The Study of Animal Autonomy to Investigate the Origin of the Other Self

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Abstract

One can never identify the basis of the performance of the other self. However, the other self can be approved when one finds out (constitutes) such a basis. The concept of the other self is characterized by this intangibility of the basis of the performance and observer's inevitable understanding of it, and its investigation is to consider how to constitute the model to understand such a contradictory aspect. I consider that the aspect of appearance of animal autonomy in an observer is the very appropriate model. Then, I have constituted some behavioral experiments and suggested a methodology for 'the science to understand the other self'. This study deeply correlates with psychology and cognitive science that investigate the origin of the mind and representation.

Keywords; Autonomy, Intangibility, Other Self, Novelty, Pill Bug

1 Introduction

1-1 The Aspect of Autonomy

The concept of autonomy appears in the system where the observer tries to understand the intangibility of the observed subject. Understanding of intangibility seems contradictory at a glance. However, this contradiction appears only when one considers intangibility as the in-understandability, which is the naïve negation implied when the understandability is defined. In this stance, the understandable domain and the in-understandable one are considered to exist with the definite and impassable boundary. However, in actual, the intangibility appears a posteriori as betrayal of understandability. Then, while in-understandability appears in the form of stochastic error, intangibility does the capacity of the subject itself. This aspect appears as the following example (Fig.1).

-- In a primary school, a teacher said to the students, 'Write a poem in a hurry (see Fig.1, below the dashed line, a man with glasses (teacher) is saying 'Poem! Hurry!'). Then one student finished it in only thirty seconds and showed it to the teacher. Looking at the page of his notebook, it was filled with a big word, 'P.O.E.M.'. The teacher confused at a moment, however, he accepted it with a bitter smile.--

The teacher has constituted the meaning of the 'poem' by finite results of the order

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('Write a poem') - reaction (presentation of a 'literary poem') relation between him and the students (see Fig.1, above the dashed line). As a result, he came to believe the existence of the meaning of 'poem', which characterizes the understandable domain. In this case, the meaning is 'Literature' (□ in Fig.1). If this meaning is definitely confirmed, those who make literary poems are considered to belong to the understandable domain and the others to the in-understandable one. Then the performance to characterize this discrimination can be observed in the teacher. For example, he 'praise' the students who make literary poems (inside of □ in Fig.1), otherwise, against those who make 'in-understandable poem', he 'reproaches'. Then, the student who makes 'a poem constituted by a big word 'P.O.E.M.'' belongs to the in-understandable domain and is reproached. In this stance, the student is regarded as the stochastic erroneous existence. However, the meaning of 'poem' can exist as far as the teacher arbitrarily believes the eternality of the confirmability of order (Write a poem) – reaction (presentation of a literary poem) relation. So, the meaning of 'poem', i.e., the understandable domain, is potentially indefinite and he has always possibility to be betrayed.

It implies that the observed subject can belong to both the understandable domain and the in-understandable one, however, the observer cannot predict which domain it belongs a posteriori. This kind of potential instability of the understandability of the observed subject is 'intangibility'. In this way, once the teacher admits the intangibility, he cannot easily reproach the student who submits 'the poem constituted by a big word 'P.O.E.M.'. In this stance, the confirmability of the order – reaction relation is broken off. He can consider that the student treated his order 'Write a Poem in hurry!' as 'a ready-wit competition' because they need a lot of time for meditation, relaxation, thinking, and so on to make a 'literary' poem, however, his order is 'Hirry' (see Fig.1, below the dashed line). Then the student could easily transform the statement 'Write a poem.' to 'Write a word, 'P.O.E.M.''. By the appearance of such a student, the teacher can find out their capacity to constitute meaning of poem, i.e., their intangibility. Then, in accepting his poem 'with a bitter smile' (in Fig.1, the teacher are talking 'Ready-Witted Answer'), the understandable domain is expanded and their intangibility is newly named 'autonomy'.

In this example, emergence of autonomy seems to depend on the observer's ability of interpretation. The student might usually regard 'poem' as the word 'POEM', i.e., might be stochastic erroneous existence. In order to approve his performance as resulting from his capacity, one must observe that he usually writes a 'literary poem' in receiving the order, 'Write a poem'. In addition, one must ask him the reason of his performance afterward.

1-2 Autonomy in Animals

Such a concept of autonomy remarkably appears between animals and observer. Animals are the very intangible existence for us. In order to understand them, one generally tries to find out an especial order (=stimulus) - reaction relation and then,

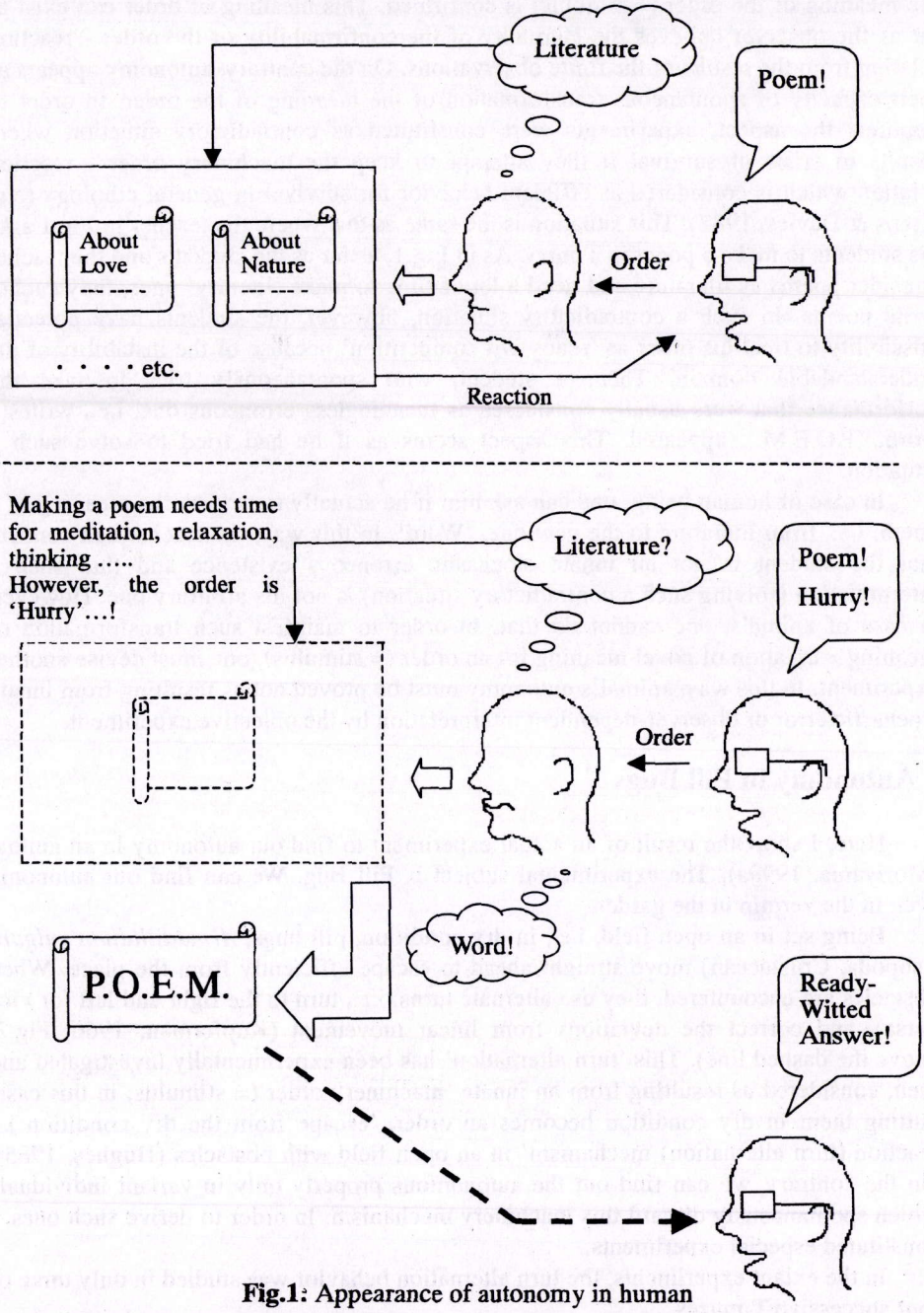

Fig.1: Appearance of autonomy in human

the meaning of the order (=stimulus) is confirmed. This meaning of order can exist as far as the observer believes the eternality of the confirmability of the order - reaction relation from the results of the finite observations. On the contrary, autonomy appears as their capacity of spontaneous transformation of the meaning of the order. In order to manifest the aspect, experiments were constituted as contradictory situation where results in crisis of survival if they attempt to keep the machinery order - reaction relation which is considered as efficient behavior for survival in general ethology (e.g, Krebs & Davies, 1987). This situation is the same as that where the teacher in Fig.1 asks his students to make a poem in a hurry. As in Fig.1, as far as the students and the teacher consider poems as literature and need a lot of time to make 'literary' ones, they cannot write poems. In such a contradictory situation, however, the students have potential possibility to treat his order as 'ready-wit competition' because of the instability of the understandable domain. Then, a student, who spontaneously tries to take the performance that were usually considered as meaningless erroneous one, i.e., writes a word, 'P.O.E.M.', appeared. This aspect seems as if he had tried to solve such a situation.

In case of human being, one can ask him if he actually transform the meaning of a poem, i.e., from literature to the new one, 'Word'. In this way, the teacher can confirm that the student is not an innate stochastic erroneous existence and that such a interpretation (solving such a contradictory situation) is not his arbitrary one. However, in case of animals, one cannot do that. In order to manifest such transformation of meaning = creation of novel meaning for an order (= stimulus), one must devise another experiment. In this way, animal's autonomy must be proved not as resulting from innate stochastic error or observer-dependent interpretation by the objective experiment.

2 Autonomy in Pill Bugs

Here, I show the result of an actual experiment to find out autonomy in an animal (Moriyama, 1999a). The experimental subject is Pill Bug. We can find out autonomy even in the vermin in the garden.

Being set in an open field, i.e., in dry condition, pill bugs, *Armadillidium vulgare* (Isopoda, Crustacean) move straight ahead to escape efficiently from the place. When obstacles are encountered, they use alternate turns, i.e., turn to the right and left (or vice versa), and correct the deviations from linear movement (Kupferman, 1966, Fig.2, above the dashed line). This 'turn alternation' has been experimentally investigated and then, considered as resulting from an innate 'machinery order (= stimulus; in this case, putting them in dry condition becomes an order, 'escape from the dry condition') - reaction (turn alternation) mechanism' in an open field with obstacles (Hughes, 1985). On the contrary, we can find out the autonomous property only in variant individuals which spontaneously discard this machinery mechanism. In order to derive such ones, I constituted especial experiments.

In the extant experiments, the turn alternation behavior was studied in only three or four successive T-mazes.

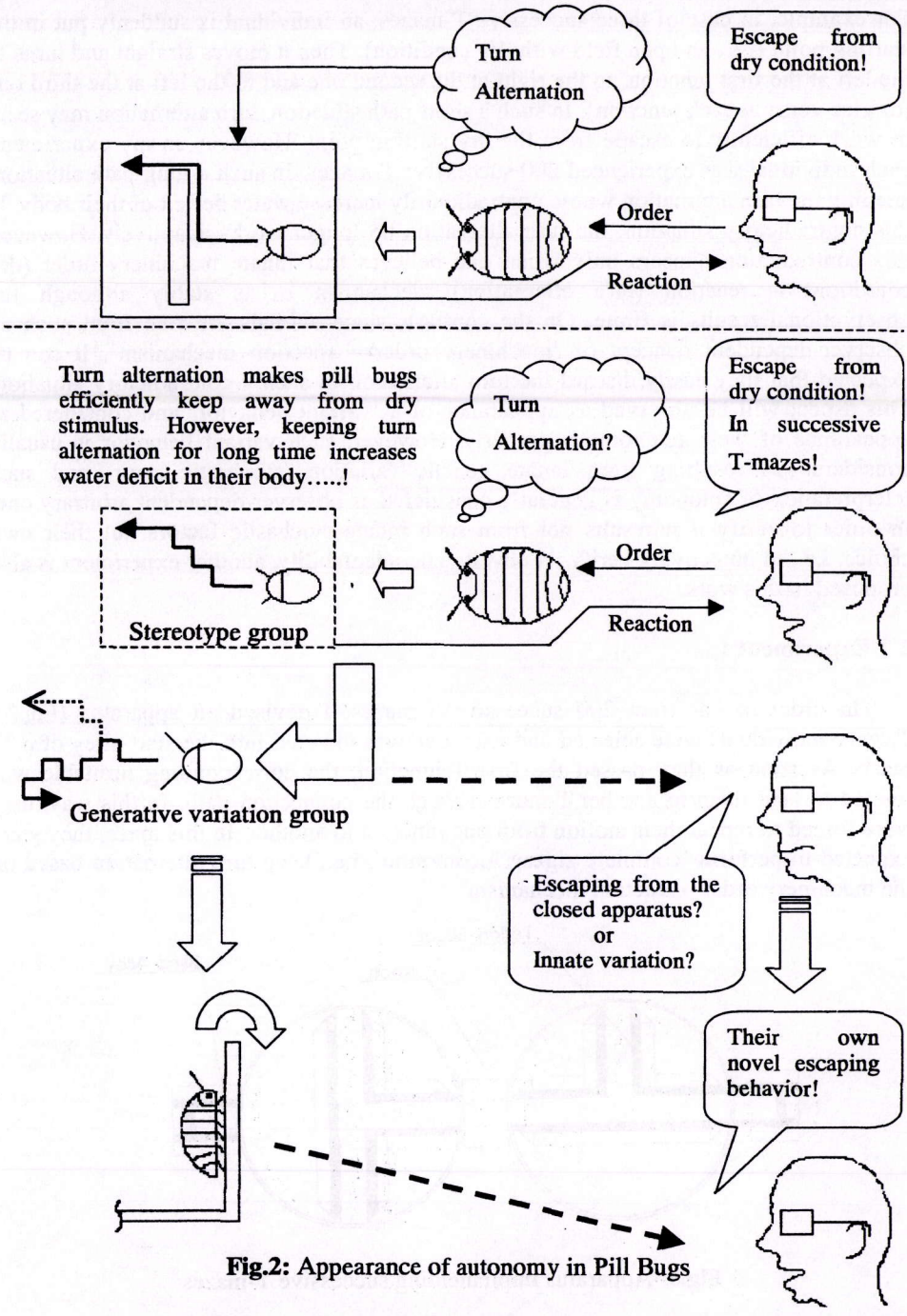

Fig.2: Appearance of autonomy in Pill Bugs

For example, in case of three successive T-mazes, an individual is suddenly put in the starting point (i.e., an open field with dry condition). Then it moves straight and turns to the left at the first junction, to the right at the second one and to the left at the third one (or vice versa at each junction). In such a short-path situation, turn alternation may seem to work efficiently to escape from the dry starting point. However, in my experiment, each individual was experienced 200 successive T-mazes. In such a long-path situation, keeping the turn alternation would contradictorily increase water deficit of their body. In this contradictory situation, the turn alternation no longer works adaptively. However, this contradiction appears only when one believes that innate machinery order (dry condition) – reaction (turn alternation) mechanism exists stably although the observational results is finite. On the contrary, since animals are free from such an observer-dependent concept of 'machinery order – reaction mechanism', it can be expected that they easily discard the turn alternation in such a contradictory situation. This aspect will be observed as appearance of a 'variant behavior' and considered as appearance of their autonomous property. However, such variant behavior is usually considered as resulting from innate genetic variation (stochastic error) and such interpretation of autonomy is generally considered as observer-dependent arbitrary one. In order to verify if it results not from such innate stochastic factors but their own choice, i.e., to objectively verify its novelty and adaptability, another experiment is also proposed in this work.

2-1 Experiment 1

In order to construct 200 successive T-mazes, I devised an apparatus (Fig.3). Twenty individuals were selected and each one was lowered into the start alley of a T-maze. As soon as they passed the first T-junction, the corresponding turntable was rotated to lead them to another T-maze through the connection path. In this way, they were forced to repeat their motion from one junction to another. In this maze, they were expected to perform 'complete zigzag locomotion', i.e., keep turn alternation based on the machinery order – reaction mechanism.

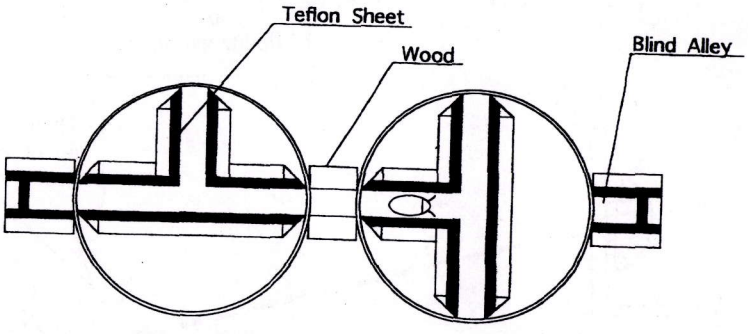

Fig.3: Apparatus implementing successive T-mazes

Twelve individuals could complete 200 mazes, however, the other eight ones stayed put in the middle of the trials. In the twelve individuals, seven tried to keep turn alternation statistically stable (Stereotype group, Fig.2), however, the other five spontaneously destabilized it although they tried to keep it stable in the first half of the trials (Generative variation group, Fig.2). (The quantitative definition to distinguish Stereotype group and Generative variation group is shown in Moriyama, 1999a.) This kind of variant behavior in the Generative variation group (spontaneous destabilization of turn alternation, i.e., spontaneous discard of machinery order – reaction mechanism) is likely to be considered as resulting from innate genetic variation. On the contrary, such a behavior seems as if they try to escape from the closed apparatus itself, i.e., their spontaneous transformation of the meaning (= reaction) of the order. However, such an interpretation is regarded as the observer-dependent arbitrary one. In order to make a clear verification that this novel escaping behavior (variant behavior) results not from such factors, the same twelve individuals were examined in another closed situation by modifying the T-maze apparatus. In the new situation, they cannot survive if they obey only innate factors, i.e., 'turn alternation and genetic variation'. A clear novel escaping behavior, which is not turn alternation but shows adaptability, is expected to appear in the Generative variation group.

2-2 Experiment 2

In the next day of Experiment 1, the same twelve individuals were examined in the maze again. In this case, after passing the fifty-first T-junction, they were led to the blind alley situated at the end of the selected arm (Fig.3). They were expected to backtrack and move to the next T-maze on the other turntable. After turning at the next junction, they were led to the blind alley again. In this manner, they were led into blind alleys successively for fifty trials (Experiment 2-1). In this experiment, since each next turn after any other one was inhibited by the blind alley, both turn alternation and variant behavior were impossible, and therefore, the individuals could not perform an automatic zigzag escaping behavior. They could not also escape by climbing the wood wall in such a dry condition, because it was reported that pill bugs climb vertical wall for transpiration only in the case of saturated air condition, for the upper place has lower humidity (Den Boer, 1961). In my experiment, individuals need not climb the wall because of the dry conditions (relative humidity, 30～40%, far from saturation)

Another twenty unexercised individuals were selected from the main stock and examined in a control experiment with the same apparatus. These individuals were led to the blind alley from the first trial and run the blind alleys for fifty trials (Experiment 2-2).

As shown in Fig.2 and Table 1, in the Experiment 2-1, all individuals from the Generative variation group have noticed the wood wall of the connection part and climbed it in the middle of the trials. The other six individuals, except for one in Stereotype group, did not climb the wall and kept moving around the apparatus. In Experiment 2-2, sixteen in eighteen unexercised individuals kept moving around, and

only two climbed the connection wall (also Table 1). Remaining two stayed put from the beginning.

Table1: Number of climbing individuals

	Climbing	Wandering	
Generative variation group	5	0	①P=0.0006
Stereotype group	1	6	②P=0.4657
Total	6	6	③P=0.0242
Unexercised individuals	2	16	

The number of climbing individuals in this Experiment 2-2 is significantly smaller than that of wandering ones (the bottom raw of Table 1; Binomial test: $p=0.0105<0.05$). This result reflects well the fact that pill bugs climb vertical walls for transpiration purpose only in the case of saturated air condition. However, despite this inhibitory condition for climbing behavior, the portion of climbing individuals in the group used in the Experiment 1 was significantly larger than that in the unexercised group (Fisher's exact probability test ③ in Table 1). This result shows that by experiencing the contradictory situation, i.e., long successive T-maze, some individuals spontaneously chose climbing behavior. Moreover, this behavior was created by individuals in Generative variation group, not by those in Stereotype group (Fisher's exact probability tests ① and ② in Table 1). These climbing individuals, at a glance, seemed committing suicide because climbing upward enhanced desiccation of their bodies. However, they could reach the outside of the closed apparatus and could have a possibility to find out moist places. In this sense, the climbing behavior can be regarded as 'novel escaping behavior', which does not result from innate factors but works adaptively.

In my experiments, I focused on the instability of the observer–dependent machinery order - reaction mechanism and, to demonstrate it, constructed a contradictory situation (Experiment 1). Then unpredictable variant behavior appeared (Generative variation group), and its novelty and adaptability have been verified in another situation (Experiment 2-1). Such variant behavior can be considered as resulting from 'animal's autonomous property' because it appeared in a contradictory situation where order - reaction mechanism theoretically cannot work adaptively, being however, the driving force that produces a novel adaptive behavior. It was also reported (Moriyama, 1999b) that this kind of variant behavior has close relation with Zipf's law (Zip, 1949). In this way, I could experimentally derive animal's independence from observer-dependent machinery concept and showed it as autonomy.

3 Conclusion

Understanding of the other self means such a discovery of the concept of autonomy and additionally one can find out the aspect of communication. This communication generates novelty, i.e., expansion or transformation of representation, while it also implies potential possibility to break down itself. It can be considered as evolutionary communication. On the contrary, the communication which presupposes the confirmed division of understandability / in-understandability can decrease danger to encounter its breakdown but cannot generate novelty, i.e., it is merely transmission.

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