# Where is the Progress?

## Review of Stephen Jay Gould's "Full House: The Spread of Excellence from Plato to Darwin"

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## 1. THE FULL HOUSE: CONSIDERING A SYSTEM'S COMPLETE VARIATION

"Full House" is undoubtedly about the misunderstanding of variation in different systems. In this sense, it follows a systems-theoretic discourse relevant to many areas of human activity – how else would it be possible to discuss baseball and evolution together so persuasively? But Gould's aim is above all to discredit the concept of "progress" in biological evolution, which he does by discussing strong evidence that such a concept derives from a short-sighted look at the whole scope of variation observed in the records of natural history. This myopic understanding of biological evidence, he proposes, stems from our desire to retain a sense of specialness in the universe after the revolutions initiated by Copernicus, Galileo, Newton, Darwin, and Freud.

The first part of the book discusses the statistical tools needed to evaluate the behavior of systems with variation, namely, the mean, the standard deviation, the median, and the mode. Different entertaining examples are presented to show the relative merits of each measure of central tendency, particularly when applied to skewed distributions. Indeed, the most important statistical notion in this book is that of a skewed probability distribution constrained by right or left finite limits or "walls". All particular phenomena discussed are shown to be based on one such distribution, where the right or left wall is present due to some physical or organizational limitation. The mean or average of these

distributions is pulled in the direction of skew as skewness increases, the median (halfway point) is pulled less, and the mode (the most common value) is not pulled at all.

An example of this behavior is found in the central tendency of the distribution of incomes in a given society, where the existence of a few zillionaires can highly skew the income distribution, causing an increase on the mean and median, but not on the mode. Of particular importance to Gould's argument is the existence of a one-sided limitation on variation; for this specific example a "left wall" below which incomes cannot decline, say a minimum unemployment benefit. Let us assume that we are analyzing a population of unemployed members of our society. They all start at this same lower limit of income. Assume that each member will, with some probability, get a new job or occupation and thus have its income adjusted, with equal probability, either upwards or downwards. Since there is a "left wall" on minimum income (the unemployment benefit), after a while, the largest income will be substantially higher than the minimum at the "left wall", the mean and the median income will also increase, while the mode will remain at the lower limit. Thus, even though each member has equal probability of having his or hers income increase or decrease, because there is only one direction for incomes to vary, the mean statistic displays an average income growth. In other words, even without an explicit mechanism for increase of some quantity, or progress, in the presence of a lower limit or "left wall" on its destribution, random change will lead such quantity to increase for individual instances, as well as on average, thus creating the illusion of progress.

Gould's foremost achievement in this book is to convincingly warn us that when speaking of progress one must make sure to consider the full house of variation of a system, not just averages or highest individuals. Only a holistic study of system's variation can distinguish the cases where an increase (or decrease) in a given quantity is a result of an explicit mechanism of directionality, from those where it is merely an implicit, directionless, random mechanism that only with the existence of a "wall" on a distribution can average out to the observed increase (or decrease). It is indeed a most noble scientific endeavor the identification of explicit mechanisms of cause and effect, as opposed to directionless or diffusion effects, from what at statistical face-value seems to be the same overall behavior.

In this quest, Gould's argument rests most strongly on the work of McShea [1993, 1994], specifically in the identification of active and passive large-scale trends in the history of change of some quantity. McShea's work focuses on biological evolution, particularly on the history of complexity in some vertebrae, which from a limited fossil record, was shown to fall into the passive kind, that is, no explicit mechanism for the increase of complexity, or progress, was detected. McShea bases this conclusion on several facts that he further proposes as criteria for the distinction between active and passive trends: for his sample record, the minimum values of complexity were preserved throughout history, descendent species did not observe a tendency for increased complexity from ancestral species, and furthermore the skewness of the complexity distribution for lineages away from the "left wall" showed no tendency towards the direction of higher complexity (right).

Gould applies much of the same reasoning to the problem of the disappearance of the .4 hitter in baseball, which has been elsewhere described as a decline in the quality of baseball hitters. He shows that the disappearance of .4 hitting is actually a result of an increase in overall quality of players, expressed in the decrease of variability in the distribution of batting averages. In other words, the

difference between the best and worst batters in professional baseball leagues has declined. Topping this with a postulated, but most plausible, "right wall" of human athletic brilliance, one can see that since there is not much room for athletic improvement of a gifted individual, and since quality of all players has increased, it becomes almost impossible for even the most gifted batters to reach the .4 mark. Non-American readers should be warned that the (too) lengthy discussion of this baseball issue may be rather boring.

## 2. PROGRESS AND CULTURAL EVOLUTION

Towards the end of the book, Gould discusses the differences between the processes of biological and cultural evolution in terms of the active and passive change trends. This last portion of the book, though perhaps unnoticed by a more biology-minded reader, is of great importance to those interested in human knowing.

Naturally, as Gould emphasizes, arguments based on the notions of progress and complexity are tricky affairs since these terms can have many distinct vernacular meanings. To study this notion scientifically or philosophically, one must be precise about which connotation of the vernacular term one is using. In biology, progress has been equated with an explicit mechanism responsible for the increase in complexity of evolving organisms. In other words, the increase of complexity found in evolution is seen as a consequence of the neo-Darwinian natural selection algorithm which leads organisms to increase their fitness in local environments. But how does one study complexity? McShea opted for a definition that can be easily quantified and still follows a common vernacular understanding: complexity as a function of the number of different parts of a system and the irregularity of their arrangement, that is, complexity as opposed to order and homogeneity.

McShea's results (as well as the results of others as discussed in Full House), can only be taken, at best, as anecdotal evidence given the very limited access to fossil records. In any case, they show that average increase in complexity can occur without an explicit mechanism to drive this increase, or progress, merely from a passive, diffusion-like, process of random change. It is also easy to set up Artificial Life experiments following a Darwinian genetic algorithm which will reach the same conclusion. Consequently, given what we know about neo-Darwinian natural selection, the limited fossil record, and the overwhelming presence on Earth of simpler bacteria, no mechanism has yet been identified in biological evolution to assert an active progressive trend towards greater complexity. Indeed, Gould's compelling argument for a passive trend of complexity increase, based on a "left-wall"/right-skewed complexity distribution, where the "left-wall" is established by a minimum threshold of complexity for life occupied by bacteria, is at the very least highly plausible.

Regarding cultural evolution, on the other hand, Gould points out two important differences that stand out as motors of a more active trend for directionality and rapidity: topology and mechanism of inheritance. The first refers to the observation that in biological evolution, once a species becomes separated from an ancestral line, it remains a distinct species forever. There is no amalgamation or joining of species, while cultural evolution thrives on the amalgamation of ideas across cultures and individuals – e.g. the rapid dissemination of firearms in Japan after their introduction by the Portuguese. The second refers to the natural selection mechanism of blind variation and selection by

elimination, as opposed to the more Lamarckian, or acquired-trait mechanism of cultural evolution: cultural knowledge acquired in one generation can be directly passed to the next via education.

Because of these two distinctions, Gould points out, cultural evolution is potentially progressive because "Lamarckian inheritance accumulates favorable innovations by direct transmission, and amalgamation of traditions allows any culture to choose and join useful inventions of several separate societies." This way, Gould concludes, biological evolution observes a passive trend towards more complexity, whereas cultural evolution observes an active, progressive, trend towards greater complexity.

One of Gould's shortcomings in this argument is to disregard some evidence that even in biology his two characterizations of the evolutionary process are not completely accurate. His argument assumes a very traditional view of evolution as a neo-Darwinist process of genetic blind variation. We do have examples of symbiosis in which species amalgamate, e.g. the symbiotic mitochondrial origin as well as other symbiotic phenomena [Margulis, 1998]. Sexual reproduction too, offers a kind of exchange of genetic information that goes beyond blind variation and allows recombination, not mere mutation, of successful genes. Sexual crossover is of course not Lamarckian, but it offers a more rapid and directional source of variation and subsequent discovery of good solutions for evolution (recombination of successful individuals in one generation potentially breeds more successful individuals), which may get closer to cultural knowledge exchanges than blind mutation. Less known genetic information exchange mechanisms such as jumping genes and other transgenic phenomena, may be responsible for even more mechanisms that can potentially reduce the passivity of the biological evolutionary process.

But even if biological evolution possesses aspects akin to those cultural evolution (e.g. symbiosis, sexual crossover, and transgenic phenomena) that can speed up its trend towards greater complexity, and conversely, cultural evolution possesses elements of genetic blind variation [Campbell, 1974], from the available evidence, the conclusion that the biological evolutionary process is of a more passive nature than the cultural one seems quite accurate. In other words, the prime mover of biological evolution seems to be the Darwinian process leading to a passive, locally adaptive, trend towards greater complexity, whereas the prime mover of cultural evolution seems to be the more directed mechanisms of cultural crossover or education.

To conclude, whether one agrees with Gould or not in these assertions, one of the great challenges left by this book is precisely the need to investigate what is the nature of evolutionary processes (those leading systems to greater complexity). Namely, whether evolving systems are based on active or passive trends which can explain their full house of variation. Instead of relying on explanations based on central tendency statistics, one should look at the whole variation phenomena in search of specific physical or organizational mechanisms responsible for such variation. In biological evolution we have clearly identified the Darwinian mechanism of blind variation based on genes, which seems to be the evolutionary prime mover. In the realm of cultural evolution, despite a long tradition of linguists dealing with semiotic behavior specific to cultural realms, it has become fashionable to seek mechanisms, such as the *meme* [Dawkins, 1976, Heylighen, 1998] that could reformulate cultural evolution as being an instance of the same evolutionary mechanisms found in biology. Even though the two evolutionary processes, both of a semiotic nature, may have some characteristics in common, from

Gould's (and others) arguments it seems obvious that the two processes are also quite distinct. Particularly, McShea's categorization of evolutionary trends as passive and active seems most appropriate here. If the biologically inspired explanations of cultural evolution are to be taken seriously, they need to advance the specific mechanisms, such as meme transmission, that could bring together two identifiably distinct (using McShea's criteria) evolutionary trends.

What we need is the identification of a taxonomy of evolutionary mechanisms which may coexist, but whose relative importance in a given system will dictate its full house of variation. Even though Gould may disagree with theoretical and computational approaches to biology, I agree with Paulos [1996] that Gould's argument in Full House *begs* the investigation of these issues in Artificial Life experiments. The investigation of the taxonomy of evolutionary mechanisms in biological and cultural evolution seems to be most appropriate for computational treatment, indeed considerable work in this area has already been developed, e.g. [Ackley and Littman, 1991; Hutchins and Hazlehurst, 1991].

Gould's chief contribution here, even if not as well-developed as in some of his previous work, is to show that one needs to consider the full house of variation of a given system, in order to distinguish genuine drive to progress from a passive trend towards higher complexity. This call for a finer identification of material and organizational causes over a generalized, central-tendency approach seems to be quite necessary to clear some of the murkiness found in trendy approaches which tend to overgeneralize the scope of evolutionary processes.

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