A Philosophical Foundation of Qualitative Modeling Methodologies Based on the Yin-Yang Principle

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Abstract

In this paper, we develop a philosophical foundation for qualitative modeling and reasoning methodologies. First, we introduce the Yin and Yang principle and briefly review its origins in Chinese philosophy. We analyze the classical Western science model from a Yin-Yang perspective, and compare Eastern and Western approaches to methods of scientific inquiry. We show that traditional dichotomies such as hard versus soft sciences, quantitative-formal versus qualitative-informal methods, or objective versus subjective perspectives break down in light of modern scientific discoveries. We argue that qualitative modeling and reasoning may provide an integrative methodological framework that overcome those rigid limitations. We point out several properties of qualitative reasoning methods and applications that bear closer relationships to Eastern philosophical principles than to the traditional model of Western science. We relate some major assumptions, features and characteristics of qualitative modeling and reasoning to Yin-Yang theory and show that Eastern thought can contribute significantly to the motivation and understanding of qualitative reasoning as a particular scientific method.

Introduction

Western thought and philosophical approaches have laid the foundation of most scientific disciplines and domains in the 19th century and continue to dominate scientific methodologies in many areas. Originating in the sciences, especially in physics, the Cartesian or Newtonian worldview has shaped scientific paradigms in terms of problem identification, problem definitions, problem description and modeling, and problem solving methods. Adopting scientific principles like objectivity, reductionism, and deterministic modeling and classification has helped advancing the sciences into the modern age and building engineering devices and artifacts of increasing complexity and utility. However, this mechanistic worldview is now increasingly showing its limitations in the understanding and mastering of intricate real-world phenomena. Modern science across all disciplines is beginning to see a certain paradigm shift moving towards a new worldview that emphasizes concepts like uncertainty, imprecision, dynamics, process-orientation, qualitativeness, and multi-perspective, holistic thinking.

Yin-Yang theory is the core of Chinese philosophy, reflecting the basic view of the world by Chinese people for over two thousand years (Yang 1993, Xu 1995, Zhu 1992). As a comprehensive theory, it includes the mechanism of Yin-Yang, the tool of Eight-Hexagrams, and the symbol of T'ai-Chi, which as a whole represents Chinese people's conception about the nature, the origin and development of the world. Such an insight into the intrinsic mechanism of the universe as well as the effort to put the idea into practice once put China ahead of Western countries in scientific advancement in both theory, technology, and cultural development.

Supported by the great scientific discoveries by scholars like Kepler (1571-1630) and Galileo (1564-1642), the metaphysical world view of the medieval times was gradually replaced by the modern scientific orientation developed and formulated by Descartes (1596-1650) and Newton (1642-1727). Originating in the sciences, especially in physics, the Cartesian or Newtonian worldview has shaped scientific paradigms in terms of problem identification, problem definitions, problem description and modeling, and problem solving methods. Adopting scientific principles like objectivity, reductionism, and deterministic modeling and classification has helped advancing the sciences into the modern age, and eventually led to the Industrial Revolution characterized by engineering projects of unprecedented scale and complexity. However, this mechanistic worldview is now increasingly showing its limitations in the understanding and mastering of intricate real-world phenomena. Modern science across all disciplines is beginning to see a certain paradigm shift moving towards a new worldview that emphasizes concepts like uncertainty, imprecision, dynamics, process-orientation, qualitativeness, and multi-perspective, holistic thinking (Capra 1988).

We argue that although seemingly different, the Western and Eastern approaches are basically different ways of tackling the same problem, that is, we can interpret modern science in the language of Yin-Yang theory, and thus suggest a new paradigm by incorporating Eastern philosophy into the Western science model. In the field of computer science, for example, Sodan (1998) has shown evidence of the correspondence between Yin/Yang theory and certain CS concepts and methods, and claimed that the integration of both qualities offers the prospect of solving more complex problems. In another piece of AI research, Minsky (1991) also proposed that AI research must now move from its traditional focus on particular schemes to an integration of modular learning machines with common sense knowledge reservoir. Specifically, we argue that Qualitative Reasoning could be seen as a particular example of such an integrative and hybrid framework.

In Section 2, the authors will introduce the concept and philosophy of Yin-Yang theory, and explain them in the light of its applicability in Western science. In Section 3, the focus of our paper, we will analyze the relationship between qualitative modeling methods and Yin-Yang theory, and propose an integrative framework for its development. In Section 4, we will conclude the paper with a discussion and point out some limitations of this paper.

Yin-Yang Theory and Modern Science

Origin and Concept of Yin-Yang

First appeared in I-ching, the concept of Yin-Yang dates back to the Xia Dynasty around 2205 B.C. (Lu 1990). It originated from the observation of real world phenomena, where there always exist pairs of opposite yet related objects or concepts (Table 1).

	Yin	Yang
Objects	Earth Moon Female Night Winter Interior	Heaven Sun Male Day Summer Surface
Properties	Coolness Responsive Intuitive	Warmth Aggressive Rational

Table 1: Yin-Yang Pairs as Real Objects and Properties (Capra 1988, p.36)

Yin-Yang is a highly abstract yet very common term. It represents the common characteristic or status of almost all things rather than a particular object (Xu D. Y. 1995 p.29). In Lao-Tzu, an ancient Chinese scripture, the concept of Yin-Yang is further abstracted into a higher conceptual level. It is seen as opposite properties of the same thing, or the relative relationship between two things (Yang X. P. 1993).

Ubiquity of Yin/Yang Dichotomic Pairs

Principle 1: *Everything in the world has both Yin and Yang properties (ubiquity). There is no absolute Yin or Yang existing (relativity). A harmonious combination of these two properties is always preferred over pure emphasis on either of them.*

Chinese people believe that the world itself is created by the interaction of two opposite forces, Yin and Yang, and therefore everything in the world has both properties. Neither of them can exists alone (Lu 1990), such as "cold" and "hot", "good" and "bad". We can easily find such dichotomic pairs in the symbolic system of modern science as well (Table 2).

	Yin	Yang
Mathematics	negative (-) odd	positive (+) even
Computer Science	analog asynchronous	digital synchronous
Physics	counter-force negative electron	force positive electron
Methodology	qualitative bottom-up theoretical	quantitative top-down empirical
Philosophy	falsehood inductive descriptive	truth deductive normative

Table 2: Yin-Yang Pairs of Scientific Symbolic System

Not only the symbolic system of western modern science is consistent with Yin-Yang concept, the difference between Eastern and Western science can also be explained by Yin-Yang theory. "Science" can be defined as a process of inquiry, inquiry into a body of knowledge and the process which generates new knowledge (Ackoff, 1962). However, the approach of making such inquiry is quite different in Eastern and Western scientific approaches (Table 3).

As we can see from the table that the Eastern science approach starts out with abstract concepts about the nature of the world, whereas Western science is foremost based on empirical observations (Ciborra 1998). The two approaches themselves can be captured as a dichotomic pair, each having its own power and weakness. While the Eastern approach (Yin) has the strength of capturing the principles of the world, it generally lacks explicitly prescribed operational procedures. On the other hand, the Western approach (Yang) is powerful at directing empirical application but prone to theoretical fragmentation. Now, deriving from Yin-Yang theory itself, we may achieve better results if we can

Methodology	Yin-Yang (Eastern)	Scientific Research (Western)
Objective	Emphasize the relationship between objects	Emphasize the objects themselves.
Direction	Start from understanding the intrinsic law of the world and objects as a whole, and then try to apply the law to real life problems. (deductive)	Start from collecting data from real life phenomena, try to reduce the data, and understand the world through laws derived from data reduction. (inductive)
Method	Holistic	Reductionist
Goal	Be in harmony with the world	Conquer the world
Tool	Symbolic system: T'ai-Chi symbol (Capra 1975, pp.107), Eight-Hexagrams, Sixty-four Hexagrams(Zhu Xi 1992)	Mathematical language, Data, modeling and analysis, etc.
Characteristics	Fuzzy, abstract, holistic, More conceptual, qualitative	Precise, concrete, fragmentary, more detailed, quantitative

Table 3: Comparison of Eastern versus Western Approaches

appropriately combine these two approaches into a harmonious one, that is, let both of them make a move towards each other.

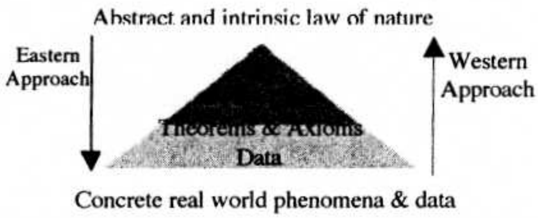
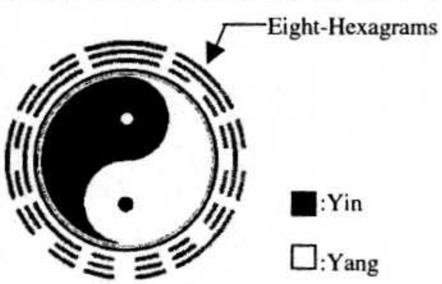


Figure 1. The Framework of Eastern versus Western Approaches

Nested Nature of Yin/Yang Dichotomic Pairs

***Principle 2**: Yin and Yang are inter-penetrating into each other, and there is no clear boundary between the two (inter-penetration). Similar patterns exist at different levels of objects and properties, but such periodical repetition is never exactly the same. (recurrence)*

The inter-penetration nature of Yin/Yang pair comes from Chinese people's belief of the creation of the world (Figure 2). They believed that the very beginning of the world was pure *chaos*, firstly splitting into *Yin* and *Yang*, then each of them further divided into one relatively Yin and one relatively Yang part, further splitting will produce Eight-Hexagram, and so on. The process went on until finally it produced the great variety in the world.



**The whole picture can be fit recursively into any of the two small circles periods.*

Figure 2: T'ai-Chi Symbol

It's interesting to note that one can always find some "Yang" characteristic in "Yin", and vice versa, just as the evidence of opposite gender characteristic on one other. If looking from a broad view, we can find "Yin" aspects in Western Science and "Yang" aspects of Eastern Science (Figure 3); if looking into the Western Science, we can also recognize subjects such as mathematics and physics are "Yang" while social science and behavior science are "Yin". However, a more detailed look will show that chaos theory in physics is an "Yin" element, while it's a common practice for social science and other "soft" science to borrow principles from physics and borrow tools from mathematics.

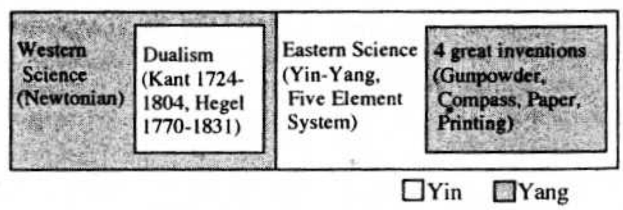


Figure 3. Nested View: Eastern versus Western Science

Dynamic Nature of Yin/Yang Dichotomic Pairs

***Principle 3**: Everything keeps on changing under the interaction and transformation between the opposite forces of Yin and Yang (mobility). The balance point must be somewhere in the middle and the two extremes will never be reached, since reversal will take place whenever one extreme is about to be reached (reversibility).*

This dynamic nature of Yin-Yang dichotomic pairs can be best illustrated by the development of modern science itself. There are roughly three stages in the development of modern science, which show an overall recursive pattern.

During the first stage (before the 15th century), Western natural science was dominated by the philosophy of Aristotle (384-322 BC), who took an organic view of the world, tried to understand rather than predict or control it. This approach is closer to the Eastern way of "Yin", but was evolved around the concept of "God" rather than the nature itself.

The second and most influential stage was from 16th to 18th century. During this period of time, a whole new scientific paradigm was set up and subsequently led to achievements in almost all disciplines. The world then was viewed as a Cartesian or Newtonian machine, which although extremely complex, could be broken down into its components, and be analyzed through each component, be exploited, controlled and destroyed respectively (Capra 1988). We can see that in this stage, the scientific approach moved towards the "Yang" side, departing from the first stage of the relatively "Yin" side of view.

The achievement that humankind had made by adopting the mechanistic worldview was tremendous. Nevertheless, the methodology does not match today's problems, which increasingly reveal new levels of complexity of interrelated processes and contingencies across multi-culture domains (Skyttner 1998). The world keeps on changing and new methodologies and paradigms are always needed when new phenomena are debated (mobility).

At the beginning of the third stage, from the end of 19th century to the early 20th century, a significant reversal took place with the emergence of Einstein's (1879-1955) special and general theories of relativity and quantum mechanics by Bohr (1885-1962), Heisenberg (1901-1976), and Schrödinger (1887-1961). Important physical quantities, such as space, time and mass, which had previously been considered as absolute concepts all proved now to be merely relative. After discovering that the physical relationships at the subatomic level are non-deterministic, physics has gradually moved towards a non-deterministic worldview (Hunt 1994). Likewise, the discovery in quantum mechanics that the observer of a scientific experiment will inevitably influence its outcome, that is, every observation and scientific statement is relative, is slowly having a great impact in other disciplines. Contemporary science puts increasingly more emphasis on relative rather than absolute concepts and truth, systemic approaches rather than pure reductionism (Daellenbach 1995, Ciborra 1998, Skyttner 1998), qualitative versus quantitative descriptions (Hayes 1985), nonlinear rather than pure linear thinking (Mainzer 1997), all of which are consistent with the Yin-Yang philosophy.

Here, both the dynamic nature and the recursive pattern are evident in the development of western modern science itself.

Quantitative Reasoning

Call for Integrative Framework

By relating Yin and Yang with different functions provided by the left and the right brain hemisphere, Sodan (1998) spot the long underestimation of right-brain methods (Yin) in Western Science. He reasons that due to the growing complexity and diversity of problems and the inability to solve them using one-sided approaches, there is a trend towards the integration and harmonious balancing of fully developed poles in Computer Science: the combination of numerical and non-numerical (i.e. qualitative and quantitative) applications; of theory and practice, of shared- and distributed-memory architectures, etc. And therefore, Sodan calls for more research into the inherent potential there.

Similarly, Minsky (1991) calls for new research efforts to develop integrative Artificial Intelligence frameworks and methodologies to overcome the currently predominating dichotomy of symbolic reasoning and connectionist methods. He argues that the solution to the inflexibility of both types of AI system lies somewhere between these two extremes, rather than the further seeking in either direction as we used to do. Minsky's idea is surprisingly close to our Yin-Yang theory even though he is not arguing in terms of Eastern philosophy of science at all. He develops his argument mainly along the traditional western approach of AI research. We identify, in Table 4, a set of dichotomic pairs that are predominant in current AI research.

Yin	Yang
Connectionist	Symbolic System
Analogical Reasoning	Numeric Reasoning
Approximate Reasoning	Logical Reasoning
Common Sense	Domain Specific
Breadth	Depth
Heuristic	Theorem
Fuzzy/Approximate	Precise/Accuracy
Multi-Perspective	Single-Perspective
Global Search	Local Optimization
Bottom-Up	Top-Down

Table 4: Yin-Yang Pairs in AI Research

Such kind of consistency between Marvin Minsky's proposed framework with the Yin/Yang theory can't be easily explained away by mere coincidence. The driving force behind that, just as we've mentioned before, is the complex nature of the problems that we are facing. The aim of AI is to mimic intelligent behavior to the greatest extent, while human intelligence intrinsically requires the integrative efforts from both the left and the right brain hemisphere, both numerical and symbolical processing, and both qualitative and quantitative representation.

Specifically, we argue that Qualitative Reasoning, or commonsense reasoning, could be developed as an integrative modeling framework balancing the Yin and Yang aspects. In the following sections, we will analyze QR modeling methods by applying Yin/Yang theory, and propose the new framework correspondingly.

Trade off Issues in Model Building

Quantitative versus Qualitative Methods. Having the advantage of producing precise results, at the cost, of course, of committing to certain modeling assumptions, quantitative approaches are widely used in almost all natural science such as physics and mathematics, but also in the social science, management and economics. Traditional quantitative methods frequently suffer from the lack of confidence in the appropriateness of the underlying model (Freedman 1992, Lang et. al. 1995), since information is hardly complete, relationships are often vague, and precise modeling of the real world situations is almost impossible.

Fortunately, however, we do not necessarily need precise answers. A qualitative prediction can be good enough in lots of cases (Hinkkanen et. al. 1995, Fishwick 1989). Therefore, as our information of the world is incomplete and often qualitative, we may as well settle with qualitative results, and thus depend on fewer assumptions and wider applicability (Kuipers 1993).

From a Yin-Yang point of view, quantitative methods are "Yang" while qualitative methods are "Yin" (recall Table 2). Therefore, they are two complementary methods of tackling the same problem, they are not mutually exclusive (as the general impression might be), but rather can be considered to be the two endpoints of one continuum. Furthermore, there is no sharp dividing line between qualitative and quantitative methods and we are always somewhere between the middle of the two. For example, Kuipers and Berleant (1990) developed a hybrid reasoning system, QSIM/Q2, that combines purely qualitative reasoning with interval-based numerical reasoning.

Information Cost versus Model Precision. The real number line can be viewed from either a qualitative or quantitative perspective. Using a qualitative scale, it may represent the qualitative distinctions of negative, zero and positive. As a quantitative scale, it represents the ordered set of the real numbers.

Alternating back-and-forth between qualitative and quantitative representation is also common in behavioral research, where the Likert scale is often used to measure qualitative responses from subjects. For example, in a questionnaire, a 5-point Likert scale would usually use 1 for representing "strongly disagree", 2 for "disagree", 3 for "neutral", 4 for "agree" and 5 for "strongly agree". The numerical values will then typically be used in some statistic analysis to come up with some numerical results. Finally, these results will be translated back and interpreted as a qualitative answer.

However, the back-forth process is not so easy when it comes to model building where information cost has to be traded off with model precision. Although it might look simple and obvious, the choice of a cut-off line is by no means an easy task in the sense that it depends on the level of precision, accuracy and reliability, as well as the difficulty and complexity of modeling scenario. Whether we should further validated and quantify the model or stop building and start using it is always a perplexing question to researchers. The optimal choice depends on the problem context and, again, lies somewhere in between. Some economists have studied the tradeoff between the model building cost of acquiring (more detailed) information and the extra benefit resulting from a more precisely specified model (Balakrishnan and Whinston 1991).

Qualitative Simulation

Qualitative Reasoning (QR), or Qualitative Physics, basically incorporates two central tasks: to identify the structure of a system (modeling), and to derive and to explain its dynamic behavior (Werthner 1994). In quantitative modeling, a real number is used to describe an attribute of a real physical object and explicit functions are used to describe the relationship between variables. However, complete quantitative knowledge contains information that is typically not available, while the human cognitive capacity may be too limited to even ascertain as little as a single number (Forbus 1988, Kuipers 1994). The emergence of qualitative reasoning as a new modeling tool coincides with other new methods like probabilistic reasoning, fuzzy modeling, chaos theory or systems thinking, that emphasize uncertainty, dynamics, and inter-connectedness.

There are mainly two types of qualitative reasoning systems: one is Qualitative Simulation (QSIM) proposed by Kuipers (1986), the other is Qualitative Process Theory (QPT) proposed by Forbus (1984). The process-centered approach by Forbus describes changes in the physical world in terms of dynamic and interactive processes, which is quite similar to the mobility principle expressed by Yin-Yang theory. In QSIM, however, the qualitative behavior of the system variables is described as bi-directional relationships called Qualitative Differential Equations (QDE). The system behavior will be predicted from a qualitative problem description by ruling out impossible combinations.

Landmarks. In qualitative reasoning, numbers are represented in usually three ways: *signs*, *inequalities*, and *order of magnitude* (Forbus 1988). Basically, however, they are different ways of using qualitative *landmarks* to describe variables. First, when we use signs to represent a number, there is a landmark of zero by default. Second, the use of inequalities is based on the introduction of exogenous or endogenous new landmark values. For example, temperature of the water (T_w) can be expressed

$$T_{freeze} \rightarrow T_w \rightarrow \begin{matrix} T_{stover} \\ T_{boil} \end{matrix}$$

as inequalities (Forbus 1988) representing a partially ordered sets of qualitative values:

Where T_w is bigger than T_{freeze}, and less than both T_{stover} and T_{boil}. Thirdly, landmarks are more explicitly used when describing the orders of magnitude. Forbus and Kuipers define a quantity space as a partially ordered set of landmark values, where a quantity is described in terms of its ordinal relations with the landmarks (Kuipers 1986).

This representation of numbers corresponds very well to the Yin-Yang splitting idea. As we mentioned before, if we view the whole set of numbers as an infinite line, then one end is Yin (-), the other end is Yang (+). When the line is split into two in the middle, two regions are created, symbolized as "+" and "-". With the introduction of more landmarks, the line is further split, and the description of numbers is more and more refined, which means we are moving gradually from a qualitative towards a quantitative knowledge representation. When the width of the intervals between landmark values is small enough, we are approaching a more quantitative representation. We can't say exactly when this change happens, because there is no clear cutting point between Yin and Yang. What we do know is that it must be a continuous process, where back and forth happens all the time. This "split" idea is also very similar to the Yin-Yang theory of how varieties of this world are created by the ever-lasting splitting behavior of Yin and Yang. Furthermore, QSIM allows new landmarks to be discovered during the qualitative simulation, and then use them to define new qualitative distinctions, which in turn creates new behaviors. However, too many distinctions or landmarks lead to prolific behavior trees and intractable branching (Kuipers 1987), which means an overemphasis of Yin. Just as we know from Yin-Yang theory, that splitting of Yin and Yang will produce new identities.

Here, we can also identify a trend in the efforts made by QR researchers to add quantitative features to QSIM so as to increase the quality and precision of model outputs. Kuipers and Berleant (1990) improved the original version of QSIM by introducing numerical ranges for landmarks to describe variables; Raiman (1988) introduced order of magnitude reasoning; and Berleant (1990) made another effort by including probability distributions in QSIM to derive probabilities for the particular qualitative behaviors. These are all nice attempts to push QSIM from its purely qualitative (Yin) position to a more balanced middle point in between. And the inclusion of numerical information, when available, in QSIM clearly improves its accuracy in predicting system behavior.

Qualitative Differential Equations (QDE). Qualitative Simulation (QSIM) is *the prediction of the possible behaviors consistent with incomplete knowledge of the structure of physical system* (Kuipers 1993 p.133). While incompletely known values may be described qualitatively in terms of their relations with a discrete set of landmark values, incompletely known functional relations may be described qualitatively as monotonically increasing or decreasing, passing through certain corresponding landmark values.

A Qualitative Differential Equation (QDE) is an abstraction made from Ordinary Differential Equations (ODE), this abstraction from numerical values to symbolic names depends on the fact that the familiar arithmetic operations that we perform on numbers have corresponding algebraic operations on symbolic names and expressions (Kuipers 1994). It's composed of variables, quantity space, constraints and transitions. A simple qualitative constraint can be expressed as: $Y= M^+(X)$, which means variable Y monotonically increases in variable X (and vice versa). For example, we know that pressure at the bottom of a container will increase will the amount of water it contains. However, we may not know the exact relationship between the two, therefore, we can express it as:

$$Pressure\ A = M^+\ (amount\ A)$$

This information is enough for a QSIM simulation. The whole mechanism can be illustrated by Figure 4. For example, we may obtain an approximate function or an estimation of the relationship between the pressure and amount from observations or by assumption, which might be $Y= aX^2 + b$, and then perform ordinary calculation to get a precise number of pressure at the bottom of the container when a certain amount of water is poured into the container. Alternatively, it would be viewed as part of the system and left as a relatively implicit QDE relationship, and then we get a QSIM solution from qualitative reasoning. The qualitative and quantitative result should be consistent with each other, since qualitative reasoning is only an abstraction of the system, which should be consistent with any possible-valued quantitative descriptions. Just as landmarks can be refined by the introduction of numerical ranges, those monotonic functions can be limited to certain ranges by bounding functions as indicated in Figure 4 (Kuipers and Berleant 1990).

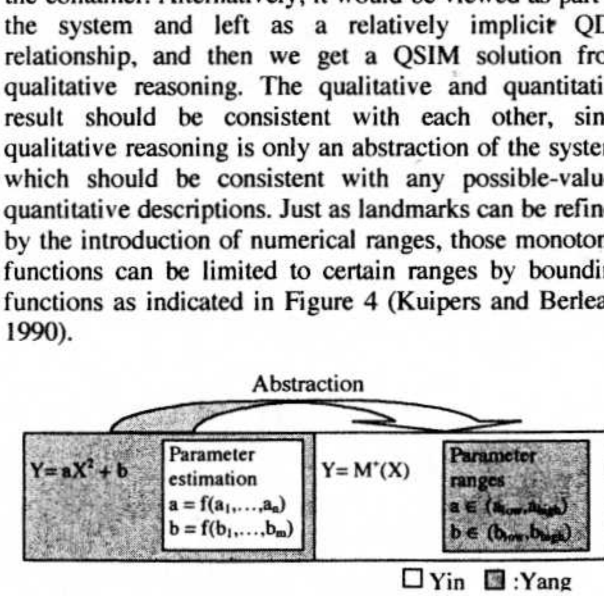


Figure 4. Qualitative versus Quantitative Reasoning

Ambiguity Problem of QR. There is always some tradeoff when choosing between qualitative and quantitative methods. While qualitative reasoning is more powerful in the sense that it needs much less arbitrary assumption about the system, the result of QR does have the problem of ambiguity. Sometimes, the qualitative solution (the behavior tree in QSIM) may be too ambiguous (too many branches) for a sensible and comprehensible result (Kuipers and Chiu 1987). However, consistent with Yin-Yang theory, where there is no exactness but inherent ambiguity, seeking uniquely determined problem solutions is not necessarily the most favorable modeling approach. Recalling Minsky (1991), we should always seek for something in between.

This is exactly what we are doing in QR, where it's clear that model building has to neglect some aspects and attributes of reality, and that simplification and abstraction are inherent features of mapping the "infinity of reality" to a finite description. Numerical solutions require exact knowledge, such as data, structure and techniques, which very often is not available. At the same time, numerical simulations provide precise answers to precise questions and assumptions, but very often we need an alternative or want to have a solution for an entire class of problems. QR, then, suits this need very well in that qualitative knowledge can be seen as a layer on top of the quantitative one and may even guide the application of quantitative knowledge (Werthner 1994). In fact, qualitative physics can be viewed as the attempt to systematically relate formal mathematical methods and commonsense reasoning, and has been mainly evaluated by matching its results with classical methods of mathematics and physics (Huberman and Struss 1992).

When we move from quantitative (Yang) to qualitative (Yin) approaches, using qualitative methods, the problem of ambiguity inevitably comes. Yet the correct answer will be covered by the set of possible answers, independent of the level of ambiguity. In that sense, ambiguous solutions are not incorrect and may very well be considered sound. According to the *reversibility* principle of Yin-Yang theory, when there is too much ambiguity, we should seek ways to reduce it (Kuipers and Chiu 1987). In QSIM, for example, a set of additional constraints may be introduced in order to reduce the solution space and the number of spurious behaviors. Once more, the success attempts will always seek balance between two extremes, corresponding to the right combination of Yin and Yang, rather than leaning towards either of the two.

Discussions and Limitations

From our previous discussions, we can see the applicability of Yin-Yang theory to scientific research methodologies, the power of which comes from capturing the very nature of the world and the mechanism through which the world operates. Properly applied, it should be able to provide some guideline to the modern scientific research. Just as Hunt (1994) put: *Philosophy is the mother of all areas of inquiry* (p.223). Researchers are calling for new paradigms that can help us understand as well as analyze new phenomena (Prahalad and Hamel 1994). Various attempts have been made so far in combining qualitative and quantitative approaches, in applying chaos theory to various domains, in system thinking, etc. All these new scientific trends represent a move away from the 400-year-old Newtonian world view, resurrecting the long-forgotten Eastern Yin-Yang approach, although most probably unintentionally.

We are anticipating the merging of Western and Eastern philosophical approaches with a positive impact on scientific research. It wouldn't be a short-term task, however, given the fact that main paradigm shifts may require a time of centuries rather than decades (Skyttner 1998).

On the one hand, we already have it in Eastern philosophy, embed in a whole set of theory developed around the concept of Yin-Yang; on the other hand, even if we do have the overarching terminology or common language, it remains a challenging task to put it into operation. We have witnessed some movements, but they are still preliminary efforts. Progress can be expected if a new paradigm based on a successful combination of Eastern and Western approaches can be developed. However, we know from our Yin-Yang theory that this process can never reach its ultimate end, oscillation between the two must be expected, therefore all that we can do is trying to be as close to the perfect combination as possible.

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