

Mark Gilbert
the emergence of the unique
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DNA – Ligase is the biochemical substance that assembles and repairs DNA. A member of the synthetase family of enzymes, it is an organic catalyst that initiates and controls the synthesis of simpler molecules into long, polymeric strands of protein. Enzymes, like all catalysts, work by reducing the activation threshold of a reaction, which is to say, they reduce the energy and effort necessary for the initial substances of a reaction – termed *substrates* – to combine into a new molecular form known as their *product*. In particular, DNA – Ligase is believed to work according to the method of “induced fit”; which means that the enzyme’s precisely articulated molecular structure “lines-up” the substrates and brings them into the relative positions required for reaction. Fortunately for the dependability of our genetic information, DNA strands are chemically quite stable. The process of their assembly is therefore extremely complex and involves not only DNA strands and DNA - Ligase themselves, but also other substances that provide the energy necessary to build or break the chemical bonds of the strand. It would appear that the role that DNA Ligase plays in this chemical Minuet is to gather the various Biochemical players in the reaction together, and then arrange them in time as well as in space.

To paraphrase Manuel De Landa, system's theoretician and the author of *A Thousand Years of Nonlinear History*, the function of enzymes is to provoke the meeting of substances and incite them into assuming forms that they would not have otherwise taken on. Human metabolism is a process in which an assortment of freely-circulating substances are drawn from the environment and integrated into our bodies. The task of sorting this array of input materials and systematically transforming them through a complex system of reactions requires molecular-level algorithms that initiate and guide these interdependent chemical processes. The molecular templates of enzymes encode these algorithms, which not only precisely define the agents, the progression and the results of the process; they enable it to transpire in the first place. Enzymes insure that our bodies’ metabolic reactions proceed in methodical fashion: rapid, yet controlled, with products that are predictable, coherent and useful to the cell.

There is, however, an interesting enigma here. Living things may have many qualities, but predictability doesn’t always top the list. Despite what we might think about some of the people in our lives, one would generally tend to say that flexibility, adaptability and surprise offer a pretty good description of human behaviour. This unpredictability of the macro-organism reflects what is happening at the molecular scale as well. While any one enzyme can produce and control a only a very specific reaction, research is showing that even the most basic biochemical reactions involve a staggering number of interrelated metabolic steps and feedback signals. Even processes as simple as the glucose cycle, which turns sugar into cellular energy, requires a chemical pathway involving ten different enzymes; processes such as the replication and maintenance of cellular proteins encompass an even greater number of chemical agents. So, while an enzyme is extremely specific in what it does, it is a part of a larger chain of interactions that is capable of great complexity and variation.

Such networks of interacting parts are described as complex systems. Although the study of complex systems has evolved into a very broad and interdisciplinary field, one definition of the term – offered by the physicists and mathematicians Nigel Goldenfeld and Leo Kadanoff – is that systems are complex when they “*can produce complex structures even in simple situations, and can obey simple laws even in complex situations*”. They are systems that can produce both structure and variation; like the human metabolism, they build an infinite of variety of states out of very simple and clearly defined reactions. It seems that many other phenomena are complex as well. Flowing water, which can be exhibit both channelled and turbulent behaviour simultaneously, or the weather, which exhibits regular seasons while producing daily unpredictability, are everyday examples of physical systems that display complex behaviour.

There is a further quality to the complexity of the cell that shares with both water and weather. The nature of all these systems is such that pattern is produced that would not be immediately predictable by the rules

governing the behaviour of their parts. Flowing water forms vortices; enzymes in cells form life. While the rules governing the behaviour of the entities that constitute the system – gravity and the attraction between water molecules, for example, or the molecular structure of an enzyme and concentration of its substrates – are in and of themselves simple, the performance of the collective system is capable of exhibiting coherence and complexity that go far beyond that of the system's individual agents themselves. Patterns seem to emerge spontaneously out of the interplay of the parts within the system itself. Systems that can induce simple agents to form coherent patterns are said to exhibit *emergent behaviour*. If one considers complexity to be a function of the information that a system contains, we see that the complex patterns produced by emergent systems contain more information than the initial agents themselves possess. The total effect of the system exceeds the sum of its parts.

We are able to observe emergent patterns in many realms of human expression. Think about the written alphabet, for example, where the information that a combination of words is able to express could hardly be predicted from the consideration of intrinsic qualities of single letters on their own. Or of music, where harmony, rhythm and melody interact to create aural impressions that vastly exceed the auditory potential promised by any single tone. Now, what differentiates these complex systems from those in the natural world is the human intention which assembles these elements into their complex form. Yet, the human assembly of these complex expressions is rarely spontaneous itself, there usually needs to be intermediaries that aid the composition of the systems agents into a coherent pattern. It is very difficult to conjure complexity out of a vacuum.

This certainly holds true in the field of design. The fascination that successful design evokes is a product of the complex interplay of form, meaning and intention of use. Yet, only in the rarest of instances can the complexity of good form be consciously willed; usually, it is the result of many steps, processes, procedures and methodologies that layer small intentions into series of iterations that progress non-linearly towards their result. Each of these courses of action is comprised of many simple acts that are in themselves determinate in character and are often resemble recipes in their application: step one, step two, step three. The actions involve specific questions or problems of the design process itself; some are involved in managing information, some are involved with producing form, others serve to scrutinize meaning. The execution of each involves some sort of algorithm or template that defines how the act will be carried out. In the end, design is a process of carrying out, and the method of the design is the sum of all the small algorithms that control the actions needed to produce a result. Method is seldom overarching; "*The Method*" is a fiction. Method is like the enzymes that catalyse the metabolism in a cell: each step is specific and defined, yet cannot exist upon its own. It is the subtle assemblage of the many small acts, the accumulation of many decisions, which brings a design to life.

It is said that the power of a method is inversely proportional to its generality, which is to say, that the more a method specifies its terms and procedures, the more effectively it will produce useful results. Seeing method as a catalyst allows us to understand how method - which is predicated upon regularity and even predictability - could be of value for a creative discipline like design, which, in the end, is predicated upon the production of the unique. It is important to remember that in many ways, uniqueness is *the* decisive attribute in design. An object that does not exhibit some new formal characteristic, for example, is by definition a copy, not a design. Yet newness itself is insufficient; a design must also be coherent and suitable for its intended use. Here the specificity of methods and procedures is highly advantageous for the design; they order and structure the relationships between the constituent parts of the incipient design. Without method, there is little chance for coherent form.

In the end, method allows for the unexpected because it produces systems that have the potential for intricacy and variation. Of course, the methodical production of formal systems doesn't guarantee complexity; but it does create the conditions necessary for it to emerge. And it is out of the emergent behavior of complex systems that the ineffable aura of good design comes to be: the uniqueness which arises when the quality of the system exceeds the sum of its parts. Method is the middleman for the new. Its role in design is to catalyze the emergence of both structure and variation through the orchestration a controlled yet complex series of simple interactions between content and form.