Completion, Evolution, and Moving beyond Nature-Nurture

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In their essay, Spencer, Blumberg, and Shenk (SBS) raise an important and provocative question: Given our new (much fuller and more sophisticated) knowledge of genes and their manifestation, of embryology, and of brain development should we abandon an old nature/nurture dichotomy in favor of a unified "developmental systems" perspective? The question has at least three levels: the science level (i.e., How does development work and what matters for development?), the philosophy of science question (i.e., What is an adequate level of abstraction: What can and cannot be left out?), the science communication level (how to best communicate science to the public). Given that there is little disagreement between me and SBS with respect to what matters and the short format of this commentary, I will focus primarily on the second question. And here the issue raised by SBS becomes rather complex. There are at least three reasons for that. First, the complex causality is not unique to developmental systems, and often the assignment of causes favor simplicity. Second, the "right" level of abstraction can be established only *a posteriori* when the framework outlives its competitors. And third, there are important trade-offs between simplicity and complexity.

Although it is tempting to think that the living systems are special with respect to causality, causality is rarely straightforward even in simpler systems. There are always multiple contributing factors, some of which are interpreted as causes (as thus primary), whereas others as merely enabling conditions (and thus secondary). Why does the pendulum swing the way it does? Is it because of the gravity or because it was put in motion? Although both are necessary conditions, physics considers gravity as the primary reason (or the cause) because this is considered to be the "right" level of abstraction. Which brings me to the next reason: the "right" level of abstraction (and thus complexity) cannot be determined *a priori*.

Similar to evolution, there is no design in science—the process is blind. Therefore, the right level of abstraction cannot be designed and decided upon, it only can be selected against the competitors. Frameworks are not selected because they are "right", but they are "right" because they were selected. For example, whereas dualism was rejected in favor of monism in mechanical or living systems, it was embraced in quantum physics in the form of particle-wave duality. And it was embraced not because it was "right", but because it won against the competitors. Which brings me to the third problem: What constitutes "winning" in a competition of science ideas?

There is a simple fact that more complex theories (or models) have more variables and thus more free parameters. As a result, the theory can explain (or fit) more data. At the same time, they may not be sufficiently constrained to make accurate predictions. Again, nothing is in the absolute, but only relative to the competitors. Therefore, theories that are too complex may explain much but predict little; the opposite is true for theories that are too simple. The clearest case of the latter is a simple empirical generalization of data. Perhaps "winning" is being better than the competitor on both.

For these reasons, I believe that the history has to play itself out. Given that no level of complexity/abstraction is right *a priori*, only direct competition may establish what is right. Furthermore, what is right today, may become wrong tomorrow. And that is the beauty of our enterprise!

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A Multi-Layered Problem

I always recommend Mameli & Bateson's (2006) paper (or Carroll's 2011 book) when faced with this false dichotomy or, if time lacks, I briefly mention some easy to visualize examples (crocodile sex, phenylketonuria, the beaver's dam, or even the genetics of height including the secular trend) to make the point that you can't seriously talk about nature *versus* nurture. On the other hand, it certainly takes me more words and drawing things in the air with my hands—and the listener more cognitive effort and patience—to follow this than to simply conceptualize a broad "innate" (or "nature") versus an even broader "learned" (or "nurture") dichotomy.

Is there enough scientific evidence to explode the old nature vs nurture view and overwhelmingly support a more nuanced and complex one? Certainly yes! But that evidence is far from complete and for those aspects that normal people care about (such as language, intelligence or sexual fidelity) most of the time we must fill in enormous gaps with metaphors and inferences and suggestions.

So, to be brief, when even those scientists at the forefront of understanding the

evolutionary and developmental aspects of language (language is my main interest) struggle with partial evidence, when they must extrapolate results from animal models and cell cultures, when the results of massive genome association studies are confusing and hard to replicate, when it is unclear what one can carry over from pathologies with a genetic component to normal language users, and when the best examples of gene-culture co-evolution and cultural niche construction come from lactose tolerance and the immune system, we probably shouldn't be too hard on non-specialist scientists or, even more so, the public at large. It is fair to say that we don't yet really understand how language came to be, how it develops in individuals and how our biology interacts with our culture. Of course, we can rule out single-gene accounts or simplistic models where the speakers of certain language are "genetically adapted" to speak those languages, but everything else is work in progress.

It is easy to be frustrated that "people don't get it" and that old stereotypes die hard (and indeed nature versus nurture is one of those that seem to stick around in almost every corner of popular culture one cares to look into) but to have any hope of replacing them we need to be realistic and first realize that, if we are successful, the process will take so long that by the time it is completed we will have unavoidably advanced past that stage and regard the new stereotype as backwards (yes, even DST will evolve into something else!).

But the most important aspect, I think, is represented by what we want people to understand and why. Granted, the nature versus nurture view probably has real-world consequences in, for example, how educational programs are enacted and in how people suffering from pathologies with a genetic component are treated by the larger society, but it has a massive advantage for the busy, tired, distracted, continuously assaulted by all sorts of persuasive nudges and conflicting information normal humans of today: it is extremely easy to convey, understand and think with (and this does hold also for scientists in other disciplines and science journalists even if arguably part of our job description is to keep abreast with all that is new, but can we realistically do it?). What can we replace that with? Even heritability percents require a lot of explaining. Do we have a simple account for these complex and not-yet-fully fleshed out theories? To be frank: my perception is that Dawkins was so good at popularizing the evolutionary theory of the 60s and 70s because he is an amazing writer but also because the theory itself was mature: can we say the same about today's DST?

Finally, if we agree that we must replace nature versus nurture by another (DST-inspired) metaphor, do we do it the right way? Do we target the right audiences with the right content and format especially given that what is aimed at here is no less than a change to deeply entrenched, almost intuitive conceptions of reality (weltanschauung)? People are complicated and even for things that really, really, really matter for them (health, diet, exercise) and where information is widely available, it is still extremely hard to change conceptions and behaviors despite research-based expensive programs running for many years. And scientists too are busy staying afloat in a highly competitive world of publish-and-get-grants-or-perish and time for changing one's assumptions about things not perceived as directly relevant is very scarce. I'm not skeptical, I am only cautious...

Mameli, M., & Bateson, P. (2006). Innateness and the Sciences. Biology and Philosophy, 21, 155–188.
Carroll, S. B. (2011). Endless Forms Most Beautiful: The New Science of Evo Devo : and the Making of the Animal Kingdom. Quercus Publishing.

Emergence, Action, & Representation

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Why is the nature-nurture conceptualization of developmental phenomena still used? The authors emphasize issues concerning communication for both students and the wider public. We agree that communication is part of the issue but would suggest two other reasons.

First, the nature-nurture framing is instrumentally useful for researchers to conduct experiments. Whether or not developmental research is focused on issues related to nature-nurture directly, it is often "convenient" for methodologies to presuppose that framing (e.g., accounting for variability with a "nurture" variable or a "nature" variable).

Second, we suggest that the nature-nurture framing is especially persistent in areas of developmental science that involve the "representational mind"—because that framing is intrinsic to a fundamental error regarding the ontology and origins of representation that is ubiquitous in the field. That is, the nature-nurture framework is presupposed in standard (false) background assumptions regarding cognition and representation.