

## The Obvious Answer

Arthur T. Johnson

*Published in the IEEE-EMBS Pulse vol. 5, no. 4, page 62 (Jul/Aug 2014).*

In his book titled “*Everything Is Obvious. Once You Know the Answer*”, Duncan Watts posits that what we value as worthwhile is often determined by chance. He cites the case of the famous painting *Mona Lisa* that is now considered among the world’s masterpieces, and hangs in a special place in the Musée du Louvre in Paris. For centuries, the *Mona Lisa* was of no particular interest, and was thought of as no more than an obscure painting by a second-rate artist. It was not until it was stolen from the Louvre in 1911 that attention was drawn to this work of art. Once it was seen to be valuable enough to be stolen, its popularity soared to its revered position today.

Watts also cited studies that showed that the popularity of music, books, or videos from among many possible competitors depends strongly on an accumulation of a few early samplings by others; once a trend starts to become apparent, later patrons want to see what the fuss is all about, and so add to the apparent popularity of the item. In positive-feedback fashion, early success begets later success.

That life is chaotic in the mathematical sense is well known. Later outcomes depend very strongly on the many choices, some quite insignificant at the time, that are made earlier. Environment, and its consequent variations, determines, to a large part, what are the final outcomes. In my own career, a series of choices about where to go to college, who to marry, where to live, and how to express my urge to activism led to becoming President of the Alliance for Engineering in Medicine and Biology (AEMB – the forerunner of AIMBE), of the Institute for Biological Engineering, of the International Society for Respiratory Protection, and the Secretary of the Biomedical Engineering Society, among others. When I look back over my career, I can see how some choices made earlier, if chosen differently, could have changed my life pathway completely. What happened earlier mostly determined what happened later.

MIT’s Dr. Nam Su once said that individual birth is a resetting process, that each life begins anew at the basic genetic potential of the species without the corrupting influence of environmental options. For the most part, this seems likely. However, with the important discovery of epigenetic changes in gene expression, it has become apparent that birth is not completely a reset. Agent orange exposure in Viet Nam, and now asthma, have been shown to affect several subsequent generations. Our progeny can also be affected by our own choices.

There is one rather mundane application of the ideas in Watts’s book. If the obviousness of what we know is determined by prior knowledge, then it would seem that we can improve our teaching if we disclose to our students the problem solutions before we show them how to arrive at the answers. I had tried a little of this in my book, “*Biological Process Engineering. An Analogical Approach to Fluid Flow, Heat Transfer, and Mass*

*Transfer Applied to Biological Systems*”, where I gave some illustrative examples of applications of basic transport concepts to fluid flow, heat transfer, and mass transfer at the end of the first chapter on basics and before the subsequent chapters dedicated to each of the transport topics. Once they know the answers, students can often figure out their own methods for arriving at the known answers, as we all know. Knowing the answers ahead of the methods is also what makes so effective the technique of teaching starting with case studies.

Another application of Watts’s conjecture is the mistake made by many presenters at technical meetings; they give their oral presentations in the same order as the written papers that they publish. Listen to these, and you will hear: 1) introduction, 2) methods, 3) results, and 4) conclusions. This is a mistake; the audience does not have the luxury of flipping a page or two to read of the outcomes of the study before focusing on the methods. They need to know the answers before the methods to be able to follow the presentation well. Instead of the typical presentation scheme, the presenter should give: 1) introduction, 2) conclusions, 3) methods, 4) results, and 5) conclusions repeated. The presenter could say something like, “These are my conclusions, and this is how I arrived at them”. In this way, the gentle audience can know where the talk will end up and be more attentive as a result.

Knowing the answer ahead of the means to arrive at it is important when there are so many possible choices that guidance is called for. With this in mind, we can all become better writers, teachers, speakers, and even life planners. Setting of long-term goals is, in some sense, knowing the tentative answers to a long process of achieving them. Then, all that’s needed is to figure out the choices to make to get there.