# Minimum Nomic, a Tool for Studying Rule Dynamics

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## Abstract

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 the rules and durability of the games change with the progress of the game. By analyzing the dynamics of purpose and goals and the self-referential property in observations of the games played, we claim that *Minimum Nomic* is an interesting tool for study rule dynamics.


**Keyword** Rule dynamics, Self-amendment, Self-reference, Nomic, Evolvability

## 1 Introduction

One of the interesting features of complex systems is "rule dynamics." It means that rules which govern behavior of a system may change through the behavior of the system [1]. 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 will 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, may 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 [2].

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.

There is a game of rule dynamics, *Nomic*, in which the move is to change the rule of the game. Nomic was invented by Peter Suber in 1982 [3]. The players of

the game change the rule of Nomic in playing the game. Suber devised Nomic based on the constitutional system of the United States. Thus, many rules are strictly set up in the Initial Set of Rules in order to keep changing the rule by restraining various interpretations of the rules and by avoiding conflicts among rules as much as possible. But this strictness of the Initial Set of Rules causes less changeability.

In the present study we propose *Minimum Nomic* which is a variant of Nomic in order to study evolution of rule dynamics. 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 9. Although it is possible to decrease the number to two, like *Pure Nomic*[1], the game come to be likely to stop in such too reduced game. 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. The rule set of Minimum Nomic is introduced in section 3. Characteristics found in observation of the plays of Minimum Nomic are discussed in section 4.

## 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

[1]See `http://www.playagaingames.com/games/pure_nomice`

Hofstadter's book [4]. Suber revised the rules and published them in his book [3]. After that, many subspecies have been proposed[2]. Nomic is a game in which players change the rules of the game. The Initial Set of Rules of Nomic consists of 29 rules[3]. These rules can be amended 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 rules in Initial Set of Rules are hierarchically categorized into "mutable" and "immutable". 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 easily and for the game to continue to be played. But this rigid property restrains the potential to keep changing the rules dynamically.

[2]See Peter Suber's *Nomic* site, `http://www.earlham.edu/~peter/nomic.htm`
[3]Look at Suber's site for the complete description of the Initial Set of Rules.

# 3 Minimum Nomic

## 3.1 Evolvabiity=Changeability+Durability

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, models of the rule dynamics must keep evolvability. We think that the evolvability is constituted of the following two properties:

1. the changeability of the rules

2. the durability of the game

The first property corresponds to adaptability of a system, and the second stability. Although these two properties seem to be incompatible to some extent, 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.

While Nomic is a good model of the self-amendment system, in which 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 of the game, and consequently, preclude the durability, too. Accordingly, in modifying the Initial Set of 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:

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.

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. Each player always has exactly one vote.

108. If two or more rules conflict with one another, then the rule with the lowest ordinal number takes precedence.

109. 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.

To increase changeability, and also playability, all rules of Minimum Nomic are simply in one category, "mutable"[4]. All the rules can be amended by a proposal and a successful vote. This increases, however, at the same time a risk to lose the durability. Thus, a conflict avoidance (Rule 108) and a judgment system (Rule 109) are inherited from the original.

### 3.3 Purpose and Goal in Minimum Nomic

While we omit many rules from Nomic, the essence of the Nomic, self-amend property and sustaining the game moves, is maintained. 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

[4]Of course, players can divide the rules into two or more category by enactment of such rules.

winner. The existence of a definite goal 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 menaces the status of Minimum Nomic as a game. A popular definition of game [5] requires "variable, quantifiable outcome" and "value assigned to possible outcomes" which Minimum Nomic does not satisfy. Despite of this menace, both players and observers of Minimum Nomic might judge, or feel, the play as a game. It depends on players and the evolution of rules if Minimum Nomic is truly game or not.

## 4 Analysis and Discussion of Game Played

We analyzed observations of two plays of Minimum Nomic. The number of players was 5 in the both observations.

### 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 observation, 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 observation, no winning condition was enacted, 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 a power to decide if proposal is approved or not according to his/her interest. Reigning game and changing rules may conflict with each other.

### 4.2 Logical Self-Referential Paradox

There is no rule how to start the game in the Initial Set of Rules of Minimum Nomic. In the first observation, 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 introduces, as Rule 108 and 109. But the player A's proposal revealed that the contradiction occurs not by conflict between plural rules by self-denying of only one rule, and not on the way but at the beginning, and the devices such as Rule 108 and 109 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 [6], even though organisms may face a crisis of their existence by the self-referential problem, as occurred in Minimum Nomic.

## 5 Conclusion

One of the important problems of complex systems is evolvability in which both changeability and durability, in other words adaptability and stability, coexist as in natural living complex systems. In such systems, the evolvability is realized not only in state dynamics but also in rule dynamics through development, genetic and cultural evolution, individual and social learning. We proposed a self-amendment game, *Minimum Nomic*, revised from *Nomic*, as a tool to consider rule dynamics. 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 Minimus Nomic. Thus, this game is a useful tool to study complex systems that typically show rule dynamics, since Minimum Nomic is much easier to play and to analyze the dynamics of rules than original Nomic. There already exist several mathematical frameworks for studying rule dynamics [7, 8]. The self-amendment game approach to rule dynamics is to combine the empirical and the theoretical rule dynamics.

We pointed out that the emergent dynamics of purpose and goal can be observed in the play of Minimum Nomic, since predefined purpose and goal are eliminated in the game. The effect of this elimination is, however, not completely clarified in this paper. We should conduct an experiment in which dynamics of rules in two self-amendment games with and without predefined purpose and goal are compared with quantitative analysis, in order to understand the feature of the emergent dynamics of purpose and goal.

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## References

[1] T. Hashimoto. Three undecomposabilities in Complex Systems, in *European Conference on Complex Systems(ECCS'07)*, Dresden, Germany, October 1–5 2007.

[2] F. J. Odling-Smee, K. N. Laland, M. W. Feldman. *Niche Construction: The Neglected Process in Evolution*, (Princeton University Press, 2003).

[3] P. Suber. *The Paradox of Self-Amendment, A Study of Logic, Law, Omnipotence, and Change* (Peter Lang Publishing 1990).

[4] D.R. Hofstadter. *Metamagical Themas: Questing for the Essence of Mind and Pattern* (Basic Book, New York 1985).

[5] J. Juul. The game, the player, the world: Looking for a heart of gameness, In *Level Up: Digital Games Research Conference Proceedings* eds by M. Copier, J. Raessens (2003) pp 30 – 45.

[6] D.R. Hofstadter. *Gödel, Escher, Bach: an Eternal Golden Braid* (Basic Book, New York 1979).

[7] S. J. Kim, Y. Aizawa. Synchronization phenomena in rule dynamical systems. *Progress of theoretical physics*, 102(4):729–748, 1999.

[8] J. Namikawa, T. Hashimoto. Dynamics and computation in functional shifts. *Nonlineality*, 17(4):1317–1336, 2004.