Quantification of Training in Human Thought using Chaos Theory: Degree of Decreasing Entropy as an Indicator

HIDEAKI YANAGISAWA
Gunma Plant, General Affairs Team,
Marelli Corporation,
132 Shin-nakano, Ora-cho, Ora-gun, Gunma 370-0612,
JAPAN

Abstract: - Many analytical methods used to quantify the technical training of human resources have been reported, but they are poor at assessing the training of human thought. Chaos theory and the degree of decreasing entropy have not yet been used in such analytics, although all phenomena—except for those in a completely fixed state (e.g., mathematics, historical facts, and true natural laws) or a random state (e.g., dialing a random digit)—are based on chaos theory. Chaos theory must therefore be considered in the quantification of the technical and intellectual training of human resources because human thinking is involved.

This report compares a method for chaos theoretical quantification of human resource training to methods that do not involve chaos theory. The development of the ability to change to a fixed state from a chaotic state beyond the Feigenbaum point is the goal for the training in thinking; this process, which involves a decrease in entropy, is the most difficult, and important process in such training. In a chaotic state with an infinite number of solutions, humans can never show their own state using any method. In many reports, each goal in a fixed state is considered after thinking has been rearranged; however, a chaotic state in human thinking can never be expressed using indices such as productivity, efficiency, or job satisfaction. Indeed, many reported results are merely a part of human resource training, but the change of entropy in the fixed state is small (this corresponds to the "creativity" of artificial intelligence). By contrast, the change in entropy from a chaotic state to a fixed state is large, and this corresponds to human intuitive. Considered in terms of chaos theory, goal achievement for thinking must therefore be quantified in terms of the degree of decreasing entropy (i.e., the problem-solving speed, and degree of problem difficulty). This type of problem-solving speed is not about achieving ta goal but about creating a new idea. The concrete methods considered are the Schedule for the Evaluation of Individual Quality of Life-Direct Weighting method, the Kawakida Jiro method, and the Mandala chart. Based on the findings presented here, considering entropy change in the chaotic state should become an index for evaluating the creation of a new idea instead of the repetition of an existing idea, as this type of thinking is beyond the scope of artificial intelligence. Given that almost all natural phenomena, including human thinking, are based on chaos theory, using this theory can promote scientific development in all academic fields.

Key-Words: - SEIQoL-DW method, Mandala chart, KJ method, chaos theory, human resource, decreasing entropy, human thinking

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1 Introduction

There are two kinds of human resource training, [1], [2], [3], [4], [5], [6], [7]: technical and intellectual (thinking-based) training; In theory, technical training is easier to accomplish than the training of human thinking patterns. It thus takes less time to consider technical training than intellectual training.

Humans cannot objectively express their thinking during the consideration period in a chaotic state, [8], [9], [10], [11], [12], [13]. Objective expressions are possible only in the fixed state because there are infinite possibilities for expression in the chaotic state. For example, indices such as productivity, efficiency, and job satisfaction are expressions in a fixed state, and change during a chaotic period is objectively ignored.

However, a degree of change (that is, movement from the problem to the solution) can, in theory, be shown with the degree of decreasing entropy in chaos. The change of entropy in human thinking to a localized chaotic state from a proliferating chaotic state is greater than that in a fixed state, [8], [9], [10], [11], [12], [13]. The degree of decreasing entropy (speed of problem-solving and degree of difficulty) in human thinking must be considered in the quantification of human resource training according to chaos theory. Entropy change in the chaotic state can become an index to evaluate the creation of new ideas instead of repeating existing ideas, which is, for example, a degree of problem difficulty that a chat generative pre-trained transformer (GPT), [14], cannot solve. In this way, chaos theory can be used to promote scientific development in all academic fields.

2 Method

2.1 Explanation of Chaos Theory

Here, we explain chaos theory and the relationship between human thinking and chaos theory, and we present some important preliminary results on the topic. The content of this section is similar to that found in the author's previous articles, [8], [9], [10], [11], [12], [13], but it is repeated in this report because of its importance.

2.1.1 Definition of Chaos Theory

Chaos theory can be defined as "the qualitative study of unstable a periodic behavior in deterministic nonlinear dynamical systems", [15]. Chaos theory is part of complexity theory that concerns itself with nonlinear dynamic systems whose behavior does not follow clearly predictable and repeatable pathways. In linear systems, the relationship between an environmental factor and system behavior is predictable and easily modeled. In such systems, as the presence of an environmental factor increases, system behavior changes linearly in response to it. In contrast, behavior in chaotic systems might be perceived as being unpredictable, [16]. It is important, however, that a chaotic state is not confused with the term "random." In mathematical terms, "random" refers to "statistics governed by or involving equal chances for each item" (New Oxford American Dictionary).

2.1.2 Relationship between Continuous Covariation and Chaos Theory

A chaotic equation requires three or more variables and continuous covariation, [8], [9], [10], [11], [12], [13], [17]. Fixed and chaotic solutions that are continuous and have a bifurcation point between them, known as the Feigenbaum point can be obtained in any chaos equation, [18]. For example, an equation that is representative of chaos is expressed as follows:

$$Y(n+1) = p[1 - Y(n)]Y(n) \tag{1}$$

In Figure 1, a schema near the Feigenbaum point is shown in parts Q, R, S, T, and U, which illustrates the converging fixed (parts Q, R, and S), localized (part T), and proliferating chaotic (part U) states. The dotted line F is the Feigenbaum point. The vertical axis is Y(n), and the horizontal axis is *p*. All natural phenomena (except mathematical principles and historical facts) obey chaos theory, because of the existence of three or more variables and their continuous covariation between several phenomena, including matter and the mind, [8], [9], [10], [11], [12], [13], [17], [19].

Three or more variables and continuous covariation exist between humans and the human environment. A chaotic state is changed to a fixed state by a living creature. This phenomenon can be confirmed in thinking and evolution. However, the fixed state changes to a new chaotic state with the environment, and the new chaotic state changes to a new fixed state with the living creature. Therefore, human thinking obeys chaos theory because it fills the necessary conditions for it. Human thinking incorporates both a fixed state and a chaotic state. If human thinking shifts excessively to one side, the person in question may have some form of mental illness. People must thus understand both fixed and chaotic states and change their thinking according to the environment.

2.2 Mathematical Classification: Inside and Outside Chaos Theory

A chaos equation has either possible or impossible solutions. Impossible solutions are those with either no solution or with an infinite number of solutions, but possible solutions comprise complete fixed, incomplete fixed, chaotic, and random states, [8], [9], [10], [11], [12], [13]. In complete fixed states, information related to who, when, what, why, where, and how is not required, because no change occurs. Examples of this would include mathematical principles, historical facts, and true natural laws, which do not change with the environment. A fixed state in chaos theory can become a chaotic state depending on the variables in the equation, which means that the state of a solution can also change as the environment changes; a fixed state is thus incomplete in chaos theory.

A schema of complete fixed, incomplete fixed, chaotic, and random states is shown in Figure 2. The extreme left side of part Q (part K) is a completely fixed state and lies outside chaos theory. However, both the incomplete fixed (parts Q, R, and S) and the chaotic (parts T and U) states, as in Figure 1, are amenable to chaos theory. The extreme right side of part U (part V) is a random state, and it is not amenable to chaos. Because a chaos equation is based on mathematical principles, it is a completely fixed state, and it can be used to resolve incomplete fixed and chaotic states as well.

2.3 Relationship between Entropy Change and Chaos Theory

The explanation of decreasing entropy is repeated in this report because of its importance, [8], [9], [10], [11], [12], [13]. Entropy is a statistical word and was originally unrelated to physical phenomena [20]; entropy decreases when there is a change of direction from a chaotic state to a fixed state, [8], [9], [10], [11], [12], [13], [21], which is shown as the arrow G in Fig. 2. A schema near the Feigenbaum point (dotted line F) are shown as parts Q, R, S, T, and U in Figure 2. Entropy increases, however, whenever there is a change of direction from a fixed state to a chaotic state; this is shown as arrow H in Figure 2.

2.4 Goal of Human Resource Training in Thinking

The goal of human resource training is for a person who receives the training to obtain answers in terms of thinking. The result of "no answer" is also considered. All problems are solved in a fixed state because they are never solved in a chaotic state. Therefore, all natural phenomena, except for fixed and random states, are in a chaotic state. That is, all problems whose answers cannot be given are in a chaotic state. A state in which a person cannot recognize a problem is chaotic.

Thus, solving a problem in a chaotic state creates a shift to a fixed state in human thinking—that is, it is equivalent to a decrease in entropy in human thought. The goal of human resource training is thus the development of the ability to decrease entropy, which is thus equivalent to human development, [22], [23]. That is, the degree to which entropy decreases must be shown as the quantification of human resource training in thinking. To the best of the author's knowledge, no study has reported on this topic, [1], [2], [3], [4], [5], [6], [7]. The degree of decreasing entropy can be shown with the variable deciding the fixed or chaotic state—for example, *p* in Equation (1). The quantification of human resource training can thus be confirmed with these indices.

2.5 Concrete Methods for Recognizing *p* in Equation (1)

The concrete methods involved are the Schedule for the Evaluation of Individual Quality of Life-Direct Weighting (SEIQoL DW) method, [24], the Kawakida Jiro (KJ) method, and the Mandala chart, [25].

2.5.1 Chaos Theoretical Explanation for the Methods Rearranging Human Thinking

Human thought can be rearranged with the methods mentioned above. The content of this section is similar to the author's previous articles, [8], [24], but it is repeated in this report because of its importance.

From Equation (1), the Z(m) axis is perpendicular to the *p* and Y(n) axes. In addition to Equation (1), the following chaos equation is assumed:

$$Z(m+1) = p[1 - Z(m)]Z(m) \tag{2}$$

The axis of Z(m) is vertical to the axes of Y(n) and *p*. From Equations (1) and (2), a three-dimensional logistic map can be imagined. An equation for the plane including the Y(n) and Z(m) axes is as follows:

$$\frac{Y(n+1)}{Z(m+1)} = \frac{[1 - Y(n)]Y(n)}{[1 - Z(m)]Z(m)} \tag{3}$$

Note that *p* is omitted from Equation (3). When *p* changes from 3.0 to 4.0, the number of answers to Equation (3) changes to 1, 4, 16, localized chaotic state, and proliferated chaotic state. The processes from the chaotic state to the fixed state are equivalent to the methods for organizing thoughts. The information collected at random is unified into one thought by these processes. As one of its procedures, the SEIQoL-DW and KJ methods are compared with Equation (3). The relationship between each of the states in Equation (3) and *p* from Equation (1) is shown on the left side of Figure 3, Figure 4, Figure 5, Figure 6, and Figure 7.

The empty circles on the left-hand plane are all correct answers and are shown with no organization of thinking. The relationship between the localized chaotic state (Feigenbaum point neighborhood) of Equation (3) and the *p* of Equation (1) is shown in Figure 3.

Each left-hand plane in Figure 3, Figure 4, Figure 5, Figure 6 and Figure 7 is equivalent to the SEIQoL-DW method. The left-hand plane in Figure

6 and Figure 7 is equivalent to the KJ method. The total of the left-hand planes in Figure 3, Figure 4, and Figure 5 is equal to a Mandala chart. In other words, The SEIQoL DW method is equivalent to the sum of the KJ method and the Mandala chart.

2.5.2 Difference between the Degree of Goal Achievement and Decrease in Entropy

Setting a goal is key in the quantification of human resource training due to the decreasing entropy beyond the Feigenbaum point. The objective degree of goal achievement—such as productivity, efficiency, and job satisfaction—is used to quantify human resource training, [1], [2], [3], [4], [5], [6], [7]. The last goal is shown as point Q in Fig. 1 and Fig. 3, which indicates the problem solution. A state in which people cannot understand or recognize goals at all is called the proliferating chaotic state (Point U) in Figure 1, Figure 2, Figure 3, Figure 4, Figure 5, Figure 6 and Figure 7. A state in which people can understand goals with some objective expressions is equivalent to the incomplete fixed state (Point S) in Figure 1 and Figure 5. People still cannot understand the final goal at this time. The final goal is point Q in Figure 1 and Figure 3. The *p* of points Q, S, and U is 2.4, 3.5, and 4.0, respectively.

$$N = \frac{4.0-3.5}{4.0-2.4} = 0.3125 \quad (4)$$

Here, *N* is the degree goal achievement.

However, this is incorrect, because the degree of decreasing entropy is not considered. The part in which entropy decreases the most is a process from the proliferating chaotic state (Point U) to the localized chaotic state (Point T) in Figure 1, Figure 5 and Figure 6. This is shown in the KJ method; however, objective expression is impossible in this process. Decreasing entropy from point U almost reaches the Feigenbaum point in Figure 1 and Figure 7. The chaos theoretical degree of goal achievement is thus almost 100% at point S (i.e., goal achievement is completed with the submission of this manuscript).

In an upcoming manuscript, an author will report on which limit of AI is chaos theoretically explained with the degree decreasing entropy. The intuitive creativity of human beings is based on the memory of 3.5 billion years, which cannot exist in AI because of no input information. There were two creative steps when a new cosmology, [9], [10], [26], denying the Big Bang theory, [27], [28], was reported.

The first step is "creativity," which involved an intuitive idea, based on many experiences, of what things were like 3.5 billion years ago, [9], [10], [21]. If the Big Bang theory is correct, more than 3.5 billion years ago the universe had a considerably higher density of matter, [9], [10]. However, information is repeated by current DNA in living creatures. This means that the density of matter more than 3.5 billion years ago is the same as that of the present, [9], [10], [21]. Changing the idea into a manuscript. Step one involves decreasing entropy in a chaotic state, while the second step involves decreasing entropy in a fixed state. When the author noticed a relationship between a new equation and the Big Bang theory, the author's thinking changed to a fixed state, such as point S beyond the Feigenbaum point in Figure 1 and Figure 5. However, the author still could not show any objective expression but had used most available energy for thinking to solve the contradiction of the Big Bang theory during this period. The author thought that the manuscript denying the Big Bang theory had almost been completed at that point.

The author's thoughts were in Japanese, which was then translated into English. The energy of the author's thoughts, with decreasing entropy, was not almost used up in this process. That is, many people, except for the author, could have created the manuscript denying the Big Bang theory if they were aware of the relationship between the new equation and the Big Bang; indeed, Chat GPT would be able to make a manuscript, too, [14]. The present quantification of human resource training mostly confirms this last point.

The creation of an idea is more difficult than the objective expression of the idea thus created. In this way, the achievement of a goal in thinking finishes at a moment beyond the Feigenbaum point, chaos theoretically. The quantification of human resource training in thinking must therefore be shown with the degree of decreasing entropy. The degree of difficulty is shown with the diffusing degree of point U in Fig. 1 and Figure 7, which ranges from 0 to 1.0 in Equation (1). The speed of problem-solving is shown with the time required for the change in *p* from point U to point S in Figure 1, Figure 5 and Figure 7; both must therefore be considered in the degree of decreasing entropy. Originally, technical training had to be shown with the degree of decreasing entropy, and considering a change in entropy in the chaotic state would become an index for evaluating the creation of a new idea instead of the application of an existing idea. For example, is the idea only repeating an existing idea? If so, the idea can be searched using AI, such as Chat GPT,

[14]. If not, the idea can never be found using AI. Such thinking should be given the highest priority in human resource training, as the former will be accomplished with AI, [29], [30]. Thus, the index for human resource training must be a problem of such difficulty that AI can never solve it.

3 Results

All phenomena—except for a completely fixed state (e.g., mathematics, historical facts, and true natural laws) and a random state (e.g., dialing a random digit)—follow chaos theory. Objective expressions in the fixed state received attention in human resource analysis; however, the change to a fixed state from a chaotic state is the most important thing in the development of human thinking. This change can be expressed as a phenomenon of decreasing entropy in thinking, and chaos theory, and can never be transformed into AI. Therefore, the quantification of human resource training, both intellectual and technical, must be shown through the degree of decreasing entropy (i.e., the speed of problem-solving and the degree of problem difficulty).

4 Discussion

Entropy never decreases in all natural phenomena, except the phenomenon in which the entropy of living creatures decreases through thinking and evolution. Entropy increases when humans are confused. One example of increasing entropy is war, [9]. Confusing a person is not the goal of human resource training; rather, the goal of such training is the development of the ability to achieve a fine target. Given that novel thinking is a phenomenon with decreasing entropy, the degree to which entropy decreases must be used in the quantification of human resource training. Objective expressions—such as productivity, efficiency, and job satisfaction—have already received much attention, [1], [2], [3], [4], [5], [6], [7], [31], and human resource analysis is expected to become an established discipline by 2025, [31]. However, the field as imagined is insufficient, because chaos theory and decreasing entropy are not considered.

The change to a fixed state from a chaotic state is the most important process in the development of human thinking, [8], [22], [23], and this ability appears quite late in developmental disorders. The development of the ability to decrease entropy is the goal of human resource training and is equivalent to a noticeable ability in human development. The key goal of training is the experience beyond the Feigenbaum point, where humans may feel the presence of God during the moment beyond the Feigenbaum point, [9], [32], [33]. Problems with a degree of difficulty that AI can never solve must be the index for human resource development. Using chaos theory thus promotes scientific development in all academic fields because almost all natural phenomena, including human thinking, follow chaos theory.

5 Conclusion

As has been outlined above, almost all natural phenomena, including human thinking, follow chaos theory, but only objective expressions in the fixed state currently receive attention in human resource analysis. However, the change from a chaotic state to a fixed state is the most important thing in the development of human thinking. The quantification of human resource training in thought, as well as in technical training, must be shown through the degree of decreasing entropy. The change of entropy from the proliferating chaotic state to the localized chaotic state in human thought is larger than in the fixed state. When considering the degree of decreasing entropy, many factors must be addressed, such as the speed of problem-solving and the degree of problem difficulty. Considering entropy change in the chaotic state can become an index for evaluating the creation of a new idea instead of the repetition or redevelopment of an existing idea (i.e., problems that Chat GPT cannot solve). Used in this way, using chaos theory can promote scientific development in all academic fields.

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Appendix

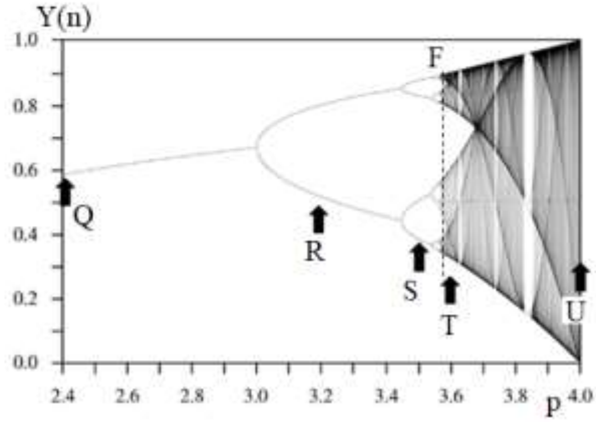

Fig. 1: Logistic schema of equation (1)

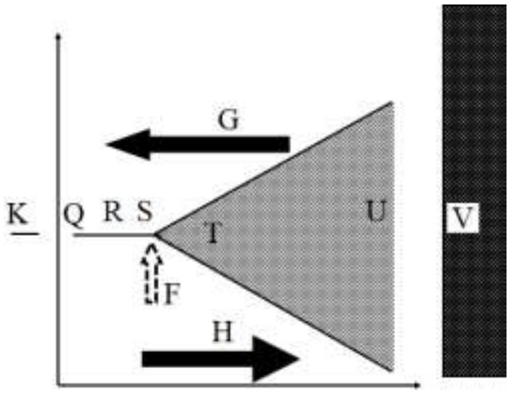

Fig. 2: Schema of complete fixed, incomplete fixed, chaotic, and random states

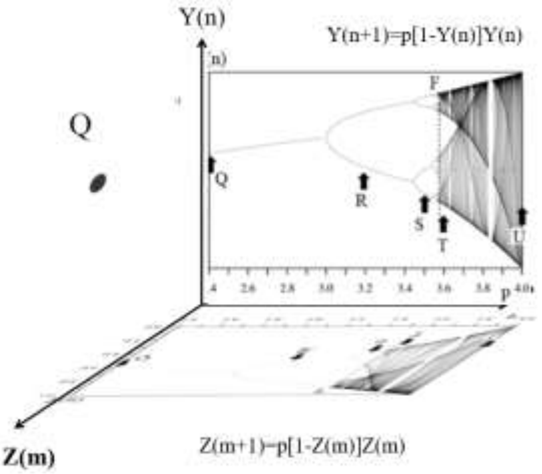

Fig. 3: Relationship between the fixed state of Equation (3) and p = 2.4 in Equation (1)

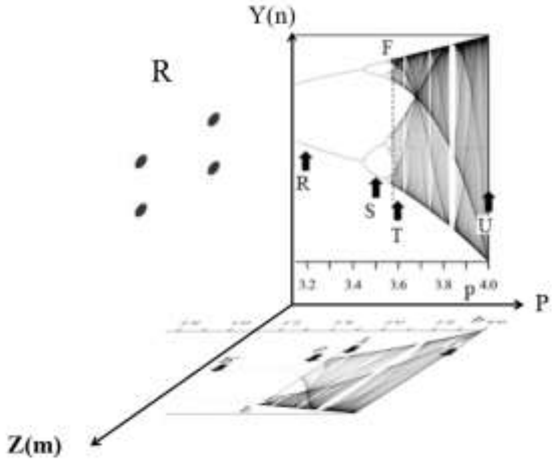

Fig. 4: Relationship between the fixed state of Equation (3) and p = 3.2 in Equation (1)

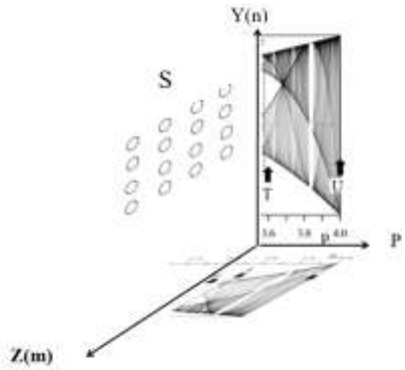

Fig. 5: Relationship between the fixed state of Equation (3) and p = 3.5 in Equation (1)

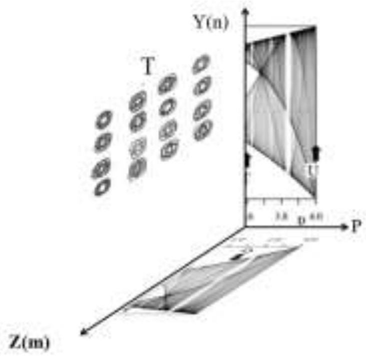

Fig. 6: Relationship between the localized chaotic state of Equation (3) and p = 3.6 in Equation (1)

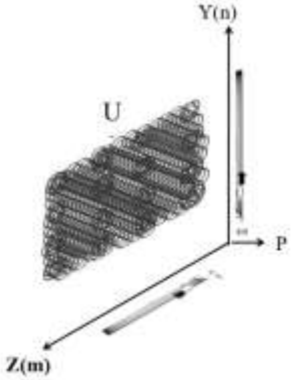

Fig. 7: Relationship between the proliferating chaotic state of Equation (3) and p = 4.0 in Equation (1)

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