Hidden Laws of Nature

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This paper defines and explores the **Principle of Non-Identical Sets**. The Principle explains the common experience of not having the right set of parts to assemble some mechanism. A number of cases under the Principle are described.

Most rational people will agree that the universe is governed by inviolate physical laws. Many of these laws are deterministic, with effects predictable to the limits of our best measuring apparatus. Other physical phenomena are more subtle. Some of these are revealed to us as statistical behaviors, and though outcomes of individual cases may be totally unpredictable, there can still be great precision in statistical averages over large numbers of trials. Both of these principles are well understood, and have important applications in helping us understand our world.

On the other hand, there are those who believe, or at least sense that there may be other forces in the universe that subvert these laws of mainstream science. These illusive, mostly hidden principles are impossible to predict or anticipate, and evade all attempts to measure or quantify them. They seem to be more likely to come into play when they are not expected, and are rarely seen when planned for. They control and account for the unlikely, the fluke, the aberration.

Even though these forces resist all attempts to detail their workings, historical observation and experience can shed light on some of their effects and properties. Of course, by the very nature of these principles, any insight gained will be utterly worthless in controlling them or predicting their effects, so the effort is really only useful as an intellectual pursuit.

Following is a brief discussion of one of the more common manifestations of these sinister laws, and some observations of its behavior.

The Principle of Non-Identical Sets

Most devotees of the mechanical arts have doubtless noticed a number of well known principles governing the processes involved in doing one's own domestic repair and assembly jobs. These principles are the prime difference between a straight forward, logical, step by step process and frustrating reality. By extension, they explain the concept of *time bloat*: two hour jobs normally take two days. While the root causes of these phenomena are still beyond our reach, they are thought by many to be evidence of a deep malevolent undercurrent in the universe towards those who fix things themselves. The following paragraphs will attempt to elucidate what is known about some of these principles in the hope that it might spur further basic research into this important area.

One area where almost everyone has felt the effects of these forces is when attempting to assemble something from component parts. The precepts in question govern the relationship between the set of parts necessary for an assembly, and the set of parts available for the assembly. Whether a car engine or a baby crib, the principle is invariant: the two sets are normally not the same.

There are two broad classifications of this problem: the so-called new assembly class wherein the parts available are from a never assembled kit which is to be assembled for the first time, and the reassembly class, where the parts available are the result of a previous disassembly, possibly with the replacement of some old parts with new ones. The distinction is largely irrelevant for most purposes however, since the history or origin of the set of available parts has little or no effect on the value of any of the parameters discussed below.

Definition: **Non-Identical Set Principle**. If n is the number of parts *required* for an assembly, there will be n + ε *available* for assembly, where ε is a small integer.

While the definition doesn't technically preclude ε being zero, it is usually not. Also keep in mind that ε can be positive or negative.

There are a number of cases to explore in studying the principle, and although mathematics would be the natural language to describe them, we can dispense with most of the jargon and notation here for the sake of brevity, and still convey a general understanding. One tool that is very useful in illustrating simple relationships between sets of items is the widely used and intuitive Venn diagram. A Venn Diagram uses circles to represent, in this case, sets of parts. The members of the sets are presumed to be inside the circles, and relationships between the circles show relationships between the sets of parts.

Throughout the following discussions, $\mathbf{S_r}$ and $\mathbf{S_a}$ represent the set of parts required for an assembly (the **required set**) and the set available for assembly (the **available set**), respectively.

Based on likelihood of occurrence, there are two main cases to investigate, depending on which set is larger, and several auxiliary cases based on more rare relationships between S_r and S_a.

Case I

The first case we'll explore is illustrated by the Venn diagram in Figure 1. As the figure shows, all of the required parts are available, but there are also parts that are members of the available set that are not required. This describes the familiar situation of having leftover parts that have no apparent place or function in the assembly. The set of these "leftover" parts (represented in the diagram by the annular region inside S_a but outside S_r) is called the **supernumerary set**.

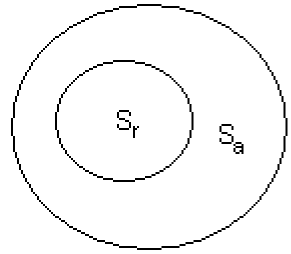

Figure 1

The size of the Supernumerary Set (ε) in Case I instances is commonly called the **creep** of the set of parts because repeated disassembly and reassembly often causes the size of set S_a to creep upward. The fraction formed by dividing the Creep by the number of required parts is usually referred to as the **creep factor**, which can range from 0.01 to about 0.10, depending on the mechanism.

For instances that fall into Case I, the Principle is lovingly referred to as the **Spontaneous Generation of Small Parts**.

Case II

Case II instances, illustrated by Figure 2, are similar to Case I instances, but with the roles of the required and available sets interchanged. In these situations, colloquially referred to as **The Law of the Missing Link**, ε is negative, implying that there are fewer parts available than required. The set of missing parts, called the **delinquent set** is, as before, represented by the space between the two circles in Figure 2.

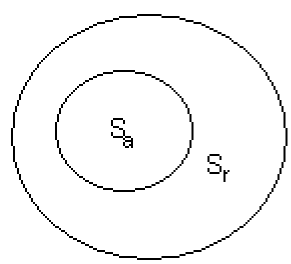

Figure 2

Delinquent set parts normally have high critically to the function of the mechanism.

Analogous to Case I, the number of missing parts divided by the number of required represents the relative size of the shortage, and is called by various names, the **shrink factor** being the most civil. Shrink factors for Case II situations normally are between -0.10 and -0.01.

<u>Case III</u>

An interesting and frustrating variation of the concept under study is shown in the Venn diagram of Figure 3.

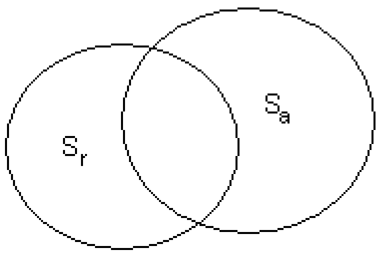

Figure 3

In this scenario, we can see the effects of both Case I and Case II, since there are both delinquent and supernumerary parts. Note that Case III technically allows an especially irritating special situation wherein the delinquent and supernumerary sets are of equal size, and thus $\varepsilon = 0$. This represents the condition where the total *number* of parts is correct, but there are one or more *incorrect* parts in the available set.

<u>Case IV</u>

Case IV, shown in Figure 4, represents situations where sets S_a and S_r are identical. This case of course represents the classical theoretical view, even though it is relatively rare in practice.

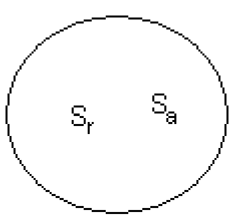

Figure 4

<u>Case V</u>

Case V is illustrated in Figure 5. This represents the situation wherein S_a and S_r are disjoint. That is, none of the parts available for an assembly seem to have anything to do with it. There is nothing to preclude being able to assemble the parts in S_a to produce a complete working mechanism, but the clear implication is that it would be a different one than the one intended, with not a single part in common.

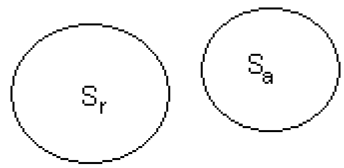

Figure 4

In this case, all the required parts are delinquent, and all the available parts are supernumerary. Fortunately, nature is not normally so cruel as to let one take a bicycle apart, and upon reassembly, end up with a toaster.

Empirical Statistical Results

Some work has been done in the author's private test facility to determine the statistical properties of the value of ε. In the simple cases where ε's sign is known, individual probability density functions (pdf) can be approximated for Cases I and II. Not surprisingly, the two cases show mirror image symmetry, and are illustrated in Figure 6.

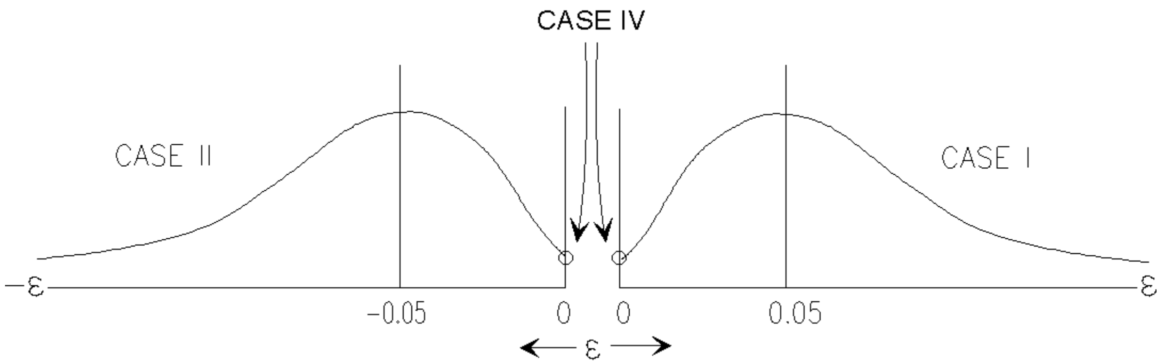

Figure 6

The behavior of **ε** approximates a Poisson distribution with a mean of ±0,05, depending on the case. Since the vast majority of real world instances fall into Case I or Case II (with a minor contribution from Case III), the overall process can be described by combining and renormalizing the two functions into a single bimodal distribution as shown in Figure 7.

Figure 7 is very telling, and deserves some comment. Workers with more mystical inclination than the author have claimed to see much symbolism in the shape of the curve. This is likely the source of the colorful description of the region around ε=0 as the "Valley of Good Karma", presumably reserved for those few lucky individuals who seem to defy the odds most of us are subject to. In a similar vein, the higher probability parts of the curve are sometimes called the "Twin Peaks of Ineptitude". People who are able to routinely operate within the valley seem to be unaware of any particular advantage they have, and even sometimes show an annoying air of bemusement at the struggles of those less fortunate. It is widely believed that this predisposition for operating in the low |ε| areas of the curve is often mistaken for talent.

Future Work

This work has served to lay part of a foundation for further research into the important but neglected field sometimes loosely referred to as "Murphy's Laws". Although some recent very successful work has been done, such as the long awaited proof of the "Toast Always Falls Buttered Side Down" conjecture, there remains vast untouched areas begging for attention.

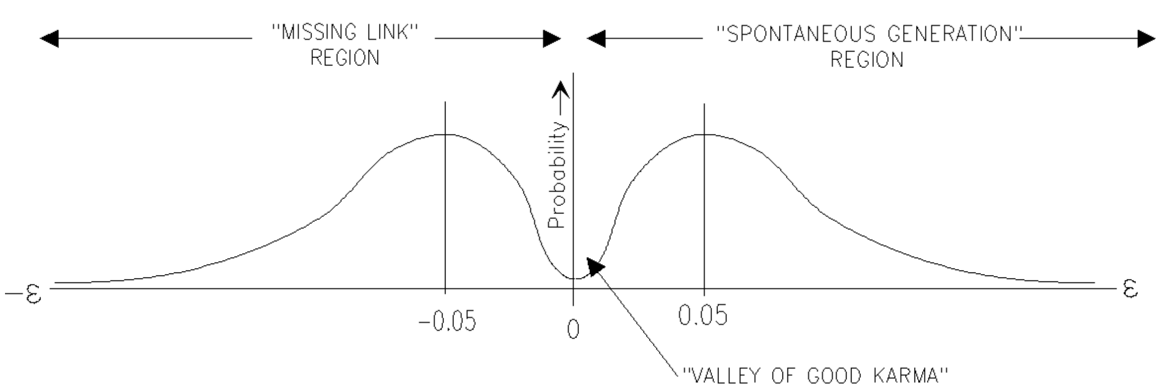

Figure 7