Expansion of Powers' Perceptual Cybernetics

Huaxia Yan

Abstract

Perceptual Control Theory (PCT), pioneered by the American systems scientist, physicist and psychologist W. Powis, advanced N. Wiener's control theory in the following three ways: (1) It combined control theory with theoretical biology, considered control mechanisms as the essence of life, and proposed a more complete model of control of life. (2) It developed the concept of purposiveness in control systems, created the scientific concept of baseline signal or baseline information, and established the purposive formulation of cybernetics. It transforms the ancient concept of purposivity into a concept of modern science and modern philosophy. (3) It proposes a multi-level control theory model and establishes a new discipline of cybernetic psychology, which is different from both behaviorist psychology and psychoanalysis. Because of this, the authors of this paper first provide a comprehensive introduction to this new theory. This theory is then applied to some extended studies of certain valueological, epistemological, and philosophical issues of technology.

Keywords

perceptual cybernetics, valueological interpretation, benchmark signals and purposiveness, levels of cognition, interpretation of technical behavior

DOI: 10.47297/wspctWSP2515-470204.2018XX02

1. Introduction

William Powis is a medical physicist at the Argonne Cancer Institute in Chicago and a principal systems engineer in the Department of Astronomy at Northwestern University. Systems Engineer at Northwestern University. He builds on the work of Wiener and Ashby to apply control theory to the study of human behavior and human cognition. In His seminal work, Behavior: The Control of Perception (1973), introduced a new theory of control, perceptual cybernetics. Later, in Life Control Systems I (1989), Life Control Systems II (1992), and Making Sense of Behavior (1998) In these works, he not only argues that perceptual cybernetics is the most important aspect of control theory, but also the most important part of control theory. In these works, he not only argued that the animal world exists everywhere with the same control mechanisms as servo-machines, but also that all life is hierarchically organized as a negative feedback control system, and that all life behavior is at all times All life acts at all times as a control of some variable for a specific purpose; the control mechanism is the essence of life.[1] He divides human perception and other cognition into eleven levels, all of which are under the behavioral control of each level to recognize the world and change the environment for the purpose of survival and development. Thus, we can say without exaggeration that Powys not only

systematically developed cybernetics and biological cybernetics, but also used cybernetic models to explain human behavior more thoroughly and completely, the and the cognitive makeup and processes of cognition and the mechanisms of cognition in humans and other animals.

Foreign scholarship has rated Powis's theory highly. D. T. Campbell, the recently deceased president of the National Psychological Association and a leading evolutionary epistemologist, once said of the book, "Powis's book is the best book to date on the application of cybernetic feedback theory to psychology. Unlike many of his pioneers, Bowers uses elegant, relevant, and novel discussions to first truly capture the premises of cybernetics, bringing to psychology the concept of 'baseline signals' from servo-system theory and the 'hierarchical order concept' of control systems ". And the famous philosopher of science Thomas Kuhn wrote: "Powys' book is the most exciting work I have read in recent times. The problem is extremely important, not only for psychology, but for other sciences as well. The synthesis it achieves is thorough and original, and its expression is always persuasive and illuminating. I will note with great interest The results of the research in which Powys has shown the way. " Unfortunately, this theory of Powys has not yet been introduced to China, so how to discuss cognitive problems from the cybernetic perspective of systems science has not received attention in our academic community.

The purpose of this paper is first to briefly introduce the basic points of Perceptual Cybernetics (PCT) and Hierarchical Control Theory of Perception (HPCT), which I call Cognitive Hierarchical Control Theory. (HPCT), which I call Hierarchical Control Theory of Perception (HPCT), and then to provide a somewhat extended study of its implications in the context of value science, philosophy of science, and epistemology in general. Then, we will make a somewhat extended study of its significance in value science, philosophy of science, and epistemology in general. Thus, Section 2 of this paper addresses the issue of perceptual control theory; Section 3 Section 3 discusses the valueological interpretation of perceptual control theory and thus the control of value systems and their perceptions; Section 4 discusses the use of perceptual control theory to discuss Hume's theory of value and control. Section 4 discusses the use of perceptual control theory to discuss Hume's yes/no division; Section 5 discusses the division of cognitive levels; Section 6 discusses the division of cognitive levels in the context of technical behavior explanation. Section 4 discusses the use of perceptual control theory to discuss Hume's division of is and ought; Section 5 discusses the division of cognitive levels; Section 6 discusses the application of the division of cognitive levels to the explanation of technical behavior; Section 7 discusses the general philosophical implications of cognitive control theory.

2. Perceptual control theory

Early cybernetics, especially Wiener's cybernetics, originated as an interdisciplinary study of engineering science and biology, but the later developments have focused on the cybernetic aspects of engineering, resulted in situation of biology loss in development of cybernetics and cybernetic lost in the development of theoretical biology. The aim of W.T. Powers was to re-integrate engineering cybernetics with theoretical biology. In this respect, he went one step ahead of

Wiener, asserting that control mechanisms are the essence of life[1] and "the central and determining factor in all behavior" or the "fundamental principle of life". This understanding makes it possible to use cybernetics to study life and its values. This understanding makes it possible to use control theory to study life and its values.

What is control? W. T. Powers points out that "A is said to control B only when, for all disturbing influences acting on B, A always produces an action which tends to strongly counteract the effects of such disturbing influences on B"[3], so that it remains dynamically stable in the face of the various factors that invite change. Since, from an energy point of view, a system must be a dissipative structure

when it can do so (and become a control system); and any complex system must achieve adaptive self-stabilization and adaptive self-organization to maintain its ordered structure through control mechanisms, cybernetics and this definition of it generalize functionally and mechanistically a wide range of systems science fields, including dissipative structure theory, the cohomology, chaos theory, and the theory of complex adaptive systems. Therefore, we must study cybernetics from a new conception of complex systems and their evolution, and we must study complex systems from the perspective of control mechanisms.

According to Powers' theory, the operation of the control system can be summarized in the following diagram.

This is a negative feedback loop (loop) diagram in which there are five k functions, represented by boxes, including the input function Ki, the output function Ko, the environment function (feedback function) Ke, the disturbance function Kd, and the comparison function Ke. There are six variables: r, p, e, a, q, and d, passed in the line with arrows. Above the dashed line in this figure is the control system; below the dashed line is the environment. Black dots indicate nodes from another level or passing to another level.

Among these variables, there are two most important relations.

(1) $a = K_o(e) = K_oK_c(r\text{-}p)$,

$e = K_c(r\text{-}p)$

(2) $P=K_i(q)=K_i(K_ea-K_dd)$

Equation (1) shows that the action a output by the system is a function of the deviation (error) between the reference signal and the perceptual signal, the larger the deviation, the larger the action variable required to correct for this deviation, Equation (2) shows that the perceived signal is a function of the weighted difference between the disturbance variable and the action variable (weighted difference), which reports how well the action cancels (counteracts) the disturbance to achieve the stability indicated by the baseline signal. For now, the question would be who really controls who in this system and its environment? Is it the perception that controls the action (or the stimulus that controls the response)? Or does the action control the perception? According to Powers' definition, control is to counteract as much as possible the disturbances to a variable so that it maintains some baseline of dynamic stability. From this point of view, it is not the perceptual signal that controls the action, but the action of the system that controls the perceptual signal, which is a fundamental principle of perceptual cybernetics.

The model of perceptual cybernetics is quite precise and quite complete, and in order to understand this model, we should pay particular attention to analyzing its s basic concepts:

(1) The controlled quantity q, also known as the controlled variable: it is a component of the environment whose changes due to disturbances are counteracted and compensated by the effects of the control system's actions, and becomes its preferred state variable q*, i.e., $q > q^*$. Not only can some parts of the external environment be controlled variables, but many variables in our body itself are controlled variables, including our body temperature, blood pressure, the concentration and amount of various body fluids, and our own life itself.

(2) Disturbance (d), in addition to the effect of the system's own action a, all factors that affect the controlled variables, including environmental disturbances, the system's own uptake and fluctuations (fluctuation) are among the disturbances.

(3) The output function K_o and the output variable a: The output function occurs on what traditional cybernetics calls an effector, or an executor, such as a muscle in an animal, a motor in an automaton, etc., which converts a command signal or a deviation signal into a physical effect, i.e., an output variable a. This output variable is an action of the system, it is a means to an end, not the end itself.

(4) The comparison function K_c and the error signal e: The action of the control system is guided by the deviation signal; the so-called deviation signal is

the deviation of the perceptual signal from the reference signal. If the perception of the controlled outcome (i.e., the controlled variable) is exactly the same as the reference condition, i.e., p=r, and thus e=r-p=0, $a=k_o(e)=0$. The control system does not need to act at all. However, since disturbances are always present, the perception though always fluctuates up and down around the reference conditions and the error between the two is always present. The task of the comparator is to compare r as input with p and output a signal proportional to this difference as command information to guide and regulate the action of the control system, so we enter the two most basic concepts of perceptual cybernetics: the perceptual signal and the baseline signal.

(5) In order to control, the control system must obtain information about the controlled environment, including information about external disturbances to the controlled variables and the effects of actions on the controlled variables and their disturbances, which is obtained from the so-called "sensor" through the input This information is obtained from the so-called "sensor" by the input function $p=k_i(q_i)$, where the sensor can be a signal receiver in a servo machine, such as a thermal resistor in an air conditioner, or in a life system. The sensor can be a signal receiver in a servo machine, such as a thermal resistor in an air conditioner, a sensory cell and a sensory organ in a living system, or a cell and a region of the cerebral cortex that obtains various information from it. of a certain cell and a certain area of the cerebral cortex. So here perception is a broad concept, starting from intensities, sensations, and ending with programs, principles, and systems concepts for human beings. There are eleven levels of perception for human beings, starting from "intensities" and "sensations" and ending with "programs", "principles" and "systems concepts". Power says that "the term perception, applied in its most general sense, can denote all experiences, from the most primitive sensory input to the most abstract manifestation."[1]

(6) Reference signal. The term reference signal can be translated as reference signal, reference signal. This concept is given in traditional cybernetics as "set point" or "set value" or "object value". For example, the temperature we expect in an air conditioner, the distance between the missile and the target in a missile. However, engineering cybernetics often treats it as an input from outside the system, and if the controller of the machine is a human being, it is often easy to create some confusion, thinking that the target exists in the environment, and

input from the environment, such as the location of the target that the missile is intended to hit, benchmark of room temperature, and in fact in this case, reference signals are also present only in the human brain. One of Powers' most important contributions is the importance he places on the concept of the reference signal as the target information, and clearly labeled in the model diagram, specify explicitly that it does not enter from outside the system, but is an intrinsic element of the system itself, and in biological systems it usually comes from a higher level, from the genes. Powers uses the terms reference condition, reference signal, reference value, and reference variable interactively to describe a state of the system in such a way that it is used as a criterion to determine how much the controlled variable deviates from it, and it is used as a criterion to determine how much the perceived state deviation from the environmental variable is used to determine actions to counteract this deviation.

We believe that Powers' perceptual cybernetics differs from traditional cybernetics in that it makes the following three new contributions to cybernetics: (1) It combines cybernetics with theoretical biology, considers control mechanism as the essence of life, and proposes a more complete model of life control. (2) It developed the concept of purposiveness in control systems, created the scientific concept of reference signal or reference information, and established the purposive formulation of cybernetics. It transformed the ancient concept of purposivity into a concept of modern science and modern philosophy. (3) It proposes a multilevel control theory model and establishes a new discipline of cybernetic psychology, which differs from both behaviorist psychology and psychoanalysis. All of these are particularly rich in valueological implications, which are inherent to it and not imposed on them. Therefore, we have chosen the perceptual cybernetic model for the valueological study of cybernetics.

3. Control of value systems and their perceptions

A fundamental question in value science is the question of whether there is an intrinsic and objective value in natural systems, especially in living systems and ecosystems. Philosophers and ethicists have had long and protracted debates on this issue. Now, we can discuss this issue from a perspective. Many ethicists, especially ecological ethicists, now recognize that nature has its objective and intrinsic value. But the question is, why does nature, and in particular all life and Earth's ecosystems, have intrinsic value to them? It is a question of the purposefulness of complex systems or the "purpose of living systems and ecosystems", This issue was discussed in detail by Wiener when he first discovered cybernetics,[1] whereas Powys' perceptual cybernetics, presented in the previous section discusses this issue more thoroughly and scientifically. Powys originated a concept for purposiveness called benchmark information, benchmark condition, or datum state, and if an organism has some datum state, its behavior is always linked to it, tending to achieve and maintain that state. We can then say that this is its "preferred state", that it is of fundamental importance to the organism, and the intrinsic value of the organism. The concept of value, which initially originated in the category of ends and means, asks whether a thing has value apart from its value as a means? If so, the value of this non-means is intrinsic, i.e. the end itself. If I have other value beyond my family, my friends, my employer, my student, and etc, this "residual value" refers that myself, and my survival, perfection and full development are intrinsically valuable, i.e. the purpose itself is intrinsically valuable. So, the terminology of function terminology (purposive terminology) and the terminology of value (value theory terminology) are but two sides of the same coin, they are intersecting families of similar concepts, the theories each built on this basis are meaningful and informative whether they are purposive theories or value theories, this has been the consensus of most value scientists. In order to understand the relationship between purpose and value, we should cite two authoritative philosophers to illustrate this issue. In the Nicomachean Ethics, Aristotle clearly stated "Something that is desired for the own sake (Other things are only desired for this reason), …… must be good in itself and it is the main good".[2] On the other hand, in Foundations of the Metaphysics of Morals, Kant stated clearly: "If there is something that, by virtue of its existence, is of absolute value in itself, then it is the purpose of itself and can produce precise laws".[3] So purposefulness itself implies intrinsic value, which has been discussed philosophically for a long time, but Powys' scientific justification of purposefulness as the reference information and its elevation to the status of the essence of life makes it possible to introduce the category of intrinsic value more explicitly into the system of life.

With the concept of purposeful and intrinsic value of the general control system, the concept of instrumental value of the system becomes clearer, in the control loop of all complex systems, any structure that facilitates the achievement of the purpose or reference state, both behavior and environment have a positive instrumental value, while the opposite has a negative or zero instrumental value, since external disturbances always have a negative effect on the system's compliance, they generally have a negative instrumental value for the system; the act of correcting the system's deviation from the goal and counteracting the disturbing effects has a positive instrumental value for the system's goal. For example, if survival, flourishing and development are the purpose and baseline state of plants, proper soil, sunlight, air and water have positive instrumental value for plants. Conversely, atmospheric, water and air pollution have a negative instrumental value for plant growth.

Why is PCT able to link cybernetics in general to value science and, by extension, to ecoethics and to make a doctrinal case for the latter? In my view, there are three important reasons here:

(1) PCT creates a basic concept for control systems, i.e., a reference signal (or reference state and reference condition), It hierarchically determines the purpose of the system and puts purposeful behavior at the heart of the control system. W. Powers says: "Intention, purpose, goal, want, aim, objective, plan, design, end, motivation, ambition, etc. form a series of words around the central concept⋯..in control theory this central concept is called the reference signal or reference condition, it refers to the selection of the result of an action before it occurs."[1] In this way, the purpose is not only a subjective attitude of people or a subjective requirement, but can be scientifically discussed in mathematical formulas and in its physical replica. The ancient concept of purposefulness is transformed into a concept of modern science and modern philosophy, as Professor D. Forssell points out "Powers transforms the millennia-old notion that a living system's actions are designed to produce its desired perceptions into a formal theory of behavior, namely perceptual cybernetics."[2] Here, we could well say that Powers transformed the millennium-old notion that living systems have their own purpose and intrinsic goodness into a new theory of value. (2) PCT deconstructs the Cartesian subject-object dichotomy and constructs a dichotomy between system and environment. The old value system based on the subject-object dichotomy of human beings is transformed into a new value system based on the distinction between system and environment. Powers says, "by knowing the control theory, we are free to use words like attempt, purposeful, will, and

desire, because we have now seen that the basic meaning of these words is defined by the specific relationship of the system to its environment, the relationship in which no kind of biting, reasoning, or cognitive process can do anything, the purpose is a more fundamental phenomenon than its various manifestations. We believe that it is the true foundation of life."[3] The shift from the subject-object dichotomy to the system-environment dichotomy is clearly a very important paradigm shift that leads to a shift from subjective values to objective values of the system, but also encompasses the recognition of subjective values, since the subject-object dichotomy can be seen as a special case of the system-environment dichotomy. This shift has led to many new horizons in environmental philosophy. (3) PCT has good theoretical models which can be interpreted in terms of value-based concepts, and thus there are a range of meta-ethical issues, especially eco-ethical meta-ethical issues that can be explained thereby. For example, ethical problems (cybernetic comparators can be understood as ethical problem generators and decision makers), purpose versus preference problems (explained as benchmark information), ends versus means problems (explained as benchmark signals versus output variables), intrinsic versus instrumental value problems (explained as feedback loop relationships between benchmark variables, output functions, environmental functions, and disturbance variables), value conflict (which can be explained as the relationship between benchmark information at different levels and between different systems connected at the same level), utility, pleasureism, welfare, and happiness (which can be explained as behavior controlling perceptions, and life aiming to produce desired perceptions), and the "yes-yes" problem that we will discuss in the next section. The "should" problem, which we will discuss in the next section, and so on, can be elucidated on this basis. In this way, all the variables and functions of the cybernetic model of perception we discussed in the previous section have a valueological meaning. In mathematical terms, the value control system represented in Figure 2 is a homomorphous image of the perceptual control system represented in Figure 1.

4. Perceptual cybernetics and Hume's is–ought problem

The question of the relationship between is and ought to be a major issue in meta-ethics, which was first raised by the Scottish philosopher David Hume in the 18th century. The question is: How can we conclude that "ought" statements (moral assertions) can be made solely from the premises of description ('is' assertions)?[4] For example, how can we deduce from the factual statement that the Earth's ecosystem tends to maintain its stability and species diversity and the fact that it is facing an ecological crisis due to human destruction the moral conclusion that we should protect the integrity, stability and beauty of the Earth's ecosystem? For example, how can we deduce the moral conclusion that we should protect the integrity, stability and beauty of the Earth's ecosystem from the factual statement that the Earth's ecosystem tends to maintain its stability and species diversity as well as the fact that it is facing an ecological crisis due to human destruction. This is where the anthropocentrists often question about the deep ecological ethics, even though they themselves face the same problem: How can we draw an anthropocentric ethical conclusion that we should only maintain ecological balance for the sake of human interests from the factual statement that human nature, or "human beings, are selfish"? To solve this Hume value problem, we now borrow from perceptual control theory to clarify the is–ought problem.

In this control system, there are three different types of signals or information: the sensing signal, the reference signal and the deviation signal, and the relationship between them can be represented by the equation $e = K_c(r-p)$ and the following diagram.

For the discussion, we will call this formula the teleological formula of perceptual cybernetics. We now give a PCT interpretation of the Hume's is/ought problem or a valueological interpretation of the formula $e = K_c(r-p)$: Perceptual signals or perceptual information are descriptive information in the sense that they report on the situation of the environment and the results of the behavior of the system, they describe and express certain facts that are a kind of descriptive information whether they are obtained from the animal senses or from the human thinking organ or from the sensor of the air conditioner (sometimes some kind of thermistor) and the problem solved by the perceptual signals is the problem of obtaining information and not the problem of processing it into instructions.

However, the deviation signal or deviation information output from the comparator has another nature and semantics, which directly directs or prevents the action of the system and changes the state of the environment according to this information, so the nature of this information is normative and directive. The working program of a computer, the electronic signals that guide the flight of a rocket, the normative statements of people, and the moral decrees, etc., are all normative and directive information. In the language of computers, this information is called "command".

In a control system, these two types of information are principally different. The descriptive information about facts tells the system "What the things are and how the things are". The command message about the action tells the system "How the action ought to and how the things ought to be". Now we see that the dichotomy between "is" and "ought", "factual statements" and "normative statements" has emerged primitively and naturalistically in control systems, especially in complex systems (e. g., living systems), where for non-human natural systems this information flow is expressed as "natural factual statements" and "natural normative statements", i. e., "command statements" or so-called "natural laws", as it is expressed, for example, in the flow of living information or in computer languages, as follows. Ralston has said that the gene is a language system, it is a system of descriptions and instructions, and (insofar as it is a reference signal) it It is also an intentional and evaluative system, "that the genetic set is a normative set, it distinguishes between what is and what ought to be.[1] For human language, however, both natural factual statements and natural legal orders can be expressed in terms of factual statements in human language because it does not involve the attitude of the human subject of the language. But when we consider human perception and will as systems or subjects, the factual and normative statements in the control system are expressed in human language in the form of a typical Hume' problem.

In a control loop, there is a third type of signal or information, the baseline information, and the nature of the statement to which it belongs is a key issue that we will discuss later. The is/ought divide was first pointed out in the history of philosophy by D. Hume in the eighteenth century, who stated that it was impossible to derive the latter deductively from the former and vice versa. G.E. Moore then added to the conceptual problem in the early twentieth century: A descriptive concept of nature cannot be equivalent to, and cannot be used to define, any value concept of the good, and vice versa, or else one commits the naturalistic fallacy that the good is undefinable, that it is the result of intuition. These assertions are obviously very important, but neither Hume nor Moore indicates what logical and conceptual (or mathematical) relations exist between "is" and "ought". Is the relationship between them inductive and empirical? In order to deduce a value judgment, what kind of premises are needed in addition to the factual ones? The important contribution and new insight of the value-based interpretation of perceptual cybernetics to this problem is that it not only re-expresses the yes/should problem using another language (e. g., computer or genetic language) and another method (e. g., mathematical method), but also states that the relationship between "is" and "should" also obeys the cybernetic teleological formula $e = K_c(r\text{-}p)$. In this formula, if we have determined, or can determine as a constant, the reference signal, i. e., the purpose statement r, the formula can bridge the "is" statement and the "should" statement and become a bridge from the "is" statement to the "should" statement. Since the variables on the left side of the above equation are "ought" statements, and the variables on the right side are "is" statements, they are linked by an equation. In this way, Hume's problem and Moore's problem are solved to some extent. Logically, the teleological formula $e = K_c(r\text{-}p)$ can be seen as a bridge principle between the "is" statement and the "should" statement, or correspondence rules. correspondence rules).

The question of "is" and "ought" to now leave only the question of how to determine and express the datum signal or datum condition. There is never a final solution to the philosophical problem, and we are still left with the question, for example, of whether the datum message or purposive statement is an "is" statement or an "ought" statement? Or is it both, or neither at the same time? From a perceptual cybernetic point of view, we can answer in three different ways:

(1) The r-signal can be expressed in the form of an "is" statement, so we can directly bridge the "is" and "should" from the above purposive formula: by identifying the purposive statement as a factual statement, we can deduce the "should" statement from the "is" statement based on this premise. For example, we have established through empirical observation the fact that all of the population, i. e., the social community, see it as their purpose to ensure the healthy growth of their offspring. This is a statement of purpose as a statement of fact, and intermarriage by blood is not conducive to ensuring the healthy growth of offspring, so we should not intermarry by blood, and historical and real-life kinship intermarriage can be introduced as a moral precept in this way. As we have pointed out above, perceptual cybernetics and its objective value theory tell

us that purposiveness is something that can be studied objectively and hierarchically through science, and thus as an empirical proposition can be expressed in the form of a yes statement in human language, so that the purposive formula becomes a deductive bridge from "is" to "ought". Once we study the objective purpose of the Earth's ecosystem and recognize its self-stabilization, self-organization and self-prosperity as its baseline information, and once this purpose statement is established, we can deductively deduce the most important "natural norms" and "natural laws" from the facts of the current ecological crisis and ecological conservation facing the Earth's ecosystem, which is what Leopoldt called "a thing is right when it tends to preserve the integrity, stability and beauty of the biological community, and it is wrong when they are the opposite "[1]

(2) r-signal or purposive statements can be stated in the form of normative statements. For, we can question the answer to (1): for a purposive statement, if it speaks of a human purpose, it is an intention, a will and a want, a conscious goal, and thus to be expressed in an imperative statement, i. e., an intention statement, a prayer statement or an imperative statement, which is a normative statement that is "shall" statements. For example, to maintain the survival, health and prosperity of a social group should be expressed as our intention to maintain the health and development of future generations, which is a normative statement or ought statement, so we are not simply deducing from a purely factual statement a moral law prohibiting intermarriage by blood, but only tracing it to a higher normative statement or normative axiom. Nevertheless, the factual statement that consanguineous intermarriage leads to the decline of the community is a very important reason for the moral injunction against consanguineous intermarriage, and the former explains the latter, although not deductively. Similarly, for the natural law of preserving the integrity, stability, and beauty of the Earth's ecosystem to logically become a moral law, it must be supplemented by the "shall" statement or purposive "should" statement that we need to treat the self-stability of the Earth's ecosystem as our demand for a baseline signal. statement. Nevertheless, the "yes" statements of ecological goals and ecological crises also explain well (though not deductively) the principles of deep ecological ethics.

(3) r-signal or purposive statement is a compound statement that is not reducible to an "is" statement or an "ought" statement. A purposive concept is a

concept of both nature and value. It is a concept of nature because it states the factual content of the purpose itself, which can be expressed in factual statements, while it is a concept of value because it states the intention and requirements of a subject, which can be expressed in normative statements. According to perceptual cybernetics, it is determined hierarchically, and it can be studied objectively and subjectively at the same time. Therefore, Powers is not simply expressed by "thought to", but by "should be" to express purposefulness. Speaking of driving a car on the road, he said, "Now how do you simulate the car being asked to be where the road is? The first control system engineers were puzzled by this dilemma for two years before they saw the obvious answer and had to use a second signal to represent the reference conditions... Now the baseline signal represents what we require the road to feel like when we see it on the windshield, and the perceptual signal represents what it actually looks like."[1] The "require to be" of the expression r signal or purposive statement differs from the "ought to be" in that it is dualistic as well as both descriptive, evaluative and normative, it can be studied both objectively and subjectively, it is difficult to separate the two aspects, with its normative aspect partially determining how its descriptive aspect should be applied to different situations, and conversely, its descriptive aspect limiting the scope of application of the purposive aspect. There are many such concepts in ethics, such as aggression, cruelty, slaughter, mercy, courage, cowardice, and justice, which contain both objective facts and subjective attitudes (with the meaning of approval or disapproval), and serve to link "is" and "ought", as does the concept of purpose. Our purpose is to maintain the integrity, stability and beauty of the earth's ecosystem, expressing both the fact that the ecosystem is an objective trend or objective law, and the fact that we use it as a benchmark for our behavior, as well as our attitude, a demand and an evaluation. Because of this, the purpose statement serves as a bridge between the "is" statement and the "ought" statement. A purpose statement, logically, can be expressed as an ensemble of statements and ought statements. Our (we) purpose (x) is to maintain the integrity of the Earth's ecosystem (y). If I () is used to denote intentionality, or what is wanted (intened), the statement can be expressed formally as:

I (W, x), i.e., I intend x, attempt to reach x, is a statement of intent, broadly speaking, or a normative statement or "ought" of the statement. The fact that $y \subset x$, that x is a component of our purpose system y, and that x has what properties and characteristics p(x), is a statement of fact or a "yes" statement. This is how purposive statements link "is" statements to "ought" statements. The linkage here is a grammatical or logical conjunction. However, as mentioned earlier, there are still semantic and pragmatic aspects to this linkage. The concept of the Nanking Massacre, whose factual element is that the Japanese killed 300, 000 of our compatriots, is a factual statement that constrains us from expressing an angry opposition to such an attitude, which is the evaluative or normative aspect of the concept of the Nanking Massacre. Without this normative, evaluative or "undeserved" statement, we cannot use the concept of "Holocaust", and conversely, if the Japanese did not kill in Nanking is accepted as a factual judgment in their revised "history textbooks", the concept of Holocaust disappears on its own. So purposive statements and other so-called "thick" (thick) concepts that unite "is" and "should" express the logical connection between the two elements of is and should. They also express the semantic and pragmatic connection between them, i. e., they express some kind of empirical connection; also, more generally, they express the cybernetic relationship between "is" and "ought". Therefore, the purposive formula of perceptual cybernetics, with its value-based interpretation, becomes a bridge between "is" and "ought" in these three aspects. It can also be said that this purposive bridge has three layers: the control layer, the logical layer, and the empirical layer.

5. Cognitive hierarchy of control theory

Powys has been using the term "perception" in the general sense that all experience (from primitive sensory input to the most abstract manifestation of thought, from amoebic sensibility to human systematic thinking) can be represented by the term perception, which is in fact what we usually use as cognition. It has eleven specific levels, namely intensity, sensation, configuration, transformation, event, relationship, category, sequence, procedure, principle, and system concept, each of which forms a control system as shown in Figure 1, whose baseline conditions or baseline information are determined by the control system of the previous level as the system output. The higher level uses the lower-level hierarchical system and uses the lower-level hierarchical system as a means of control to achieve the purpose that the highest-level hierarchy is trying to achieve, which is the cognitive control process that makes up the ten levels.

(1) Intensity perception

First, it is necessary to define a first-order control system. On the input side, for the external world to exert a flow of information in the nervous system, it must act by stimulating sensory nerve endings, so that the sensory endings convert some physical interaction The sensory endings convert some amount of physical interaction into a neural stream. All sensory information received and processed by the brain is present in the form of primitive neural streams in the first-order perceptual signals, and on the output side, the central system alters the body's muscle state or body fluid state by adjusting the baseline signals of the first-order control system, and in this way influences the external world as well as our intensity of perception. The first-order perceptual signal is generated by the sensory nerve endings, and as a neural signal, its variation is quantitative and one-dimensional, i. e., it only shows how many stimuli are present, not what kinds of stimuli are present, thus the first-order perceptual signal shows the intensity of stimuli at the sensory endings, and the first layer of perception is simply a myriad of signals and collections that show pure quantity. It is a neuroanatomical fact that we have the sensation of warmth, and in fact it is the result of a stream of signals of different intensities received by receivers in countless parts of our skin. Powys' decomposition of sensation into a collection of intensity perceptions makes sense. From the definition and nature of first-order perceptual signals, first-order perception does not necessarily correspond empirically to a physical state. For example, electric current, touch, and chemical intoxication all cause the same tactile sensation, but from the perspective of first-order perception, these different causes cannot be distinguished, nor can we distinguish whether the tactile sensation comes from the left or the right, it simply reflects what is happening at the sensory endings and how much stimulation is received in physical units.

(2) Sensation

This layer of perception is generated on the basis of the first layer of perception, which is a function of intensity perception. It is the result of the joint influence of many first-order neural streams, which are associated with some average intensity, each intensity becoming its one-dimensional vector. Therefore, the relationship between the second-order input function and the first-order input function is a many-to-one correspondence. From the point of view of vector relations, if first-order intensity signals are used as basic vectors, then their weighted sums form a new vector, e.g., taste as a function of four intensity signal variables and color as a function of three signal variables, so the signals at this level can be called "senses.

Does this level of signal correspond to a separate entity in the external world? Powys says that "whether this signal corresponds to any single entity in the external world is a secondary question; it can have a correspondence or no correspondence at all "[1] It is undeniable that sensory signals depend on physical events: the taste of a fresh lemon contains an easily recognizable vector derived from the intensity signal produced by the sugar and the acid, but apparently there is no physical entity corresponding to it. In the lemon entity, the sugar and acid concentrations do not mix or merge together, an issue that will be discussed later in the discussion of constructivism.

(3) Configuration

Walking into the room and looking at my table from different angles, it presented us with different images that were extremely different, side view, front view, close view, far view, our image perception changed dramatically. But we can obviously tell that it is the same table. This means that there is isomorphism between different sensations, which is what we usually call "target", "subject", "object", and it is the isomorphic form of sensory change. If you could live on the sun, where change is so elusive that there is no different form or continuity in change, you might not have the concept of subject or object at all. Conformational perception is therefore an invariant function of a set of sensory vectors, i. e., certain stable conformational relationships obtained after the information processing and refinement of second-order perceptual signals entering the higher levels in the perceptual computing center. From this point of view, when we look around us, we not only have some sensations about our surroundings, but we can also notice the invariant forms implied in many sensory variations, and thus, visual, tactile, and auditory configurations can provide us with the concept of so-called objects. Of course, an organism with only a third-order control system can only select conformational states by an intrinsic process provided by genetics, and for the system itself to be able to control these conformations, and for the system to have a higher form of cognition, the organism needs a higher level of organization and control.

(4) Transitions

Transformation here is the perception of a solid configuration and its associated sensations and intensities changing from one state to another. This is what we usually call movement and change in various ways, and for our brain, the movement and change of a configuration can be perceived if it is similar enough in its movement, and if the movement is not too slow (like the hour and minute hands in a clock) or too fast (if the second hand rotates one week in 1/10th of a second). Not only is the observation of external motion a form of translational perception, but the perception of the rising water temperature in the bathtub and the perception of one's own body movement are both forms of translational perception. Transformation perception is absolutely necessary for more advanced animals, organisms that perceive and react not only to the static environment, but also to the dynamic environment and to their own conformational changes, to perceive, react and control. The flexibility of the body configuration of basketball players and dancers is a living example of the perception and control of transformation. Experimental neuropsychology demonstrates that the perception and control of the transition is realized in the area between the thalamus and the inner cortex of the brain, where the receptors and controllers of this cognitive level exist, and that the stimulation of this part of the brain with a certain electric current in some clinical patients causes the patient to have a visual image of a doctor coming rapidly, although in fact there is no such thing. When a charged test pin is inserted into this part of the cat's head and the frequency of the electrical pulse is slowly changed, the cat's head will smoothly turn from one side to the other.

(5) Event

An event is a series of transitions, configurations, sensations or intensity perceptions that has its beginning, middle process and end, which is perceived and controlled as a unified whole experiencing a certain time, so called the perception of an event, such as the bounce of a ball falling, the explosion of a bomb, the collapse of two World Trade Center buildings, opening a door, singing a song, eating a dinner, etc. In short, the perception of an event is composed of a sequence of transitions, which is recognized as an inseparable whole. To control and change the event, we must change the sequence or combination of transitions, and the event is the basic unit of this sequence.

Brain stimulation experiments also demonstrated that this level of cognitive control, perception and control of events and sequences, takes place in the inner layers of the cerebral cortex, and Bickford et al. conducted an experiment in a woman directly below the anterior vertebral cortex, where she was given a current of 1 to 8 pulses per second, and she involuntarily performed and repeated an action sequence. For example, she rubbed one foot against the other, or flicked her fingers at something she held in her hand and rotated it. This is the perception and control of events.[1]

(6) Relationships

We move up from the level of perception and control of events. We enter a new level where we go beyond the scope of the intuitive "external physical world" and enter mainly the realm of our "subjective conceptual relevance". This is the relational level. In this regard, we first come in contact with a relationship of space, back and forth, left and right, up and down, near and far, inside and outside, in time with sequence, beginning middle and end, in quantity with greater than, less than, higher than, shorter than, in nature with beautiful than, evil than, ugly than, etc. All these are a kind of relationship between event perceptions, between configuration perceptions and other lower-level perceptions that we talked about earlier, and when individuals walk side by side, we say that there is a proximity relationship between them. Can we see, touch or smell this "proximity"? When I say, "I am much more beautiful than you," can this relationship of "beauty" be intuited? We have entered the realm of perception one by one. Here we should pay special attention to the cause-and-effect relationship between events, we first have the perception of the first event, then the perception of the second event, and many times repeated we get the concept of the cause leading to the effect. What we have to grasp is the level of cognition and control of the relationship, mainly that it exists in our mind's perception, not in the physical world, which is again a constructivist cognitive view of Powys. From this level, which Powys still calls the "perception" level, we believe that the subsequent levels from this one has already crossed over to the narrower "perception" level, and that we are entering a new level of cognition. This may seem to be a matter of terminology. In fact, this terminology has influenced the academic community to look at perceptual cybernetics from a cognitive point of view.

(7) Category

A category denotes a class, type, range of kinds, naming, etc. of something or event. As defined by Powys: "A category is any perception that arises when a collection of lower-order perceptions appears".[2] It summarizes the common features among the elements of that collection of things with a naming. Its practical advantage is that it helps us to identify things that have certain characteristics. The use of the category or type "bring me a pair of scissors" helps us to find the right thing for you. If the scissors you are given do not fit, you will add some features. Clarify or modify the scope of your set, clarify or modify your "class". In this way there is a system of perception and control of particular lower-order perceptions and lower-order actions in the mind, or in cognition. There is another role for categories: the inclusion, intersection, concurrence, and equivalence of categories in a set make up the logic of reasoning. At lower levels than the category level, all perceptions or cognitions are continuous and variable, but at the category level, there is a delimited nature, i.e., an "either yes or no" nature. At the level of type, we can combine the type of a cat with the type of a dog, and we can form the type of a sphinx, but at the level of category, we are unambiguous, it is "dog", it is "cat", it is "lion" and not "man". Because we are talking about categories, not individual concrete things or configurations, and when we want to refer to concrete things by categories, we have to add many features with great difficulty, and in fact a concrete image cannot be adequately expressed by words, by symbols. I ask you to put into words what our face looks like, and you always say it incompletely.

(8) Sequence

Sequences are the temporal order of some lower level of perception or cognition (e.g., configurations, events, categories, etc.) The role of this sequence control level and perception level is to give us the ability to control sequences. The difference between whether a disease is treated with an incision followed by anesthesia, or anesthesia followed by an incision, or an injection followed by sterilization, or sterilization followed by an injection is very significant; human perception and action are temporal in sequence. The order of actions, categories, and symbols cannot be reversed when reading a sentence, knitting a sweater, or making a phone call. The human mind has a baseline signal to orchestrate this sequence, an effector to execute this sequence, a receptor to perceive this sequence, and a comparator to correct the wrong sequence, so that we can live in a neat and organized world.

(9) Program

A program is a structure consisting of a sequence of trials and choice-points, also called decision points, linked together. It may be in the form of a tree, but in most cases, it is a network. When a sequence comes to a choice or decision point, the program requires a choice. When you graduate from college, if you want to go to graduate school, you have to "do this" such as studying for your homework, preparing English, etc. If you choose to get a job, you have to "do that". If you choose to get a job, you have to "do that", such as applying for a job, finding connections, etc. When a sequence passes a certain test point, if you are tested for hepatitis B, you have to perform a specific medical sequence, and if you are tested for cystitis, you have to perform another medical sequence.

To control a program cognitively is to change lower-level perception or cognition to keep the program going correctly, Powis said. "Long division is a good example of what we have to learn. On a certain sequence, the instructions don't tell us what number to write down, it all depends on what number we've come up with. There's a rule that tells us what you're going to do if a number is greater than the number that can be divided, and what you're going to do if it's less than the number that can be divided, but you don't know how to do that until the program runs to that We can all accept the structure of a long division program, but it does not specify a specific sequence of actions. There at the procedural level we have to think rationally, to figure out what to do to achieve our purpose."[1] So a program is likewise a separate cognitive level where we have receptors with basic information and comparative decision makers and executive effectors.

(10) Principle

An action or rational procedure has to be created, replaced, evaluated, to decide what procedures to have and what not to have goes beyond the level of the procedure itself to a new level of cognition that can guide and control the procedure, which is the principal level. In the program, we use thinking to think about our action steps, and in the principle, we think about what we think about. In mathematics our program is to organize our computational steps to solve problems and arrange our symbolic algorithms, and in the principal level we think about whether our steps and algorithms are possible and appropriate, and the principle is a metasystem for the program.

The principle is a fundamental strategy and tactic for the purpose of our actions. There are various procedures for a trip, and one basic principle is to ensure sleep. There are various construction procedures for a project, and one of the most important principles or principles is safety first. There are many ways to fight guerrilla warfare, and different guerrilla warfare has different procedures, but these procedures are governed by one principle, which is what Mao Zedong said, "The enemy advances, I retreat, the enemy stations, I disturb, the enemy is tired, I fight, the enemy retreats, I chase.

In science, Newton's laws, conservation of energy, marginal utility, ecological conservation, etc., for the development, evaluation, replacement, and implementation of the relevant procedures are principles that once they are mastered by the actor become the hierarchy of principles in his mind.

In terms of ethics, we have a series of principles such as utilitarianism, benevolence, justice, environmental protection and more specific ones such as honesty, do no harm, cooperation, etc., all of which play a high level of control on the procedural level.

All these practical, scientific and ethical principles are more general and abstract, but it is indisputable that they exert control over the lower levels of cognition and action, although this control is quite flexible because it is inherently principled.

（11） System Concept

The combination of the various principles forms a coherent category of cognition, which is the last level of cognition, which Powys calls the system concept. Powys says that "the system concept is the supreme idea of some organized entity; the principal level below this level is what it is because of this system concept. The physical sciences are a huge set of system concepts that are based on a well-crafted and coherent physics. Other system concepts, such as 'self', are also built from a collection of principles, though of course not as well as the principles of physics work. Certain system concepts, such as religion, are important and sublime, while others are completely mundane and secular, such as things like bowling clubs."[1] It is clear that the level of system concepts belongs to conceptual systems, scientific norms, and general concepts like ideology. But instead of looking at it from the socio-cultural point of view, which sees socio-culture as the control of the individual mind, Powys sees the system of concepts received by the individual as one of the highest levels of the individual psychological system, which exists not in the socio-cultural system in society, but in the mind of the individual as the supreme soul that determines the individual's humanity. It is clear that there is a difference in the systemic perception between a

Christian and an Islamist and a terrorist. We should acknowledge this subjective reality. Powys says, "The systemic conception that most directly governs our lives is, I believe, something that is completely real to us and something that we try to maintain. It leads to all kinds of trouble caused by conflicting principles and conflicting rules among people."

What is unique about Powys' cognitive hierarchy theory is that (1) all cognitive hierarchies have the same type of control structure horizontally, i. e., they all consist of an input function I (receptor), an output function O (effector), and a comparator C (controller or decision maker) linking the two, all interconnected through perceptual, baseline, and deviance information. The cognitions are functionally related to each other in the longitudinal direction, forming a chain of functions of multiple orders in a progressive manner. Refer to Figure 4. (2) The division of these cognitive levels has a solid neuroanatomical basis at the lower levels (the first five levels) and a very clear logical basis at the higher levels (the last six levels). And from an evolutionary epistemological point of view these eleven levels all develop from low to high and from simple to complex in the history of biological evolution, psychological evolution, and social evolution.

6. The explanatory structure of technical behavior

Using the hierarchical control theory of cognition, we analyze an important issue in the philosophy of technology, which is the problem of explaining people's technical behavior. Putting aside the differences between the various schools of philosophy of technology concerning the various definitions of technology, we can broadly see technology as an intelligent system for achieving certain practical goals, and technical behavior as an intelligent act of designing, manufacturing, adjusting and monitoring various artificial things and artificial processes in order to meet certain realistic needs of people. The most fundamental difference between technical explanation and scientific explanation lies in the fact that scientific explanation is intended to explain a natural phenomenon, while technical explanation is aimed at explaining a human behavior. Natural phenomena can have no purpose, and the explanation of a natural phenomenon is primarily to state the reason for its creation and existence, as W. C. Salmon said that scientific explanations must introduce causes, saying, "that the time has come to put 'cause' back into 'cause. ' back into 'cause'".[1] But the explanation of technical behavior cannot merely state the cause, but mainly the ends and means that produce a behavior.

According to the control system schema we talked about in Section 2 (Figure 1) and the value theory interpretation of control systems discussed in Section 3 (Figure 2), the technical problem arises from the contradiction between certain real needs of people (which is their purpose r) and the failure of the current environment to satisfy these needs (which is perceived through P), i. e., the deviation or contradiction $e = K_c(r - P)$. To resolve this contradiction in order to achieve the purpose, i.e., to eliminate the contradiction, so that $e = K_c (r - P) \approx 0$. This leads to some way of technical behavior a. According to cybernetics, how effective a is must feed back into K_c, i. e., get cognitive P′, which leads to continuous improvement of behavior a.

Note in particular the formula in Section 2 $\alpha = k_o (e) = k_0 k_c (r\text{-}P)$. This functional equation illustrates that to explain the technical behavior a , there are two main items, the first of which is the goal to be achieved by the technical behavior. It is denoted by r, or r - P = 0. For example, the actors want to build an atomic bomb or the actors want to prevent the SARS epidemic, etc. Here r - P = 0 means that the goal is achieved. The second term is the function symbol or operator k_o, k_c. k_c denotes a choice and decision of the comparator, decision maker or controller on the means of behavior. K_o denotes an execution of a decision. Actors are convinced that choosing a certain rule of behavior ($k_0 k_c$ (r - P)) will achieve an end based on some causal relationship or causal chain (causality) and a goal-means relationship or goal-means chain (regularity). For example, actors believe that taking steps such as mining uranium, opening fuel plants, and refining U235 will create an atomic bomb, and doctors believe that taking steps such as infrared inspection and full containment of patients will prevent the spread of the SARS virus. With these two basic explanatory factors, the behavior of the Americans who made the first atomic bomb in opening the mysterious factory in Tennessee where only raw materials came in but no products came out is explained, as is the behavior of the SARS hospital doctors dressed like the astronauts there. Thus, we lead from the cybernetic formulation to the famous will/belief explanatory model proposed by the logician V. Wright (1971) as well as by the philosopher J. L. March (1974)[1]:

The logic of this explanation is not evolutionary nor fully inductive, but rather the logic of decision making with free will. A discussion of this issue is beyond the scope of this paper. What we want to highlight here is that: (1) the explanation of technical behavior and the will/belief explanation logic can be derived from the cybernetic formulation. (2) Item (2) of the above explanatory model, i.e., the belief term, actually unfolds as a goal-means chain of the form if there is condition K_1, then there is condition K_2, if there is condition K_2 then there is condition K_i, and if there is a condition K_i then there is an end G. For example, K1→K2……→Ki……→G, or <K1,K2……Ki,……G>. This is the cognitive level (9) sequence and the cognitive level (10) procedure described in the previous section, which is expressed in the technical explanation as a set of technical rules of behaviour. It shows that we are confident that if we follow the technical rules, we will be able to achieve our purpose. (3) This explanation of technical behaviour using purposive will and rule-based beliefs is not only static but also dynamic, i. e., it also explains how people change their technical behaviour or technical behaviour rules when a behaviour or action does not achieve or fully achieve its purpose. For example, according to TCM theory, acupuncture at the "foot three li" point can be used to treat migraine headaches. However, in a particular case, the acupuncture point "foot three li" fails to achieve the expected effect, it is possible to change the acupuncture point, or add some other points, research a new acupuncture treatment plan, set a new technical rule, acupuncture medicine in Chinese medicine is this way in the dark groping and thus constantly improve. The second level of technical explanation, we still see the change or improvement of technical behaviour without changing the purpose of technical behaviour and without changing the rules of technical behaviour. At this point, we consider that the technical

goal is not achieved or not fully achieved, and the problem is not that a technical goal is impossible to achieve or that the technical rules are wrong, but that the technical behaviour deviates from the requirements of the technical goal and the technical rules, i. e., the problem is K0 there. For example, the acupuncturist does not use the needle with the right skill, does not insert the point itself, or does not insert the needle long enough, etc. Improving the method and technique of using needles then becomes a modified, improved or renewed technical behaviour. This change in technical behaviour can be explained by the following cybernetic model:

According to the study of cognitive levels talked about in the previous section, above the level of behavioral rules, which consists of sequences and procedures, there is a cognitive level of principles that control the formulation, modification, and change of behavioral rules. This brings a second level of technical explanation, namely, the use of scientific and technical principles to explain technical rules and their changes. We have already pointed out in the previous section that the rules of combat in guerrilla warfare are formulated on the basis of guerrilla warfare principles and are explained from the latter. We could add many more examples, such as the fact that the rules for SARS disease control were developed on the basis of the principle of SARS virus transmission or, more generally, on the principle of Pasteurian germ theory, and were explained from the latter.

In the philosophy of technology, G. Wright (1994), M. Bunge (1998) and K. Kornwachs (1998) have proposed explanatory models of technical rules. Roughly, they can be synthesized as follows:

Using also the technology of the atomic bomb as an example solution of equation (2):

(1) Scientific principle: according to nuclear physics, when U235 material reaches its critical mass (12 pounds), it will undergo chain fission.

(2) Behavioral objective: Actors A intend to create an artificial nuclear fission bomb.

(3) Means: Actor A is to produce 12 pounds of U235 nuclear fuel by refining uranium.

(4) Behavior rule: In order to build an atomic bomb, 12 pounds of U235 nuclear fuel must first be made.

Here again, it is shown that the corresponding scientific or technical principles that express the law of cause and effect are the basis of the technical rules.

If the technical rules discussed here refer to the technical rules by which people design, manufacture, commission, operate or monitor an artificial object, then it is obvious that the structure and function of the artificial object and its laws make up the technical principle. According to the philosopher of technology W. G. Vincenti, the technical principle is composed of two main parts: (1) the principle of operation. All artifacts have their operating principle, which explains "how the device works", for example, the operating principle of a winged aircraft is that "the upward force that must balance the gravity of the means of transport is generated by pushing a rigid surface against air resistance and moving forward". (2) Conventional type configuration. It is the general shape and layout of the device that best realizes the operating principle. For example, the rational layout of wings, fuselage, engine, and tail steering wheel in an aircraft. [1] (1) and (2) constitute the technical principles that distinguish scientific principles. For example, for the production and use of steam locomotives, there is a set of basic technical rules of behavior in accordance with the operating principles and specific configuration of steam engines, while for the production or piloting of certain types of civil airliners, there is another set of technical rules that need to be implemented by the relevant personnel in accordance with the realization of the structural operating principles of civil airliners in specific configurations. Calling engineers who design and manufacture steam engines to build airplanes, or train drivers to fly civil aircraft, that is the wind and the ox are not the same, is completely unworkable. Because each other's technical principles are not the same, and therefore each other's technical rules and technical behavior are not the same.

According to Powys' analysis, there is a highest level of cognition that regulates the level of principles, and this is the systemic perspective. When applying scientific and technical principles to technical behavior, there must be political, economic, cultural, and ecological perspectives, which is a systemic view. To produce atomic bombs or not to produce atomic bombs, to make jet airliners or not to make jet airliners is not only a technical problem, but also a problem of systemic perception. Thus, applying the hierarchy of cognition to technical explanation, technical explanation has the following levels, which can be represented in a sketch as follows:

From the above analysis of the explanatory structure of technical behavior, it can be seen that it is corroborated with Powys' cognitive hierarchy cybernetics. The analysis of the explanatory structure of technological behavior can be seen as an application of cognitive hierarchy cybernetics in philosophy.

7. Epistemological constructivism and modeling approaches

Epistemological constructivist and modeling approaches According to perceptual cybernetics, the brain is hierarchically organized as a negative feedback control system, and what Powers calls the perceptual process is actually the entire cognitive process, Powers says: "When we refer to perception, I generally mean the complete set of events that follow stimuli occurring in parts of the brain, that is, from the sensory receivers to the all the way from the sensory receivers to the highest centers of the cerebral cortex" (Powers, 1987, p. 35) This means that all our perceptions can only begin with the reception of external stimuli, while the entire rest of the cognitive process occurs at one level only inside the brain, and all the information we know about the external world is mostly generated inside the brain, through various All the information we know about the external world is mostly generated inside the brain, transformed according to its own nature and requirements through various input functions. How then is knowledge about the external world obtained, and what is the nature of this knowledge? In what sense can it be said to be objective? Perceptual cybernetics offers a new answer to this question. This new answer is called epistemological constructivism. The so-called constructivism, as explained by its modern founder Glasersfeld, has two basic ideas. □ Knowledge is not a negative reflection of the external world, but an active construction of the knowing subject. □ The function of cognition is not to discover the ontological reality of objective objects, but to serve the subject's organization of the empirical world in order to achieve the subject's practical purposes.[1]

The brain is composed of eleven types of model levels such as intensity, sensation, configuration, transformation, event, relationship, category, sequence, procedure, principle, system concept, etc. Each level of the model is actually a control system, and each model control system is composed of input function (sensor), comparison function (comparator), output function (effector), reference signal, controlled quantity, interference quantity, which are the same components. In this way, things in the external world are processed in the form of perceptual signals through layer after layer of a specific hierarchical model to form different levels of understanding of the same thing.

The question now is whether the knowledge we construct about things, objects, objects, changes and their laws, other than the first-order perceptual information we receive directly, is necessarily a reflection of something objective and necessarily physically meaningful? No, because after the external stimulus passes through the input function, i.e., the sensor, it has to be rearranged and recalculated by the sensor according to its own nature, and it may result in a perception without any physical meaning, without any external thing corresponding to it. "This reasoning leads us to the particular notion of perception. The brain may be filled with many perceptual signals that are completely arbitrary in relation to the external reality on which it depends. At least we cannot assert that any given perception has a meaning outside the mind, or perhaps no meaning at all, not even of first-order perception; we can conjecture that there is an objective world a few millimeters away from the nervous system, but our perceptions are not this world; they depend on it, but the form of dependence is determined by the brain, through the neural computer, which layer by layer, through one set of neural streams converts to another set of neural streams and creates the perceptual signal". [1] Thus, cognition is not a negative reflection but an active construction, and as for higher levels of awareness, its constructive character becomes more evident.

Powys' constructivist epistemology conforms to Kant's proposition of innate synthesis to a considerable extent. The "objective world a few millimeters away" is Kant's object-self, and we do not have direct access to the external object-self; we gain knowledge by organizing our experiences from the outside world through a priori categories. The model of Powys' neural system of cognition is Kant's "categories". So, is there any objectivity in our perceptions? According to our understanding and interpretation of perceptual cybernetics, our knowledge at all levels still has the aspect of objectivity because:

1) Our awareness and knowledge, although actively constructed by us, its ultimate source, the perceptual intensity signal, comes directly from the external world, and perceptual cybernetics does not deny that there is an external world, and that the stimulation of the untouched parts of our nervous system by this external world is one of the sources of our awareness and perceptual signals at all levels.

2) The perceptual structures at all levels of intensity, sensation, configuration, transformation, sequence, and relationship up to the system concept are inherent to the human cognitive structure itself and are a priori structures for each individual's perception, but these structures are the result of the whole biological evolutionary process adapted to the external environment, and it condenses the experience of the entire biological development history of this species, and from this point of view it is a posteriori again, in the sense that

it can effectively correspond to the It is also objective in terms of its ability to effectively correspond to the environment. Therefore, this a priori cognitive structure of humans themselves determines the object we construct to be objective.

3) The result of knowing at each level of perception, although it is a model of many subjective constructs, is subject to the control of human practice, and any of those constructs that do not meet the needs of human practice and are not suitable for our survival and development will be eliminated. Although we do not know whether our model is consistent with the objective world, it is objective in the sense that it can solve problems.

So, what we understand by perceptual cybernetics is again different from Kantianism in that we believe that the object-self is itself somehow knowable. The knowledge that we actively construct is somehow objective. We differ from extreme constructivism We differ from extreme constructivism in that we recognize that there is an objective world.

According to Powys, there are three stages of scientific understanding, namely, extrapolation, abstraction, and modeling. Modeling is the advanced stage of scientific understanding, "until after physical models become central, when the theoretical power of physics is finally developed. "[2] Typical examples are models of molecular kinematics to account for thermal phenomena of temperature, pressure, and volume, as well as empirical laws such as Boyle's Law, and Gay-Lussac's law. Powys considered his theory of perceptual control to be equivalent in psychology to the work done by molecular kinematics in thermodynamics.

Secondly, in building a model, Powys believes that the key to the problem is to actually find the real subsystem of a system, or the real internal organization or "real entity" of a system. If this "real subsystem" and internal structure is not found, the model built can only be a "symptomatic" model or a "superficial" model. In the journey of behavioral science to find a model of the brain, Freud's psychoanalytic model is only a symptomatic model. Because the three factors he looked for, id, ego and superego, were only a division of signs, not the fundamental nature of the brain's work, equivalent to the "thermal" phase in the development of the thermodynamic model, another model of the brain's work was Another model of brain work is Mucdoch's model of neural network logical operations, or thought simulation programs, which "attempt to replicate the human mind by describing what the brain does, rather than the functional concepts in the brain that make it capable of doing these things" and "those elements are not subsystems of the system that is acting. those components are not subsystems of the acting system, but rather a small part of its externally observable behavior."

The working model of the brain that Powys was determined to develop was a "persuasive model of the intrinsic causes of behavior. The model of the perceptual hierarchy that he developed over the course of twenty-five years has many components that have a neuroanatomical basis. For example, the input functions, or sensors, of each layer of control have a certain anatomical location in the brain. Strength sensors are located at the nerve endings of the muscles and nerves of the cord, sensors for sensation are located in the vertebral nuclei, sensors for conformational control are located in the cerebellum, thalamus, and midbrain regions, sensors for translational control are located between the thalamus, cerebral cortex, sensors for serial control are located within the cerebral cortex, etc. Because Powys has the basis for his brain experiments, it gives one reason to believe the following passage in which he states that "This book presents a model of the internal organization of the brain which, as far as I can tell, is a model of the same type as the molecular theory of matter, in which the entity hypothesized to inhabit the brain has its own unique properties, just as a molecule has its own unique mass and speed. The observed behavior is not deduced from past instances of behavior, but from the interaction of internal entities with each other and with the external world, which, of course, are carefully chosen so that they are suitable for action when put together, but chosen so that they conform to anatomical clues about the nervous system, to the physical model of the organism and its environment, and to basic mathematical logic. models, and basic mathematical logic. "

Powys' analysis and practice of the three major steps of scientific understanding and the three stages of the scientific model are of great significance to the philosophy of science has significant inspirational implications.