

The *Dao* of Mathematical Creativity, Symmetry Theories, and *Yin-Yang* Philosophy With Their Classroom Applications

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This paper introduces creativity, one of the significant features in maths. The creative mathematical beauty of symmetry and asymmetry are worth investigating in the practicing of *Taichi*. Symmetrical variances make the real world. Symmetry can be regarded as a kind of mirroring, like the line symmetry, the mirror image of the other parts, or rotational symmetry. Such characteristics can be vividly demonstrated in the traditional Chinese philosophical *yin-yang* theory (*YY*). The accompanying of male and female reveals the friendly cooperative relationship. *YY* reflects the counterparts of vacancy and firm, inhale and exhale, noun and verb, theory and practice, light and heavy, slow and fast, the pace, the sound effect in the classroom. Such an analysis is undergone about *yin* and *yang* in *Yi* School and *Dao De Ching (DDC)*. Furthermore, there are detailed arguments of the symmetric nature of every verse of *DDC*, revealing the cultural value of the language. Their applications in the class admit the recognition under the new liberal arts project by China's Ministry of Education. Yet, the integration of research and teaching is required to go further.

Keywords: mathematical creativity, symmetry and asymmetry, *yin-yang* theory (*YY*), *Dao De Ching* (*DDC*)

Introduction

From the Chinese mathematician, *Qiu Chengtong*, a winner of Fields Medal in 1982, math itself is a science to seek the truth in nature, which is a bridge of social science and natural science, with unique glamour, challenging one's cultural awareness. We can see a host of features in maths, such as conciseness, numbers and figures, signs, charts, tables, Cartesian systems, computing. All of these link to the charm of creativity.

One of the innovative natures in mathematics is symmetry. Symmetry requires no alteration of the size or that shape of the object in the transformation. This transformation meeting this requirement is known as an "isometry", or a rigid motion, and the fundamental isometries are reflection over a line, rotation about a point, and translation along a vector.

Asymmetrical balance is when you have two dissimilar sides of a design and have positioned visual weight unequally, and yet you've still achieved a sense of balance. It evokes a sense of modernism and movement. Symmetrical balance, on the other hand, is when you have two identical sides of a design with equal weight on either side of a central point of axis. It evokes a sense of formality and structure (https://blog.hubspot.com/marketing/asymmetrical-balance). Balance in the imbalance arrests more concerns, just like curves catch more eyes than lines. Abnormality weighs heavier than normality.

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Interestingly, the Chinese *yin* and *yang* theory embraces the characteristic of the perfect symmetry. It is dominating its cultures over thousands of years. Such a philosophical category covers almost all the topics of literature, history, and philosophy directly or indirectly. These dialectical, Daoist, Yist, and medical blessings permeate the daily life. *Yi*, pronounced with a wealth of *pin yin* of Chinese characters, \overline{B} , -, \overline{E} , \overline{B} , \overline{K} , \overline{B} , \overline{K} , \overline{E} , \overline{K} , \overline{K} , \overline{M} , \overline{K} , $\overline{K$

YY, the changing and integration of sun and moon in traditional Chinese culture, reminds us of the bright moon and shining sun. It witnesses the antitheses of heaven and earth, high and low, the front side and back side, long and short, thick and thin.

The Mathematical Creative Thoughts and Culture and Its Application in the Teaching

The essence of mathematics is of creative thinking. Singh (1988) applied Torrance's definition of creativity to the formulation of cause and effect hypotheses in mathematical situations. A mathematical frame of mind is to solve problems with independence, judgment, originality, and creativity. This can be well illustrated in the Cartesian coordinate systems. Y and Z and other axes are based on the X, the independent variable, typical causal links. Runco (1993) described creativity as a multifaceted construct involving "divergent and convergent thinking, problem finding and problem solving, self-expression, intrinsic motivation, a questioning attitude, and self-confidence" (p. ix). Balka (1974) addressed both convergent thinking, defined as formulating mathematical hypotheses, evaluating unusual mathematical ideas, sensing what is missing from a problem, and splitting general problems into specific subproblems. The mathematical thinking modes can facilitate all other subjects in fostering the learners' habits.

How to motivate the students is the key part in the class. The greater a learner's intrinsic motivation, the greater the likelihood of creative applications and discoveries. Sure, it wants time to develop and thrives on experience. The inquiry-oriented, creativity-enriched curriculum and instruction should be of the priority. Students need to be encouraged to appreciate the teaching material, or independent thinking and learning, before any instruction. As the great educator, Confucius, illuminated 3,000 years ago that there was no straining for understanding, no training for upstanding; no struggling for expressing, no stirring for impressing; no inferring for furthering, no illustrating for frustrating.

It is known that so many academically gifted students are working intelligently on Chinese campus, while the rising voice is crying for more creatively talented. Part of them are trying to explore, question, interpret, and employ creativity in all studies like language arts, science, or the social sciences; yet, the current situation is that a host of teachers still sticks to the rules-based dogma.

In reality, the Chinese are rich in creative culture, such as *The Book of Changes (Yi)*, *Dao De Ching (DDC)*, of which *YY* is the crucial part in understanding the initiative and innovation of all things in the cosmos. Luckily and interestingly, it is running along with the counterparts of symmetry and asymmetry, which share similarities and distinctiveness. The two divergent and convergent thinking models mentioned above can be interpreted in the Chinese terms of *yin* and *yang* theory.

The Concerns of Symmetries and Yin-Yang (YY) Theory With Its Role in Taichi Practices

Symmetry and beauty are often claimed to be connected, particularly by mathematicians and scientists.

Are there shared values between symmetry and *YY*? Knowingly, *YY* is the core of analects of *DDC* and *Yi*. However, *it* is distinctive in these two great books, of which in the former the twins come from the *Dao*, while in the latter it is a whole sign, the symbol of *Yi*. It is fascinating to motivate the students to seek the beauty of symmetry and *YY*.

Definitions of Symmetry and Its Explorations in Taiji Practices

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Symmetry is a key element, often the central or defining theme, in art, music, dance, poetry, or architecture. Symmetry permeates all of science, occupying a prominent place in chemistry, biology, physiology, and astronomy (Lederman & Hill, 2004, p. 13). Symmetry can be a hot issue in philosophy, whose application can be tackled in Taoism, in which *Taichi*'s practicing cannot go without symmetry, a kind of *YY* theory, a typical expression of the balance and unity of firmness and flexibility. Such dynamic symmetry can be clearly reflected in the different movements of the arms and legs. A physical system is said to possess symmetry if one can make a change in the system such that, after the change, the system is exactly the same as it was before. We call the change we are making to the system a symmetry operation or a symmetry transformation (Lederman & Hill, 2004, p. 15). *Taichi* is a kind of physical system, any change of the operation bringing a new symmetry of the whole body; it is also a mental system, an inhale and exhale generating style of the limb transforming. The mechanism remains the same as the invariant while the shifts of variables of X, legs, and Y, arms. Can we apply this theory into our daily instruction in the classroom?

Symmetry is an expression of equality between things. The things can be different objects, or different parts of one object. Or the things can be the appearance of a single object *before* and *after* we do something to it (Lederman & Hill, 2004, p. 15). The left hand and the right hand are united and balanced with the going of the two feet in *Taichi*; every movement reveals a symmetry picture. It goes along the organic breath. The dynamic of the limbs and waist is symmetrical with the static of the head. Equality for symmetry and asymmetry renders balance and stability. Symmetry is an invariance of an object or system to a transformation. The invariance is the sameness or constancy of the system in form, appearance, composition, arrangement, and so on, and a *transformation* is the abstract action we apply to the system that takes it from one state into another, equivalent, one (Lederman & Hill, 2004, p. 15). Symmetry can be an invariable as well as variable; this is another kind of symmetry, the transforming of invariable and variable. Asymmetry is a particular symmetry, a variable as well as an invariable. In truth, symmetry comes from asymmetry, just like a straight line from curves. The only unchanging in the cosmos is the changing, the underlying idea in *The Book of Changes*.

Symmetry gives wings to our creativity. It provides organizing principles for our artistic impulses and our thinking, and it is a source of hypotheses that we can make to understand the physical world (Lederman & Hill, 2004, p. 18). The doing of *Taiji* is of creative business, daily exercising of which reveals the symmetry of your body and spirit. In this process, your soul is cultivated and refined with the fine movements of the limbs. The initiative of critical thinking of the students can be conducted with the introduction of symmetry connotations. Symmetry is a powerful tool, even when it is only an approximation to reality. But human species has often made mistakes, assuming some things have or are perfect symmetries when the symmetries are actually only illusory or accidental consequences of something else (Lederman & Hill, 2004, p. 19). Symmetry and asymmetry are symmetries on their own. Perfect symmetries are rarely demonstrated in mathematical perspective; the changing and shifting of every movement in the Taoism yoga is the transforming of symmetry and asymmetry. They are giving birth of energies which are flowing the whole body, refreshing your mind,

polishing your soul. *Dao* can be *daoed* is not the everlasting *dao*, whose interpretation in the talks with students will reveal the ongoing symmetry.

Group theory is the mathematical language of symmetry, and it is so important that it seems to play a fundamental role in the very structure of nature. ... Indeed, in modern physics the concept of symmetry serves as perhaps the most crucial concept of all. (ibid, 20) Symmetry principles are now known to dictate the basic laws of physics, to control the structure and dynamics of matter, and to define the fundamental forces in nature. Nature, at its most fundamental level, is defined by symmetry (Lederman & Hill, 2004, p. 20). Taoism undergoes with the nature of law, and Taiji, following the nature of the physical and mental worlds, discloses varieties of balance, integration and unity of the body, spirit and soul. The energy, qi, goes with body movements, as the mind sitting still with the soul. Some typical courses of humanities or liberal arts can be running better with mathematical language and culture, ideas of physics, and other so-called natural science. The integration of subjects in different disciplines can mirror the unity of the distinctive features, and such transdiciplinary balance is an interesting symmetry. Group theory is an essential component to appreciate symmetry as well as its applications in science and other fields (M. Livio, 2012, pp. 472-473). The Taichi exercise is dynamic rotation with the waist or hip bone. The rotation is the axis, a moving stillness, other parts going around it. The universe is rotating, and the micro cosmos of the human body also is going. The sport of *Taichi* is just rotating with the hip bone. Your small universe can be exploded with your rotation. Its moving shows variety of shapes, like triangles,

Helping us seeing connections in the world around us is perhaps the single most important merit of the symmetry concept (I. Hargittai & M. Hargittai, 2000, p. 2). Visual world image of symmetry is an object of many studies. However, the material world can be seen so many symmetrical features. Bertamini, Silvanto, Norcia, Makin, and Wagemans (2018) presented that symmetry is a prominent feature of the visual world studied as a basis for image segmentation and perceptual organization, playing a part in higher level processes. It is often dissected in the perspective of science, such as maths, physics, and astronomy. Saffran, Barchfeld, Sodian, and Alibali (2016) demonstrated that in a series of three experiments, the authors investigated the influence of symmetry of variables on children's and adults' data interpretation. We can see Lisee, Slater, Hertel, and Hart (2017) that an abstract of the study compared lower extremity strength, functional performance and limb symmetry in healthy participants based on sex (male, female) and level of activity (athlete, non-athlete). For aesthetically-pleasing objects, its symmetrical balance can evoke a sense of traditionalism and stability, while asymmetrical ones are the variants of dynamic, chaos. What it matters is the percentage of symmetry, partial jobs, such as one-third, one half, or 80 percent, or 100, the perfect one. Thus, the cosmos is an interrelated world thanks to the symmetric features. In practicing *Taichi*, one's balance is ongoingly kept with the moving steps, symmetric or asymmetric, as well as the *qi* or breath coming and going.

The Study of Yin-Yang (YY) Theory and Its Variants

The *yin-yang* and *Taichi* cultures create a scientific demonstration of the traditional culture, enhancing the studies of the traditional Chinese medicine (TCM), culture, philosophy, building, customs, as well as *Taichi*. It can specify the vagueness. The introducing into the class will render a clearer picture. There are more sayings about *YY* belief.

This theory is the generalization of the properties of the two opposites entailed in all things and phenomena in the cosmos. It is originated from *The Book of Changes*. Since the Spring and Autumn periods of

China about 3,000 years ago, it was launched in the medical treatment, of which there was the most detailed information in the Huangdi's Classic on Medicine. It read that *YY* is the *dao* of the heaven and earth, the guiding principle of all things, the mother of changing, the essence of death or life, which is the top priority of medical treatment. This statement goes well till now.

In the essay of *Four Seasons* by Guan Zhong (723-475 BC), a famous politician, it emphasized "YY is the great principle in nature; the four seasons are the great revealing of the *yin* and *yang*". The four seasons are the alternating of *yin* and *yang*; the different days of the seasons reflect the best use of *yin* and *yang*; the alternative of day and night is the changing of *yin* and *yang*. *Yin-yang* is splitting the one into two, one being the opposite of the other.

TCM is not only of a medical skill, but also a philosophy, a culture. It comes from the daily medical practices, its theory gradually growing and developing better with the ancient Chinese philosophy. In it, the naïve dialectics is the most brilliant star, of which some concepts and categories such as *yin* and *yang* can be considered as the logical beginning of the TCM theory. Some terms, like *zangxiang*, Visceral Manifestation, cold and hot, deficiency and excess, exterior and interior systems, are of the typical dialectic thinking. They are the followers of *yin* and *yang*.

Of metabolism of the human body, anything restricted ascribes to *yin*, while any active and live is to *yang*. *Yin* lives with *yang*, and verse visa. The other end of *yang* is close to *yin*, and the opposite is true.

YY in *The Book of Changes. Yi* is historically embraced as the engine of all analects, the origin of the great *dao*. *Yi* School is the unique Chinese cultural academic scheme, *yin* and *yang* being the remarkable notion. *Yi* School is on the *dao* of *yin* and *yang*, which is the fundamental to the *Yi* philosophy.

The views of heaven and man, *yin* and *yang*, as well as no extremes, are the big three core perceptions in this book.

One *yin* and one *yang* make the great *Dao*. It is said that the first ancestor of Chinese drew trigrams. Such eight trigrams are based on *yin* and *yang* theory, of which *yin* line and *yang* line are the only two units, with three tiers of the upper (heaven), the middle (earth), and lower (human). This is regarded as the earliest Chinese sign languages.

YY in *Dao De Ching.* The three *daoes* of Laozi are the *dao* with names, the *dao* without names, and the eternal *dao*. The three virtues, the profound *De*, suggest doing, going, and living along with others. The three likeness, abstruse *tong*, never come with relations, harms, and humbles. The three treasures: affection, simpleness, and cautiousness. *Dao* bears *De*, so with likeness and treasures. This is the Laozi's interpretation of the great likeness (*daxiang*) of *Yi* School.

YY, negative and positive (NP), is a twin image. While talking about two concepts or things, as long as they are complementary, fighting against each other or mutual dependent, they can be viewed as *YY* or NP. *DDC* is filled with these terms, like big and small, high and low, being and non-being, hard and easy, long and short, front and back, normal and abnormal, beautiful and ugly, smart and stupid, nimble and clumsy, male and female, strong and weak, aggressive and soft, full and vacancy, fortune and misfortune. Positive wording appears negative, which is the moving of *Dao*, whose function is to be weak. All these are of *YY* thinking.

The Symmetrical Analysis of Dao De Ching (DDC) and Its Profound Likeness

Symmetry, although mathematically fascinating, also has a coldness, a rigidity, a fixity, a sense of stasis, which is less interesting, less attractive, indeed less beautiful than asymmetry. Too much asymmetry is however

mere chaos. ...However, without an understanding of the deep mathematical structures of symmetry we would not be able to realize how asymmetry is generated. Symmetry and asymmetry are therefore an essential dialectic for both science and aesthetics (Mcmanus, 2005, pp. 176-177). In theory, different languages admit different beauty recognition. For example, Chinese prefers the symmetric glamour, which can exert forces, momentum and power in expression. It is like law and order, static balance, which generally is followed with some comments. This partly reflects its culture, the power from the authoritative.

The Chinese bible, *Dao De Ching*, has such rigid and powerful symmetry, dotted with asymmetric statements. Some are supersymmetry, some more symmetric, some a taint, some asymmetric, some symmetry-breaking, which can attribute to *yin-yang* division or split. In this book, *Dao* and *De* are symmetric terms, as it is with *Yi* Canon, *the Book of Changes*, of which, the Chinese character *Yi* (易), the original meaning is the mixture of sun (the upper part) and moon (the lower).

Yet, one feature cannot be ignored that the asymmetric seems to be the comments of the symmetric wording. What is the symmetric beauty of the whole? What about the comparison and contrast between and among the different sections? How about every verse?

It is knowingly of 81 verses, a book of Dao (the first section) and De (the second), nevertheless, the division of which is arguable. The first 37 are on Dao, the rest on De? Can we make it other splits? 9 times 9, 9 sections with each of 9 verses? Or the section of the 40th to 42rd as a whole is the dividing line, which is about the general description of the great Dao? This so-called line can be considered as the guiding line of the book. And these three chapters present the typical symmetry, the 40th, 100%; 41, over 62.5 or even 80%, 4/5 (of eight sentences, five are symmetric) or even 80%, 4/5; 42, over 83% (of six sentences, five are symmetric, some paralleled sentences, some paralleled within the sentence). The 42, the functioning of the Dao, is rendered as the engine. It reads that Dao gives birth to one, one to two, two to three, three to a myriad of things, which carries *yin* on the back and hug *yang*, the breakthrough of which brings forward the energy, *qi*. This saying is cited as the top wordings. The 41 tells the different experiencing of the Dao, showing the very dao as it is. The 40 has only 21 Chinese characters, arguing about the dynamic *Dao*, is of simple material dialectical thought. It emphasizes being and nonbeing, the reverse force (the antigravity), and the powerful weak. The symmetry in form, in language constructer, is demonstrating the chaotic contents, the philosophical thought. "Three" in Verse 40, means the harmonious qi, the balance of yin and yang (Xu, 2015, p. 5), which means three: itself, heaven-earth-human, or *yin-yang*-entity, carrying the perfect symmetry. Languages are for the philosophical contents. The following data are describing the symmetric situation in DDC, from Chapter 1 to 81, some of which are not the only statements owing to the ambiguous contexts, different punctuations leading to distinctive data. However, in language form or in contents, they reveal the general conditions. 1, 4/5; 2, 4/5; 3, 3/4; 4, 3/5; 5, 2/4; 6, 2/3; 7, 4/4; 8, 3/4; 9, 4/5; 10, 7/7; 11, 4/4; 12, 3/3; 13, 3/4; 14, 5/7; 15, 4/5; 16, 5/7, 7/7; 17, 1/4, 4/7; 18, 1/1, 2/2, 4/4; 19, 2/3, 4/5; 20, 7/9; 21, 5/7; 22, 2/6; 23, 4/7; 24, 2/4; 25, 7/7; 26, 2/5; 27, 4/4; 28, 5/6; 29, 4/5; 30, 5/7? 4/7; 31, 4/8, 5/9; 32, 0/8, 1/7; 33, 3/3; 34, 4/4, 3/4; 35, 3/5, 3/4, 1/4; 36, 3/4; 37, 0/538, 7/739, 7/7; 40, 2/2; ...43, 3/4, 3/3; 44, 3/3; 45, 4/5; 46, 4/4, 3/4; 47, 3/3; 48, 2/4, 3/4; 49, 3/4, 4/4; 50, 4/65/5; 51, 6/6; 52, 4/7, 4/6; 53, 3/6, 1/4?; 54, 3/4; 55, 7/8, 8/9; 56, 3/4; 57, 3/4; 58, 4/6; 59, 3/3; 60, 3/5; 61, 4/6; 62, 1/8; 63, 5/6; 64, 7/9; 65, 1/6; 66, 2/5, 1/4; 67, 6/8; 68, 2/2; 69, 3/4; 70, 6/6; 71, 3/3; 72, 5/5; 73, 4/6; 74, 0/5, 3/4; 75, 3/4; 76, 5/5; 77, 5/7, 3/5, 4/6; 78, 4/4; 79, 1/4; 80, 4/6; 81, 5/5. In the above numbers, the first ones (before the semicolons) are different verses or chapters; of the second, the numerators are the symmetric number of the sentences, the denominators the whole of each verse.

Roughly speaking, of the whole book, 15 verses are asymmetric, and 66 symmetric. 15/81 = 5/27(9*3) = 18.5%, 66/81 = 22/27(9*3) = 81.5%, an interesting symmetric percentage. 9*9 = 81, odd number is odd, which was lucky in the ancient Chinese, not today.

Symmetry means rest and tie; asymmetry means movement and detachment: order and law here, arbitrariness and chance there; stiffness and compulsion here, liveliness, play, and freedom there. Somewhere at the ladder between the two extremes, every style, every individual, or every artwork finds its own particular place (Mcmanus, 2005, pp. 159-160). Four-fifths of *DDC* are symmetric in language expressions. This proves that *DDC* is heavily focused on rest and tranquility, while one-fifth are inserted into the symmetric verses, driving the whole, the universe, going in all directions. It tells the law and order of nature, leaving some chances to obtain; nevertheless, *DDC* seems to be no dualism, some are tied and rigid, some arbitrary, some in the between; there is no named *dao*.

The Symmetric Analysis of YY and DDC With Its Application in the Classroom

The Chinese Ministry of Education (CMOE) calls on an international consciousness to the analysis of higher education in its new liberal arts initiatives, which is going along with the new engineering, agriculture, and medical disciplines. They prefer an international perspective will contribute to the enlightened policy and practice. To serve this objective, the CMOE exerts a special concern for its majors in liberal arts. It requires that all students participate in the initiative of inclusive and innovation, incorporated into the local development. It provides a framework for a "real world" experience for students of higher education, parrelled with an in-depth transfer in the practice. The mixture of practical teaching experience with research is designed to offer students an appreciation for the ways that the daily study of the key and critical terms in the traditional Chinese culture, like the *Dao*, *yin-yang*, may be framed by questions and concerns that require the ability to undertake a detailed exploration of information and ideas in order to inform policy and practice.

The concept of global competence denotes not only knowledge or skills, but also the capacity to meet complex demands in a particular cultural context, demonstrated by a combination of contextualized knowledge, skills, values, and attitudes (Lambert, 1993)... universities have aimed to foster global-ready graduates, teachers, engineers, who can "work knowledgeably and live comfortably in a global society" (Lohmann, Rollins, & Hoey, 2006). Focusing on the career aspect of global competencies, universities aim to cultivate students' knowledge of language and communication skills to prepare for competition within the global labor market, to obtain global employment, and to increase productivity, innovation, and economic prosperity (Zhou & Green, 2019, p. 79). The Chinese students are demanded to obtain such global competencies to integrate across disciplinary domains and to comprehend global affairs and events and the intellect to create possibilities to address them. How to enhance their employability is every teacher's responsibility. Students should be able to find collaborative solutions to global issues and towards the common good, such as climate change and social justice issues. Also, much attention has to be paid to their mental health, like academic, social, and cultural stress and vulnerability. To handle this, the cultural distance is a leading factor.

In the classroom, there shall be fresher atmosphere. More competent teaching coordinators are crying for nomination. The systematic barrier of relations will challenge the implementing of this initiative. Whether those with creative thinking can be promoted or not will be one of the leading elements in determining the efficiency of this project. Teachers as well as students are both needed to be motivated. The *YY* thinking and teaching is

running with the *YY* learning symmetrically. If the *dao* of relations outweighs the competence, the new program will turn out to be a failure. The *DDC* of research and teaching is totally integrated, with such an unlucky history of mismatch. *YY* can be *daoed* in the class, and symmetrically and asymmetrically, it is such a stranger in the higher learning. Luckily at least theoretically, new projects are launched; a rising number of colleges and universities are struggling to join the building of educational reforms.

Concluding Remarks

There are a large quantity of *yin* and *yang* variances, such as languages and other specialties, full text translating and adaption, the east and the west, vagueness and clarification, abstract and specific, social science and natural science, law and morals, civil and commercial, civil and criminal, officials and civilians, physics and chemistry, differentials and integrals, addition and minus, multiplication and division, astronomy and geography, man and god, right and wrong, spear and shield, head and foot, body and soul, left hands and right hands, thumb and little finger, chest and back ,walk and run, front and back , heritance and creative, one and two, black and white, beautiful and ugly, good and bad.

Symmetry is positive, and asymmetry is negative, or just the opposite? Who knows? The *Dao* cannot be told. *Yin* is the opposite of *yang*, and the opposite is true; it is similar to symmetry and asymmetry. What abstruse is of identify or similarity is *Tong* (\square) which is profound; profound sameness is similar vagueness. Accuracy and fuzziness carry like properties. Its effect is compelling. Every rule leaks, the exception the *yin-yang* rule. The chaos in the chaotic situation is the static.

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