补充说明
关于复杂性尺度排序反转现象及其方法论定位
Supplementary Note
On Scale-Dependent Complexity Ordering and the Methodological Role of Failure

0. 定位声明（Scope and Status）

本补充说明不构成对《残破动态平衡论》正文理论结构、核心命题或基本假设的修订、削弱或否定。

其目的仅在于：

记录与澄清若干数值实验中观察到的**尺度相关复杂性排序现象**；

明确这些现象在理论体系中的**层级位置**；

说明其中哪些路径被证明为**不稳健、不可外推或易受观测算子影响**。

本说明应被视为实验性与方法论性的补充记录，而非正文理论的组成部分。

English

This supplementary note **does not constitute** a revision, weakening, or negation of the theoretical structure, core claims, or foundational assumptions of Broken Dynamic Equilibrium Theory.

Its sole purposes are:

to record and clarify **scale-dependent complexity ordering phenomena** observed in numerical experiments;

to specify the **theoretical level** at which these phenomena reside;

to document which exploratory paths have been shown to be non-robust, n**on-generalizable, or highly dependent on observational operators.**

This document should be regarded as an **experimental and methodological record,** not as part of the core theoretical body.

1. 方法论立场声明：关于“失败”的科学地位
1. Methodological Position: On the Scientific Status of Failure

我们在此明确采用如下科学立场：

科学不是成功学，而是失败学。

科学知识的真实积累，并非来自少数“成功结论”的不断强化，而是来自**大量失败路径的系统性记录、比较与压缩。**

历史上绝大多数被视为“成功”的科学理论，实质上是：

无数研究者在不同路径上反复失败的结果；

而最终被某个处于合适时间与视角位置的研究者加以总结。

在这一意义上，**失败路径比成功结论更具可复用性。**
成功往往是条件极其狭窄的幸存样本，而失败则定义了理论与方法的**有效边界**。

因此，在本工作中：

不稳健的实验现象；

对观测算子、粗粒化方式或测度选择高度敏感的结果；

在更严格测试下消失或转化形态的结论；

均被视为**一等科学信息（first-class scientific information）**，而非应被隐藏或修饰的“负结果”。

We explicitly adopt the following scientific position:

Science is not a discipline of success, but a discipline of failure.

The genuine accumulation of scientific knowledge does not arise from the repeated reinforcement of a few “successful conclusions,” but from the **systematic recording, comparison, and compression of failed paths.**

Historically, most theories later regarded as “successful” were in fact distilled from:

innumerable failed attempts along divergent paths;

subsequently summarized by a researcher situated at a fortunate temporal and conceptual vantage point.

In this sense, **failed paths are more reusable than successful conclusions.**
Success often survives only under narrowly constrained conditions, whereas failure delineates the **valid operational boundaries of theories and methods**.

Accordingly, in this work:

non-robust experimental observations;

results highly sensitive to observational operators, coarse-graining schemes, or metric choices;

conclusions that vanish or change character under stricter testing;

are treated as first-class scientific information, rather than as “negative results” to be concealed.

2. 实验背景与初始观察
2. Experimental Context and Initial Observations

在正文相关实验部分中，我们观察到如下现象：

对若干离散动力系统（以一维基本元胞自动机 ECA 规则族为代表）；

在不同粗粒化尺度 σ 下；

采用同一复杂性测度 $C(\sigma)$；

系统之间的复杂性比较结果随尺度发生变化。

在初始表述中，该现象曾被直观描述为“中间尺度复杂性增强”或“尺度窗口”。

In the experimental sections accompanying the main text, we observed the following phenomenon:

for several discrete dynamical systems (notably one-dimensional elementary cellular automata, ECA);

under varying coarse-graining scales σ;

using a fixed complexity measure $C(\sigma)$;

the relative complexity comparisons between systems change with scale.

In initial descriptions, this behavior was informally referred to as “intermediate-scale complexity enhancement” or a “scale window.”

3. 进一步测试与失败路径的暴露
3. Further Tests and the Exposure of Failed Paths

在随后进行的系统性反证测试中，我们显式扰动并扫描了：

不同粗粒化算子（如 majority 与 parity 等）；

时间窗口长度与瞬态截断；

重复次数与随机初态；

峰值判据与排序判据的区分。

结果表明：

单一系统的 $C(\sigma)$ 曲线**未必存在稳健的中间尺度极大值**；

所谓“绝对峰值”对观测与粗粒化选择高度敏感，在合理的 **pipeline** 下可能完全消失；

将“峰值存在性”作为核心判据，是一条已被验证为**不稳健的失败路径。**

这些失败路径未被回避，而被明确记录于本补充说明中。

Subsequent systematic falsification tests explicitly varied and scanned:

distinct coarse-graining operators (e.g., majority vs. parity);

temporal window lengths and transient removal;

repetition counts and random initial conditions;

the distinction between peak-based and ordering-based criteria.

The results show that:

a single system’s $C(\sigma)$ curve **need not exhibit a robust intermediate-scale maximum;**

purported “absolute peaks” are highly sensitive to observational and coarse-graining choices and may vanish under reasonable pipelines;

treating peak existence as a central criterion constitutes a **failed and non-robust path.**

These failed paths are not concealed but explicitly documented here.

4. 从失败中保留下来的稳健结构：排序反转
4. Robust Structure Preserved from Failure: Ranking Flip

尽管“绝对峰值”路径被否定，但进一步分析表明：

复杂性排序随尺度发生反转（ranking flip）的现象在多种合理 pipeline 下保持稳定存在。

即存在 $\sigma_1 \neq \sigma_2$，使得：

该现象：

$$C(S_i, \sigma_1) > C(S_j, \sigma_1), \quad C(S_i, \sigma_2) < C(S_j, \sigma_2)$$

不依赖单系统的非单调性或峰值结构；

即便在各系统

$C(\sigma)$ 单调变化时仍可出现；

对不同粗粒化算子均可复现。

因此，**排序反转而非绝对峰值**被确认为该实验框架下的稳健结构。

Although the “absolute peak” path fails, further analysis demonstrates that:

Scale-dependent ranking flips remain robust across multiple reasonable pipelines.

That is, there exist $\sigma_1 \neq \sigma_2$ such that:

$$C(S_i, \sigma_1) > C(S_j, \sigma_1), \quad C(S_i, \sigma_2) < C(S_j, \sigma_2)$$

This phenomenon:

does not require non-monotonicity or peak structures in individual systems;

can occur even when all $C(\sigma)$ curves are monotonic;

is reproducible across distinct coarse-graining operators.

Hence, **ranking reversal rather than absolute extremum behavior** constitutes the robust experimental structure.

5. 理论层级的澄清
5. Clarification of Theoretical Levels

基于上述失败路径与保留结构，我们明确区分：

正文理论关注结构性与生成机制问题，不依赖具体测度的极值行为；

本补充说明仅讨论在给定观测框架下复杂性比较所呈现的**尺度依赖序关系**。

因此，本补充说明的结论应被理解为：

复杂性不具有尺度无关的全序结构。

而非任何“最佳尺度”或“普适峰值”的存在性断言。

Based on the failed paths and preserved structures above, we distinguish:

the **core theory,** which addresses structural and generative mechanisms independent of metric extrema;

this **supplementary note,** which concerns scale-dependent ordering within a specified observational framework.

Accordingly, the conclusion here should be read as:

Complexity does not admit a scale-independent total ordering.

rather than as a claim about optimal scales or universal maxima.

6. 关于不修改正文理论的说明
6. On the Decision Not to Modify the Core Theory

我们选择不对正文理论作出修订，理由如下：

正文并未将任何实验峰值作为逻辑公理；

失败路径属于实验与方法层信息，不应反向侵蚀理论结构；

将失败显式分离并记录，比削弱理论命题更符合科学积累方式。

We therefore refrain from modifying the core theory because:

no experimental peak is used as a logical axiom in the main text;

failed paths belong to experimental and methodological layers, not to theory;

explicitly recording failure is preferable to progressively dulling theoretical claims.

7. 结语：失败作为可传承的知识
7. Concluding Remark: Failure as Transferable Knowledge

失败不是需要被修正的瑕疵，而是科学得以前进的压缩记录。

本补充说明正是以此立场被保留与发布。

Failure is not a flaw to be corrected, but a compressed record through which science advances.

This supplementary note is preserved and released in precisely that spirit.