

Review of: "On the statistical arrow of time"

J. Kasmire¹

¹ The University of Manchester

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First, the easy comments.

I enjoyed reading the article very much. Thank you for writing this very interesting piece.

There are several minor grammatical errors involving agreement between subject and verb. For example, "as the system evolve" should be either "as the systems evolve" or "as the system evolves". I did not note down all of these because they did not impede my comprehension when reading. Thus, I did not consider them a priority to find and correct. However, they may be distracting or may even impede comprehension for some readers. The author may wish to run the text through grammar check software to correct them or to ask a pedantic friend to read through the text and find these subject-verb disagreement errors.

There are a few instances in which the author used "loose" instead of "lose". One example is the line reading "The observer loose information about the system over time." This is a common confusion in English but could potentially cause some comprehension errors for readers that try to understand the text as "loose" rather than assume it is a typo. The line should read "The observer loses information about the system over time." which corrects a the minor subject-verb agreement error but also uses the correct verb. I encourage the author to find all instances of "loose" and change them to "lose" or "loses" if appropriate.

I really enjoyed the idea that a monkey should have a much greater sense of time's arrow than a human. Playful examples and language in scientific papers is a delight and I am pleased the authors have included it here.

Now for the less easy comments.

I understood the systems discussed in this article to be both closed and non-living as the second law of thermodynamics is not generally understood to apply to open systems that are capable of evolution by natural selection. The examples given, such as the box of gas or the deck of cards, are indeed closed and non-living in ways that a petri dish of bacteria or a colony of mole rats are not.

However, the changes described as happening to these systems happen from "outside". The box of gas is opened and the deck of cards is thrown upwards, both presumably by a person that acts on the system from its environment. Later in the article the author explain about ergodicity breaking and how the system can be redefined to include any interactions

that were previously considered to be part of the “environment”. However, this complicates the issue for me as including the human actor that opened the box of gas or that threw the deck of cards means that the systems are no longer closed and non-living.

There is no easy resolution here: the examples given are deliberately simple to demonstrate the point but in so doing they introduce complicated concepts about outside actors that are not fully explained and that conflict with common knowledge readers are likely to have about the second law of thermodynamics.

Personally, this is further complicated by the author's use of the word “evolve” to mean any change in the system over time. The word “evolve” is definitely used this way, but some readers (including me) may automatically interpret it to mean a change in response to environmental pressure by preserving more advantageous differences (e.g. evolution by natural selection). This article does not seem to touch on how entropy applies to living systems that evolve by natural selection (thankfully, because that is a hot mess). However, the examples that seem to include-but-not-really-include outisid actors and the use of evolve to describe change could muddy the waters a bit.

I don't have a good suggestion for how to improve the examples. But I would encourage the the author to clarify early on that the systems in question are intended to be understood as closed and non-living and that “evolve” is meant to be read as “change over time” rather than “evolution by natural selection”.