research Towards General Theories of Systems, The Taichi Yin-Yang system, Traditional Chinese Medicine Differential Diagnosis-Cure process, Buddha, Dhamma.

INTRODUCTION

We humans want to analyze systems, to control systems, in order to fulfill our desires, and eliminate our disappointments, so as to achieve stability, efficiency, longevity and growth. The development of system theory in the past few decades has opened up a completely new simplified version of the real world (ISSS, 2007) (Bolton, 1992). In the first years of IT engineering study, the modeling of amplifiers simplified the tedious calculation and provide a very easy way to analyze those otherwise complicated electrical circuits. Terminology like Yin-Yang, Good-Evil, Water-Fire in Traditional Chinese Medicine make much more sense with this system viewpoint, than with the Western medicine's biochemical and anatomical point of view. In a university study of Traditional Chinese Medicine (TCM), the theory of TCM become more and more logical, but we still could not use modern science to clearly explain the theory until 15 years of study and practice. The use of the Good & Evil Yin-Yang chart allows the transformation of the traditional literal description of the theory into a graphical and mathematical one. More research revealed that similarities exist between this model and those modern physical, social and biological systems of modern days.

This model is introduced here to provide an ancient logical view of the systems in the universe and in the hope that it will inspire new research to better understand our world and ourselves. It is believed in traditional Chinese culture that this model is logical, correct, simple, efficient, practical and widely applicable (universal) to any systems either new/old, natural/man-made, or physical/abstract.

In order to be a widely applicable (universal) control theory, we must start from the very top level, our universe (Wu Chi). Taichi is differentiated from the universe but its integration with the environment is essential and hence the input and output of the systems arise. Traditional Chinese emphasize very much on the internal structure and the current state of a system, because both of them affects how the output behavior response to input influences.

The classic Water-Fire model (Heating Water system) is used as an example to illustrate the application of the theory and the meanings of different states of a system. The output behavior and input influences are all classified according to the

Taichi and the internal structure of the system. Rules of changes between the components of the system are discussed but it can only serve as an introduction to the books published in the last 2000 years. In conclusion, the steps on how to apply this theory to other scientific areas are listed, and a few diagrams of applications are shown which include social and biological sciences.

WU CHI: THE UNIVERSE

Taichi Yin-Yang theory is more than 5000-years old and hence contains lots of ancient terminology which will be explained along the way according to our research and understanding. The Chinese characters for the Universe is "〞Ó÷Ê" which means all space and time. Some scholars surmise that it is very difficult to precisely describe the universe because any "word" is just one part of the universe. The word "everything" become just "something", but the universe is

"Everything" + "Nothing" at "all times".

The Chinese characters of Wu Chi are ___ which is usually interpreted as "Nothing to the extreme" but the character _ mean a vast and dense forest that one cannot see any people within (CHU, 2007). It could also mean "Everything to the extreme". Hence Wu Chi should mean everything and nothing in the Universe in all space and time. Chinese further use ideas similar to modern logic and set theory in mathematics to describe the Universe. In Taoism Lao-tse of 590 BC called Wu Chi as Tao and he said the Tao should not be named, because once it is named, it is just become a particular thing at that moment. However, he felt that if he did not name it, others would not know what he was talking about. Hence he reluctantly called it Tao, and tried to use words of this world to describe it. Note that “Universe” is a word and hence is a set according to set theory, thus there exists "not universe" according to set theory.

The closest description of the Universe in Chinese culture is:

- "The Tao that can be explained (in words) is not the true and everlasting Tao. The name that can be named (in words) is not the true and everlasting name." (Laozi, 590 BC, Ch01)
- "Tao always does no action and does not do no action" (Laozi, 590 BC, Ch37)
- "Meditate at the place of nothing and everything" 7th level meditation technique (jhana) of Buddha (Buddhaghosa, 1956, p198).
- "Meditate at the place of not thinking and not not thinking" 8th level meditation technique (jhana) of Buddha (Buddhaghosa, 1956, p198).
- “They are neither Dhamma nor non-Dhamma.” (Buddha 2500BC Ch7) (Dhamma: the principle or law that orders the universe)

In terms of modern logic, these concepts are compared with the three fundamental principles of Aristotelian logic (Johnson 1998) using the format of predicate calculus:

1. Identity: $\forall x\ (Ax \equiv Ax)$: A is A

2. Non-contradiction: ¬ ∃ x (Ax ∧ ¬ Ax): A and non-A cannot both be the case
3. Either-or: ∀x (Ax ∨ ¬ Ax): Either A or non-A.
where A is a predicate, x is an individual, ¬ is the negation (complement), ∧ is the intersection, the ∨ is the union.

The second principle states that none of the object of interest (Nothing) can be A ∧ non-A at any one moment. And the third principle states that all of the objects of interest (Everything) is either A ∨ non-A at any one moment.

Mathematics is a universal common language for human to think and communicate with each other. It must be consistent and logical. From the above simplest fundamental axiom of logic, it seems that a frame of reference, A, is required before thoughts and communications are possible. The complement non-A, which is the exact opposite of A, exists at the same time once A is identified. As soon as two objects are identified, there exists a relationship, say ∧, between them. And also at the same time there exists another relationship, say ∨, which is the exact opposite of ∧. And the concept of "something", "everything", and "nothing" follows. Interestingly, these processes of identification and differentiation are exactly how our universe starts according to the teaching of Buddha 2500yrs ago. Differentiation is hence our source of awareness and knowingness, without which we cannot act, speak or even think.

Our interpretation of Wu Chi in the language of logic could be: With any frame of reference, Wu Chi includes all objects of interest inside, outside, both inside and outside, and not inside nor outside of the frame of reference, that is, Everything and Nothing at this moment. Extending these sets of fundamental axioms of logic to the concept of set theory, we will have the following axioms (Al Lehnen) (Johnson, 1998):

1 The Set A is set A.
2 The set not A, denoted by $\bar{A}$ is the compliment of the set A
3 The set A intersected with $\bar{A}$ is the empty set, $\emptyset$ such that $A \cap \bar{A} = \emptyset$ and
4 The set A union with $\bar{A}$ is the Universal set, U such that $A \cup \bar{A} = U$ and

Wu Chi is all the objects of interest at all time, including no object. Therefore, it should include both the universal set and the empty set. Hence expressing Wu Chi in terms of set theory could be as follows:

Wu Chi = $\emptyset \cup U$

But how can time be expressed? There is a believe that time is just an illusion, there exists only this moment, NOW, which includes the memory of both a particular frame of reference, say A, and the object of interest, say x. The concept of time comes from two characteristics of this universe, namely impermanence and memory.

Impermanence is the ever changing nature of the universe, without which there is no time. The fundamental behavior of impermanence is the vibration of atoms. Memory includes human brain, drawings, writings, video, computer hard-disk, the rings of trees, the layers of earth, the layers of ice, etc, without which we do not realize the changes of the object of interest. Humans experience time by realizing the differences (change) between the memory and the "not memory", which include both the object of interest and the environment. Therefore $(A \cup \underline{A}) \cup (A \cap \underline{A})$ already includes all time. Therefore,

$$\text{Wu Chi} = (A \cup \underline{A}) \cup (A \cap \underline{A})$$

Figure 1 compares the Venn diagram of the above set and the diagram that traditionally describe Wu Chi (Zhow, 1072)

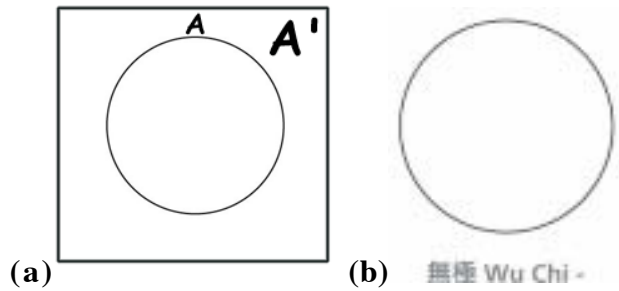


Fig.1 (a) Venn diagram of Wu Chi and (b) the traditional diagram of Wu Chi.

Note that the expression of the universe in the ancient has the format of (not A union not not A). According to set theory, this is the same as (not A union A). However the ancients may be trying to tell us that the truth is not in A but it is also not in not A. It is not everything and not nothing neither? The answer to this question may goes outside the scope of mathematics and any language, and is also outside the scope of this paper. However for the rest of the paper, we "reluctantly" use the notion (A union not A) to denote Wu Chi.

CHANGE: IMPERMANENCE

Everything is changing, incidents are happening all around all the time. All changes are due to the changes of different Quarks, according to Quantum Physics (Feynman, 1985), or all due to the vibration of strings of different length according to string theory (length and vibration) (Hawking, 2001). However, changes do not matter to the universe itself according to the 1st law of thermodynamics (Law of conversation of energy) (Perrot, 1998). That is, nothing changes as a whole. Changes only matters to an observer because changes become signals to the observer. If there is no change, there is no time. Change is the difference between now and just now. Only observer "feels" time. The Universe as a whole has not time. Space and Time are relative concepts in

relativity (Hawking, 2001) and only become absolute to observers in their frame of reference. Nothing is permanent, except maybe the Universe. We humans want to keep things the way we want them to be, and hence try to control things.

TAICHI: DIFFERENTIATION

The first sentence of the Taichi exercise classic is "Taichi is born from Wu Chi, and is the mother of Yin and Yang' (Wile, 1995) (Wong, TBP b). Taichi is also an ancient Chinese terminology which could be interpreted as any particular set A. It can be an object, a movement, an incident, a thought, an idea, a method, a strategy, a tactic, a concept, a process, a system, energy, matter, signal (information), goal, etc.

Observers want to analyze and control set A according to their desires. Hence differentiating set A from (A union not A). The power of Differentiation is Taichi and the decrease in entropy measures the power initiated by the Taichi. On the other hand, Integration comes naturally after Differentiation where entropy increases as the power dissipates back into Wu Chi and A becomes (A union not A) again.

Differentiation can reduce the entropy of set A. At a glance, it may contradict with the 2nd law of thermodynamics, but the observer is actually inserting energy into the system for the differentiation. It is similar to an air conditioner using power to differentiate cold and hot air. After the process of differentiation, anything in the universe become either A or not A from the viewpoint of the observer, which agrees with the third fundamental principles of Aristotelian logic (Either-or).

ENVIRONMENT: INTEGRATION

If the system (A) can be isolated from its environment (not A), then the changes within A do not affect our goal (Taichi). In a way A becomes another universe. If total isolation is achieved, there is no way we can observe if the system is still at our goal. The third law of thermodynamics states that as temperature approaches absolute zero, the entropy of a system approaches a constant (Perrot, 1998). If absolute zero is actually achieved, will the system become another universe with no changes to the observer?

Therefore, for us to observe the system it cannot be isolated and it is susceptible to influences from its environment. Influences will cause changes and possible the destruction of the system, and hence A is impermanent. If (A union not A) is the universe, then A is imperfect without (not A), but we humans "try" to make A perfect!

Even a sealed glass ball of worms, plants and water, it still requires sunlight (absorb energy from the environment) during daytime and darkness during nighttime (dissipate energy to the environment) for it to work.

Integration is unavoidable in the analysis of systems because A is always part of (A union not A). A will always interact with (not A), the environment. Hence control is necessary to influence the system back to the goal initiated by Taichi. However, some people keep using the method of differentiation in their daily analysis and forget about the big picture, which should be an integral part of the whole analysis. Holistic analysis is extremely important in Chinese culture including Traditional Chinese Medicine. They call it the unity of human and the sky, which means the unity with their environment or the whole universe.

INPUT INFLUENCE AND OUTPUT BEHAVIOR: THE INTERFACE WITH THE ENVIRONMENT

We differentiate A from (A union not A) but A cannot sustain without (not A), its environment. Influences between A and (not A) are achieved through the interface of input and output of the system A.

Inputs of a system include routine and abnormal changes of time and space of the environment which will influence the system. Output of a system is the collection of all the behavior of the system.

The Ancient Chinese viewpoint of systems is a bit different from the modern system theory. Modern system theory considers a system as a black box with an input and an output, and identifying the input/output relationship is the most important task. Chinese regard all “black boxes” to have a common structure and the output behavior depends on the current state of the black box as well as the input. Different inputs will influence a system, and the output will behave accordingly. However, the same input feeding into the same system at a different time may have different output behavior because the state of the system changed. This state is represented by the common structure and can be determined from the output behavior.

In order to determine the exact state of the system, we need to analyze ALL the outputs, which is another area of the holistic point of view. However, in practice we only need to consider the most obvious and the subtlest behaviors, or the strongest and weakest behaviors, in order to exercise proper control or to understand the system.

In the analysis of the input influences or the output behavior, one should employ the holistic analysis of "Everything and Nothing" by observing both everything and nothing at both input and output. Nothing at the input is also an input influence. Nothing at the output is also an output behavior. But only when the observer is not sure if there is an input/output or not, then further observation is required.

TAO: A UNIVERSAL STRUCTURE, TAICHI YIN-YANG

When we play with toy bricks, the first thing we need to do is to learn about the basic building blocks and the building rules. Then we learn about the behavior of toy bricks

and how they react to different influences. In real systems it is sometimes very hard to determine the basic building components and the rule of interaction between them. The Chinese found a basic structure for all the systems they encountered, and applied the structure to different areas of knowledge in their culture. This basic structure was extended into 64 more complicated structures. These structures were not further divided because it was felt that going further would only complicate the analysis, and the integrated big picture of being one, the unity would be lost (Confucius, 479 BC).

A universal system structure is very important to system analysis because we want to develop a theory that can be applied to everything. A structure includes the components, their predicates, and their relationships. Knowing this, the changes between the components and the rule of changes can be studied. A state is a snapshot of all the components at a given time, which can be used to determine the required Input/Output relationship. Because of the property of integration, changes to one component always affect other components.

How can set A be analyzed? Again, if we want to analyze something, we need to differentiate; we need to make a comparison between at least 2 sets. Chinese applied the same A and (not A) differentiation method again within set A. Let us now differentiate set B and set (not B) within set A where all B is A:

$A = \{B, \underline{B} \cap A\} = \{B, G\}$ where $G = \{\underline{B} \cap A\}$.

In Ancient Chinese terminology, the simplest structure of Taichi is: Taichi = {Yang, Yin}, and can be described by the Venn diagram in Figure 2. "One Yin and one Yang is Tao" (Confucius, 479 BC).

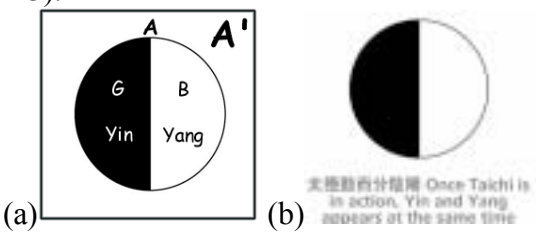


Fig.2 (a) Venn diagram A={B,G} or Taichi={Yin, Yang} and (b) the Traditional Chinese Taichi in action diagram

Yin and Yang are the fundamental interacting components within any system (Taichi), rather than just any arbitrary components within a system. Chinese have clear definition for the properties for each one of them. In simple terms, we can understand

"Yin is the component that supports the system, and Yang is the component that operates the system. _'/_£¨_÷Æ ÿ"≤£ª_'/Õ,£¨_÷Æ ¤"≤°£ " (HuangDi, 206BC, Ch5) (Gou, 1999).

Figure 3 graphically shows the Taichi Yin-Yang structure of systems. There are many examples in classic texts that describe rules of how these two components interact with each other, including I Ching the Book of Changes (FuXi, 1122 BC), the

Confusions Ten Wings (Confucius, 479 BC), classics of Traditional Chinese Medicine (HuangDi, 206BC, Ch5) (Zhang 219) (Wiseman 2000), classics of Taichi exercise (Wile 1995) and many others. In other words, Yin and Yang are the functional differentiations of the two fundamental components of a system. It is a scientific classification method rather than a pure philosophy.

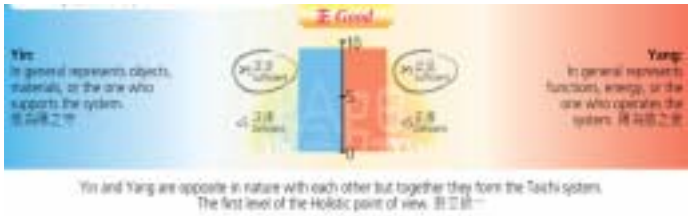


Fig. 3 The basic structure of systems.

Note that the same differentiation method can be applied within set B again and the same results follow. Hence, "size doesn't matter". This structure applies to the biggest system and the smallest system. No size limitations were imposed on set A (Taichi) in the analysis. Also the nature of set A can be any particular one in this universe, no matter how simple or complex. The level of set A is also unlimited from the most macroscopic level to the most microscopic level.

Once the Taichi is in action, Yin and Yang appears at the same time. E.g. an idea is a Taichi, and until the idea is put into action, Yin and Yang remain hidden. Therefore, the Taichi, Yin and Yang cannot be separated and form the simplest structure of any system in this universe. That is why Chinese say any system in this universe is a Taichi Yin-Yang system.

Western culture also has a similar concept: There are always two sides of a coin. Most people love one side of the coin and want to ignore the other side. Some people realize and accept both sides of the coin. But only a few clearly understand the definition of a coin: Head, Tail, and the Coin. Some people try to group all the Heads of different coins together, or group all the Tails of different coins together for analysis and get confused. The fact is that different coins have different Heads and Tails and each coin should be analyzed together its corresponding Head and Tail.

The same Taichi Yin-Yang structure can be observed in physical, social or biological sciences. For example in physical science, if we want to make a mechanical sound (Taichi), then we need to have an action force (Yang operated) and an reaction force (Yin supported) according to Newton's 3rd Law of Motion. An example in social science could be an economic system where the economy (Taichi) is composed of Demand (Yang operated) and Supply (Yin supported). In Traditional Chinese Medicine, the human body (Taichi) is composed of the materials of the body (Yin supported) and the function of the body (Yang operated). Research is ongoing on how to apply this theory to Economics, Business Management, Mechanical Physics, Unity theory of the forces in the universe, and more.

It is believed that this structure should also be able to analyze the phenomenon in Quantum physics. If quarks are the basic building blocks of all energy and matter, then energy and matter are both just the cohesion phenomenon of quarks and are just an impermanent illusion, which is deemed to fail and fall apart at some time. Remember that only (A union not A) could be permanent. Anything else is just A or (not A) which will constantly interact with each other, will integrate together again at some time, and then could be differentiated again at some other time by some observer. However, many people have the illusion that A can be permanent and keep analyzing the properties of A, keep controlling A to fulfill their desires. Traditional Chinese theories states that the final truth can only be found by releasing the unity, (A union not A).

RULES OF CHANGES: COMPONENTS' RELATIONSHIPS

Now the Yin-Yang structure of a Taichi system has been examined, the predicates for each of these components and the relationship between Yin and Yang is studied. There are many possible changes between the Yin-Yang combo but here the basic and practical ones out of the publications of the last 3000 years will be looked at. These predicates are simply stated here but will be clearer when the Heating Water system is used as an example to illustrate the Taichi Yin-Yang system.

Unity of Yin-Yang: Taichi

Yin and Yang coexist and rooted in each other. They carry each other. Yin supports Yang and Yang operates Yin. Yin and Yang must be balanced by each other, the portion that cannot be balanced by the other component becomes excess. When Yin and Yang are balanced with each other, the whole system will be stable, be efficient, have longevity and be able to grow. Yin and Yang grow and diminish together.

Viscous Cycle

Excess components will ruin the system and will form viscous cycle of diminishing Yin and Yang. Nature will balance itself, only systems with feedback control will fall into the viscous cycle. For example, low spending causes high unemployment which then causes people to decrease their spending more.

Tolerance

Yin or Yang can tolerate a certain level of the component that cannot be balanced normally and would have become the excess.

Conductance/resistance/delay

The rate of change of the input maybe high and the resistance may prevent the effect from spreading to the whole system instantaneously which causes delay and stagnation.

STATE: SNAPSHOT OF THE SYSTEM

Yin and Yang are part of the universe and hence will change all the time. The simplest change is increasing or decreasing, compared to another instant of time or compared to Yin and Yang.

Taichi can be in a BALANCED state or in an Imbalanced state. A BALANCED system will be stable, efficient, long-life and able to growth. An Imbalanced system will be unstable, inefficient, short-lived and diminish.

An Imbalanced state at this level of analysis can either be due to more Yin than Yang or less Yin than Yang and these states are traditionally called COLD and HOT respectively. Hence we can represent the state of the set A in a matrix form as follows:

A[Yin,=,Yang] = BALANCED.
A[Yin,>,Yang] = COLD.
A[Yin,<,Yang] = HOT.

Control needs to be exercised to push the system back to a BALANCED state. However, there is not enough information at this level of analysis because it cannot be identified if the imbalanced states are caused by a problem with Yin or Yang. This is the same scenario in relativity and the frame of reference of the observer needs to be decided. If Yin and Yang are of different units, it is even impossible to compare. Therefore we need the frame of reference (Taichi) even just to determine COLD/HOT.

Before continuing further down the analysis tree, a simple model will be used as an example to illustrate the theory. The most famous and widely used model is the Water-Fire model, and here it will be referred to as the Heating Water System to suit modern scientific terminologies, as shown in Figure 4. For example, even with the same water with the same heat energy, to someone the water is HOT but to someone else the same water is COLD, because the HOT and COLD depends on the Taichi (frame of reference) of the system.

WATER-FIRE ANALOGY: THE HEATING WATER SYSTEM EXAMPLE

Taichi:

Our "goal" is to keep 50L of distilled water at 36.8¢xC so that our body feel good when we drink the water. We call this set A the set HeatingWater or the set HW. Here we assume that there is no usable heat energy in water at absolute zero temperature and there are 305MJ of usable heat energy in 50L of water at 36.8¢xC.

HeatingWater{50L,305MJ} = ideal BALANCED state
HeatingWater{Water,Heat}
HeatingWater{Water,Fire}
HeatingWater{Yin,Yang}
HeatingWater{Material,Energy}

Fig. 4 The Heating Water system

Note that some systems cannot be balanced, for example a distilled water system of 50L with 200¢XC at normal pressure and expandable volume.

Identification:

The first step of applying the Taichi Yin-Yang system to any system A is to identify the Yin and Yang component in the system. Yin is the one that supports the system and here is the water. Yang is the one that operates and here is the Heat energy.

Changes:

The BALANCED state of our system is to have 50L of distilled water at 36.8¢XC .

The simplest change is an increase/decrease of our Yin-Yang combo in comparison with our goal. Quantity of water or quantity of heat energy can be increased/decreased in comparison to another set or another instance. Quantity has no meaning without comparison. Quality of our system involves both Yin and Yang and can be good/bad. A BALANCED system is good quality, while an IMBALANCED system of COLD/HOT is bad. The Quality can be further "quantify" as being high/low. A(40L,36.8¢XC) is BALANCED at low good quality, while (50L,36¢XC) is a COLD state at "low" bad quality. Nature of the current state can be COLD/HOT or BALANCED in comparison to the Taichi. Therefore quantity, quality and nature only exist in comparison (differentiation).

For simplicity, it is assumed for now that there are no changes initiated internally, e.g. chemical reaction, nuclear reaction, feedback reaction.

Current State:

The question of determining the source of the problem in the imbalanced system is now returned to. The 3 basic states are:

A[Yin,=,Yang] = BALANCED
A[Yin,>,Yang] = COLD
A[Yin,<,Yang] = HOT

which depends on the definition of Taichi being used and each one can further divide into another Yin-Yang combo: Low/High. Some of the possible states of our example of Heating Water system are as follows:

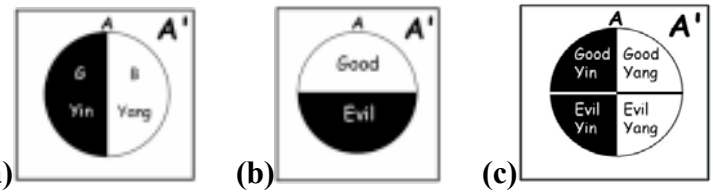
1. HW{60L,305 MJ}->HW[60L,>305MJ] < 36.8¢XC = COLD
2. HW{50L,300MJ}-> HW[50L,>,300MJ] < 36.8¢XC = COLD
3. HW{50L,310 MJ}-> HW[60L,<,310MJ] > 36.8¢XC = HOT
4. HW{40L,305MJ} -> HW[40L,<,305MJ] > 36.8¢XC = HOT
5.HW{60L,366MJ}->HW[60L,=,366MJ]=36.8¢XC = BALANCED
6. HW{40L,244MJ} -> HW[40L,=,244MJ]=36.8¢XC = BALANCED

Once the Taichi is well defined, it can be determined if the imbalanced state is caused by the Yin or the Yang. Note that these states depend on the definition of Taichi being used and once it is changed, for example if 50¢xC, all the other states will be changed.

With the frame of reference of the observer (Taichi), we have two more possible states namely DEFICIENT and EXCESS. When Yin/Yang is too much in comparison to our Taichi, it is said Yin/Yang is in EXCESS, and when Yin/Yang is too little in comparison to our Taichi, it is said Yin/Yang is in DEFICIENT. Hence the problem can be pinpointed and proper control can be exercised to push the system back to the ideal BALANCED state.

1. HW[60L,>,305MJ] < 36.8¢XC = COLD = Yin EXCESS
2. HW[50L,>,300MJ] < 36.8¢XC = COLD = Yang DEFICIENT
3. HW[60L,<,310MJ] > 36.8¢XC = HOT = Yang EXCESS
4. HW[40L,<,305MJ] > 36.8¢XC = HOT = Yin DEFICIENT
5. HW[60L,=,366MJ] = 36.8¢XC = BALANCED = both Yin-Yang EXCESS
6. HW[40L,=,244MJ] = 36.8¢XC = BALANCED = both Yin-Yang DEFICIENT

Analysis is started by differentiating set A (Taichi) from (A union not A), the universe, and then differentiate Yin and Yang as the basic components of any systems. Then the COLD-HOT analytical method is used to investigate the changes of the Yin-Yang combo. Here the DEFICIENT-EXCESS analytical method is used to compare the changes of the Yin-Yang combo in reference to the Taichi. These are the six of the Eight-principals in the Traditional Chinese Medicine Differential Diagnosis-Cure Process. The other two will be introduced in the paper (Wong, TBP a). Figure 5 and Figure 6 show the basic structure of the Taichi Yin-Yang system using Venn Diagram and the Good & Evil Yin-Yang chart respectively. The use of graphical chats to represent the state of the Yin-Yang combo has been used in (Kaptchuk, 2000) (Wong, 2005) (Wong, 2006) (Wong, 2007a) and the traditional one is shown in figure 7. The one that is employed in our research was inspired by Mr Philip CHU and was modified to incorporate more properties of the practical changes in the Yin-Yang combo in different systems. It is called the Good & Evil Yin-Yang chart because it represents exactly those information of the system.



(a) (b) (c)

Fig. 5 Venn Diagram (a) A={Yin,Yang} (b) A={Good,Evil}, and (c) A={Good Yin, Good Yang ,Evil Yin, Evil Yang}

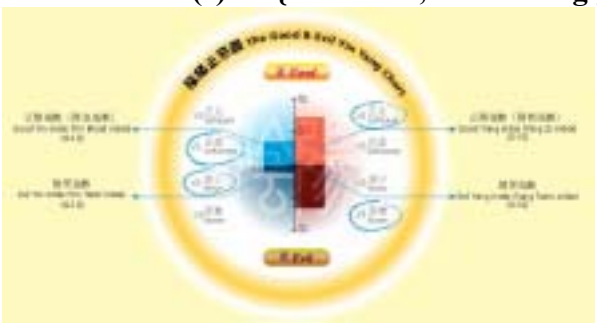


Fig. 6 The Good & Evil Yin-Yang chart. Fig. 7 The Traditional representation of the Yin-Yang BALANCED state of Taichi

Note that the same differentiation technique has been used throughout. In order to understand the DEFICIENT-EXCESS concept better, the Good and Evil components of the Yin-Yang combo will be introduced. The components that a system requires to achieve its goal (Taichi) are something "Good" for the system, and these components can either be DEFICIENT or not DEFICIENT in reference to the goal. The components that a system does not require to achieve its goal (Taichi) are something "Evil" for the system, and these components can either be in EXCESS or not in EXCESS in reference to the goal.

A larger matrix is now needed to describe the state of a system where the first row shows the state of the Good component of Yin and Yang and the second row shows the state of the Evil component of Yin and Yang. In our example

HW[60L,> ,305MJ] < 36.8¢xC
=HW ⌈not DEFICIENT, , not DEFICIENT⌉ < 36.8¢xC
⌊EXCESS , > , not EXCESS ⌋
= COLD = Evil Yin EXCESS

Rules of Changes

Unity of Yin-Yang: Taich

Water and energy coexist and rooted in each other. They carry each other. Water supports energy to stay within the system, and energy operates water to reach a certain temperature. The amount of water and energy must be balanced by each other according to the goal of Taichi. And the portion that cannot be balanced by the other component becomes excess. When the water and energy levels are balanced with each other, the whole system is said to be stable, be efficient, have longevity and be able to

grow according to our definition of Taichi. Water and energy grow (into the system) and diminish (out of the system) together.

Note that all changes of Yin and Yang affect each other and they also depend on the Taichi frame of reference. Together they form unity, which is another level of the holistic nature.

Viscous Cycle
To be discussed in our future research work.

Tolerance:
Figure 8 shows the possible changes when tolerance is introduced into the system. That could be done by allowing the temperature of the system to vary within a range instead of being fixed at 36.8¢XC.

For example, human body need to be balanced with the Taichi Alive{sleep 8h, =, work 12h}=IDEAL BALANCED. However, one can burn a few mid-night oil to write up papers while keeping one alive with Alive{sleep 4h, <, work 16h}=YIN DEFICIENT. This tolerance acts like a stretchable string between Good Yin and Good Yang in the Good & Evil Yin-Yang chart.

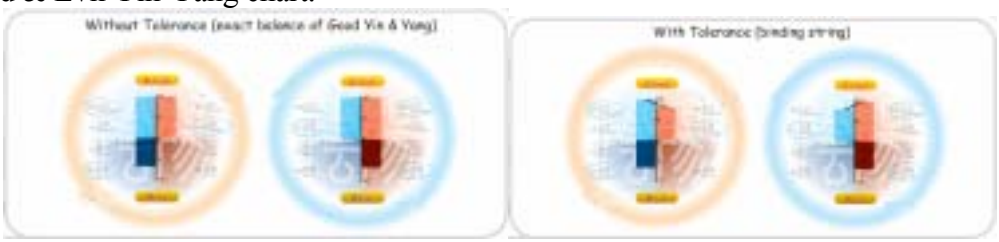


Fig. 8 The Taichi Yin-Yang systems with and without Tolerance.

Conductance/resistance/delay
Note that in the simple Heating Water model, the state of Yin or Yang can either be DEFICIENT or EXCESS or (not DEFICIENT & not EXCESS). However, this property will be gone once we introduce another special factor into the system: conductance/resistance/delay. Without resistance, increasing the water level will fill up the YIN DEFICIENT. However, the water may not be able to mix with the COLD water immediately and hence causing YIN EXCESS in one area while the other area is experiencing YIN DEFICIENT.

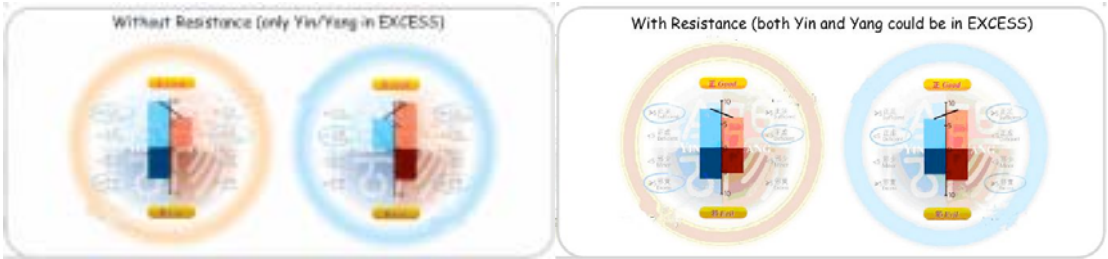


Fig.9 The Taichi Yin-Yang systems with and without Resistance.

Environment:

In our heating water system, water (Yin) evaporates to or condensed from the environment all the time depending on the state of the environment. Heat (Yang) is dissipated to or absorbed from the environment as well. The rate of change depends on the difference between the system (A) and the environment (not A) and the conductance between them.

Output Behavior:

Note that here Yin is the matter and the level can be measured with out sight, however, Yang is energy that cannot be measured with our sight and we need the help of some other sensors (matter) to deduct the level of Yang.

The possible static states of a system have been studied. In the next paper (Wong, 2007d) the Rule of Changes of a Taichi Yin-Yang system will be looked at in order to understand the dynamic changes of a system.

New state[Yin,comparison,Yang] = Old state[] + Input state[] - Output state[]

The Good & Evil Yin-Yang chart can now be used to show the possible states of the Taichi Yin-Yang system. There are eight possible Good states and eight possible Evil states and hence a total of 64 states for the system. The simplified version is shown in Figure 10.

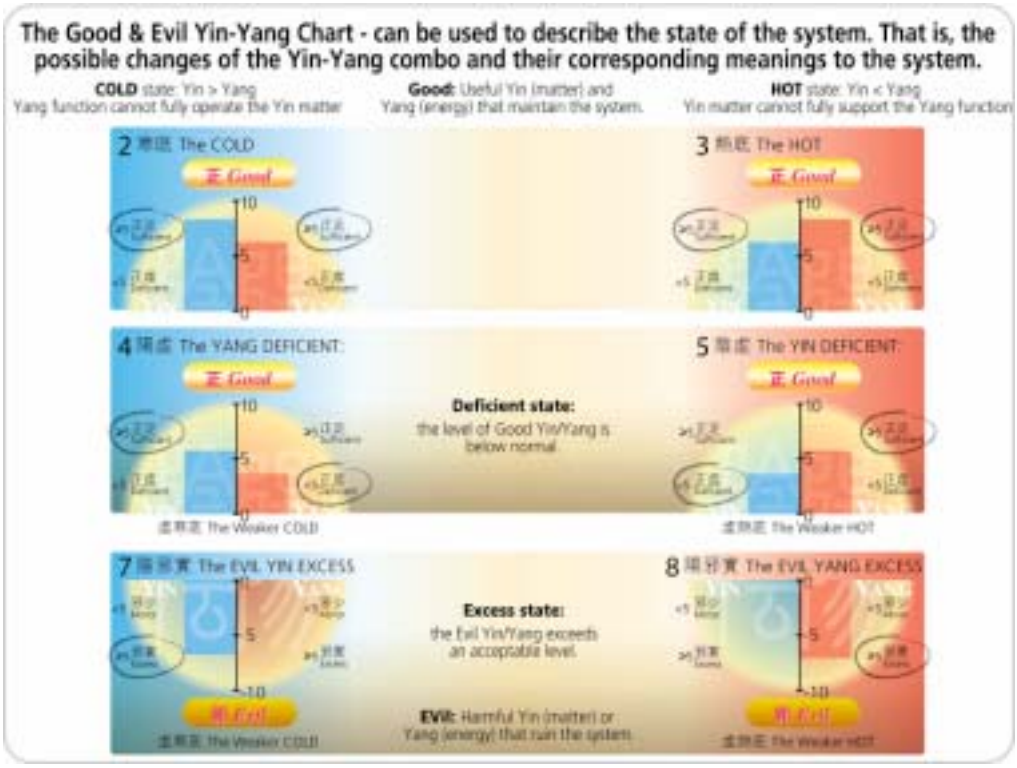


Fig. 10 The Good & Evil Yin-Yang chart of basic states.

Excretion

Note that excretion is also part of the behavior and they can be either Good or Evil where Good excretion composes of rubbish and Evil excretion composes of essence of the system. The response of a system to a particular input depends on the current behavior of the system, which is the current state of the system. It also depends on the other current inputs. Once again this is another holistic point of view. Sometimes a special input is required to stimulate the system in order to more accurately determine the current state of the system, something similar to frequency or impulse response in modern control theory. There are standard special sets of behavior for the BALANCED state, the COLD state, the HOT state, the YIN DEFICIENT state, the YANG DEFICIENT state, the YIN EXCESS state, and the YANG EXCESS state. They will all be discussed in more details in (Wong, 2007d).

Input Influences:

Input to this Heating Water system can be pure heat energy, pure water, or water with some heat energy.

All influences must be studied for their nature and strength in reference to the system before they can be used to influence the system accordingly when required. This kind of study allows the use of a combination of influences as a formula for the most effective control in different or difficult states.

All influences can only affect the levels of the four components: Good Yin, Good Yang, Evil Yin and Evil Yang. Input Influences are classified according to how they affect these for levels and form the COLD-HOT Influence Spectrum, which will all be discussed in more details in (Wong, 2007d). Figure 11 shows the three basic classes of influences.

Fig. 11 The three basic classes of influences.

Feedback Influences:

Feedback is intentional or unintentional self control according to some rules that can or cannot be changed. These rules can be seen as the "habits" of the system and such systems may be considered to have "life". In modern system theory systems with feedback are called closed-loop systems.

Time Influence:
The environment changes with time, some are regular and some are irregular. Figure 12 shows the source of Input Influences.

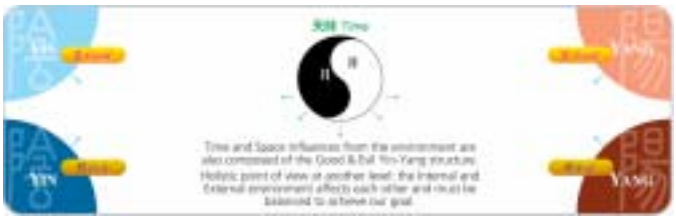


Fig. 12 The Sources of Input Influence

The complete Taichi Yin-Yang system diagram from an observer point of view has been developed in our research and different areas of applications is our ongoing research. It is believed that this is "The Structure of Everything" but extensive research is required to apply this structure to different physical, social and biological sciences. Figure 13 shows the general steps for the application of the Taichi Yin-Yang system. The heating water system example in this paper illustrated an application of the Taichi Yin-Yang system in the field of physical science, while Figure 14 and 15 show the application in the field of biological science (human health) and social science (economic system) respectively.

CONCLUSION

(A union not A) is the closest description of the universe, Wu Chi. Similar descriptions appear in the Chinese, Indian and other traditional cultures. Taichi is the goal of a system and must be clearly defined as a frame of reference in order to identify the Yin and Yang, and Good and Evil components of a system. Even if the Taichi Yin-Yang system is differentiated from the universe for analysis, its environment is always an integral part of the system. In a way, the environment of the system is another system in a way, and hence can also be represented by the Good & Evil Yin-Yang chart. Current state of a system can be COLD/HOT, DEFICIENT or not, or in EXCESS or not. Hence the system could be in one of the 64 different states.

The output behavior of each one of these states is different and hence the input responses are different. The internal changes caused by the interaction between these special components has been explored for the last 5000 years in China, and the most important ones include the Yin-Yang viscous cycle, conductance/resistance delay in transfer, and the tolerance of imbalances. The input influences can be classified into a COLD-HOT influence spectrum according to the definition of Taichi. However, the inputs can be external factors, necessities, strategies, time or the internal feedback.

Following the simple 15 simple steps, one can apply the theory to any kind of system for analysis. The only key is thoughtful differentiation of the system of interest according to the predicate of each of the Yin, Yang, Good and Evil component.

FURTHER WORK

This is merely the introduction of the Taichi Yin-Yang system. 5000 years of investigation has further enhanced the theory. But once this basic structure is understood, one can conduct further research on the classics to explore the whole field of the theory. More research should be done in this field because of its simplicity, efficiency and universality. Modern science would benefit very much from the help of this ancient theory. Anyone who conducts further research on this theory should translate into a major breakthrough in their field of science. Research has also be done and is ongoing in applying the theory to physical sciences such as the unification of basic forces (Wong, 2007c), social sciences such as economics (Wong, 2007c) and meditation (Wong, 2007e), and biological sciences (Wong, 2007a) (Wong, 2007b) (Wong, TBP c).

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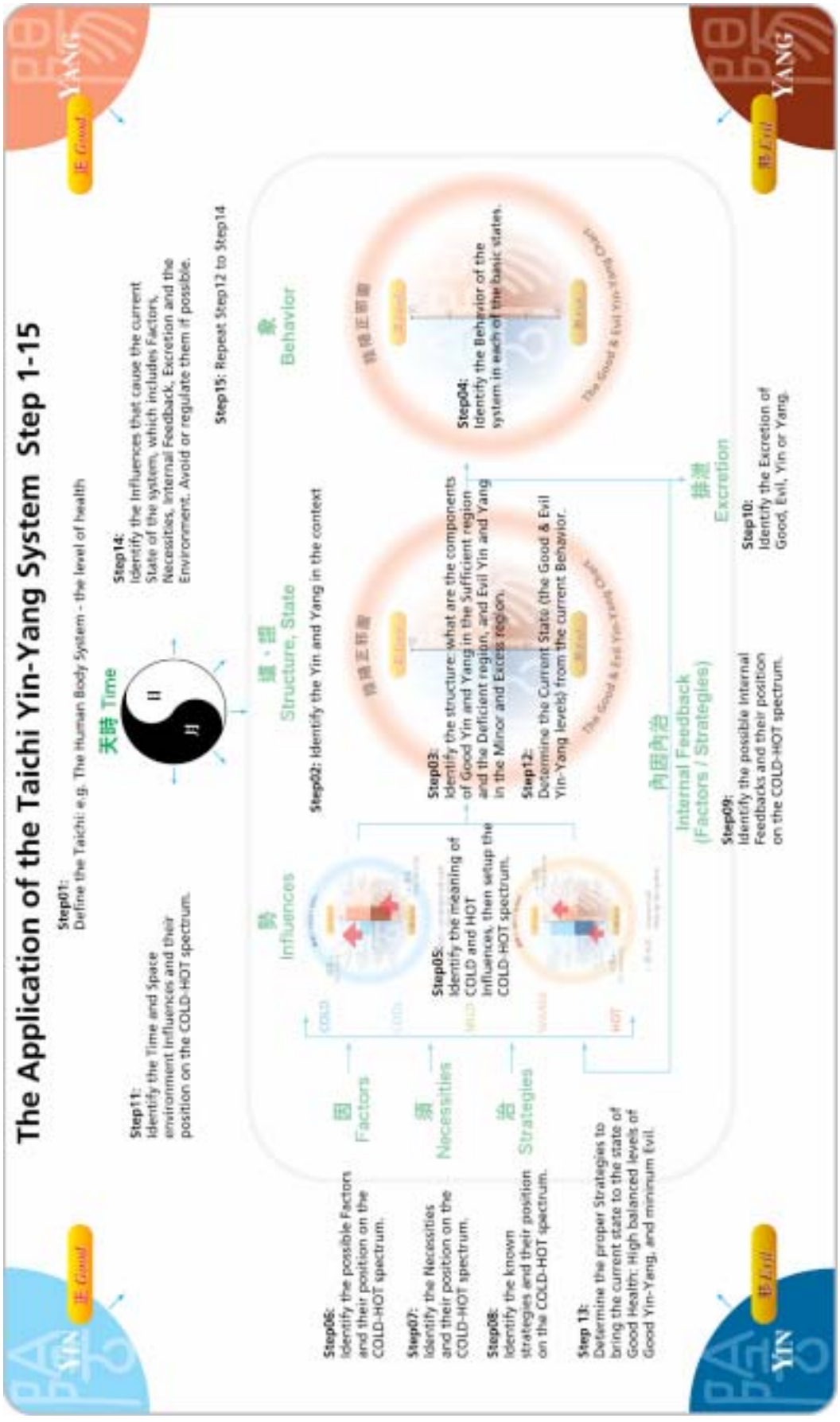

Fig.13 The Application of the Taichi Yin-Yang system Step 1-15

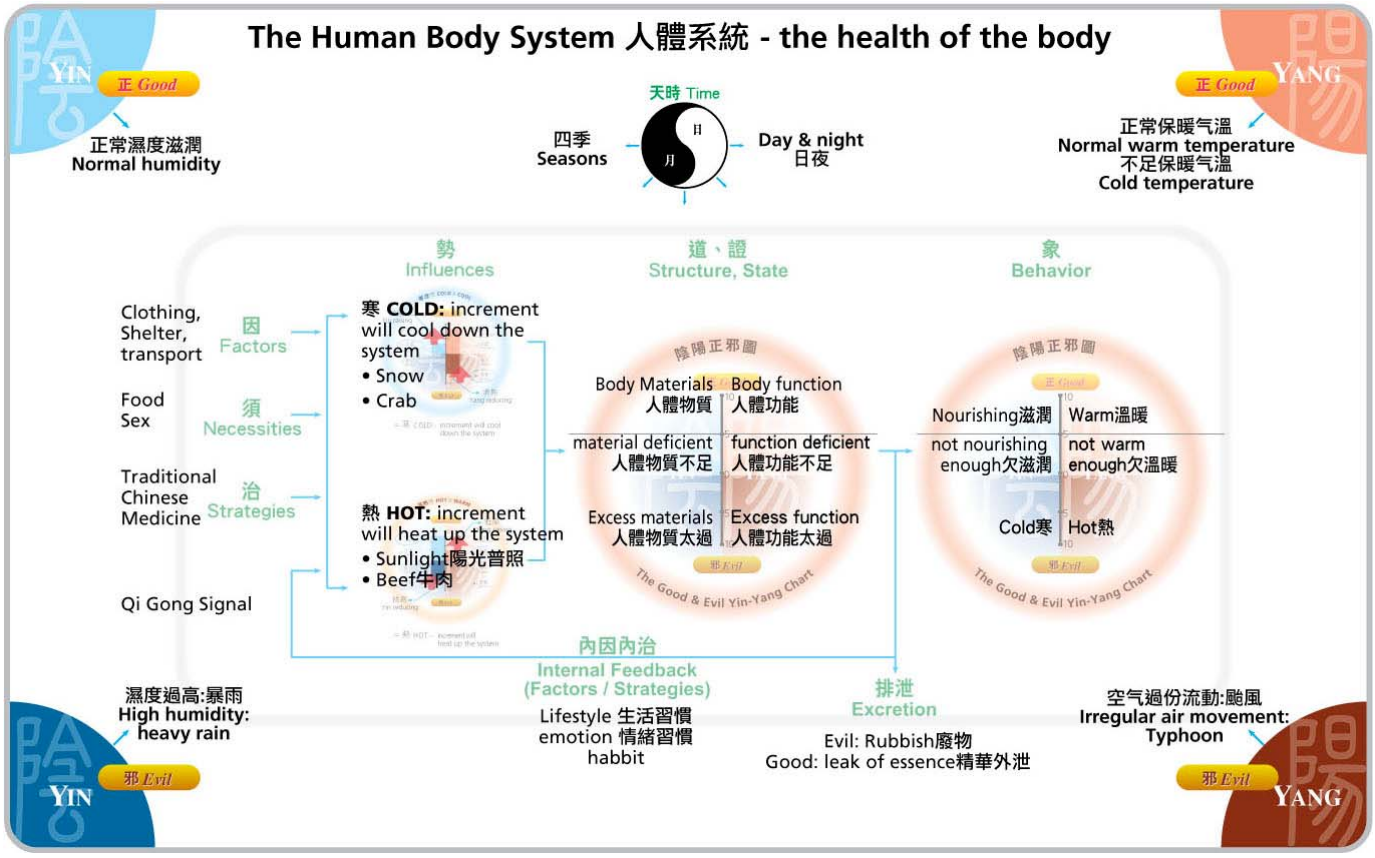

Fig. 14 The application of the Taichi Yin-Yang system on human health system (biological science).

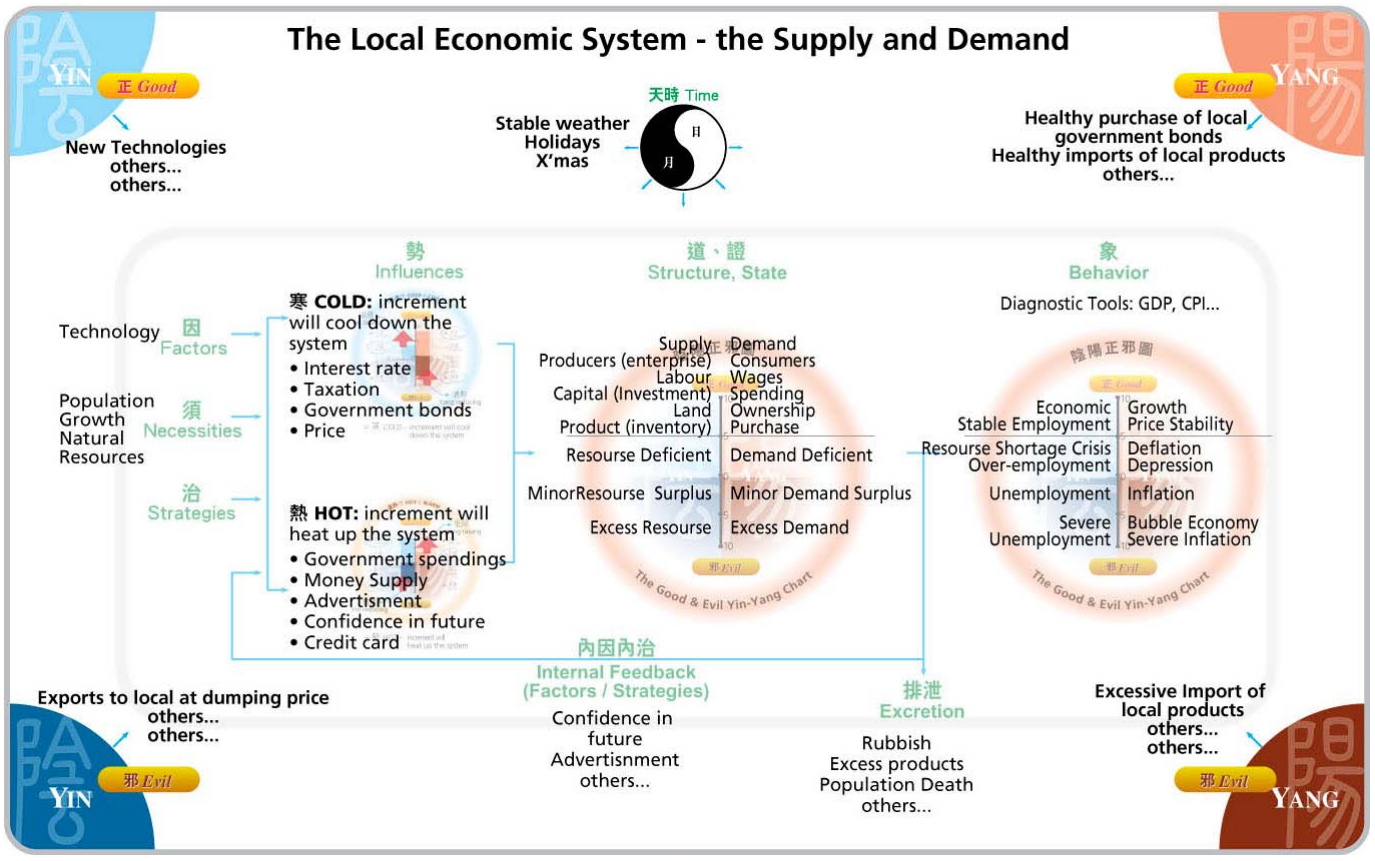

Fig. 15 The application of the Taichi Yin-Yang system on Economic system (social science)