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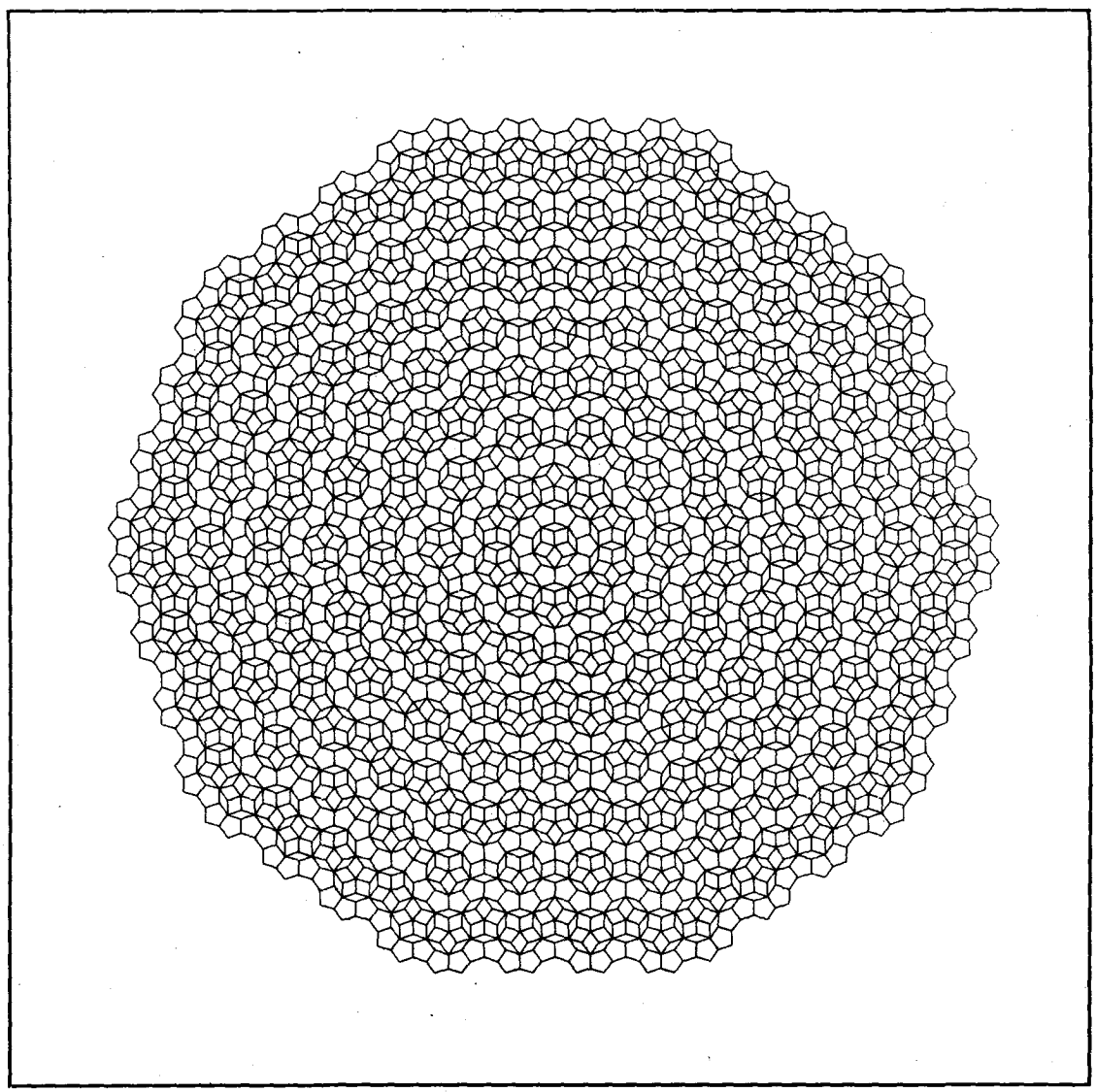

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THE DIFFERENCE OF STATUS BETWEEN INTERNAL AND EXTERNAL MEASUREMENT

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Abstract: *Questions resulting from biologically motivated computing and/or the investigation of emergent properties can lead to the problem that any biological process must be indefinite and/or paradoxical. However, this type of problem is derived not from the nature of living things but from describing the measurement process consistently. Also, the measurement process can be proved neither obeying a definite rule nor something ignored completely. We distinguish internal measurement from external measurement. From the perspective of internal measurement one can constitute a metaphoric model by which one can understand ontological process in which both generation and degeneracy of inconsistency are comprehended. This can lead to the understanding of emergent property or origin. Information generation can be sketched in the form of the degeneracy of symmetry from asymmetrical processes.*

1. INTRODUCTION

Talking about internal choice is highly relevant for talking about how to understand emergent properties. The concept of an emergent property sounds erroneous in its own right. Emergence is not just a change. It implies that a change appears while this change is impossible in its own right (Küppers, 1992). Therefore, whenever one talks about an emergent property, he accepts invariance with respect to a state on the one hand, and finds out the change of the state on the other hand (Gunji et al, 1996).

One is faced with the problem of emergent properties, especially when one attempts to understand biological neural networks in terms of emergent computation (Conrad, 1993). This is called biologically motivated computing (Paton, 1992). Also, when one talks about biological neural networks, one is faced with the interaction between inter- and intra-cellular computation called the vertical scheme (Conrad, 1984; Marijuan & Westley, 1992; Conrad, 1993). This process aspect sounds erroneous in its own right, because the mixture between function and state is comprehended in this aspect and it cannot be consistently described (Matsuno, 1989; Gunji, 1992; 1994; 1995). However, researchers often investigate this aspect from the perspective that the relationship between state and function can be proved either to be a definite rule or to be independently separated. That is why the question arises whether functionality of spatial aspect can be proved either channelized or dependent on diffusional metabolic

transfer (Ovadi, 1991).

It seems that this kind of problem relating to paradox results from the complexity and/or hierarchical aspect of living systems. However, it generally results from the attempt to consistently formalize measurement process. If the object of a theory is to determine a consistent relationship among states and/or structures, we call the theory the perspective of external measurement. In contrast, we call the perspective from which a measurement process is found to be inconsistent on the one hand and accompanied with degeneracy from inconsistent aspect, on the other, that of internal measurement. Because one is faced with an ontological measurement process, one has to talk about not only inconsistency but also the idea of choice.

This aspect is generally sketched as the process in which a paradox resulting from the mixture between individual experience and a rule by which one can refer to a general condition, is being proved (Gunji et al., 1995; Gunji & Toyoda, 1995), under the idea of philosophical investigation by Wittgenstein and Kripke (1982). Matsuno (1995) expresses this aspect as the chasm between experience and description.

In this paper, first we investigate the general structure of a paradox by illustrating measurement problems such as Schrödinger's cat. We argue that this type of paradox cannot be solved from the perspective of external measurement. Second, we show that the process of proving a paradox and ignoring it is an internal measurement, while the consequence of proving a paradox is a model from the perspective of an external measurement. We make manifest the status of internal measurement, by illustrating the well-known prisoner's dilemma. As a result, we can sketch the process in which an emergent structure appears. In other words, the origin of state and/or structure, or the idea of an emergent property can be abstractly formalized from the perspective of internal measurement. Of course, the significance of the model is destined to be metaphorical.

2. THE MEASUREMENT PROBLEM IN THE BASIS OF EXTERNAL MEASUREMENT

We here sketch that the measurement problem such as Schrödinger's cat results not uniquely from quantum mechanics but generally from naive realism. Gunji et al. (1996) defines naive realism by the axiom; for any identified state X there uniquely exists a measurement instrument f_X following the state X iff naive realism holds. Naive realism defined by this form is the same as the theory of descriptions proposed by Russell (1903). It implies that for any indicator X there uniquely exists an important collection of X's meaning. This meaning can be replaced by a measurement instrument f_X, and it can lead to the unique choice of a referent as well as f_X leading to the unique choice of a real entity. This theory and naive realism can lead to the justification of objective truth. In this context observation and/or measurement is said to be external. It is assumed that an object and an observer are independently separated from each other.

In assuming naive realism, let us consider Schrödinger's cat. We can replace the problem without the radioactive substance. One can doubt the foundation of a rule by which an observer can determine that a cat is dead or alive after opening a window. Of course, an observer believes that he follows a specific rule, while this specific rule can be expressed in the form of finite individual experiences. He can concretely determine

whether an individual cat dead or alive, and he can believe that he can do so for any cat. However, the status of the term "any" belongs not to his concrete experiences and actions but to theory in its own right. Therefore, all that an observer can do for the determination of any cat is to believe that he can determine any cat. A rule is always opened for any state, and belongs to theory. However, whenever an observer confesses a rule by which he can determine the state of a cat, a rule is destined to be expressed in the form of experiences and/or actions. The different status of theory and experiences can be mixed. As a result, a specific rule by which an observer determines the state is founded on his experiences. It implies that his individual experiences of determination are explained by the rule.

Because a rule is justified only by an observer's individual experiences, it entails that there exist plural rules by which an observer determines the state of a cat. Imagine an unexperienced state of a cat and denote it by *UE*. Also define a rule *F* such that for *UE* one can determine that a cat is dead by this rule *F*, which is expressed *F*(*UE*)=dead, and define the other rule *G* such that *G*(*UE*)=alive. Assume that both *F* and *G* satisfy an observer's experiences of determination, which implies that for all experienced conditions *E*, *F*(E)=*G*(*E*). Therefore, the problem arises whether an observer cannot determine whether he follows *F* or *G* in determining the state of the cat. This argument is used by Kripke (1982) in finding indeterminacy of the meaning of "+" in calculus.

One can enhance the concept of meanings of the individual experience of determination. One can accept all possible rules satisfying an observer's experiences, both *F* and *G*. Therefore the important meaning of the individual experience of determination can be replaced with a set of {*F*, *G*}. In this case, one can maintain the statement of

((dead) AND (alive))=False; (1a)
((dead) OR (alive))=True, (1b)

because one can still determine whether the state of the cat is dead or alive. Although for the concept of "dead" one can determine the dual concept of "alive" as far as Eq-(1) holds, "alive" dependent on *F* has to be distinguished from "alive" dependent on *G*. Call the former state "alive1", and the latter "alive2". This means, for the concept of the state "dead", one has to accept both alive1 and alive 2 to satisfy Eq-(1).

Strictly speaking, the lattice in which Eq-(1) holds is called a complemented lattice, where one can constitute a logic derived from a lattice. Also, if for the concept of dead, the state of alive is uniquely determined, then the lattice must be distributive and complemented. Note that by the distributive and complemented lattice one can define a Boolean lattice, from which one can constitute a propositional classical logic. Therefore, a naive realist can say that an observer believing that he follows a specific rule by which one can determines the state of the cat to be either dead or alive follows a classical logic. Indeed, if an observer pays attention to indeterminacy between *F* and *G*, one is destined to accept both alive1 and alive2 for the concept of dead. It implies that one has to give up the distributive law, and that one follows just a complemented lattice. One can weaken the distributive law by introducing a modular or semi-modular law. One can adopt a complemented modular law in which an observer can accept both alive1 and alive2 while Eq-(1) still holds. A modular complemented lattice is a Von Neumann lattice from which one can constitute quantum logic (Birkhoff, 1967).

Finally, the perspective of naive realism is highly relevant for the problem of the indeterminacy of *F* and *G*. All one who still holds naive realism can do for this problem

is either to ignore this problem or constitute a new logic by taking the problem into consideration. The former stance can lead to a Boolean lattice or classical logic, and the latter can lead to a Von Neumann lattice or quantum logic. Remember original Schrödinger's cat. The problem results from the co-existence of classical and quantum logic. Also, we can constitute the two logics of Boolean and Von Neumann lattice by the difference of the attitude toward the indeterminacy between F and G. The next question is: can we justify the one logic better than the other ?

If one can justify the argument that the problem of this indeterminacy can be solved in principle by the Von Neumann lattice, one can argue that the Von Neumann lattice is better than the Boolean lattice. Is this argument necessarily true? We emphasize that the solution using a Von Neumann lattice is still ad hoc, because the Von Neumann lattice is still open to the problem of indeterminacy. If one introduces Von Neumann lattice, then one is destined to formalize and/or symbolize indeterminacy as a specific expression that is illustrated as $\{F, G\}$. It is clear that one can imagine unknown condition for the meaning of F and G. It leads to the same problem based on indeterminacy of the meaning of F and G. Still, it is possible to say that the one logic is better than the other, while there is no foundation to justify this argument. This estimation is possible in terms of pragmatism, while pragmatic good or bad cannot be justified by a specific theory (e.g., naive realism). It is determined in a community in which Boolean or Von Neumann lattice is used. Finally the problem resulting from the indeterminacy on a rule that an observer follows in determining the state of a cat is isomorphic to the original measurement problem of Schrödinger's cat that is expressed as the indeterminacy of a classical and a quantum logic. This problem can be arbitrarily improved by introducing the other logic, however, in this newly adopted logic the same problem appears again (Figure 1).

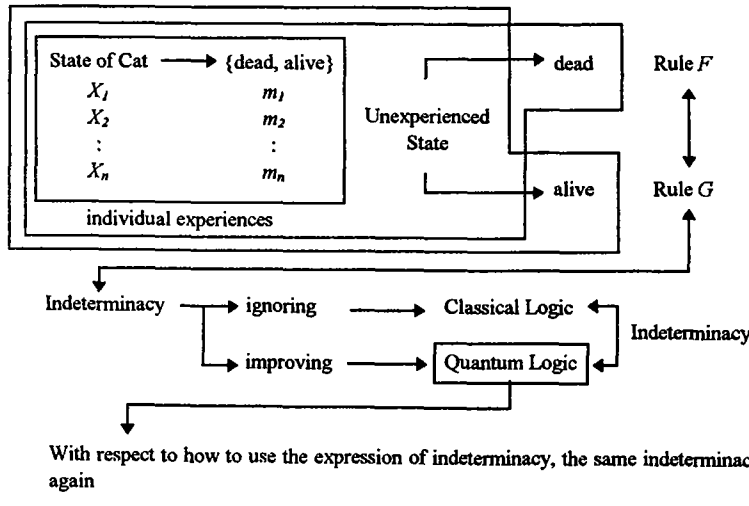

Figure 1: *Schematic diagram for the reconstruction of Von Neumann lattice (e.g., quantum logic) resulting from indeterminacy with respect to a rule by which one can determine a state of a cat from the perspective of naive realism. Also, the same indeterminacy arises in the problem of indeterminacy whether quantum or classical logic is better.*

We can call this problem a paradox. Whenever one speaks of a paradox, it sounds as if it had a status which had to be solved whether it could be solved or not. Clearly, if one still holds the perspective of naive realism, then a paradox has such a status. However, if one gives up the perspective of naive realism, then a paradox has no status to be solved. It is well-known that Wittgenstein and/or Kripke proposes the perspective of a language game against the theory of description. They argue that a language is possible not because there exists meaning of a word but because a word is performatively used in a community (Wittgenstein, 1953). In this sense, the meaning of a word is invented in a semantics that is invented a posteriori. One can say that from the perspective of a language game, the paradox of indeterminacy mentioned above is just a pseudo-problem. From the perspective of a language game, this problem is not a troublesome one. Similarly, measurement processes have nothing to do with a rule and/or a measurement instrument by which measurement is assumed to be made possible.

However, it is clear that talking about a paradox is very useful and performative to understand the perspective of a language game. Through a paradox, the perspective of a language game can be paradoxically comprehended. Now we call theory based on complete identification of the concept of state, state-oriented theory or the perspective of external measurement. The system of modern physics including quantum mechanics is still state-oriented physics. In this theory, the concept of state is a priori, and one cannot refer to the foundation of a state or measurement process following a state. However, researchers depending on state-oriented theory often refer to the origin of a state, which entails a measurement problem. Against state-oriented theory, if one takes measurement processes as the subject of theory, one can talk about measurement processes and/or the origin of state or order. In this theory, one has to accept a measurement process itself. Note that measurement is local and individual for an observer, while it must be performative because one can communicate with others on the consequence of measurement.

We call the theory whose subject is measurement measurement-oriented theory, or the perspective of internal measurement. It is clear that measurement-oriented theory is a measurement process sketched from the perspective of a language game. However, for this sketch it is necessary to paradoxically use state-oriented theory or the theory of description. Naive realists can talk about naive realism independent of a paradox. This process can be sketched in the following form: naive realists are faced with a paradox, then they modify the meaning of a word against the paradox, and this process is perpetually iterated. This just implies that a naive realism is a specific language game. In this sense, a paradox is a performative tool to comprehend a process. We mentioned that emergent properties are erroneous. We can say that the problem of emergence is also just a pseudo-problem. However all that we can do is not to point out the paradox. When one dynamically expresses the process leading a paradox as measurement process, we can constitute the model in which one can talk about emergent information generation. It is examined in the next section.

3. INTERNAL MEASUREMENT SKETCHED AS A PARADOXICAL PROCESS OF EXTERNAL MEASUREMENT

In order to illuminate the status of internal measurement, let us consider the well-known prisoner's puzzle. Two of three prisoners (indicated by A, B or C) will be put to death, while no prisoner knows who will be. Therefore, the probability that a prisoner A will be executed, $P(A)$, is 2/3. Although the jailer is prohibited from informing

prisoners who will be executed, prisoner A learns that B will be executed from the jailer by persuasion. Then, prisoner A considers the following: Because it is decided that B will be executed, one can remove the possibility that B will not be executed in calculating the possibility that A will be executed. Therefore, since one of C and A can be executed, $P(A)$ becomes 1/2. Finally, knowing that B will be executed makes $P(A)$ to be decreased from 2/3 to 1/2, and then prisoner A enjoys this result. A puzzle is whether prisoner A's joy is justified or not.

We can construct a second puzzle. Prisoner A first considers that one of B and C must be executed, because two of three will be executed. Then, he considers that the man who is either B or C must be executed, and one can call this man X. One can confirm that X will be executed, and remove the possibility of non-execution of X. When one calls Y the other in B and C, all that one has to consider in terms of $P(A)$ is that either A or Y must be executed. Also in this case $P(A)$ is decreased from 2/3 to 1/2. Finally just considering the argument mentioned above can make $P(A)$ be decreased. The second puzzle is whether knowing that B will be executed (called knowing-puzzle) can coincide with considering that one of B and C must be executed (called considering-puzzle), or not.

We put the puzzle in order. In ordinary sense $P(A)$ is expressed as

$$P(A)=P(A/B)P(B)+P(A/B^c)P(B^c), \tag{2}$$

where $P(N)$ is the probability that N is executed, and $P(N^c)$ is the probability that N is not executed. Therefore $P(N)+P(N^c)=1$. Also, $P(N/M)$ is the conditional probability that N is executed under the condition that M is executed. Before knowing and/or considering, $P(B)=2/3$ and $P(B^c)=1/3$. If B is executed then $P(A/B)=1/2$. If B is not executed then both C and A must be executed and $P(A/B^c)=1$. Therefore, one can obtain $P(A)=(1/2)(2/3)+(1)(1/3)=2/3$. What is changed by knowing or considering?

After A knows that B will be executed, prisoner A confirms that $P(B)=1$ and $P(B^c)=0$. There is no change in terms of $P(A/B)$ and $P(A/B^c)$. Then, A obtains $P(A)=(1/2)(1)+(1)(0)=1/2$. The question arises whether one can exchange $P(B)=2/3$ with $P(B)=1$ by knowing. Of course, it is possible to say the probability of the jailer's confession that prisoner B will be executed is 2/3. In this case even after the jailer confesses $P(B)=2/3$ and then one can says that $P(A)=2/3$ and there is no change with respect to the probability. However, the problem mentioned here has nothing to do with this solution, because the problem depends on whether it is justified or not that prisoner A argues that knowing of B's execution makes the concept of probability to be changed and that one can ignore the possibility that B is not to be executed after knowing the jailer's words. Before examining this question, we handle the considering-puzzle. In considering-puzzle, $P(B \text{ OR } C)$ is dexterously exchanged with $P(B)$. Before considering, of course $P(B)=2/3$, and the process of prisoner A's considering is expressed as,

[at least one of B and C] is executed	— :$P(B \text{ OR } C)=1$	(3a)
[X] is executed	— :$P(X)=1$	(3b)
[B] is executed	— :$P(B)=1$	(3c)

The process from (3b) to (3c) is here added. Note that every statement is expressed as "[N] is executed". We define the operation of co-indicating based on the theory of description in the following. If by both indicator [N] and [M] one refers to the same referent then [N] and [M] are co-indicators. Also it is reasonable and adequate to

assume that the probability of the statement is invariant with respect to the exchange of co-indicator.

In the process of (3), can one accept that [at least one of B and C] and [X] are co-indicators? Because [at least one of B and C] is co-indicator to [B OR C], one can obtain $P(B \text{ OR } C)=1$, on one hand. However, if one assumes the man who is either B or C must be executed and calls him X, designating it by a symbol B is the same as believing that the man who is either B or C and must be executed is prisoner B. Therefore, [X] is co-indicator to [B] on the other hand. The term [B OR C] belongs to different category from the category to which [B] belongs. One can say that the process from (3a) to (3c) is just a category mistake. Only if one ignores this category mistake, can one substitute $P(B)=1$ for Eq-(2) and obtain $P(A)=1/2$. In knowing-puzzle, prisoner A believes that [at least one of B and C] is co-indicator to [B] and that this exchange of co-indicators is possible by knowing. In this case A obtains the same result as in considering-puzzle.

We can simplify the problem resulting from considering-puzzle. One of three prisoners, A, B and C will be executed. Anyone must be executed. Then a prisoner can express

[anyone] is executed (4a)
[B] is executed (4b)

Of course, [anyone] is not co-indicator to [B], because [anyone] indicates [A OR B OR C]. In ordinary sense, P[anyone]=1 and $P[B]=1/3$. However, the prisoner imagines One who knows all the future, and this One knows that [anyone] is nobody but [B]. According to this man, there is no concept of indefiniteness, and [anyone] is [anyone who is executed]. Substituting it for the statement (4a), the prisoner expresses it as

[[anyone] is executed] is executed. (5)

The prisoner imagines the man who knows everything in the future and believes that according to him [anyone]=[[anyone] is executed]=[B], then he can change the probability of which B is executed from 1/3 to 1. This is called believing-puzzle.

In all knowing-, considering- and believing-puzzles, a prisoner can change the probability by his action of knowing, considering and believing. In this sense all puzzles are the same. These changes of probability result from a category mistake which one identifies terms which are not co-indicators with co-indicators.

However, can one necessarily reject a prisoner's proposal of which probability is changed by his own action? From the perspective of an external measurement, any term and/or statement is definite, and then one can clearly determine whether two terms are co-indicators or not. An external observer does not accept any indefinite statement in his own right, while he accepts the concept of probability. We evoke that the concept of probability is definite because the concept of distribution is definitely determined. It is reasonable that once one can use the term probability it implies a definite distribution of probability. That is why a prisoner's proposal of which probability has changed owing to his own action is erroneous. However, the most important point is that one has to take into account both the concept of indefiniteness and the choice derived from indefiniteness when talking about a prisoner's own action and/or internal measurement if one focuses on the prisoner's own perspective.

A prisoner breaks the concept of probability in the form of category mistake, not

because he does not understand the concept of probability, but because he cannot help breaking the concept of probability whenever he talks about his own actions. As for a prisoner, the concept of change resulting from his own action is intrinsic, and this change must be emergent. In order to talk about emergent change, first he accepts the concept of invariance in the form of concept of probability. By definition any change cannot be accepted. In spite of this invariance, he simultaneously accepts the change of the concept of probability. That is why this change can be accompanied with emergent property. The concept of emergency sounds like categorical mistake in its own right. Then a prisoner has to argue that terms which are not co-indicators must be co-indicators when he talks about the process of knowing, considering and/or believing.

In this philosophical foundation we define the status of an internal measurement by not only always being exposed to the crisis of a paradox, but also by having the ability to be degenerated by choice. This asymmetry is not found in the status of an external measurement. Imagine the action of writing a novel. Possible performative arrangements of alphabets and possible plot of a novel must be finite. Imagine that a man called a simulationist says that any novel is just a simulation of an other novel, and that nobody can determine whether a novel is original or not, from this argument. Also, he says, "that is why there is no concept of plagiarism, and nobody says that a novel is plagiarized from a specific novel". Also imagine that you are a novelist, and then you belong to a community of producers. It must be said that you, a novelist, can determine whether you plagiarize your novel from other novels or not whenever you write. There is no rule to determine a rule by which a novel is judged to be plagiarized or not; however, you can determine whether your action depends on plagiarism or not because you are the person concerned.

The novelist, as the person concerned, is always exposed to the crisis of which his own novels can be be plagiarized because of a paradox. In spite of this crisis, a novelist has ethics that plagiarism is prohibited. This asymmetry is not found in the perspective of a simulationist because he is just a looker-on. He cannot commit to a community of novelists, and in this sense he is destined to be an external observer. However, a novelist participates in a community of novelists. There are both active mode to a novel (a novelist has ethics on plagiarism) and passive mode (a novel can be exposed to plagiarism) from the perspective of an internal observer, a novelist. These two modes are symmetrical and are identified with each other in the stance of a simulationist, an external observer. Also in a prisoner's dilemma, change of the probability resulting from knowing is a paradox (passive), while the prisoner can realize the change of his own feeling by knowing (active).

Strictly speaking, the aspect consisting of active and passive mode shows a nested-structure. First, an observer (e.g. a prisoner) can measure an object and can show his own method to measure in the form of a rule, in his own right. This is active mode. However, one cannot reject that there can be others who doubt the foundation of the rule. Then, an observer is exposed to the crisis of skepticism. This is a passive mode. Second, the active mode of showing a rule, itself consists of both passive and active mode, because an observer actively generalizes his individual passive experiences. Because this aspect is inconsistent, it can lead to the passive mode, that is the crisis of skepticism. Third, the perpetual iteration of passive and active mode, or the perpetual transformation of a rule derived from others is called a paradox. Therefore, a paradox sounds like a true problem. However, because measurement process is not rule-following, we can actively measure an object independent of a paradox. This is active mode, while an observer showing the result of measurement can be exposed to a

universe that there can be others who says that the observer cannot understand a paradox as a true problem. An observer is passively in this universe, and actively acts in this universe.

A final question arises whether an internal perspective can lead to a new performative and powerful perspectives in science. As suggested in section 1, one can talk about the emergent property from internal perspective. One can talk about origin of structures, origin of downward causation in the form of degeneracy. Let us consider the prisoner's puzzle again. We here concentrate on the structure of what a prisoner can emergently get by his own action. By knowing, considering or believing, a prisoner gives a sigh of relief. It results from getting the emergent change of probability. How can we give a metaphoric model for this emergent change? It is enough only to consider about the change from the statement of (4a) to that of (4b). Also, this process is transmitted by the statement of (5). Now we can enhance this idea and can obtain the expression of

$$[..[[[\text{anyone}] \text{ is exccuted}] \text{ is executed}]..] \text{ is executed} \qquad (6)$$

This nested-structure is expressed only by

$$[[\text{anyone}] \text{ is executed}]=[\text{anyone}]. \qquad (7)$$

Therefore, we evoke that the structure (7) is degenerate due to the process of internal measurement. In other words, a prisoner who regards the transition from (3a) to (3b), or from (4a) to (4c) as the exchange of co-indicators emergently obtains the structure (7). We can metaphorically understand what a prisoner does in the form of the degeneracy of the structure (7).

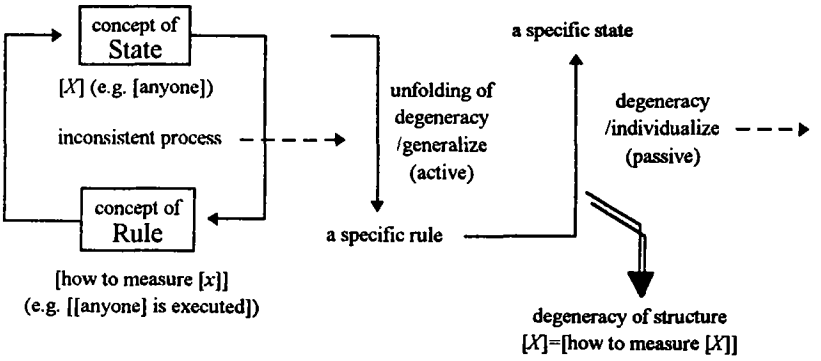

Figure 2: The concept of a state is metaphorically formalized in terms of inconsistent but coherent process between the concept of a state and the concept of a rule following a state from the perspective of internal measurement. This scheme is similar with a paradox resulting from describing measurement process from the perspective of external measurement, while this scheme is accompanied not only with an appearance of a paradox but also with degeneracy from a paradox. As discussed later, this process can lead to the degeneracy of the structure in which the concept of a state is isomorphic to that of a rule.

Internal measurement is paradoxical in its own right. With respect to any state X, an observer uses X in spite of indeterminacy in terms of a rule of how to measure X. We here express how to measure $[X]$ as [How to measure $[X]$]. In other words, any

measurement proceeds in spite of a paradox resulting from the mixture of [X] and [How to measure [X]], and with the choice against this paradox (Figure 2). Of course, [anyone] and [[anyone] is executed] can be generally replaced with [X] and [How to measure [X]]. Finally we can argue that internal measurement process against the mixture of [X] and [How to measure [X]] becomes degenerate into the structure of [X]=[How to measure [X]]. This process is expressed as

$$([X] \overset{\text{interaction}}{\longleftrightarrow} [\text{How to measure } [X]]) \overset{\text{degeneracy}}{\longrightarrow} [X]=[\text{How to measure } [X]] \quad (8)$$

Gunji & Toyoda (1996) presents that the structure [X]=[How to measure [X]] can degenerate by the interaction between one logic by which [X] is comprehended and the other logic by which [How to measure [X]] is comprehended. In their model, it implies that the inconsistent perpetual process of making consistency between operand and operator can degenerate into the structure of which operand coincides with operator, and that the degenerate structure is a rule itself in the form of a Cantor set (fractal). When [X] is formalized as a set D, [How to measure [X]] is formalized as a set of a map whose domain is D and codmain is Y, that is expressed as Hom(D, Y). Therefore, the interaction between D and Hom(D, Y) is expressed as the following; First, given a specific state (d, y) in a product set of D and Y, a map f^t that satisfies $f^t(d)=y$ is chosen from Hom(D, Y). Second, given $d+\delta d$, and a map f^t+1 that satisfies $f^t+1(d)=f^t(d+\delta d)$ is chosen. This process is iterated, where a product set of D and Y are defined as a finite set, and Hom(D, Y) is defined as an infinite set. Therefore, this iteration is open ended, and f t is perpetually changed. As a result, a structure of D =Hom(D, Y) is degenerated, where the equational symbol represents isomorphism. We can express this process as

$$(D \overset{\text{interaction}}{\longleftrightarrow} \text{Hom}(D, Y)) \overset{\text{degeneracy}}{\longrightarrow} D=\text{Hom}(D, Y) \quad (9)$$

That is an example of a positive contribution from the internal perspective (also see Gunji, 1995).

The structure of operand=operator implies the upper level taking downward causation, because by the concept of operand and operator one can connote local and global property, respectively. Also, degeneracy of this structure implies the emergent appearance of such upper level. Because the process of the interaction between [X] and [How to measure [X]] is constituted in order to formalize the process of which [X] is used, it is just local and/or lower level process, on one hand. Degenerate structure is in the form of a rule, and it is in the upper level. Because [How to measure [X]] simultaneously implies [X] in the structure of [X]=[How to measure [X]], it can enhance the downward causation. Also, it is paradoxical before the degeneracy of this structure, and then this appearance has emergent property in its own right.

By the structure of [X]=[How to measure [X]] one can superficially solve the paradox resulting from the mixture of [X] and [How to measure [X]]. However, our sketch does not imply that [X]=[How to measure [X]] is generated as a solution for a paradox. Only as a consequence of degeneracy one can say that [X]=[How to measure [X]] is a solution for the paradox. Our idea is different from the concept of autopoiesis (e.g., Varela, 1979), because he evokes that inconsistency in living systems can be consistently described in a logic in which a paradox can be removed by introducing the structure of [X]=[How to measure [X]]. He suggests that this structure is a priori in living systems. It is just a specific semantics a posteriori. We by no means argue that a hierarchical

structure is a priori and is intrinsic in living things. That is erroneous, resulting from the mixture of transcendent mechanism and consequence, which is the basis of naive realism.

4. CONCLUSION

Whenever one focuses on process, interaction and/or measurement, an intrinsic paradox that cannot be dissolved is always found. In order to manifest this problem, the status of a paradox, we examine the measurement problem in general form. While original measurement problems such as Schrödinger's cat result from inconsistency between quantum and classical mechanics, we show that Von Neumann lattice corresponding to quantum logic can be derived from embedding indefiniteness resulting from indeterminacy in terms of a rule by which the state of a cat is determined by an observer with classical logic. We also evoke that indeterminacy is destined to be definitely formalized in Von Neumann lattice because indeterminacy is embedded consistently and it gives rise to consistent Von Neumann lattice. If one examines measurement process from the perspective of naive realism, any state has to be uniquely determined in terms of real objective state. That is why indeterminacy of whether Von Neumann or classical lattice is true logic for real state appears again. Finally the intrinsic problem is whether or not one can escape from the entrapment by naive realism or not.

Second, we have examined the well-known prisoner's puzzle, and showed the status of internal measurement. In this puzzle one can find indeterminacy or paradox as well as in the case of Schrödinger's cat. This puzzle can lead to the problem of indefinite choice, while this kind of choice cannot be consistently formalized in a formal system. If one attempts to formalize this type of choice, for example by introducing Baysian statistics, then it looks the same as the solution introducing a Von Neumann lattice. Finally, the concept of indefiniteness can be by no means formalized consistently, because consistent formalization implies that indefiniteness is regarded as definiteness. One has to give up naive realism and/or consistent theory in the understanding of measurement process. Instead of consistent relationship, one accepts both inconsistent one and choice against inconsistency, which is constituted from the perspective of internal measurement.

From the internal perspective, the aspect of measurement process is articulated into both passive mode implying that an agent can be exposed to a paradox and active mode implying that an agent can prove a paradox ad hoc in its own right. This is a paradoxical expression for the measurement process being independent of the nature paradox. Because a paradox results from the mixture of individual and general conditions, it can correspond to that of operand and operator respectively. The passive mode can be expressed as a perpetual interaction between operand and operator, and the active mode can be expressed as designating a rule (i.e., proving a paradox) ad hoc. Because designating a rule is arbitrary in principle, it can constantly lead to subsequent paradoxes. This process ceaselessly perpetuates.

In this scheme, one can talk about the degeneracy of emergent upper level of a system. In other words, a paradox resulting from the inevitable mixture of a state and a rule following the choice of a state can give rise to the degeneracy of structure of $[X]$=[how to measure X]. Because this degenerate structure appears as an arbitrary solution of the paradox, we can say that it is an emergent change and/or information generation. In

external perspective, passive and active mode are symmetrical. One has to apply symmetry breaking for the occurrence of emergent phenomena. In contrast, internal perspective enables us to talk about the degeneracy of symmetrical structure based on the asymmetrical measurement processes.

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