

A Rose by Any Other Name is a Different Rose

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The voting is over and the election is done. The people have spoken. There were winners and losers, sometimes the right ones and sometimes the wrong ones, but it is over.

I have learned a lot about biology, and one of the most stunning things I have learned is that voting preferences are 60% genetically determined. This was reported by Hatemi et al, (*Behavior Genetics*, 37(3): 435-448, 2007) from results of twin studies in Australia. This voting preference fact was brought to mind again by a recent study that identified a certain gene in people that made them more likely than others to have liberal tendencies. This so-called “liberal gene” apparently relates to dopamine receptors in the brain that makes those who possess them much more likely to have personalities open to new ideas (Settle et al, *Journal of Politics*, 72(4): 1189-1198, 2010).

It seems that, despite how much we protest, much of what we say or do is determined by some basic and primal characteristics over which we have little or no control. Our genes are powerful indeed, and have a lot to say about who we are and how we act.

There are those who would point to the 60% voting preference figure and forget the other 40%. These are the people who believe that if we could figure out what genes are present, and the functions of each of these genes, we could determine exactly what each microbe, plant, animal, and person is likely to do. The genome *uber alles!*

We are still on the cusp of the genetic revolution, and, as with all new technologies, the gene has been oversold. There is still that other 40%, and that’s where my interest lies. What are the environmental factors that modify behaviors that would otherwise be predictable from the genes that are present?

Biology displays a complexity based upon many interactions, feedback loops, and redundancy. The genome is one example. We know that Mendelian genetics is only the simplest of cases; there are interactions, modifiers, competition, and overlappings among genes; there are epigenetics and transposons. A gene may be an active gene in one set of circumstances and may not act at all as a gene under other circumstances.

The genome serves as an information legacy to pass successful biological characteristics from one generation to the next. However, it is not the only such legacy. There is cultural information taught by members of older generations to those younger than themselves (so called memes). This mode of information transfer has been particularly successful for humans, but has also been advantageous for survival and reproduction of mammals and birds (and perhaps other animals). Another information legacy is in the microbes we carry in numbers ten times as many as our own human somatic cells. These microbes are very important to our health and survival, and, because of this, are passed down from generation to generation. They are so important, that probiotics, microbes normally passed from mother to infant during nursing, have been added to commercially-available infant formula. Microbes are passed from older cud-chewing animals to their youngsters through fecal exposure. Nitrogen-fixing bacteria are

passed from growing legumes to seedlings. This is truly an important information legacy.

A fourth information legacy appears in the form of prions, those misfolded proteins that are the cause of many degenerative diseases, such as Alzheimers and transmissible spongiform encephalopathy (TSE). Prions also may have positive effects in that they assist in the formation of new neural memory connections in the brain. Importantly, prions can self-replicate; they don't need the DNA-RNA-ribosomal-protein process that other proteins require. These prions may be passed from one individual to another as a source of information.

So, there you have it. Four types of information storage and transfer, only one of which, the genome, has generally been credited with wondrous properties. How much of the other 40% is determined by the alternative three legacies is not yet known, but there are challenges for bio-based engineers and scientists to find out. Once we know, and our comprehensive models can truly and accurately predict outcomes, we won't need to endure endless Robocalls, TV ads, and the surprises that result from real live voting.