Innateness And Emergentism – A Critical Review

> *“Can you tell me Socrates, can virtue be taught? Or is it not teachable but the result of practice, or is it neither of these, but men possess it by nature or some other way?” - Meno in Plato (388 BC.)*

1. Introduction:

The topic at hand goes as follows; human mind and animals to some extent, exhibit behavior that we can not explain, nor comprehend fully. Such is the case is for no surprise tough, throughout the history we kept observing things that we could not explain, and most of that time we did not even know what an explanation itself is. Two main methods prevailed, namely First Philosophy (later mistakenly called Metaphysics) and Mathematics. The former tried to explain beings as beings. The latter made the most useful abstraction that ever sought by human mind, and invented/discovered a language that could describe the relation of every being to another, beings as their relations to each other.

A running joke in philosophy goes as, “Surely the planets do not constantly solve differential equations to move around the space”, a shot at mathematics surely. Another lesser-known idiom goes as, by Martin Heidegger, “Human soul is like our glasses, we see everything through it, but we cannot see it itself”. Considering the two thousand year development of continental philosophy from object to subject, surely a pondering thought that we still can not explain what defines explanation itself, the subject.

The article at hand deals with a small section of this quest to uncover the mechanics of the subject; whether the characteristics of it comes before itself, or after. Now, of course, any rationalist argument in this day and age is compelled to exclusively rely on genes. But still, the question is the most useful for us. The article at hand cites two reasons, (1) for the question’s practical implications on human mind and ergo its actions, (2) because we lack a clear theory of the interaction of genes with environments, so we default to such ideological camps, and we add thirdly, most important for us, (3) to know whether any attempt at recreating a subject in AI should relay on prior-insertion of cognition, or a learning model.

As the article will clarify, (Elman et al, 1996, p.357) the big question will not be whether the knowledge comes from this or that source. The question is how these sources combine and interact, and the answer is bound to be not nature or nurture, but nature and nurture, tough in what way.

2. The goal:

The main point of our article, “Innateness and Emergentism” by Bates et al. (1999), is (1) to clarify the Innateness position and (2) argue how it falls short in injecting itself as a necessity in various domains of cognition. As a third point, (3) through empirical observations, the article tries to make way for an empirical-emergentist position.

For the first two point, two tasks are imminent; (1) how does an innate form acts on the interaction of what is inside with what comes from outside, and (2) what are the candidate theories of innateness that a proponent of the position relies on. For the latter point, the article lists some

3. How can a system be innate:

The article, as we stated, stand in an interactionist ground, claiming that what needs to be uncovered is the interactions taking place between the innate components and the systems environment. So the article first states a “three-level taxonomy of claims about innateness”, explaining how in three different ways an innate component of a system would be “affecting” or “constraining” the interaction of the whole system with its environment.

These levels are claims an innate position would argue that such constraints do exist by innate components, they are ordered with respect to “required contribution from genes [or any innateness-injecting component] for the claim to work”. By the brackets, this taxonomy is applicable to neural networks or other cognitive systems too. Let’s quickly review these claims:

a) Representational constraints: This kind of constraints requires the genes to determine and hardwire the representations the systems have. Elman et al(1996,p.25) gives examples of children having representations of grammar by birth. Practically this means; for brains genes determining “fine-grained patterns of synaptic connectivity in the cortical level”, and for neural networks, this would mean “prespecified weights no the inter-unit connections”.

b) Architectural Constraints: As a much more probable ground, this kind of constraints are structural ones, acts above the level of connectivities, and determines the qualities of the components rather than quantities. Since a wide range of particularities can fit the term, these constraints are divided into three, with respect to how wide through the system the constraint acts; unit level, local level, global level. Names are self-explanatory so we will not go into detail.

c) Chronotopic (Temporal) Constraints: This kind of constraints determines when and where certain developments/structural events occur in a cognitive system. For example, specialization of cortical regions may be determined by Temporal constraints by genes, or the embryonic cell divisions. Linguistic’s “critical age for learning language” is also an example of a temporal constraint. The same kind of constraints can be acted on neural networks by learning decays or order of presentation of data. This is the most superficial one because most of the examples given in Elman et al(1996,p.35) are already presupposes interactions or in accordance with the interactions from the environment.

In short, the article that different claims of innateness can be categorized into these 3 levels where each level can be best described by constraints acting on the system.

The article lacks clear examples to justify such categorizations, but such examples are given in the related book.

We also hold that, and agree with the article, the representational constraint account is bound to come out too strict to leave room to any interactive development with the environment, and further fails to compile with the empirical data.

The other two constraints tough are very natural and in accordance with the emergentist narrative. After all we never except any random clump of matter to turn in to a cognitive system, how ever you interact with it; nor should we deny that importance of taking advantage of *kairos*, the opportune moment, neither in cognition nor in nature itself.

4. Availability of emergentist accounts:

Before the recent development in various fields, the emergentist camp has failed to give a convincing theory, and furthermore, their reliance on metaphor seemed as an insufficiency on their parts.

So before moving to actual innate theories, the article tries to justify an emergentist account on empirical grounds. The article bases this claim on three recent development.

a) Modern physics' widespread usage of non-linear dynamics and how those observations play into developmentalist account.

b) Recent success in neural networks successfully modeling narrow cognitive tasks.

c) Recent success in neurobiology in mapping a bigger and more detailed portion of the brain, and the founding of extraordinary plasticity in the human brain.

One immediate criticism would be that such observations are highly empirical, and forms no theoretical insight into the actual workings of the tasks they describe. Neural Networks for example, as a self-learning system, may be a good counter-example to the Representational Constraint proponents, but they heavily fail without some human intervention injection meta-domain-knowledge into them.

5. Innate Theories :

The article considers some number of "observations" on the nature of cognitive activities that proponents of innateness may mistakenly take as an argument in favor of their view. Then it goes on to differentiate each such observation from any requirement of innateness. We will call such activities “tasks”, and the cognitive mechanisms that permit these tasks as “modules”. While in classical view the name "module" carries the meaning of mental organ, we will specifically use this term to show that such modules do not carry the requirements of such conceptions like mental organs.

The general trend for the proponents of innateness seems to be to cite some domain’s very “specific” and “special” nature and claim innateness by this, that such systems in this or that way are very specific and requires innate/hand-waved modules to work. Such general this-or-thats are called “Doman Specifities”. Following the major ways such Domain Specifities may be argued, the article also mentions three more special cases of specificity claims. We will mention each of these one by one, first the article’s explanation, then our commentary.

a) Domain Specificity: This kind of argument is the one with the most breadth. The main thought is that the human brain has some number of “well-defined modules” that acts on a specific domain such that this module is too specific and well defined to not to be innate. For example a module specific to language domain, or a module specific to face recognition domain. The article says there are four hierarchical levels such specifities may occur. The article uses the language domain as an example. The task is to produce a module, a functionality that maps meaning to sounds.

1) Specificity of behavior: Does the existence of specific behaviors that are common across producing such mapping an evidence to the claim that such module/functionality is innate? Afterall, many such mapping (ie. different languages) share similar behaviors, like heads and inflections.

The article gives no assuring argument that such not may be the case. But let us say that we agree, we argue that the fact that the task itself is well defined, though the “true” mapping function is not, on an emergentist account similarities between solutions are bound to happen, not because of innateness but because similar constraints enforced by the task would lead to similar emergences. There are natural ways that languages may occur, determined by the goal of the task itself and not necessarily by any innate representational constraints genes may act on.

2) Specificity of representations: An easily dismissed level, if a behavior can be produced, whether learned or innate; the cognitive system has to have some representations related to such behavior. It does not follow from this that such representations have to be innate.

3) Specificity of processes: Now that we have our behaviors that we apply to the environment and representations to model things related to such behaviors; there is a need for processes that will process such representations. The article asks,

can a general device learn such narrow processes, instead of being innately tailored to them?

The article's argument is similar to one we gave priorly, namely that strange/narrow/unique processes/elements may not be so strange from the point of view of the task; the processes, if they are emergent, can be the only way for the goals to be accomplished. We start to see the pattern of reliance on the apparent goals of the system, which we gladly accept and will elaborate in our conclusion.

4) Genetic Specificity: At the lowest level, any claim on innateness will imply the outcomes are constrained by the genes. Now, neither the article nor we deny that predetermined effects of genes on the cognitive system; the article here objects to a view that a single gene or an isolated group of genes predetermines, again in isolation, effects on the cognitive system. The usually given SLI example is counter-argued rather well in the article.

Such accords are highly in contrast with the modern empirical evidence so the conclusion, that no such specificity even exist ‘at isolation’ is obvious. The temporal constraints on the cognitive system’s development enforced by the genes are much more probable, which we take no issue with.

b) Species Specificity: Some argue that the fact that there are “modules” with related tasks which solely humans can do and all humans can do is an evidence for such modules to be innate, modules which all humans possess, and only humans possess. If such tasks were learnable, surely other species could have learned it, right?

The article cites the fact that no qualitatively different structure unique to humans ever found. Furthermore, such species specificity can easily be explained by the computing power of the human brain; where we see that the quantitative structure and the cognitive abilities increase proportionally. So again, only chronotopic constraints are necessary to explain such specificity.

c) Localization: Does cognitive modules as a whole only concern localized parts of the brain? We both know that brain plasticity admits changes in the brain parts that heavily affect those parts functionalities, and we know there are observed cases where some cognitive tasks like visual recognition growing in unusual parts of the brain, and we also have neural networks models which behave well with strictly distributed representations across the system.

While the article feels the need to take a step back, we argue as far as to say that localization of cognitive tasks occurs only at a very superficial level.

d) Learnability: And finally, there is the argument that some tasks are too peculiar to be learned. The article counters this only by countering Gold’s theorem and mentioning how Elman successfully fit a very restricted grammar to a neural network.

Even though the article's countering is weak (since we do many great language processing tasks in this age and all of them fails to generalize), the claim itself is weak too. Citing hardness to learn is in no way an argument on the impracticality to learn. As we argued in the behavioral specificity case, constraints on the goal task may always act on the system to force it to emerge into useful, unpredictable forms.

So in general, the article relies heavily on empirical evidence to discredit the necessity of innateness in such cognitions. In essence, the empirical data shows heavy counter-evidence to the set-in-stone nature of representational constraints. At many levels, it also shows how in early development, both in human brains and neural networks, even Architectural constraints may be defiled without heavy damage to the cognitive system.

A compelling theory of an emergent system seems missing, yet it also shows how it is in a sense necessary for some kind of emergent process is required for such cognition to occur without guidance by the innate constraints, which such constraints cannot be as they are, since they are (to say superficially) "too strict".

To stress again, the article tries to only wage war on claims which carry with them representational constraints and take no issue with other two kinds of constraints. We found such approach to be a soft belly for such a strong emergentist position, that those two constraints too could be tried to weaken to their shackles. A specially the existence of architectural constraints is problematic, considering we humans too enforce such constraints on modern neural networks, which is the exact reasons such networks are not generalizable at all.

6. Conclusion :

In the end, at many levels and times, we looked like replacing innateness of cognitive system with some kind of "innateness of the goal required to accomplish". Did we simply shift the blame from the cognitive system's *formal cause* to its *final cause*, as was defined by Aristotle two thousand years ago?

Or is it only plausible to except systems, necessarily innately constructed at one level, to necessarily cause the system to develop in such a fashion to enable whatever its *telos* (goal), which we eventually relay on in our account?

Yes, it is necessary for any system which admits goals to have the *dunamis* (potentiality) for the means to achieve these goals, by nature. But it is also only natural for such systems to in order to move towards their goals, they require interaction with the constraints of the goal.

To put it in more concrete terms, we humans at some point could not flourish to have rich cognitive capacities, and at this point we do; what changed is our genes and their innate constraints (albeit not representational constraints, as was argued) acting on the cognitive development (the word development here is an untrivial part, as no human is born cognitive by birth). But actualizing such potentiality bound to require interaction from the constraints/requirements of the goal itself, as flourishing is flourishing as something, into something. We can only be smart by exercising smartness, we can only be just by exercising just actions.

So the way of this interaction is, as far as we argue, is innate constraints and constraints coming from the goal to try and align, to iteratively act on the system to mold it fit better to both actualize its innate constraints and potentialize its goal's constraints. It is for our innate constraints to try and replicate the end goals, in each case, and for our end goals to act on the system to generalize on the available knowledge, albeit potentialize it.

The empirical evidence is bountiful, as was mentioned we at this day and age have both ways to generate such emergent accounts in AI, albeit in restricted senses; and describe such emergent accounts in neurobiology, albeit in unintuitive ways. In either case, every design is designed to move towards its goal.

As we said in the beginning, the answer is nature and nurture, but in what way. We argued here that, it is in a way such that whatever comes by nature tries to solidify the system, and whatever comes by nurture tries to set it free. Nature acts by constraining it ergo guiding it, and nurture acts by generalizing it ergo opening it up for its goal. Surely a philosophical account, but the best we could conjure.

References:

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