BRIAN SMITH

How do we Recognize Structural Realism?

1. Introduction

The title of this paper clearly references Gilles Deleuze's 1973 essay, 'How do we Recognize Structuralism?' where he tries to articulate both the power and limitations of the structuralist approach, so prevalent in French studies of the humanities and philosophy in the 1960/70s.[1] At this time the humanities sought to model themselves on the sciences.[2] Following the lead of the structural linguistics of Saussure and Jakobson, Levi-Strauss' structural anthropology set the pattern by breaking from an historical, or developmental, account of the variety of different societies, and, instead, sought to give an account of this variety in terms of universally shared elements and relations. The difference between societies was due to the different relations between the same fundamental elements: each society is simply a permutation of these basic elements and their relations.

This image of science, as having a set of a-historical universal laws, which could be used to explain the workings of Nature, was in stark contrast to the rapidly changing world of fundamental physics. It owed more to a nostalgic view of Newtonian mechanics and its pre-eminence over the last 250 years than to the contemporary practices of science, or the philosophy of science of the mid to late C20th. This resulted in structuralism erring toward a fetishistic scientism, rather than a genuine scientific practice. The focus on a set of unchanging universal elements and relations began to be challenged by figures such as Foucault, Lacan and Althusser, who have a much more uneasy relation to the structuralist label. In his essay, Deleuze is concentrating on the innovations of these thinkers

[1] Deleuze (1973).
[2] Dosse (1991), pp. 13, 24.

Bollettino Filosofico 29 (2014): 175-200
ISSN 1593 -7178 - 00029
E-ISSN 2035 -2670
DOI 10.6093/1593-7178/2843

and their interpretation of structuralist thought, which aimed to bring out structuralism's own inherent power to transform itself as a process of constant change.

The term structuralism has recently gained popularity in the area of the philosophy of science under the title of structural realism. What is the appeal of structuralism as an approach, and what does this contemporary notion of structuralism have in common with the structuralism discussed in Deleuze's paper? In this paper I will focus on the work of James Ladyman and Don Ross' influential 2007 book *Every Thing Must Go*.[3] Although their position is an extreme form of structural realism, I think it helps to highlight what is both interesting and problematic about this use of the term structuralism, and it has also provoked comment from across the philosophical spectrum.

I think there is a significant philosophical thread that links these two discussions of structuralism, and there are two central aims in *Every Thing Must Go* that can be investigated through a comparison with Deleuze's essay.

The first concerns realism and theory change. Science, unlike its simple image, is not the accumulation of true theories, but rather a succession of false theories. Theory change entails ontological discontinuity, due to the different ontological commitments of each new successive theory.[4] Ladyman and Ross (hereafter L&D) want to attribute what is real, and truly representative of mind independent aspects of the world, to something that is preserved between theories. It is the successful part of each theory that is preserved. These are the structures and patterns that are used to make accurate and useful predictions. These structures are preserved in the new theory as special cases, which reappear under limiting conditions. L&D call these preserved structures real patterns, after Daniel Dennett's influential paper.[5] What is real are those structures that are preserved, rather than the explicit atomic elements,

[3] Ladyman (1997).
[4] Ivi, p. 83.
[5] Ivi, p. 119-121.

forces or relations of any specific theory. We no longer have ontological commitment to the domain of objects given in a particular theory, but to the information carrying patterns that can be expressed across a specific succession of theories, which form the historical succession of theories in a given science. L&D state, echoing Quine: 'To be is to be a real pattern'.[6] This emphasis on the reality of the structure is central to L&D's ontic structural realism (OSR), as opposed to what they call epistemic structural realism.[7] The basic claim of OSR is to give the ontological priority to the structure or patterns themselves, rather than to some ultimate, yet inaccessible/unknowable, base. Epistemic structural realism, by contrast, keeps faith with an ultimate ontological base, and claims that structures, or relational patterns, are all that we can empirically know about this base.

The second concerns the unity of science as a whole; a reflection of the unity of the world.[8] The role of any useful metaphysics, for L&D, is to provide the criteria under which scientific practice can be thought of as a whole. Without a completed science, or absolute measure, a number of pragmatic and regulative measures must be deployed under the banner of the Principle of Natural Closure (PNC).[9] I want to focus mainly on what they call the Primacy of Physics Constraint (PPC), which is a non-reductive but regulative use of fundamental physics to unify scientific practice.[10] Fundamental physics has a high degree of autonomy, it must be internally consistent, but it need not check whether its own theories are consistent with those of the special sciences, the same is not true in reverse: all special sciences must be both internally consistent and consistent with fundamental physics.

[6] Ivi, p. 226.
[7] Ivi, pp. 67, 124-125. Ladyman (2007), pp. 24, 28.
[8] Ivi, p. 27.
[9] Ivi, pp. 27-38. See especially the definition on p. 37.
[10] Ivi, pp. 38-45.

> Special science hypotheses that conflict with fundamental physics, or such consensus as there is in fundamental physics, should be rejected for that reason alone. Physical hypotheses are not symmetrically hostage to the conclusion of the special sciences.[11]

The task of metaphysics is restricted to the task of giving a unified picture of science, a new form of scientistic naturalism, a label they enthuiastically adopt.

In this paper I want to endorse L&D's first point concerning theory change, and compare it with Deleuze's own analysis of structuralism. For Deleuze, structuralism develops beyond the belief in a single system, a single set of elements and relations capable of supporting all relevant structures, and moves to a focus on how structures move between and disrupt systems. Using Deleuze's concept of sense, especially the French meaning of *sens* as 'direction', I want to suggest that theory change in scientific practice characterizes the special sense of science. The notion of progress gives science its sense; it preserves, or communicates, its patterns via a linear movement of progression, based on the extension of predictive success. This is enough to characterize the unity of science as a loose fabric composed of the threads of the special sciences, without the need to place these separate sciences in any form of hierarchy. There is no need for L&D's severe measure to ground the unity of science in fundamental physics.

This analysis will fall into three distinct sections: 1) An examination of Deleuze's essay, 'How do we Recognize Structuralism?' to outline and develop his terminology of the real, imaginary and symbolic as the basic means for analysing structures. The symbolic will be the central term, giving rise to the movement between systems and to the important notion of the empty square, which gives sense to this movement without ever being apparent in any given system. 2) A brief summary of Daniel Dennett's paper 'Real Patterns' in order to build a bridge

[11] Ivi, p. 44.

between Deleuze and L&D.[12] 3) A discussion of L&D's form of structural realism and the positive role that Deleuze's theory can have on the structural realist debate.

2. Deleuze and the encounter as the production of the symbolic

Deleuze frames his question in terms of the linguistic pioneers of structuralism; a structural approach is relevant whenever we discover something structured like a language, a structure capable of communicating.[13] This gives rise to the initial terminology of a coupling between the real and the imaginary. To put it simply: everything begins with an encounter between two heterogeneous systems, and this encounter only occurs if it is productive/communicative. The symbolic arises from this encounter, it is what is interesting in any encounter, what stands out in the application of a theory to a domain, what emerges from a process as it works on its material.

The symbolic gives value to the encounter, not through a static set of measures, but through the dynamic perpetuation of the encounter itself. An encounter can only be recognized as such after it has occurred, it cannot be known in advance or at the first moment of contact. This recognition can only occur through the structure of the symbolic, the encounter must give rise to and continue to produce the symbolic, which can only retrospectively recognize and attempt to name and locate its origin in the original encounter. This symbolic reflection always already finds itself in the middle of a process, in a productive encounter that is underway.

The symbolic is reducible to neither the real nor the imaginary, even if the two domains are wholly transparent and their relation is fully determined. Take the game of Chess as a simple example. The real corresponds to the limited world of the board and pieces, and the imaginary to the set of rules. The symbolic is then the realm of tactics, strategy and style, in short,

[12] Dennett (1991), pp. 27-51.
[13] Deleuze (1973), p. 171.

everything that makes the game worth playing. Chess is a living game due to its symbolic order; it is this that perpetuates the relation between the board and its rules, through various human and non-human means. The symbolic order is the structure that organizes the two linked systems of the real and the imaginary into a territory.

It is at this stage that Deleuze introduces his concept of sense to characterize the symbolic.[14] The double meaning of *sens*, in French, as both meaning and direction will be highly significant. The symbolic gives meaning, or structure to the linked systems of the imaginary and real, as it circulates and animates this territory. But, as Deleuze states: 'For structuralism… there is always too much sense, an overproduction, an over-determination of sense, always produced in excess by the combination of places in the structure'.[15] The direction, or trajectory, of the symbolic cannot be exhausted in this circulation within its own territory; the symbolic always threatens to escape and move beyond its territory. The symbolic is dependent on a territory in order to express itself, but it is not necessarily tied to the territory in which it is currently being expressed.

Nonsense captures the excessive or saturated aspect of the symbolic, sense is always in excess of the sense it makes within a given territory: it can always express more.[16] The ideas, patterns and relations that emerge within the connections of a specific territory are a structure, but this structure is not limited to expressing just the conditions of the specific real and imaginary systems coupled together in a territory. The structure has a mobility and freedom to find expression beyond these conditions.

Deleuze claims that describing how the symbolic operates within a territory is to only account for half of the structure, to fully understand how the symbolic animates this territory,

[14] Ivi, pp. 173-174.
[15] Ivi, p. 175.
[16] *Ibidem*.

perpetuating the encounter, we must look at how the sense of the symbolic allows it to escape and communicate between territories.[17] This is more than piecemeal symbolic fragments escaping from one system and appearing within another, such as the use of Chess terms, like "checkmate" in everyday conversation, and relates to a much larger structural migration or resonance between territories. In effect, a territory can never be completely closed, the symbolic meaning that it generates always escapes the territory, but the territory itself is productive and animated only by being open to influences beyond the closure of its measured or calculable conditions.

The symbolic elements form a series and this is what constitutes the structure within a territory:

> [T]he symbolic elements that we have previously defined, taken in their differential relations, are organized necessarily in series. But so organized, they relate to another series, constituted by other symbolic elements and other relations…[18]

The symbolic series in one territory resonates with another series in a different territory, and the structure is only fully filled out as it extends across territories and between series: every structure is serial. Every structure is composed of a minimum of two series, and it is the sense of the structure that the trajectory linking one territory with another.

Deleuze offers Foucault's linked series of the linguistic, economic and biological, or Levi-Strauss' link between a series of social relations and a series of animal relations, in his study of totemism as examples.[19] Turning back to the simple example of Chess, we realise that modern International Chess is simply one series in the serial structure of Chess – a structure that is fully fleshed out in terms of its diachronic historical development (giving greater mobility to the bishop and queen in order to

[17] Ivi, p. 182.
[18] *Ibidem*.
[19] *Ibidem*.

shorten games and make them more decisive) and its synchronic co-existence with a multitude of Chess variants (Japanese Shogi, Chinese Xiangqi and many modern variants, such as Baroque Chess). The invention and imagination shown by these variations, all held, for our purposes, under the name of "Chess" argue against any unified notion of Chess in which these variants could be seen as permutations of some form of "Universal Chess". Rather, there is a sense in which these variants are unified, a sense that is both intensified and distorted by the name "Chess". This sense is the manner in which these variants communicate with each other. There is no determinate or calculable notion of all possible variants of Chess, as opposed to the calculable set of all possible games under a given rule set. This notion of structure puts an emphasis on the autonomy of the structure itself, something Deleuze develops more fully in his technical reworking of the idea in *Difference and Repetition*, rather than a Wittgensteinian family resemblance, dependant on the uses that language users put it too.

The language being used here is wilfully ambiguous, avoiding any set criteria that would condition the transition between territories. The structure that animates its territories and links them together cannot be an isomorphic transformation between territories; the different series do not simply find themselves reflected, or repeated, in each other.[20] This would give rise to a strong reductive collapse of one territory onto another, but the notion of partial isomorphisms, as developed by L&D, to explain theory change, will begin to impart a certain determinate character on the specific structure of the scientific. It is at this stage that we can catch a glimpse of the effective power of Deleuze's approach.

There is a real difference between the type of structure that animates the game Chess and that which animates the sciences. Whereas the structure of Chess is distinctly horizontal, where all of its territories are encouraged to directly communicate and affect each other, with the trajectory of sense bending back on

[20] *Ibidem*.

itself to create multiple circuits of feedback. The recent wealth of innovation in chess variants expresses this openness in the structure of "Chess", especially in response to certain perceived problem of draws and indecisive games at the professional level. The sciences, under the ideas of predictive power, partial isomorphism and progress present a much more vertical and linear trajectory.

Each structure has one symbolic element that imparts a character to the structure as a whole, but without ever finding explicit expression in any of its territories/series, called the empty square or paradoxical object.[21] This is the element that never directly manifests itself in any territory, yet is the sense that all the territories of a structure share; it is what the structure is about. Each territory sustains itself as an adequate expression of this mobile element, which connects all the territories together. With the sciences as a whole it could be called the idea of Nature, which no theory or science ever captures, but it is the idea that continues to animate each theory and each science. With Chess, it is the idea of a certain kind of noble and hierarchical strategy game, which makes a family out of its variants. Each variant is an adequate expression of the game to the extent that it is played, that its symbolic series continues to move as the strategy of the game evolves. An adequate expression is, therefore, any such territory that continues to be inhabited, any process that continues to capture and hold together two heterogeneous systems in a productive encounter, and what they express is given by the sense of this continued encounter. The empty square is the sense of unity that holds the seriality of the structure together, the trajectory that passes through each member in the series, each territory, but which is never found or actualized in any member. The sense expressed by the empty square is the non-sense of a saturated, inconsistent, whole; the incalculable and indeterminate potential of the idea that can only find expression in its consistent ordered actualizations.

[21] Ivi, p. 184.

I now want to turn directly to explore the character of science as examined in Daniel Dennett's paper 'Real Patterns', where the real patterns share much in common with the symbolic as explored above. The analysis of real patterns can be used to narrow the meaning of the symbolic to the scientific domain. L&D carry this meaning forward in their version of OSR.

3. Dennett's real patterns

Dennett wants to cast the problem of the symbolic in his own terms, as real patterns, which, at their most basic, are patterns recognized by an observer and useful in terms of prediction. There is an effort made here to frame the problem in terms of an intentional perspective: that of the observer. This is a move that both Deleuze tries to avoid. Part of the reason for the use of such ambiguous language has been to resist this intentional, and possibly anthropomorphic, stance. Dennett makes these important claims early on:

> I shall concentrate always on folk-psychological prediction, not because I make the mistake of ignoring all the other interests we have in people… but because I claim that our power to *interpret* the actions of others depends on our power—seldom explicitly exercised—to predict them.[22]

And

> [I]n the root case a pattern is "by definition" a candidate for pattern *recognition*. (It is this loose but unbreakable link to observers or perspectives, of course, that makes "pattern" an attractive term to someone like me perched between instrumentalism and industrial-strength realism).[23]

With this emphasis on recognition Dennett is signalling the importance of the encounter examined above. Every pattern by

[22] Dennett (1991), p. 30.
[23] Ivi, p. 32.

definition presupposes recognition, it presupposes being the site for the capture of someone's, or something's, attention. The common sense appeal, made in the first quotation above, Dennett immediately narrows the scope of the encounter to the phenomenological, or intentional, and places prediction as the grounding paradigm. I agree, the paradigm of prediction does lie at the heart of scientific thought, and imparts to it its characteristic structure of progress, but it is overly restrictive as a means of interpreting every mode of productive encounter. By making this move Dennett fixes his attention at the conscious level of thought, giving rise to his well-known intentional stance, while also making sure that the structure of consciousness has a proto-scientific attitude, guaranteeing a strong naturalistic interpretation of the world.

Dennett tries to downplay the importance of the encounter, the original selection that expresses something interesting by and through a continued productive engagement. By making an appeal to the grounding role of prediction, thereby giving the notion of "interesting" a specific meaning in terms of an objective measure; either an information theoretic measure of compression or a statistical predictive measure of success.[24]

With this objective measure, Dennett claims that these patterns display mind independent qualities. Although they are perspectival, intentional, observations they also capture some real structure of the world.[25] The whole question of realism rests on the manner in which these real patterns already exist in the world, prior to their discovery and exploitation by intentional subjects. Are these patterns calculable possibilities within a totality that can be thought of as a consistent yet incomplete whole, or, with reference to Deleuze, can they be thought of as a saturated inconsistent whole, a virtual excess? The former makes predictive power a universal property and defining characteristic of real patterns, while the later leaves the notion of

[24] Ivi, pp. 32-33, 47-48
[25] Ivi, p. 30.

"interesting" inherent in real patterns more open and presents more of a challenge to a realist interpretation.

Dennett begins with an information theoretic measure, framed in terms of the efficiency of compression. A real pattern is any capture of information that is more efficient than the original source. If something is incompressible, if there are no real patterns, then there is just noise, a purely random source.[26] His example is a simple pattern of five black squares in a row, composed on a grid of pixels. The uncompressed form simply designates each pixel individually as either black or white, which he calls the bit-map encoding. Any pattern that can be seen in the source can be used to describe the information more simply and therefore compress it. The value for such compression, in terms of predictive power, is reasonably obvious. If I can work out the behaviour of a system using less effort, or information, than the system itself uses, then I can gain an advantage over that system, in terms of effort/energy saved, or in time saved.

The main issue with this conceptual model is that we often have no real measure of what the base level of information is, and therefore we have no idea to what extent we have compressed reality in the patterns that we recognize. The value we give to these patterns cannot, therefore, be given in terms of some absolute objective measure, but only in terms of their instrumental success, or relatively, by comparing the complexity and compression of competing patterns. This is a problem that L&D try to directly tackle with their Primacy of Physics Constraint (PPC). In the end the result is that 'The choice of a pattern would indeed be up to the observer, a matter to be decided on idiosyncratic pragmatic grounds'. [27]

Dennett's example of Conway's Game of Life is important here.[28] The cellular automata world and its catalogue of patterns only exists due to the curiosity that it provokes due to the life

[26] Ivi, p. 33.
[27] Ivi, p. 34.
[28] Ivi, pp. 37-42.

like behaviour it exhibits. It is far better known and studied than other, similar, rule sets. My point here is not that the automata world is fully determined, a point that L&D raise, but that it only exists as a living system in its relation to us (and our pattern searching computers and algorithms). Two systems, the automata rule set and us, linked together to catalogue and explore the meaningful patterns that emerge. It is this intervention between two heterogeneous systems, the encounter that captures the energy of one system, human curiosity, and its attendant technology, in the production and process of another. And the patterns of the Game of Life have established themselves beyond the limits of just a single rule set, gliders in particular have become a mainstay of cellular automata study, and have an influence far beyond its hobbyist beginnings and home in computer science. The sense of the symbolic communicates beyond its initial site.

We are back at the level of Deleuze's symbolic. What is significant about Dennett's paper is to focus on how these symbolic elements, or real patterns, communicate a scientific structure. The emphasis on prediction fixes the relation into an intentional relation, there is one system that has an interest in a second, and the symbolic meaning is fixed in favour of this first system and its interests.

This comes out in the culminating example of the paper. Dennett commits himself to the position that two rival interpretations of a given situation can only be differentiated and selected between on the grounds of their predictive power. If both theories make different predictions, but are, in general, equally successful then each theory, and the patterns that they recognize and track, are equally real. This demonstrates the ultimate limit of grounding a philosophy of the encounter solely on predictive power. What can two theories, and their patterns, equally successful in their predictive power, communicate to each other? Nothing. But, beyond this predictive stalemate we always feel that there is some excess, something to meaningfully differentiate between the two. L&D want to resist the collapse of

scientific practice into a wholly instrumental view, one that would embody the worst vices of speculative metaphysics.

4. Ladyman and Ross and theory change

To avoid the unpalatable conclusion of Dennett's paper, L&D seek to show how the special sciences are inevitably tied to pragmatic concerns, inherent in the specific choice of their subject, which fixes a scale and perspective for that science. [29] Only fundamental physics avoids this narrow perspectivism. Although it is in no sense finished or complete, fundamental physics is our most general science, it represents our most general view, the background against which every special science makes its selection and chooses its focus.[30] Fundamental physics can then be used to bring unity to the apparent partial disunity of the special sciences, not as a base to which all other sciences could, or should, be reduced, but as a ground to support and co-ordinate the other sciences into a hierarchy of dependence. [31] The role of metaphysics will be to realize this unity.

In order to pursue this unifying role of metaphysics, under the sign of fundamental physics, it will first be useful to understand the unity of the individual special sciences and especially the role of theory change. L&D introduce the idea of a notional world in order to describe how the special sciences are constrained in order to recognize real patterns that only become stable and persistent under these conditions; conditions that are taken as given. These could be thought of, in a transcendental sense, as conditions for the possibility of pattern recognition. But what do L&D take real patterns to be? Their more precise definition of a real pattern is as follows:

> To be is to be a real pattern; and a pattern is real if

[29] Ladyman (2007), pp. 249-250.
[30] Ivi, p. 251.
[31] Ivi, pp. 252.

> (i) it is projectible under at least one physically possible perspective; and
>
> (ii) it encodes information about at least one structure of events or entities *S* where that encoding is more efficient, in information-theoretic terms, than the bit-map encoding of *S*, and where for at least one of the physically possible perspectives under which the pattern is projectible, there exists an aspect of *S* that cannot be tracked unless the encoding is recovered from the perspective in question.[32]

The information theoretic measure of structure becomes the most important measure, giving rise to their fully-fledged theory of structural realism, which they call Information- Theoretic Structural Realism (ITSR).[33] Clause one reiterates Dennett's commitment to prediction; a real pattern is one that can be used to project the behaviour of a system. Clause two gives a definite way to measure the reality of a pattern in terms of its ability to compress information about a physical system. The second clause appears to be a robust and objective measure, but in practice it turns out to be problematic. To revisit an issue raised above, how do we know how much information the bit-map encoding of the real pattern contains, or if this is even an appropriate way to talk about the original pattern? If I record a live music performance in an uncompressed digital format, then that recording will have measurable information content, but it does not seem possible to measure the difference in information content between that recording and the original performance. I can go on to compress my original recording, to produce a new copy of the recoding that is comparable, in terms of measurable information content, with the original recording.

L&D recognize this issue, stating: '…one can meaningfully talk about "the" bit-map encoding of P only relative to some background structuring of P. Such background structures are

[32] Ivi, p. 226.
[33] Ivi, p. 238.

always presupposed in scientific descriptions'.[34] This gives us an insight into the structure of the sciences, and the importance of theory change, progress and succession for scientific thought. Every recognized science finds itself already underway, already in the in the middle of an established practice. What is presupposed, in the quotation above, is a history. Every special science is grounded in a prehistory where its main concepts arise as curiosities or extreme phenomena in some more established practice/science. This prehistory can only be read retrospectively from the viewpoint of the established science, but this established position does not arise with the first systematic theory that fully focuses on the real patterns of interest. The established position only arises with the second theory, the first successor theory, the first improvement. The presuppositions required for a nominal world require a pre-theoretical stage that has gone through at least two stages of theorization in order to establish the background necessary to provide the stability for the propagation, investigation and control of real patterns. Bueno, French and Ladyman make this point concisely:

> It is not the case that we have, in some sense, ''raw'' structures and we then seek to establish set-theoretic relations between them; rather it is that we—philosophers of science, that is—are presented with the structures that arise out of scientific practice and we then characterise, or, if one prefers, represent, these structures in such a way as to illuminate those features that we, as philosophers of science, are interested in.[35]

Theory change is essential for science, and this is the most compelling aspect of L&D's theory. To be is to be a real pattern, and to be a real pattern is to be able to measure the increase in predictive power, or projectibility of a pattern from one theory to another. This is the structure of the sciences; the real patterns only become truly recognized in their persistence between

[34] Ivi, p. 232.
[35] Bueno (2012), p. 45.

theories, in the partial isomorphisms that can be retrospectively constructed to recover the successful parts of previous theories. Ontological dependency has been reversed, the real patterns that emerge in a given theory are no longer secondary in relation to the primary commitments to the "things" that constitute a theory; its atoms, elements, or primary forces, for example. The patterns that persist, that are communicated between theories, are now primary and their realization, in particular theories, are secondary. L&D do not ask us to do without things, but only to realize that they are derivative and dependent on real patterns, even though these patterns are always expressed by way of the "things" of a given theory. The character of the sciences is to recognize its patterns only in terms of increased predictive power or efficient compression.

This recognition that science always already finds itself within a sequence of mathematical theories, or models, allows them to abdicate responsibility for metaphysics to talk about the immeasurable excess of the real, that initial encounter and selection. Philosophical metaphysics should not try to talk about the "raw structure" beyond its mathematical models and the relations between them; such speculation is empty or poetic, not usefully scientific/naturalistic.[36] For both Graham Harmann and Jack Ritchie, two philosophers coming from opposite ends of the philosophical spectrum, this is a problem. Harmann, who is happy to endorse an inflationary view of objects/things, is keen to point out the inability of L&D to speculate on the difference between physical reality and our mathematical representations, and their awkwardness in approaching this issue: they simply do not know what the relationship is, refuse to speculate on it and simply accept it as given.[37] For Ritchie, the question as to the difference between mathematical structure and physical reality is a compulsory question for the philosophy of science.[38] The realist claims of a naturalist philosopher of science must step

[36] Ladyman (2007), pp. 158, 247-248.
[37] Harmann (2010), p. 783
[38] Ritchie (2010), pp. 680-681.

over this boundary, and say something about the physical nature of reality, beyond its mathematical structure. Ritchie believes it is necessary to make sense of the claims of OSR and to properly claim the title of being a naturalist, by giving an account of the difference (or identity) between our mathematical theories and physical reality itself. This request to just accept the givenness of the world-structure is seen in terms of L&D's praise for the institutional structures of science (peer reviewed journals and funding applications/bodies, for example) as error filters, and our only means of demarcating between science and non-science.[39] These institutional structures are, in lieu of a complete science, or an absolutely objective measure, our best pragmatic means for implementing scientific practice and progress.

L&D's best defence of their position is seen from their positive account of the role of the philosophy of science, rather than dwelling on what it cannot, or should not do. This positive role is to unify the sciences under the authority of fundamental physics.

Central to the aim of unifying the sciences is the distinction between how real patterns function in the special sciences in contrast to fundamental physics. L&D present the special sciences as creating, and being tied to, nominal worlds, which signal the constraints, especially in scale, necessary to provide the context to stabilize certain patterns of interest. Stated in their own words:

> Special scientists assume, at least implicitly, that all real patterns they aim to track must be stabilized by *something* against entropic dissolution… In our terms 'resistance' can be interpreted here as referring directly to the extent to which a pattern supports projectibility by physically possible observers.[40]

In this presentation we hear the strong echo of Dennett's emphasis on patterns as, by definition, candidates for pattern

[39] Ladyman (2007), pp. 28-34.
[40] Ivi, p. 250.

recognition by an observer and in terms of their special interests. The desire to differentiate fundamental science (currently fundamental physics) from all other special sciences will find its voice in the language of a science purified of any specific interest, and therefore freed from the subjective perspective conditioned by these interests. They are tentative, despite the Kantian overtones, of calling the patterns of fundamental science universal patterns due to the provisional nature of our current best fundamental science.[41] Fundamental physics, as it stands, is not the last word in science, but it does hold an autonomous position relative to the other special sciences, it is the most general science with the widest scope and its results must hold in all the domains of the special sciences. The aim of philosophical metaphysics then is not to place itself beyond fundamental physics and empirical science, as the final real basis of Nature, but to examine and realise the unity, which means the consistency, of all the sciences. This is the more formal statement of the Primacy of Physics Constraint (PPC):

> The hypothesis that there is a true fundamental physics explains our observation of the PPC: every measurement of some real pattern on a scale of resolution appropriate to a special science that studies real patterns of that type must be consistent with fundamental physics.[42]

In lieu of a completed fundamental science, we use our best theory, currently found in fundamental physics, to fashion science into a consistent unity. The main upshot of this is that where a special science produces results or theories that are inconsistent with fundamental physics, it is the special science that is expected to change, giving a rather authoritarian character to fundamental physics. Philosophical metaphysics then concerns itself with enforcing this authoritarian rule of consistent unity.

---

[41] Ivi, p. 251.
[42] Ivi, p. 252.

One of the main themes in the analysis of Deleuze's essay was the recognition that every structure of linked territories (a nominal world) is the result of an encounter that embodies an excess: the production of the symbolic, or the recognition of real patterns, entails an excess that escapes the system, and can only appear as a contingent choice, or selection within the structure, or world, itself. This is the background that L&D talk about; every established science (including fundamental physics) always already finds itself within such a nominal world, with its presuppositions and accepted norms/history.

This is not a limitation, but necessary for the process of actualization, that is, for a meaningful, consistent, expression of reality, Nature or a world. This is something that fundamental physics is no more capable of escaping that any other science. The name that Deleuze gives to this something against which a nominal world, or structure, resists in order to realize its patterns, is the empty square. Each science is brought to the edge of inconsistency by its empty square, the idea that motivates it, but which is never fully captured or expressed within the frame of a theory. In order to be able to give a consistent expression it must exclude something, and in doing so every nominal world remains open, animated and living.

To give a brief example, take biology and look at some of its central ideas, such as life, organism and individual, these central concepts motivate the science without ever conclusively being pinned down or defined, with any accepted view carrying a sense of pragmatic limitation, or bias of interest.[43] For Deleuze, the totality, or unity, of the sciences is real but it is inconsistent, expressed in every consistent science by a sense that escapes it. The unity of the sciences lies is in their shared structure, and in their individual consistency; each has a sense that gives a trajectory to their progress through theory change. This trajectory needs a background against which to plot its course, and needs a history from at least one theory to another in order

[43] Bouchard (2013).

to plot a trajectory, giving the science as a whole meaning and sense.

In this model, science as a whole cannot be conditioned by one of its elements, such as fundamental physics, in the way that L&D prescribe. Within science, as a whole, there may be nodes of problematic interest, where the results of specific sciences appear to be in contradiction to each other, but each such case must be treated individually. There is no value in presupposing the truth of one science as outranking another, and therefore giving preconditions to the creative communication opened by the problem at the boundary between two sciences. Take the well known relationship between fundamental physics and cosmology, here there are examples of fundamental physics predicting physical objects, such as black holes, but there are also many examples of cosmological data contradicting fundamental physics, such as Einstein's abandonment of the cosmological constant, and revisions to fundamental physics motivated by the observations of an accelerating expansion to the universe. It is not the case that fundamental physics is used to reform contradictions it finds between itself and other sciences. Contradiction simply gives rise to a problematic site, a point of communication, instigating creative speculative responses that give free reign to what may be revised, incorporated or rejected.

5. Conclusion

Trying to give a unified and consistent picture to the whole of science is as stifling under an abstract and empirically unfounded metaphysical system, which L&D rightly challenge, as it is under the empirically motivated guidance of our best fundamental science. One possible response that we can draw from Deleuze's analysis of structuralism is that the unity of science is not a consistent unity but an inconsistent unity.

The sciences form a unified response to the World, or reality, which is their shared structure, as outlined in L&D's position of

Ontic Structural Realism (OSR). The sciences provide a number of structurally similar expressions of reality, in terms of real patterns, predictive power and, especially, the preservation of predicatively useful real patterns across theory change. This expression of reality is precisely in terms that are internal to the sciences themselves, and gives rise to the particular potential for communication between the sciences. The sense of every particular science expresses a trajectory that extends beyond the measurable limits of its theoretical frame, a trajectory that can suggest potential connections, convergence or contradiction with other sciences in an informal space. But, because of the structural character shared by the sciences, these informal connections always hold the promise of scientific formalization: the incorporation of one science under another, in a form of reduction, or the formation of a new science, not reducible to either of its motivating predecessors. The unity of science is therefore loose, and its borders are open. Although the symbolic elements, or real patterns, that gain a certain independence and freedom from their original domain are likely to circulate within the unity of science, there is nothing to stop the trajectory of their sense carrying them beyond the sciences and finding adequate expression in other areas, such as the realm of aesthetic expression. And, of course, this commerce is two-way. Science often expands by turning its attentions to areas previously considered beyond its scope.

The reduction of what makes a pattern interesting, and therefore a real pattern, to its capacity to be used to predict or compress information is characteristic of science, but cannot fully encompass the meaning of "interesting". The way in which two heterogeneous systems can become coupled, bound by an interest that links the two is far broader than that of successful prediction. Dennett's passing concession to other aims beyond predictive leverage is cursory, as he immediately states the dependence of these other interests on predictive power. The implicit claim here is that predictive power is the ground for

these other, further interests, rather than a more open idea of a mutual interdependence between these interests.[44]

The aim of this paper has been to suggest that science is more open to the non-scientific than it thinks, and not merely as a resource to be mastered. Sense is not restricted to circulating through exclusively scientific circuits. There are other formal structures of thought, or analysis, that are not centred on prediction, and which produce a very different, more horizontal structure. Think, for example, about the methods and aims of artistic or literary analysis, where the study of particular styles and techniques does not aim to tell a progressive story, or aim at a program of making better paintings or novels. Rather, this study makes the plurality of practices in art and literature communicate with each other, making their specific influence on any new form of creative production less predictable. This is in contrast to the very particular lines of influence drawn in the sciences, expressed through theory change and captured in the history of named special sciences.

Although the sciences have a special relationship with other sciences, when their expression extends beyond the measurable limits of their theoretical frame, they are open to an informal communication with any other form of thought. Deleuze's thought embodies this openness, not as a desire to elide the difference between science and non-science, but to show how that difference does not preclude science from positively interacting with other forms of thought, to recognize that science does not have a monopoly on formal thought, and that other structural forms of thought are both possible, valuable, and may even constitute knowledge. Although the focus of this paper has been on Deleuze's early essay 'How do we Recognize Structuralism', in his last work with Felix Guattari, he returns to look at what constitutes the specific character of science as one of the three major strands in *What is Philosophy?*. [45] Harmann

[44] Dennett (1991), p. 29.

[45] Deleuze (1991/1994), see especially Part Two, Chapter 5: Functives and Concepts, pp. 117-133.

makes a similar point in his assessment of *Every Thing Must Go*, noting that scientists rarely ask philosophy to keep house for its various theories and areas of interest, but instead often turns to philosophy for speculative invention, to think beyond science, or to think without the burden of experimental evidence and quantitative techniques.[46] For example, look at the influence of Eastern philosophy on the pioneers of quantum theory, especially Schrödinger's interest in Vedanta and the Upanishads.[47] Here the speculative and even mystical elements of philosophy, found in Schopenhauer and Indian philosophy are employed in the creation of a new scientific worldview.

It is not the material that is being analysed that constitutes an area as scientific or not, but the structure of that analysis. This leads to a position of weak naturalism, compatible with both Deleuze and the aspects of L&D endorsed in this conclusion. There is nothing, no area of study, material or thing, which could not be subjected to a creative/productive scientific analysis. This position is weak as it does not demand that everything should be subjected to such an analysis, or that science is either the only or best for thought to engage with the world.

In conclusion, it is possible to demarcate between the sciences and non-science. Science, when understood correctly, is a valid and adequate expression of this inconsistent whole that we variably name as Nature, the World or Reality. By creating an ordered hierarchy, science creates the unique structure of progress, based on the measure of increasing predictive success and accuracy. But it cannot be seen as making any move to exhaust Nature; with every progressive step in science we are no closer to reducing Nature to a naturalistic scientific whole, or of transforming the totality of the World into a consistent whole. Science presents only one of the many structures that can capture interest and develop real patterns; it is only one of many adequate expressions of Reality.

[46] Harmann (2010), pp. 785-786.
[47] Götschl (1992), pp. 11-13.

References

Bouchard, F. and Huneman, P. (eds.) (2013), *From Groups to Individuals: Evolution and Emerging Individuality*, The MIT Press, London.
Bueno, O., French, S. and Ladyman J. (2012), "Models and structures: Phenomenological and partial", *Studies in History and Philosophy of Modern Physics*, Vol 43, pp. 43-46.
Deleuze, G. (1972), "How do we Recognize Structuralism" in Deleuze G., *Desert Islands and Other Texts: 1953-1974*, trans. M. Taormina edited by D. Lapoujade, Semiotext(e), 2004, pp. 170-192.
Deleuze, G. and Guattari, F. (1991), *What is Philosophy?*, trans. G. Burchell and H. Tomlinson, Verso, London 1994.
Dennett, D. (1991), "Real Patterns", *The Journal of Philosophy*, Vol. 88, No. 1, pp. 27-51.
Dosse, F. (1991), *History of Structuralism: The rising sign, 1945-1966*, trans. D. Glassman, University of Minnesota Press, Minneapolis 1997.
Götschl, J. and Leinfellner, W. (1992), "Introduction" in Götschl J. (ed.), *Erwin Schrödinger's World View: The Dynamics of Knowledge and Reality*, Kluwer Academic Publishers, 1992.
Harmann, G. (2010), "I am also of the opinion that materialism must be destroyed", *Environment and Planning Society and Space*, Vol 28, pp. 772-790.
Ladyman, J., and Ross, D., *Every Thing Must Go*, Oxford University Press, London 2007.
Ladyman, J. (2007), "On the Identity and Diversity of Objects in a Structure", *The Aristotelian Society*, supplementary Vol. LXXXI, pp. 23-43.
Ritchie, J. (2010), "Naturalized Metaphysics", *International Journal of Philosophical Studies*, Vol. 18(5), pp. 673-685.

Abstract
Structuralism is an ambiguous term, finding a home in both continental and analytic schools of thought. The title of this paper seeks to find common ground in the use of this term, and to use both traditions to contribute to the current debates surrounding structural realism in the philosophy of science. The paper's title makes reference to both Gilles Deleuze's overview of the structuralism of the 1960/70s in French philosophy and social sciences, found in his well known essay 'How do we Recognize Structuralism?', and the contemporary structural realism, as developed by James Ladyman and Don Ross in their book *Every Thing Must Go*. Common aspects in both Deleuze's and Ladyman and Ross' analysis will be brought out via Daniel Dennett's development of "real patterns" and the problem of theory change, while the co-ordinating and unifying role of fundamental physics will be challenged.

Keywords: Structuralism, Structural realism, Philosophy of science, Reality, Scientific theory