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# Minimum Nomic, a Tool for Studying Rule Dynamics

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**Summary.** We propose a kind of self-amendment game, *Minimum Nomic*, as a model to study rule dynamics. *Nomic* is a game in which changing the rule of game is a move. *Minimum Nomic* is a reduced version of the original *Nomic* to keep the essence but promote evolvability of the self-amendment game. We discuss the characteristics of *Minimum Nomic* from the viewpoint that how changeability of rules and durability of games change. By analyzing the dynamics of purpose and goals and the self-referential property, we claim that *Minimum Nomic* is an interesting tool for study rule dynamics.

## 1 Introduction

One of the interesting features of complex systems is “rule dynamics.” It means that a set of rules which describe the dynamics or the behavior of the system has a possibility to change through the behavior of the system. We can find many examples of the system with rule dynamics here and there such as, laws, languages, and life. Laws are enacted according to laws. We use a language according to linguistic rules including a grammar and lexicon but the rules change based on our use of the language.

The evolution of life also can be seen as a rule dynamics. Chemical reaction networks characterizing a biological system, which is considered as a kind of rules of the biological system, change when the life evolves. From the viewpoint of rule dynamics, the most important feature of life is, among others, its evolvability. The biological evolution is an open-ended, an ever-changing process. The system of life, not as an individual but as a lineage, does not stop to change their rules responding to dynamic environment, since organisms form their own and others’ environment.

We take a stand point that, in understanding complex systems, considering rule dynamics of the systems as a general feature of complex systems is necessary rather than pursuing particular key matters such as DNAs, RNAs, or

proteins as reductionism. In particular, it is interesting how the system gradually wanders among stable and unstable points in a rule-space or develops from unstable to stable points.

In this paper, we propose *Minimum Nomic* which is a variant of *Nomic* [1, 2] in order to study evolution of rule dynamics. *Nomic* is thought of as a game of rule dynamics, in which changing the rule is a move. The players of the game change the rule of *Nomic* in playing the game. We modify the rules of the original *Nomic* in order to increase the changeability but to keep the essence of *Nomic*. The number of initial rules is reduced from 29 of the original to 8. Although it is possible to decrease the number to two, like *Pure Nomic*<sup>3</sup>, the game come to be likely to stop. Accordingly, we revise the Initial Set of Rules taking both the changeability of the rules and the durability of the game into consideration.

This paper is organized as follows. We explain briefly *Nomic* in the next section. *Minimum Nomic* is introduced in section 3. We discuss experimental results in section 4 and state conclusion in section 5.

## 2 Nomic

*Nomic* was invented by Peter Suber in 1982 as a self-amendment game based on constitutional system of the United States. The game was introduced in Hofstadter's book [2]. Suber revised the rules and published them in his book [1]. After that, many subspecies have been proposed<sup>4</sup>.

*Nomic* is a game in which players change the rules of the game. The Initial Set of Rules of *Nomic* consists of 29 rules<sup>5</sup>. These rules can be changed in the game. There is a key rule, numbered as 202 in the original Initial Set of Rules.

Rule 202: One turn consists of two parts, in this order:

1. Propose one rule change and having it voted on;
2. Throwing one die once and adding the number of points on its face to one's score.

The procedure to change rules is enacted in the first part. Further, the score which the players pursue by trying to change the rules is defined by the second part. Accordingly, this rule decides the framework of the game and the purpose of the players. Of course, they can be amended in the course of the game.

The Initial Set of Rule has hierarchical property. It means that the Initial Set of Rules is categorized into "mutable" and "immutable" rules. The players can propose to amend or to repeal the mutable rules. The immutable rules can not be modified before it becomes mutable. This hierarchical setup are devised for the rules not to be in conflict with each other and for the game to

<sup>3</sup> See [http://www.playagaingames.com/games/pure\\_nomic](http://www.playagaingames.com/games/pure_nomic)

<sup>4</sup> See Peter Suber's *Nomic* site, <http://www.earlham.edu/~peter/nomic.htm>

<sup>5</sup> Look at Suber's site for the complete description of the Initial Set of Rules.

keep playing. But this rigid property restrains the potential to keep changing the rules dynamically.

### 3 Minimum Nomic

#### 3.1 Evolvability

We propose *Minimum Nomic* as a tool for studying rule dynamics. One of the most important aspects in rule dynamics is a trajectory of rules, namely, how an objective system moves around in a rule-space. In order to study this aspect, model of the rule dynamics must keep evolvability which consists of the following two properties:

1. changeability of rules
2. durability of game

The first property corresponds to adaptability, and the second stability of a system. While these two properties are sometimes incompatible, they often coexist in natural dynamical systems such as living, cognitive, linguistic, and social systems. If a system is too rigid, it cannot adapt to changing situations. If it is too unstable, it is likely to cease existing.

*Nomic* is a good model of the self-amendment system. The rules are contrived strictly to maintain the durability of the game. The strictness, however, lessens the changeability of rules. Further, the rules are so many and so interdependent complicatedly that players occasionally feel a cognitive load to keep playing. This characteristic may reduce the playability, and consequently the durability, of the game. Accordingly, in modifying the rules of the game, we attempt to reduce the number of rules and to simplify the structure of rules with paying attention to improve the changeability and the durability.

#### 3.2 The Initial Set of Rules

The Initial Set of Rules of *Minimum Nomic* is the followings<sup>6</sup>:

101. All players must always abide by all the rules then in effect, in the form in which they are then in effect. The rules in the Initial Set are in effect whenever a game begins. The Initial Set consists of Rules 101-109.
102. A rule-change is the following: the enactment, repeal, or amendment of a rule.
103. Players shall alternate in clockwise order, taking one whole turn apiece.
104. Each player proposes one rule-change and has it voted on in her/his turn.
105. A rule-change is adopted if and only if the vote is unanimous among the players.

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<sup>6</sup> All rules are mutable.

106. An adopted rule-change takes full effect at the movement of the completion of the vote that adopted it. Each new rule adopted shall be given a number. The numbers shall begin with 201.
107. If two or more rules conflict with one another, then the rule with the lowest ordinal number takes precedence.
108. If players disagree about the legality of a move or the interpretation or application of a rule, then the player preceding the one moving is to be the Judge and decide the question. Disagreement for the purposes of this rule may be created by the insistence of any player. This process is called invoking Judgment. The next player become a Judge, and the Judge gives a decision. The Judge's Judgment is overruled only by a unanimous vote of the other players taken before the next turn is begun. If a Judge's Judgment is overruled, the next player to Judge become a new Judge and gives a decision, and do as same as above until Judgement is not overruled.

### 3.3 Characterization of *Minimum Nomic*

While we cut many rules from *Nomic*, the essence of the *Nomic*, self-amend property and sustaining the game moves, is remained. The key rule is Rule. 104 that defines the method to amend rules. This is from the first half of the original Rule. 202, depicted in section 2.

Note that removing the second half of Rule. 202 eliminates the purpose of playing in *Minimum Nomic*. Therefore, the goal is, of course not prescribed, different from *Nomic* in which the first player achieving 100 points becomes a winner. The existence of a definite goal may lose the durability and the changeability of the game, sine the game ceases and the rules does not change when the goal is attained. Eliminating the purpose and the goal in *Minimum Nomic* makes us possible to inquire very interesting questions: when and how a purpose and a goal of the game emerge and how they change in the course of the game.

This modification affects the status of *Minimum Nomic* as a game. A popular definition of game [4] requires “variable, quantifiable outcome” and “value assigned to possible outcomes” which *Minimum Nomic* does not satisfy. While players play *Minimum Nomic* observers of the games might judge this as a game. It depends on players and the evolution of rules if *Minimum Nomic* is truly game or not.

To increase changeability, and also playability, we do not categorize the rules as “mutable” and “immutable”. All the rules can be amended by one proposal. This increases, however, at the same time a risk to lose the durability. Thus, we leave a conflict avoidance (Rule. 107) and a judgment system (Rule. 108) from the original.

## 4 Analysis and Discussion of Experimental Results

We analyzed two experimental plays of *Minimum Nomic*. The number of players was 5 in both experiments.

### 4.1 Emergence of Purpose and Goal

In order to obtain reasonable results, we had to add an auxiliary but important rule, “The game stops when two hours elapses from the start.” Although this rule defines a condition to end a game, strictly speaking, goal is still not prescribed, since a condition to win is not determined.

In the first experiment, a condition to win was enacted: “a winner is a player who uses a particular rule the most.” By this rule, the purpose of the players were to propose rule amendment related to the particular rule. It seems that most players have implicit purpose, stealthily introduced by Rule. 104, that is to change rules as much as possible, even though definite and objective value is not given for doing so. The implicit purpose was manifested but narrowed to change rules related to one specific rule.

On the other hand, in the second experiment, no winning condition was defined, even proposed. Thus, explicit purpose of the game did not emerge. However, implicit purpose seemed to change. A player proposed to change his vote from one to two and it was approved. After that, several proposals to increase the right to vote was submitted. Here, the implicit purpose became to reign the game, it means that each player wanted to decide if proposal is approved or not by his/her interest.

In both experiments, the purposes emerged among the players regardless of if a goal exists or not. The range of proposals were narrowed by the purposes but the players were motivated to play the game. The shared purpose could lead to promoting durability.

### 4.2 Logical Self-Referential Paradox

There is no rule how to start the game in the Initial Set of Rules of *Minimum Nomic*. Interestingly, in the first experiment, the player A proposed a rule, “this game begins from the player A,” at the starting point. This raised an interesting issue. Rejecting the proposal means that “this game does not start from the player A.” In order to reject the proposal, there must be a voting process. But evoking the voting process means that the game has already started from the player A. This situation can be expressed as a logical equation with contradiction,  $X = \neg X$ , where  $X$  is a predicate that “this game begins from the player A.” This is a typical self-referential paradox.

It is easily expected that the self-amendment game suffers from the contradiction problem on the course of game. It is usually supposed that a new rule denies existing rules, that is, the contradiction among different rules. Therefore, the arrangements to avoid and to resolve conflicts are introduced, as Rule.

107 and 108. But the proposal by the player A revealed that the contradiction occurs by only one rule and not on the way but at the beginning, and these devices cannot settle this problem. It was pointed out that the self-referential problem is a key concept to understand the evolution of living systems to obtain subjectivity and adaptability to an ever-changing environment in which novel situations may always occur [3], even though organisms may face a crisis of their existence by the self-referential problem, as occurred in *Minimum Nomic*. In this regard, *Minimum Nomic* has a possibility to crash anytime even if the durability seems to high temporarily.

## 5 Conclusion

We propose a self-amendment game, *Minimum Nomic*, as a revised version of *Nomic*, as a tool to consider rule dynamics. The important problem of complex systems is evolvability in which both changeability and durability, in other words adaptability and stability, coexist as many natural living complex systems realize. We could discuss the emergence of purpose and goal and the self-referential feature of rule dynamics by analyzing the evolution of rules in actual play of *Minimum Nomic*. Thus, this game is a useful tool to study complex systems that typically show rule dynamics. There already exist several mathematical frameworks for studying rule dynamics [5, 6]. The self-amendment game approach to rule dynamics is to combine the empirical and the theoretical rule dynamics.

## Acknowledgment

We thank Haruhisa Tanaka and Masamichi Ushijima for useful discussions.

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