On the Relation Between Philosophy and Science

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1. Three roles for philosophy

This talk discusses the role of philosophy in intellectual life as I see it today, especially the relation between philosophy and science.[1] I will start by outlining a general view of philosophy, and afterwards consider philosophy of science.

The best one-sentence account of what philosophy is up to was given by Wilfrid Sellars in 1963: philosophy is concerned with "how things in the broadest possible sense of the term hang together in the broadest possible sense of the term." Philosophy aims at an overall picture of what the world is like and how we fit into it.

A lot of people say they like the Sellars formulation but do not really take it on board. It expresses a view of philosophy in which the field is not self-contained, and makes extensive contact with what goes on outside it. That contact is inevitable if we want to work out how the picture of our minds we get from first-person experience relates to the picture in scientific psychology, how the biological world relates to the physical sciences, how moral judgments relate to our factual knowledge. Philosophy can make contact with other fields without being swallowed up by them, though, and it makes this contact while keeping an eye on philosophy's distinctive role, which I will call an *integrative* role.

[1] This paper was prompted in large part by a conversation with Maria Kronfeldner. I am grateful also for comments by Chrysostomos Mantzavinos.

I think of the integrative role as a relatively permanent one for philosophy, but it is one that is especially relevant now, because of specialization in intellectual life. Maybe as late as the mid 19th century, a person could know a large fraction of what there was to know without greatly sacrificing their pursuit of detailed work in one field. This is probably no longer possible; now it is necessary to specialize in generalism, at least to some extent.

Sellars' summary is broad but it doesn't cover everything. Another role consistently played by philosophy is what I will call an *incubator* role. Philosophy is a place where ideas are developed in speculative and broad form, in theory-sketches and schemata, that often then make their way into an empirical form within some science, or into a mathematical form, or some other more focused form. A version of this view was defended by Karl Popper (in *LSD*). Michael Friedman argues (in *Dynamics of Reason*) that 19th century debates about space and the interpretation of geometry influenced Einstein's theory of relativity.[2] There are many examples in psychology, both from the transition that gave birth to psychology as a science and also later. *Associationism* made its way from a philosophical to a recognizably scientific form through the mid 19th to early 20th century (Bain, Mill, Thorndike, Pavlov). Much of the theoretical framework used in current cognitive psychology and linguistics originates in philosophy: Wittgenstein, Grice, Fodor. Michael Tomasello's recent scientific work emphasizes as precursors Grice, Searle, and Bratman. The "embodied" approach to cognition is presently making its way from a very philosophical side of cognitive science into more scientific form (compare Andy Clark and Rolf Pfeifer). Another recent case, though one where there has been more to and fro between fields, is "Bayes net" framework for understanding causal relations (Reichenbach, the CMU group with Scheines, Glymour, and Spirtes, also Pearl, Gopnik, and Woodward). A more tendentious example is the way Hegel paved the way for Marx, or for the scientific side of Marxism. Logic is a special case because the work was not so inchoate, and it shaded quickly into mathematics. But

[2] Friedman: "[I]n creating the general theory of relativity... Einstein explicitly appealed to a preceding tradition of reflection on the nature and character of geometry within nineteenth century scientific philosophy. This was the famous debate between Helmholtz and Poincaré, in which empiricist and conventionalist interpretations of the new non-Euclidean geometries opposed one another against the ever present backdrop of Kant's original theory."

by any standard philosophy had a great deal of impact, through Boole, Frege, and Russell, on the development of computers.

I see the integrative role for philosophy as compulsory, in a sense: there is a need to somehow achieve the Sellars project, and to some extent "philosophy" is a name for whatever does this, no matter where the people are trained and work. The incubator role is less of a definite project, and one that philosophy certainly has no monopoly on. Incubation of new ideas is undeniably important, and questions can then be asked about the most effective ways to organize novel and speculative work. One way would be to ensure that each specialized field allows some work of this kind to develop, and to ensure that this work can survive and grow for a while between existing fields. Another option is to have a department where it is part of the culture, and this is what many philosophy departments are. The way philosophy engages in this incubator role is then affected by other features of its culture – attention to the integrative project, in particular.

There is another kind of interaction between these two roles. The integrative, synoptic philosophical viewpoint in some cases enables new highly general models to be developed that then inform the more specialized work that prompted the "how things hang together" discussion. While these could in principle be developed within the more specialized disciplines, their housing within philosophy comes naturally. A theory of this kind need not be primitive, in a state of incubation, while remaining in philosophy. I'll discuss an example later.

A third role for philosophy is tied more to its immediate social context. In the US, when asked about the point of philosophy people quite often say that what is distinctive is a set of skills – clarity, analysis, critical thinking. Philosophers, they say, do not know any special facts or theories, and have no permanent subject-matter, but they have a skill-set that can be usefully brought to bear on any problem. When this is presented as a general view of the point of philosophy as an activity or profession, I am against it; philosophy is not an uninvited management consultant to more substantive intellectual life. This is, though, an important part of a role of a philosophy *department* in a modern university. It is part of what philosophy contributes to education, especially

undergraduate education.[3] Philosophy also has a futher educational role. Richard Rorty once made a comment (which I have not been able to track down in print) that I like here. Rorty said that philosophy is the place in the university where a student can bring any two books from the library and ask what, if anything, they have to do with each other.

Before going on I will briefly note an ambiguity in the discussion so far. When asking about what role "philosophy" has, one can roughly be speaking be asking about two things: a style of work, or a cultural lineage, something with a location in space and time. This is akin to the distinction between more typological and more lineage-based views of species and some other biological kinds. To some extent philosophy is a style of work housed within a lineage, but there is plenty of work in that style outside the lineage, and the lineage gives rise to work that is not really in the style. Separate questions can be asked about each – about whether anything useful comes out of a certain style of inquiry, and what the proper role is for philosophy departments. What is the right way to associate the integrative project with an educational role? To what extent does the traditional role given to the history of philosophy within university departments facilitate, or impede, the three roles I have discussed here?

I'll head towards the end of this section of the talk by looking at a couple of quotes from other recent discussions of the nature of philosophy. The first is from Scott Soames.[4]

> Near the beginning of the final lecture of *The Philosophy of Logical Atomism*, in 1918, Bertrand Russell articulates a view of the relationship between philosophy and science for which there is much to be said. He says:
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> > I believe the only difference between science and philosophy is that science is what you more or less know and philosophy is what you do not know. Philosophy is that part of science which at present people choose to have opinions about, but which they have no knowledge about. Therefore every advance in knowledge robs philosophy of some problems which formerly it had… [and] a number of problems which had belonged to philosophy will

[3] The value of this role depends a lot on what is going on in other fields and on the structure of the undergradiate curriculum. It is diminished where undergraduates specialize very early. On my view that is bad for all sides – for undergraduates who choose philosophy and do not get exposed to enough other material (my own undergraduate degree was like that, through a choice I do not endorse), for undergraduates who miss out on exposure to philosophy while doing other fields, and for professors too.

[4] From *From Analytic Philosophy in America and Other Historical and Contemporary Essays*, Princeton University Press, forthcoming.

have ceased to belong to philosophy and will belong to science.

> In short philosophy is the way we approach problems that are presently too elusive to be investigated scientifically. The goal is to frame questions, explore possible solutions, and forge conceptual tools needed to advance to a more definitive stage of investigation.

This is a statement of something like the incubator role, but it seems to rule out the integrative role. Russell certainly means to do this; I am not sure about Soames, as his comment is made at the beginning of a treatment of a specific case. For Russell, though, philosophy is only a place for the immature, never the highly general and mature.

Here is a quote from Dick Moran, in an interview on the "3AM" website:

> [P]hilosophy has always been a place for questions that have no other home among the disciplines, and yet which we remain convinced are real questions even if we don't yet even know what it would mean to answer them. Sometimes, of course, we discover that our sense of the question we were asking was confused, or there wasn't really the question we thought there was. But it is very important to the health of philosophy that we resist the idea that there is a way of knowing in advance whether our questions are real ones or not.
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> That is a perennial temptation in philosophy, to think that we could arrive or have arrived at a method or general principle (e.g., verificationism, certain forms of pragmatism) for knowing in advance which questions are "real" and which are not, the dream of a formal method for banishing "metaphysics" in the pejorative sense.

I agree with this and I see the critical point being made – the point made about attempts within philosophy to rule styles of work out.

An old paper by Rorty is called "Keeping Philosophy Pure." The instinct to preserve purity is seen in attempts to mark out a special domain for philosophy such as "the analysis of concepts," or of the *a priori* preconditions for living and thinking as we do. I am opposed to moves like that. The natural role for philosophy involves impurity. Good philosophy is impure philosophy. I say that as something as a slogan and I mean it. There might then seem to be a tension between that slogan and the openness of the discipline that I endorse, seen in the Moran quote: do not close off avenues with a theory of what cannot be done. I agree and qualify my sloganeering. We can distinguish between

purity of first-order work and purity in metaphilosophical attitude. I am certainly against purity in metaphilosophical attitude. I also tend to bet on impurity in first-order work.

2. Critics

As an interlude I will look at a series of increasingly hostile comments made about philosophy by physicists during recent years.

The first is by Stephen Weinberg, who wrote a chapter in his 1992 book *Dreams of a Final Theory* called "Against Philosophy." Weinberg's remarks are mild and thoughtful by the standards of what came later.

> I know of no one who has participated actively in the advance of physics in the postwar period whose research has been significantly helped by the work of philosophers. I raised in the previous chapter the problem of what Wigner calls the "unreasonable effectiveness" of mathematics; here I want to take up another equally puzzling phenomenon, the unreasonable ineffectiveness of philosophy.

Weinberg argued that the usual role of philosophy is to impede progress, because it is a place where old ideas stay around and function as dogma.

We can certainly see how that *could* happen; there is a plausible sequence here. A scientific idea develops and comes to influence general ideas about how the world is. It makes its way into philosophy, and there it hardens, and in the hardened form it is treated as how things *must* be. In the science itself, eventually ideas start to move on, as the old view has run out of resources, but to the extent that scientists attend to philosophy, they will be held back by the more dogmatic version of the older view that has taken hold there. For Weinberg philosophy is not an incubator but a dim place where once-vigorous ideas live on in suspended animation, and do so in a way that blocks new inquiry.

Is this true, or partly true? Weinberg gave two examples, mechanism as a view about the physical world and positivism as a view about theoretical language. The former case I think is weak. Weinberg thinks that it was imperative that the once-vigorous mechanistic view of nature be overcome, especially round the turn of the 20th century, but some people resisted. He does not give evidence that it was resisted because of the influence of philosophy, though, and this seems unlikely to me. Weinberg's other case is better. He thinks that the positivistic insistence that theoretical language be tied closely to

known observable tests is occasionally progressive in specific contexts, such as Einstein's, but is harmful as a general constraint on theorizing. Here I agree more with the case, with qualifications that we could discuss. So there is certainly a kind of accounting that can be done here, balancing the creative role of philosophy with the constraining role. It would be fortunate if scientists paid attention to the creative work and ignored the constraining work. In fact, I think things might be a bit like that, something that reflects better on the scientists than the philosophers.

Other anti-philosophy remarks have been less well-informed and there is less to say about them individually. Stephen Hawking and Leonard Mlodinow's book *The Grand Design* (2010) starts out by saying that there are good general questions about reality, the creation of the universe, and so on that are traditionally philosophical questions, but "philosophy is dead," because it has "not kept up with modern developments in science, particularly physics." As James Ladyman and Don Ross argue in *Every Thing Must Go* (2007) there is a high-profile part of philosophy, analytic metaphysics, where the messages of recent physics should guide the work much more than it presently does, but as a general claim what Hawking and Mlodinow say is simply erroneous.[5]

The denunciation with the most vigor comes from Freeman Dyson, writing last year in the *NYRB*.[6] Trimming it down to the basics:

> For most of the twenty-five centuries since written history began, philosophers were important.... Through all the vicissitudes of history, from classical Greece and China until the end of the nineteenth century, philosophers were giants playing a dominant role in the kingdom of the mind.

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[5] Lawrence Krauss wrote a book called *A Universe From Nothing* (2012) with some mildly negative comments about philosophy, one of which has real content: the universe is stranger than our imaginations can anticipate, and philosophers trust their imaginations too much. David Albert wrote a negative review of the book in the *New York Times*, and Krauss subsequently became very aggressive, calling Albert "moronic" in a speech, and said in an interview in the *Atlantic*:

> Philosophy is a field that, unfortunately, reminds me of that old Woody Allen joke, "those that can't do, teach, and those that can't teach, teach gym." And the worst part of philosophy is the philosophy of science; the only people, as far as I can tell, that read work by philosophers of science are other philosophers of science. It has no impact on physics what so ever, and I doubt that other philosophers read it because it's fairly technical. And so it's really hard to understand what justifies it.

He partly recanted these remarks later: http://www.scientificamerican.com/article.cfm?id=the-consolation-of-philos.

[6] Freeman Dyson, "What Can You Really Know?" NYRB, November 8, 2012.

> Holt's philosophers [those discussed in Dyson's review] belong to the twentieth and twenty-first centuries. Compared with the giants of the past, they are a sorry bunch of dwarfs. They are thinking deep thoughts and giving scholarly lectures to academic audiences, but hardly anybody in the world outside is listening.
>
> When and why did philosophy lose its bite? How did it become a toothless relic of past glories? ... Philosophers became insignificant when philosophy became a separate academic discipline, distinct from science and history and literature and religion.

A first thought in response to Dyson is to wonder if he has never heard of John Rawls and Peter Singer. Singer is someone whose philosophical work has had more effect on the world – more "bite," to use Dyson's term – than perhaps any other living academic. Dyson's final comment is a nudge in the right direction, though; philosophy risks becoming insignificant when it becomes more self-contained, and some parts of it do risk that outcome. If we look at epistemology in American philosophy, for example, and think of a sequence from James to Dewey to Quine and then the current generation, it is reasonable to wonder. Thomas Kuhn, someone who had immense impact as an epistemologist, was only marginally a philosopher.

Several physicist critics – Weinberg quoted here and also Krauss and Perakh, but not Dyson – complain that philosophy is no good because it does not influence scientists.[7] Bracketing whether or not this is true, the view I defended earlier is one in which the point of philosophy is not to help other fields, but to answer questions within its own. Philosophy's "field" is a somewhat unusual thing, given its synoptic quality and its open-endedness, but the goal is not to help some other field – just as the goal of history or theoretical physics is not to help some other field.[8][9] In doing the accounting in

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[7] Similar comments were made by physicist Mark Perakh on a website round the same time:

> I dare to claim that the sole value of philosophy of science is its entertaining ability. I doubt that all the multiple opuses debating various aspects of the philosophy of science have ever produced even a minute amount of anything that could be helpful for a scientist, be he/she physicist, biologist, geologist, you name it.

(http://www.pandasthumb.org/archives/2010/12/philosopher-rus.html)

[8] Massimo Pigliucci made this point in reply to Krauss:

> To see how absurd Krauss' complaint is just think of what it would sound like if he had said that historians of science haven't solved a single puzzle in theoretical physics. That's because historians do history, not science. When was the last time a theoretical physicist solved a problem in history?

this area, there are risks of philosophy not getting credit for its successes. Via the Russell and Soames comments, we are reminded that once an investigation starts to show obvious progress, it often passes from philosophy into something else. It would make no sense to criticize an incubator for failing to produce well-rounded adults - its role is to produce promising infants. If a person thought the incubator role was central, this might be their main reply to the physicists.[10] I see the incubator role as secondary, though, so philosophy is to be judged more for its producing real understanding of the integrative kind.

5. Information and Communication

I will finish with a closer look at the relation between philosophy and science, and with an example that illustrates themes of the previous sections.

Within philosophy of science in a broad and familiar sense we can distinguish two specific projects, which I call *philosophy of science* and *philosophy of nature*. Philosophy of *science* in this narrower sense studies science itself – the aim is to investigate how evidence works, how explanations work, how theories represent phenomena, both in general and in particular areas. In philosophy of nature, on the other hand, the philosopher's attention is not on scientific work itself, but on nature, or some part of nature, seen through the lens of science. The philosopher takes as their starting point the descriptions of some part of the natural world that come from science, but when working out what we have learned about this part of nature, and how it relates to the rest, the philosopher need not just accept the raw science, or the scientists' own simplifications of it for export. Philosophy of nature is based on science but it is philosophically processed science.

Why think there is something for philosophy to add here? First, a philosopher can engage in straightforward criticism of the science, if they see a problem. What you think

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(http://rationallyspeaking.blogspot.de/2012/04/lawrence-krauss-another-physicist-with.html)

[9] Dyson: "I put narrow limits on science, but I recognize other sources of human wisdom going beyond science. Other sources of wisdom are literature, art, history, religion, and philosophy."

[10] In the *Altantic* interview Krauss was asked about Bertrand Russell and his role in the origin of computers. Krauss said that Russell was doing mathematics, not philosophy. In fact Russell was doing a mix of the two – doing what by both current standards, and the standards of his time, was a mix of both. He was doing new kinds of things in mathematics as a response to partly philosophical motivations.

about the role of philosophy will also depend on the details of your views about how science works – on views in philosophy of science. Suppose you believe the following: the ideas developed within scientific communities have contours that reflect both the subject-matter and the practicalities of scientific work. These include the demand for questions to be tractable, and discussable by people with diverse background assumptions, also for contrasts between options to be usably sharp.[11] In science we also encounter language that is infused with subtle metaphors, and simplifications that oil the wheels of day-to-day work. If you think those things about scientific language, and you also think that scientific work is a reliable way of learning how things are, then you will think that the integrative philosophical project involves a role for what I called processing of raw scientific work, and scope for criticism of various kinds.

To finish I will look at an example: recent work on information and communication in biology.

The discovery and unraveling of the "genetic code" in the mid 20th century led to the enthusiastic application of concepts of coding and information to the processes of gene expression, and since then this mode of description has spread much further in biology. This, in turn, has led to foundational discussions from both biologists and philosophers. Is evolution itself in some sense an information-based process, one that takes place in what George Williams called the "codical domain"? Is biological development the execution of a program, and if so, how does this fact about change at one time-scale relate to the role of information in evolutionary change?

One possible view is that talk of information-processing in these areas is just a loose metaphor. At an early stage in the discussion Philip Kitcher made a comment of this kind as a way of setting the issue aside.[12] No weight is carried by talk of coding and representation in genetic systems, so discussion of the important issues concerning genes and causation should not worry about it. That is a claim in the philosophy of science that bears upon projects in philosophy of nature. Ongoing developments in biology have made this analysis less and less defensible. Notions of communication, programming, and information use have become more and more deeply embedded in biological practice.

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[11] See Shapin and Schaffer, *Leviathan and the Air Pump*.

[12] See his "Battling the Undead: How (and How Not) to Resist Genetic Determinism," in Singh, Krimbas, Paul, and Beatty (eds.), *Thinking About Evolution*, 2001.

Arnon Levy recently offered a detailed and sophisticated metaphor-based view.[13] Here as often in science, Levy thinks, communities develop highly regimented fictional modes of talk. The culture learns to play a game of make-believe. In this case, the game is one in which we treat parts of organisms as sending and receiving messages, interpreting what they are told, and so on. If you ask whether this is meant literally, Levy's answer is a simple no. It is fictionalizing. But it is serious fictionalizing. Explanations can be given in these terms and novel facts discovered. But there is no need, on Levy's view, for a general theory of how communication or representation can really be present in these systems – a philosophy of nature project in which communication is treated as a real feature of systems at a wide range of scales.[14] "Information-talk" in cell biology "is serious but it isn't literally true."

There is a lot to be said for Levy's analysis but I favor a different approach. The philosophical topics of meaning and representation have been transformed by recent work on sign *use*, especially by Brian Skyrms's generalization of David Lewis' model of "conventional signaling" from the 1960s.[15] I will outline my own version of these ideas. Lewis gave a first model of a special sort of natural kind, a *sender-receiver system*. Imagine two agents, a *sender* who can see the state of the world but cannot act except to produce messages or signals of some kind, and a receiver who can only see these signals but can act in a way that affects both sides. Some process of *selection* shapes, and may stabilize, the behaviors of these two agents or devices. It shapes the *sender's rule*, a mapping of states to signs, and a receiver's rule, a mapping of signs to acts. The process of selection may be evolution by differential reproduction, reinforcement learning,

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[13] Information in Biology: A Fictionalist Account. *Noûs* 45 (2011): 640-657.

[14] Some quotes from Levy's paper:

> The activity of genes, hormones, morphogens and other factors is described *as if* it were a process of communication in which a sender transmits a signal that regulates a receiver‘s behavior.
>
> Biologists metaphorically describe molecules and cells as engaged in communication and information sharing. Such descriptions invoke games of make believe in which participants are to imagine the relevant elements – genes, hormones, cells or whole organs – as if they were sending and receiving messages.
>
> Invoking an informational pretense consists in treating one element of a causal interaction as a sender, another as a recipient and an intermediate factor as a signal that informs the recipient of some state and/or induces in it an appropriate response.

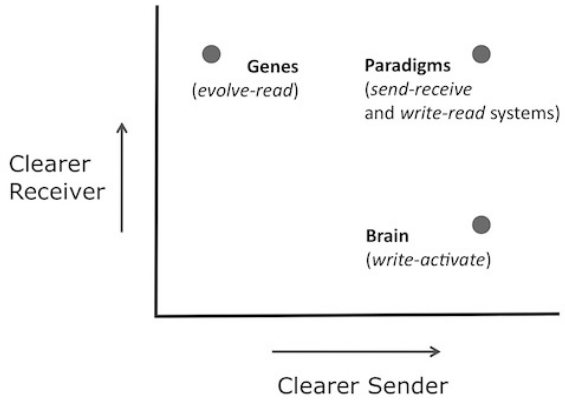
[15] See especially Skyrms's *Signals* (2010).

rational choice, or another process with a family that can play this role. The process of shaping sender and receiver behaviors is highly sensitive to the relations between interests of the two agents, especially to their degree of *common* interest, essentially the similarity of their preferences about which acts are best produced in each state of the world. To understand the semantic properties of signs of any kind is to understand their relations to these rules on either side of them, a rule of production and a rule of use, a rule of writing and a rule of reading, where these rules co-evolve as a result of the consequences of the pairing of actions with states of the world.

The model can be linked to information theory in Shannon's sense. Shannon gave an engineering analysis of how a channel can be used to transmit information between a sender and receiver, *taking for granted* that agents of some kind are playing these roles. Lewis and Skyrms take for granted the existence of a Shannon-type channel, and give an analysis of how the dispositions of senders and receivers are stabilized: in Lewis, 1969, by rational choice and common knowledge; in Skyrms, 2010, by any consequence-driven selection process.

The Lewis-Skyrms model is an idealized but fairly accurate model of one range of natural phenomena – parts of language use as in Lewis, bee dances and some other animal signals, also some tinier systems, quorum-sensing systems in bacteria – and is also a much more imperfect but still informative model of a further class of systems, where something *like* sending and receiving is in place but there are major departures from the model. These include cases where there is "entanglement" of entities treated as distinct by the model – sign and receiver, for example – so the degrees of freedom assumed in the model are not present. They also include cases where the "acts" of the receiver are filtered through many other processes before any outcome relevant to selection occurs, and cases where the "sender" and "receiver" are just so simple or so embedded in other machinery that the model's focus on a particular set of causal relations is questionable when applied to them. It then becomes a project to work out how and why, in the many domains where sending-*like* and receiving-*like* processes go on, nature gives rise to clear cases of the basic set-up in some cases and more partial and submerged ones in others. Gene expression is very much like a process of reading a content written in cell-level memory, but the message *evolves* rather than being *inscribed*, and I see these

as quite different. Mainstream neuroscience holds that memories in the brain are not read with a dedicated reader mechanism; in the brain "memory is everywhere, intermixed with computational elements"; memories are marks made that affect later processing (as in "long-term potentiation") but they have these effects without being read. There, in contrast to the genetic case, it is the reader or receiver side that fits the basic model less well.[16] These relationships can be roughly summarized in a figure like this:



Where outside human social life do we find sender-receiver systems like the kind we are embedded in now, using language at a conference, and where do we find systems in which the combination of receptivity and activity, stabilized by selection, that seen in the SR model takes other forms?

Many systems studied by biology contain partial, semi-submerged sender-receiver systems of this sort. In the most recent issue of the *New York Review of Books* Colin McGinn reviews a book by Ray Kurzweil, and objects to claims made routinely in biology about signaling between cells in our brains:

> [I]ndividual neurons don't *say* things or *predict* things or *see* things—though it is perhaps *as if* they do. *People* say and predict and see, not little bunches of neurons, still less bits of machines. Such anthropomorphic descriptions of cortical activity must ultimately be replaced by literal descriptions of electric charge and chemical transmission (though they may be harmless for expository purposes). Still, they are not scientifically acceptable as they stand....

[16] For more discussion (including more about the diagram) see my "Sender-Receiver Systems Within and Between Organisms," which was given at PSA 2012 and is on my website.

> [H]omunculus talk can give rise to the illusion that one is nearer to accounting for the mind, properly so-called, than one really is.
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> Why do we say that telephone lines convey information? Not because they are *intrinsically* informational, but because conscious subjects are at either end of them, exchanging information in the ordinary sense. Without the conscious subjects and their informational states, wires and neurons would not warrant being described in informational terms.....
>
> It is simply false to say that one neuron literally "sends a signal" to another; what it does is engage in certain chemical and electrical activities that are causally connected to genuine informational activities.
>
> We have discovered that nerve fibers transmit electricity. We have not, in the same way, discovered that they transmit information. We have simply postulated this conclusion by falsely modeling neurons on persons.[17]

McGinn is right that an illusion of understanding can arise from describing a marginal case of an sender-receiver system using terms that only apply to a paradigm case. Neuron-to-neuron interactions in complex brains are marginal cases.[18] He is wrong to think that the only coherent treatment of communication and information use that is fully literal is one requiring "conscious subjects" on either side of a communication channel (consider bee dances), and he seems not to countenance a treatment that investigates the factors that give rise to clearer as opposed to more marginal cases, and treats these distinctions in a gradient way.[19]

A research program taking shape in this area is doing several things. One is further formal development of the models. Another is looking at how the central model and its variants apply to different kinds of natural systems, using it to ask what kind of unity there is in communication-like processes in different domains. This is philosophical in a way that fits the integrative vision. Models of this kind developed within philosophy are also influencing discussions in other fields. Lewis's 1969 model seems to have been

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[17] "Homunculism," March 21, 2013, a review of *How to Create a Mind: The Secret of Human Thought Revealed,* by Ray Kurzweil.

[18] For discussion of how neuronal interactions relate to current sender-receiver models, see Rosa Cao, "A teleosemantic approach to information in the brain," *Biology and Philosophy*, 2012.

[19] Levy might reply to McGinn that this talk about neurons is indeed metaphor, but valuable metaphor. It is not merely merely harmless at best, as McGinn supposes, but reflects and encapsulates hard-won knowledge about the causal properties of biological systems. Dennett's detailed discussions of how to "discharge homunculi" in *Brainstorms* (1981) and *The Intentional Stance* (1987) are also applicable here.

the first formal treatment of the stabilization of sender-receiver interactions, predating the first model of its kind in economics (which admittedly took on a much more challenging case) by a few years.[20] The Lewis model may turn out to be a fruitful piece of philosophical incubation in the sense discussed earlier. But this is also a case where, as described before, a novel theory is developing in philosophy in a way that is not merely provisional and preliminary. The high degree of generality and abstraction that comes naturally in philosophy is shaping the development of a particular style of model. The result is what I see as the best approach developed to date for understanding how the diverse range of natural phenomena that involve communication, meaning, and information exchange all hang together.

[20] I have in mind Michael Spence's 1973 model of "Job Market Signaling," *Quarterly Journal of Economics* 87: 355-374.