



The Red Queen Principle

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for an evolutionary system, continuing development is needed just in order to maintain its [fitness](#) relative to the systems it is co-evolving with

This principle was proposed by the evolutionary biologist L. van Valen (1973), and is based on the observation to Alice by the Red Queen in Lewis Carroll's "Through the Looking Glass" that "in this place it takes all the running you can do, to keep in the same place."

Since every improvement in one species will lead to a selective advantage for that species, variation will normally continuously lead to increases in fitness in one species or another. However, since in general different species are coevolving, improvement in one species implies that it will get a competitive advantage on the other species, and thus be able to capture a larger share of the resources available to all. This means that fitness increase in one evolutionary system will tend to lead to fitness decrease in another system. The only way that a species involved in a competition can maintain its fitness relative to the others is by in turn improving its design.

The most obvious example of this effect are the "arms races" between predators and prey, where the only way predators can compensate for a better defense by the prey (e.g. rabbits running faster) is by developing a better offense (e.g. foxes running faster). In this case we might consider the relative improvements (running faster) to be also absolute improvements in fitness.

However, the example of trees shows that in some cases the net effect of an "arms race" may also be an absolute decrease in fitness. Trees in a forest are normally competing for access to sunlight. If one tree grows a little bit taller than its neighbours it can capture part of their sunlight. This forces the other trees in turn to grow taller, in order not to be overshadowed. The net effect is that all trees tend to become taller and taller, yet still gather on average just the same amount of sunlight, while spending much

[Home](#)[Metasystem
Transition Theory](#)[Principles of
Systems and
Cybernetics /
Direction and
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Up

[Prev.](#)[Next](#)

Down

more resources in order to sustain their increased height. This is an example of the [problem of suboptimization](#): optimizing access to sunlight for each individual tree does not lead to optimal performance for the forest as a whole.

In sum, in a competitive world, relative progress ("running") is necessary just for maintenance ("staying put").

In its emphasis on the stress that necessarily accompanies evolutionary development, the Red Queen Principle is related to the [generalized "Peter Principle"](#).

Reference:

Van Valen L. (1973): "A New Evolutionary Law", *Evolutionary Theory* 1, p. 1-30.

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