**Dynamical Systems Theory, Understanding, and Explanation: Comments and Responses on Malapi-Nelson’s paper.**

**Pak Kin Ho, Concordia University**

**Alcibiades Malapi-Nelson, Concordia University / University of Ottawa**

**PKH:** The thesis of this paper is that the dynamical systems theory of the mind, due to its abstract mathematical framework, may leave out important nitty-gritty details that should not be left out if we want to understand how the mind works. This point has a more general counterpart, namely that excessive mathematization is not conducive to understanding or explaining the world because over-abstraction leaves out important phenomenal details.

**AM-N:** Thanks to Pak Ho for the useful insights. It helped me revising some untied points in my paper. I’m specially grateful for the appraisal and highlighting of the main points of the paper. Nevertheless, I find that even the positive remarks are somehow misleading, as the conclusions to which he arrives are not directly drawn from my paper; moreover, the remarks bear some mainstream slogans that I purposely, although probably not clearly enough, tried to avoid.

**PKH:** The paper is divided into 4 parts. The 1st part selectively traces the development in philosophy of science from Hempel’s D-N model to van Fraassen’s constructive empiricism. This is supposed to introduce the reader to debates regarding the nature of scientific explanation. No conclusion (about what it is that makes a scientific theory explanatory) is explicitly argued for, but the author is sympathetic to van Fraassen’s anti-realist view that no metaphysics should be read into science (science does not answer ontological questions) and to Nancy Cartwright’s reservations about the explanatory value of overarching mathematical frameworks. The issue of explanation via mathematics is important, as the aim of the author is to put into doubt the explanatory value of the (mathematically robust) dynamical hypothesis of the mind.

**AM-N:** First, when Ho says that “No conclusion (about what it is that makes a scientific theory explanatory) is explicitly argued for”, it seems that the point of the introduction did not make its
way through. It is precisely the fact that theory of explanation in philosophy of science is unable up to now to define precisely what explanation is, which renders the background for the problematic addressed after (dynamics in cognition). Second, concerning the remark “the author is sympathetic to van Fraassen’s anti-realist view that no metaphysics should be read into science”, although it could be echoed in some philosophers’ views, it suggests something that at least I would not back up by any means. Moreover, my position is exactly the opposite: to say that Van Frassen is an anti-realist (or an ‘instrumentalist’ as some like to put) is completely to miss the point of the Canadian philosopher, and, it could be added, to show a fairly inaccurate understanding of Kant’s Transcendental Aesthetic (First part of the First Critique). Reality for these matters is not experience, but rather experience is the construction of our cognitive/epistemic capacities plus that whatever we are approaching is furnishing us with, of course, unconsciously (it is constitutive to our cognitive faculty); therefore experience is far more complex than the mere conjunction of whatever our sensa provide us with, or, as Kant would put it, “experience is already a type of knowledge”.

**PKH:** The 2nd part of the paper contrasts the dynamical hypothesis of the mind with the classical computational theory as well as connectionism. It is said that dynamical systems theory of the mind (1) yields more complete and biologically realistic analyses of cognitive processes than do computational theories because the former is able to bring “real time” into considerations, (2) can explain cognitive processes without appealing to the notion of representations or symbols and (3) can “subsume” computational theories. I find that the author does not go into sufficient details regarding any of these points. For example, regarding point (1), the author says that the classical computational theory fails to take time into consideration because it is underpinned by Cartesian Dualism (no further explanation is given) whereas dynamical systems theory is sensitive to time because of its use of mathematics.

**AM-N:** First, that is DST’s claim, not mine, or not entirely anyway, because I do agree with DST in some ways. Cartesian assumptions left for us the extremely difficult legacy of viewing cognitive processes as divided between a heavily loaded operative mind that entirely orders and gives meaning to what is provided by the sensory capacities of the carrier shell, the body, as the result of what is input from the world; for some the first two are one half of the duality, for
others, the second two are (mind/body-world, mind-body/world). Be that as it may, it inspired a
disengaged explanatory machinery, which, by means of computational processes, put all the
theoretical burden inside the skull, whereas probably cognition has to do more with a less clear
cut boundary between mind, body and world, like a ‘system’, in which elements regarded before
as mere providers of raw material for sensa, can be actually already-shaping whatever we
perceive about ‘reality’. In this DST has a point. In which it does not, is in the fact – this
according to me – that ‘fitting facts into equations’ (Cartwright) still leaves the door open for
the explanatory vexing problems of Relevance (Kitcher, Friedman), despite the features that the
systemic elements have to show in order to be counted as part of the system. Why? Because we
are talking about a model after all, and as every model, it could find in reality what the model is
itself designated to find in virtue of its own built nature. Therefore, No, I do not entirely agree
with DST in relation to being the one which brings time back into the game; and Yes, Cartesian
dualism inspires a ‘pilot-ship’(kyver-nautos: cyber-netics) kind of picture of cognition that can
be regarded as tremendously speculative, homuncular, complex and, most interestingly, difficult
to re-model. Only in that way DST’s excessively strong claims can be reasonably toned down
and considered.

PKH: But since the classical, Turing notion of computation is itself a part of pure mathematics
(recursion theory), one cannot distinguish classical computational theory from dynamical
systems theory on the basis of the presence or absence of a mathematical framework qua
mathematical framework: both theories of the mind are buttressed by mathematics. A fortiori,
mathematics qua mathematics cannot be what makes classical computational theory insensitive
to time. I am sure that the real answer lies in the specific mathematical details of the two
theories (classical and dynamical), but discussions of such details are lacking in the paper.
Similar criticisms apply regarding points (2) and (3).

AM-N: The Turing notion of computation is not a part of pure mathematics. First, computation,
as we know it, is Turing-machine inspired, so a ‘Turing notion of computation’ is a redundancy
that has consequences as we will see. Second, recursion theory is not the field that underpins the
(already said erroneous) tenet of the ‘Turing notion of computation’ as its theoretical carrier
within Pure Mathematics; rather recursion theory is the discipline inspired upon the findings of
what the Turing machine or computations can not do; and tangentially, it is more a field of logic than of math. Right there we see a major difference: the Turing machine, upon which (in conjunction with Chomsky’s Nativism) the CTM is based, is not part of Math, let alone of pure Math; Turing’s speculation rather unveiled the hidden power of syntax. Yes, Turing was a mathematician, but he foresaw the tremendously powerful notion of “machine” as a theoretical device capable of rendering a non-static account of processes. That is what we look for in an explanatory mechanism (an account for processes), and that is why we prefer it over a picturesque static description. Logic is famous for giving us the latter; syntax gave us the former, and we got a neat theory of the operative mind. DST, on the contrary, is Dynamics applied to cognition. Dynamical systems is a branch of pure math, since its inception (Maxwell’s usage of Lagrange’s formulae for the Electro-magnetism and Optics Unification) until now (Quantum Mechanics). Therefore the subsequent claim: I am sure that the real answer lies in the specific mathematical details of the two theories (classical and dynamical), but discussions of such details are lacking in the paper. Similar criticisms apply regarding points (2) and (3), gets ipso facto discarded, as one item is computational, syntactical, linguistic, and the other is part of pure math; no clarification of features can obtain, as the two have very little foundational features in common (as the paper says, echoing DST in this, even the archenemy ANN has more in common with CTM than CTM with DST). Maybe it is useful to remind here, that that is precisely what DST claims throughout the paper since the moment of its introduction: Dynamics applied to the mind is entirely other in nature to whatever has been done for the last 25 years in CogSci.

PKH: The 3rd part of the paper concerns underlying mathematical structure of dynamical systems theory which, we are told, is called Lagrangian formalism. The purpose of this part of the paper seems to be to show that the subsuming power (of bringing diverse phenomena under one theoretical/mathematical edifice) of dynamical systems theory consists in the abstractness of its mathematical structure. Regrettably the author’s description of Lagrangian formalism boils down to the following (pp. 13-14): (1) this formalism “brings dynamics under the power of calculus”, (2) the mathematical manoeuvres in Lagrangian mechanics are “purely algebraical” and (3) mathematical operations in Lagrangian mechanics “become simplified after some steps”. While point (1) is somewhat enlightening (but it is not followed by any further elaboration), (2) and (3) seem to be true of many (if not any) mathematical theories. The author cannot expect a
lay person such as myself to grasp what Lagrangian mechanics is just from the above characterization, except that it is pretty abstract algebraic math stuff that, because of its abstraction, can be used to talk about (or to “subsume” – a word that gets used a lot but is never explicated) very diverse things.

**AM-N:** Let’s put it this way. The reader has to trust me on this one if he is not acquainted with the particular problem of cogsci that I’m raising. The bibliography is not abundant, as the approach is new, however the paper had to have, as every paper, a limited number of words. The bibliography at the end is available for whoever wants to plunge deeper. If the review deals more with the possibility of my remarks being found trivial, then I would say: if it seems that every mathematical treatment renders features by which we lose the very explanatory elements that we were looking for in the first place, then so be it, I subscribe to that statement with my Heidegger under the arm. Math is the ultimate planning, calculating, formalizing engine that voids every item in this earth from meaning. Dressed up by numbers, we will have the most admired accuracy parallel to the moment in which we will no longer recognize what we wanted to understand in the first place. Hyper-Virtual reality and the current trends in Machine-man Interactivity could be a good example of that. Even if the reader would not agree with that (let’s say he does not speak Heideggerian), then at least he can concede me that highly abstract mathematics applied to you could leave aside some ‘negligible elements’ that, in virtue of the very method we are using in this case, Lagrangians (that is exactly what it does: vanishes inconvenient or ‘uncomfortable’ variables), are lost, thus giving us no understanding. Math and accuracy does not mean understanding, and less, truth.

**PKH:** The last part of the paper warns of the dangers of mathematical abstraction in theorizing (including theorizing about the mind) which brings us back to the issue of scientific explanation brought up in the first part of the paper. As was mentioned, the idea is that abstraction leaves out details about the phenomena that should not be left out in good explanations. The author talks about the need for an “explanatory mechanism” (emphasis on ‘mechanism’): the idea seems to be that to truly explain x (an event, a process, etc.) one has to understand the ‘mechanism’ that underlies x (this is suggested by Margaret Morrison). And to understand this mechanism one has to take into account certain phenomenal details that cannot be accommodated by abstract
mathematical framework. What the author means by ‘mechanism’ is never explicated, and not one concrete example of the explanatorily important phenomenal details is given. I think concrete examples are very important for if the author is to make his case convincing: it is trivial and inevitable that some phenomenal details get left out by mathematization, what needs to be shown is that such details are explanatorily relevant. I see no way of showing this except through giving specific examples.

AM-N: This is Ho’s best critique. Sure, my speculation regarding the notion of ‘mechanism’, or ‘machine’ for that matter, is entirely insufficient. I don’t want to repeat that the length of the paper was in some normal way fixed, but I do want to say that I worked on this notion ever since, taking the time to explicate the consequences of the notion of machine applied to ‘explanation’ and hence, to us (more on this, below). Ironically, the best critique is followed by, to my wit, the weakest one: the need of an example. First, to fall into the empiricist temptation of the concrete in order to clarify the abstract, the simple in order to reduce the complex, is an empiricist move in which I don’t play for the very simple reason that I’m not an empiricist, more over, in choir with Heidegger I would say that empiricism is the part of the completion of the history of metaphysics, and hence, the prolegomena for the end of philosophy. And I don’t want philosophy to end. Crude happenings in reality filtered by our sensa would not show more than the utility or uselessness of a model; in doing philosophy we try to decentralize ourselves from the frames of immediateness, elevate ourselves, and look for the prima causa. So, No, no examples are given, for the very reasons that to give them would be to enter into the realm of a worldview that is precisely part of the source of the problems we are confronting in cogsci. Am I the only one who says that? No; it takes minutes to check how the cogsci literature is turning into phenomenology as a way to break free from the oh-so-taken-for-granted bad response to the Descartes’ dilemma: empiricism. If the reviewer would judge the previous words as pure sophism, then I would say that, still, no examples are given, but now because there simply aren’t any: DST’s approach is way too abstract and to deny it is equally abstract. For what is worthy, the only empirical outcome that could be regarded as somewhat proof of the superiority of DST over CTM (& ANN for that matter, although the reviewer does not even mention the latter, being present in the paper), is the fact that successful cognitive recreations are popping out in different realms of cog-sci, whose designers claim to be ‘neo-Heideggerian’ themselves, hence, way
closer to DST and TREC (thesis of radical embodied cognition, or a-life, very related, if not sometimes based upon, DST) than to CTM, having ANN somewhere in between. So by far CTM is the one that carries the burden of the multimillionaire failure of the last 30 years. That is the legacy of Descartes, ill-answered by the wealthy, technical and language obsessed W.A.S.P. philosophy.

PKH: The thesis of the paper is that Dynamical Systems Theory of the mind may be too abstract to provide true explanation of cognitive processes. Again, it is not unreasonable to expect at least some suggestions of what these details might be, and (more importantly) why they are explanatorily crucial. The author makes no such suggestion, and pretty much bases his whole case on the tautological idea that mathematical/abstract representation of phenomena do not capture every concrete detail of the phenomena in question. This approach makes the reader unsure as to whether the author is expressing doubts about the prospect of the dynamical systems theory of mind per se or about the epistemic value of the whole enterprise of using mathematics in science (see the last sentence of the paper). Perhaps the author is trying to say that excessive mathematization is dangerous. If this is what the author is saying, then he fails to show where the threshold lies (e.g., what makes dynamical systems theory more mathematical (or mathematical in a bad way) than classical computational theory?).

AM-N: See above. About Explanation, see below.

PKH: I find the exposition given in this paper of dynamical systems theory in both its mathematical and cognitive scientific aspects (no example as to how a cognitive process may be modeled dynamically is given) telegraphic and hence uninformative. Terms (such as ‘explanatory mechanism’, ‘subsumption’, ‘abstract mathematical framework’) whose explication are crucial to the central argument of the paper are used without much explanation. And the term ‘abstract’ is doing way too much argumentative work, giving rise to a rather vague argument.

AM-N: As a conclusion, it seems that more than philosophical questions, what is found in the review is a call for more clarification, which is valid. I have presumed a fair knowledge of
CTM/ANN perpetual competition right from the start, so I cannot expect that just any layperson would understand all the claims being made.

I would like to make one last remark regarding explanation, and with this, a clarification of other terms hungry for being unfolded, as the reviewer suggests. For example, for ‘subsumption’ I mean no other that what the term means for Hempel and Oppenheim’s DNm (the founder of the theory of Explanation): in the covering law model, a phenomenon is said to be a concretization of a particular (stipulated/discovered) law whenever this phenomenon essentially bears a feature which is identified by one of the statements that constitute that law; in that way the law ‘explains’ the phenomenon. I would not have a problem in accepting as well the Kantian notion of subsumption within his theory of schemata of the pure concepts of understanding. For ‘abstract mathematical framework’ I mean what Morrison means, namely, in my words, a formulaic situation in which, in virtue of a particularly broad mathematical devise used, one can virtually subsume anything, having exact results because of the mathematical nature of the operation, furnishing a view of accuracy based upon the numerical values of the result; of course, the more abstract the device, the more universal the outreach. I’m not saying that what math gives is wrong, or right. Here the problematic notion of explanation kicks in. The problem of Dynamics applied to the mind is not a problem about the success or failure of the application of the theory per se, but of the explanatory outcome that the said model is rendering. Returning to the beginning of this reply, that is the quid of the situation: the explanatory concerns of philosophy of science can be applied to philosophy of mind if we are to understand our mind through the laws of physics. If the dynamic model will equip cogsci with unprecedented empirical success, it does not mean that we are going to have understanding, as understanding is inherently a subjective happening: we understand. Explanation gives understanding, it is said; and DST is not giving either, which is not to say that DST has nothing to do with reality, on the contrary, the burden is on us to know what we are looking for when we want Explanation. In sum, the explanatory problems that mathematization provided to physics, can be translated to cog-sci, as long as we apply highly mathematized physics to the mind. Hence the concerns are explanatory, and not theoretical per se, in other words, if math makes our experiential data fit with models, it does not mean that we are understanding, but rather that we can prove the success of our models, because, again, understanding is an inherently subjective phenomenon: it is we who understand, not the object; and mathematization does not satisfy that: understanding. I
would even suggest something a bit scary: If we ever think that a non-explanation of this sort gives understanding, that will probably mean that we already are the object we wanted to approach to in the first place. As Hempel would say, it is ridiculous to compare statements with anything other than statements. If we fall into the temptation of relating them in a positive, absolute and dogmatic way with whatever we call reality (macro- or micro-cosmic), then the ugly face of metaphysics will be already sneaking at the corner. And it is not that I have something against metaphysics per se, but to apply it to science, or cognitive science is not realistic, but the opposite: hopelessly naïve. Instead of this, I would rather prefer staying with St. Anselm’s account of experience as stated in the Proslogium, unknown for those of you who believe that the history of philosophy is divided in three plus a gap, instead of four periods: “Experience is necessary for knowledge. Faith is necessary for experience.” We can replace “Faith” with whatever the fashion of the day dictates, of course.