Theory structure and the explanation of natural necessity

Kelly Alexandra Roe

2003

Abstract

The kind of necessity that has been variously known as nomic, physical, and natural is a puzzling notion in the philosophy of science. While the empiricists considered that necessity was something that could be empirically discovered, Hume (1739-40) countered that we can never observe necessity or the causal nexus that compels one event to follow another. Since then there has been much debate and controversy as to whether necessity is a mind-independent (extensional) fact to be discovered by scientific observation and generalisation, or whether Kuhn (1962) and others have shown that observation is theory-laden and that science is governed by (intensional) constructs. Hung (forthcoming) has recently offered an explanation of physical necessity, where necessity is considered to be relative to a theory, or cross-theoretic. While conceptual spaces or theoretical structures are constructed by us, they are intended to be an adequate space for the modelling of nature. The structure of the theory is thought to restrict the range of possible experiences that we can encounter in the natural world. My interpretation of Hung is that Natural necessity is thus governed by the world, and explained by our representations of it.

Universal claims by way of generalisation

I will begin with a variation on a parable that Hung, (forthcoming, p.8) utilises to illustrate the appearances / reality distinction, and to introduce the notion of conceptual shift. I shall use it to illustrate alternative conceptions of the scientific enterprise that have been held by various individuals and schools of thought through the history of science; and ultimately to demonstrate the cross-theoretic nature of natural necessity.

> There are a group of children (A) who inhabit a very large room. The room is divided in half by two rows of iron bars. The children are prevented from passing through the first row of bars. Each child discovers that behind the second row of bars there is a counter-part child (B) that looks just like him or her[1].

[1]The term counter-part is not intended in David Lewis' sense. 'Counter-parts' are simply the children who are behind the second row of bars.

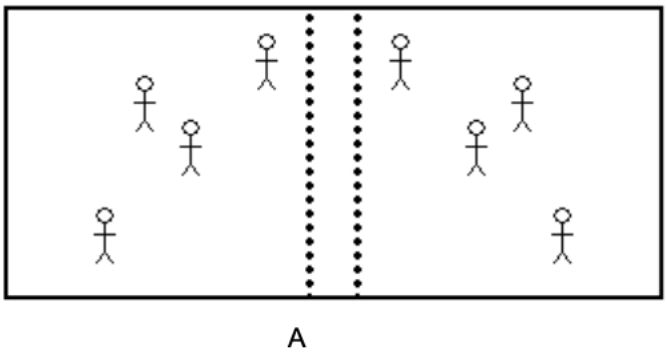

Figure 1.

Some of these children, being scientifically inclined, observe the movements of the counter-parts closely. They observe that counter-part n_1 mimics at t_1, t_2, t_3, t_4 ... and they generalise, or infer from these observations that a counter-part (counter-part n_1) always mimics. Counter-parts n_2, n_3, n_4 ... are also observed to mimic the movements of each relevant child, and so the children generalise from these observations to the following: all counter-parts mimic. By conjoining these observations they reach the following universal claim by way of generalisation:

- (a) All counter-parts always mimic.

The empiricists: Necessity by way of universal generalisation

Empiricists such as Bacon (1561-1626) and Mill (1806-1873) considered science to progress from observation of phenomena to generalisations, as illustrated by the way in which the children arrive at (a)[2]. It was thought that further progress was made in virtue of the generalisation from some finite number of observed instances, capturing a law of nature. Hempel (1948, in Brody, 1970 p.11) and Popper (in Caws, 1965 p.180) considered laws of nature to play a special role in the logic of scientific explanations. The classical view of science presented the logic of explanations as being of Deductive-Nomological, or D-N form. The explanandum is explained in virtue of its being deductively implied by one or more initial conditions, together with

[2]Bacon and Mill considered that science progressed by induction by analogy and simple enumeration; and they systematised five other methods of induction: agreement, difference, agreement and difference, concomitant variation, and residues (e.g., Mill, 1952, pp.253-264).

one or more laws of nature. This is known as the *covering law thesis*.

Laws of nature come to play a special role in scientific explanation as if it is accepted that the initial condition(s) obtain and that the law of nature is naturally necessary,then it follows that the explanandum inherits the natural necessity of the law and thus could not have been otherwise. Let us suppose that one of the children asks why a particular counter-part mimics on a particular occasion, and the scientists offer the following explanation:

- (i) *initial condition* This is a counter-part.
- (ii) *law of nature* Counter-parts always mimic.
- (iii) *explanandum* This counter-part mimics on this occasion.

Given the initial condition and the necessity of the law the explanation is considered to be satisfactory. Laws of nature would thus seem to be required to compel the explanandum (in order to explain that it could have not been otherwise), and as such we have an explanation as to why the explanandum is naturally necessary. This characterisation of natural necessity would seem to leave us with the following question, however: Why do counter-parts always mimic?

Hung, (forthcoming, pp.83-84) considers that a 'nominal' sort of necessity can be reached by arbitrary stipulation.

> Why is it that all P's are Q's? Because it can't be otherwise. Why can't it be otherwise? Because... If no answer can be provided for the second question, the explanation is only explanation in name. It is a nominal explanation. Criterion: An explanation of E is a nominal explanation if its explanans amounts to a statement of the form: 'Necessarily E,' where the claim of necessity is left unsupported with further reasons.

Hung (forthcoming, pp. 83-84) relates that some theorists (e.g., Burks) have considered that by prefacing the law with '©', or another operator to signify natural necessity the necessity is carried through to the explanandum. While some theorists (that we shall go on to consider) maintain that laws are nothing other then true generalisations (and thus there need be no *compulsion*) between associated phenomena this cannot be considered an explanation as to *why* the law and the conclusion are necessary. Could the children not stipulate the necessity of the law that counter-parts always mimic in the same fashion, by prefacing *(iii)* with '©'? If we do not have an explanation as to why some statements reached by generalisation are laws whereas others are not then how could we tell whether any given generalisation is naturally

necessary or not[3]? While Wittgenstein (2001, p.35) considered that explanation has to stop somewhere, to stop the explanation at this point is to not even get an explanation up off the ground. To characterise natural necessity as nominal should be a last resort strategy, one whose adoption signifies that one has given up on an explanation of natural necessity.

A problem that would seem to arise with 'laws of nature' reached by way of empirical generalisation is that as explanations they are circular, or, *ad hoc* (Hempel, 1966, p.28). We observe instances and we abstract or generalise from these instances to general 'laws'. To then use this abstraction or generalisation to explain those very same instances would be explanatorily circular, as the law was inferred from those instances[4]. With respect to explanation we would need an account of the necessity of the law. In virtue of what are such generalisations as 'copper conducts heat' naturally necessary, while 'counter-parts always mimic', is intuitively contingent? We shall come back to this.

Necessity: scientific realism and the empirical discovery of necessity

Direct reference has increased in popularity as an account of how some of our linguistic expressions succeed in denoting objects in the world. Kripke, (1972, pp.120-127), Putnam, (1975), and other direct reference theorists presuppose a realist view of science for their account of reference. It is considered that the reference of some of our expressions is determined by an object, substance, or kinds 'real nature'. The real nature consists in essential properties that are to be determined by a-posteriori scientific investigation (Kripke, 1972, pp.122-127). We may consider the view of science that this picture encourages:

- (a) There is a mind independent world consisting of objects with their essential properties that are governed by laws of nature.
- (b) The business of science is to a-posteriori (or empirically) discover

[3]Hempel, (1966, p. 55) states that he needs to 'consider the explanation of laws by theories', which is something that I shall go on to do.

[4]The radical behaviourists consider that this is why mental states (such as mimicking dispositions) are unacceptable as explanations of behaviour (Baum, 1994 pp.33-35). They are considered to be inferred from instances of behaviour and so to use them to explain those same instances is circular as an explanation. I shall consider Comte's call for the abolition of 'metaphysics' (theoretical terms) from science and the prospects for operationalising theoretical terms in a subsequent section.

these essential properties and laws of nature.

- (c) There are facts of the matter about essential properties and laws of nature. Scientists may be right or wrong about them (derived from Kripke, 1972 and Salmon, 1981).

Kripke and Putnam consider that natural kind terms (such as 'water' and 'gold') have their essential properties fixed by the world. Kripke considers that we have an initial baptism of a sufficient sample of water, and thereafter the sample is fixed by the essential properties of that sample (Kripke, pp. 135-140). Kripke and Putnam maintain that something that does not share the essential property does not count as water (or the same kind of stuff) even though they both consider it to be metaphysically possible for H_2O (or whatever the final science endorses as the essential nature of water) to appear black and tarry, and another substance (XYZ) to appear watery.

This notion of metaphysical necessity seems to me to be puzzling, as it seems that they endorse three claims that cannot all be true:

- 1. It is metaphysically possible for experiential properties (watery-stuff) and real nature properties (H_2O) to vary independently of one another (e.g., on Twin Earth)[5].
- 2. The reality explains the appearances (which is the thesis we want to hold for the notion of necessity to be interesting to us)[6].
- 3. Scientists will discover this mind independent reality and reveal it to us.

The problems would seem to be;

- 1. How is it possible for scientists to discover this reality if it is not essentially related to appearances yet is more than a human construct?
- 2. How is it possible for the reality to explain appearances if it is metaphysically possible for them to vary independently of one another?

Hume (1739-40) may be considered to provide a sceptical challenge to the notion that necessity can be discovered a-posteriori by scientists, as the di-

[5]Direct reference theorists shun observation in favour of unobservable 'real nature', which seems to be the converse of the logical positivists (who we shall come on to in a subsequent section).

[6]It is not only that we want to hold onto this thesis. If the observation theoretical distinction does indeed collapse (as Quine and Kuhn convincingly illustrate) then it may be untenable to drop this claim.

rect reference theorists require. Hume notoriously maintained that necessity could not be a- posteriori discovered, as we cannot observe it (1978 pp78-82). Although we may observe that n_1 types of events always seem to be followed by, or associated with $n2$ types of events, we cannot observe the causal nexus, the compulsion, and hence the necessity.

While many find Hume's analysis somewhat disconcerting a decisive refutation has not been forthcoming. While some have taken the point that necessity is not a causal compulsion (e.g., the logical positivists considered this to express illegitimate belief in an occult power as we shall soon see); Hume's claim just seems to be discounted by realists on the grounds that it is too radically sceptical. The challenge remains, though, as to how we can provide an explanation of necessity. Ultimately what may be required is an abandonment of the notion of necessity as something to be observed or reached by a straightforward process of abstraction, or generalisation as the empiricists took it to be. The dangers of realism would seem to be that necessity is forever beyond us in principle because we lack the faculties by which to apprehend it and it is required to be independent of human construction.

Towards laws of functional relations

There is a story, often told, that Newton discovered the law of gravity (by empirical generalisation) when an apple hit him on the head. But this story would not seem to provide an explanation as to why the 'law' is necessary any more than the children were able to do, with their explanation by generalisation. We may also consider that there are counter-examples to such a 'law' as expressed by the statement 'apples (or other objects), when unsupported fall downwards'. Indeed there are not many universal generalisations that are without exceptions. A great wind or tornado, for example could have an apple blown side-ways. Likewise, it would seem to be conceivable (at this stage of the investigation) that a counter-part may cease to mimic. The very conceivability that there is a world of objects (including counter- parts) and these objects *prima facie* could move in a variety of ways, but they do not is the very thing that needs to be explained.

'Laws' reached by generalisation or association of observed phenomenon do not seem to be enough with respect to ruling out certain phenomena from occurring (and thus providing natural necessity that is comprehensible to us). Typically the most highly prized and revered laws, and those that are considered to provide strict physical necessity or compulsion are laws pertaining to the functional interactions of theoretic notions (such as Newtonian

force, mass, density etc) to produce phenomenon that are naturally necessary given the necessity of the laws. Some of these laws of functional interactions are expressed as equations[7]. Newton provided the corpuscularian theory of light, where light corpuscles are thought to functionally interact or behave in accordance with the laws of motion that he enumerates.

Let us suppose that some of the children take (a) to be naturally necessary, though they consider that this is not to *explain* why it is necessary. They enumerate a theory of functional interactions in order to explain why it is that a counter-part must mimic. They consider that this 'mimicking disposition' is problematic as it is circular (or ad hoc) as an explanation. One of the children proclaims:

> 'We know that a counter-part possesses the mimicking disposition because we see it mimic, and if it didn't mimic then we would explain this by saying that it possessed the mimicking disposition no longer. But is it the counter-parts that possess the mimicking disposition, or is it us; and how could we decide? We cannot, and thus we should exorcise this superfluous 'mimicking disposition' from our explanations'.

The child goes on to elaborate her theory:

> "Our body and our environment cause our beliefs and desires. Our beliefs and desires cause our behaviour. Look again inside our room, Counter-parts have duplicate bodies and environments. They thus have duplicate mental states; which cause their behaviour to be duplicated as well. My theory is better because it explains how your movements are duplicated *when your backs are turned*".

Counter-parts, on this account would thus seem to live in something like Leibnizean pre-established harmony. There is no question as to who is mimicking who as the movements are synchronised in time and thus, according to this theory counter-parts do not mimic, they just appear to do so. Let us attempt to render this explanation in D-N form:

- (i) *initial condition* Counter-parts have duplicate bodies and live in duplicate environments
- (ii) *laws of nature* Body and environment cause beliefs and desires. Beliefs and desires cause behaviour.

[7]E.g., Boyle's law and Hook's law.

- (iii) *explanandum* The children will always conclude that Counter-parts always appear to mimic. (or, more perspicuously, the children will never encounter an experience that would falsify (a)[8]).

Explanation 1. Functional Psychology

Logical Positivism and the observation / theoretic collapse

Positivists such as Comte, (1788-1853) and Mach (1838-1916) considered that there was a sharp distinction between observational and theoretical terms. Comte characterised science as progressing through three stages: The theological stage, the metaphysical stage, and the positive stage (in Hung, 1997, p.320). According to the positivist's theoretical terms such as such as 'mass', 'force', 'gravity' and 'velocity' were metaphysical postulates called in to compel observable phenomena. They considered that the proper business of science was to exorcise these occult forces and proceed in the manner that the empiricists had enumerated, employing methods such as Mill's to associate observed phenomena and make generalisations from them.

We have already considered the prospects of explaining necessity when it is obtained by generalisation from observed phenomena. If we cannot observe necessity (as Hume maintained) then the necessity must be unobservable. The positivists considered that these metaphysical notions were explanatory fictions and that theoretical terms failed to refer and so were meaningless. They thus concurred with Hume that there isn't any necessity in the natural world.

The logical positivists (e.g., Carnap, 1937 in Danto & Morgenbesser (Eds), 1960 pp.150-158) Schlick, in Hung 1997 p.324) continued this theme but were faced with the successes of laws expressing functional relations between theoretic entities. They switched the focus from the theoretic terms to providing an analysis of statements employing theoretical terms in accordance with Frege's maxim that one should never ask for the meaning of a term in isolation from the context in which it occurs (Frege, in Baillie pp. 23-40). They thus introduced the famous verification principle of meaning so as to account for laws of functional relations expressing legitimate generalisations in sci-

[8]We will come back to the issue of whether this explanation is of traditional D-N form or not. The reason why I have chosen to formulate the example in this way (and indeed the question as to whether I could have formulated it otherwise) will emerge in due course.

ence. It was thought that the meaning of a theoretical term could be given by an operational definition where they were thus translated into statements that secured reference to the natural world. By specifying an operation that could be performed to either support or falsify the statement it was thought that the statement referred to observable phenomena after all even though it used what *prima facie* seemed to be theoretical terms.

The logical positivists considered there to be a theoretically neutral observation language and that scientists should use this language to record and accumulate data. In this way they would be able to generalise to more accurate general claims. There were insurmountable problems with attempting to 'unearth' or construct a theory neutral language (out of sense data, or even 'object language'), and with the attempt to provide a single operation for each 'theoretic' term. As scientists discovered new operations the term would alter in meaning if the meaning was thought to be given by the operations.

This is in direct contrast to the direct reference theory where part of the motivation for there being an objective 'essential nature' is to ensure sameness of reference despite changes in the theories we have of it. While the direct reference theorists are concerned with 'observational terms' it would seem that the verificationists would have meaning vary as new operations are discovered and old ones fall into disuse. The notion of a non-arbitrary distinction between observation and theory also came under fire from theorists such as Quine (1953 in Baillie, 1997), and Kuhn (1962).

Kuhn and theory laden observation

Kuhn (1962) challenged the traditional notion of the scientific enterprise as progressing by accumulation of a-theoretic observations and data. As a historian of science he considered the way in which science has progressed through history. Instead of finding that science progresses cumulatively, Kuhn (1962) found that the history of science is characterised by the following stages:

- (1) *Pre-paradigm*, before the scientific community adopts a paradigm.
- (2) *The emergence of a paradigm*, several compete for the attention of the scientific community and eventually a paradigm is adopted.
- (3) *Normal science*, a period of productive science ensues where scientists construct a cumulative record of data and set about solving problems.
- (4) *Crisis*, anomalies arise that the paradigm cannot explain.

- (5) *Revolution*, a new paradigm is adopted, before the resumption of normal science.

Kuhn thus has a paradigm view of science. Although Kuhn is not clear on the distinction between alternative theories and alternative paradigms (which we will see to be important when we consider the claims that he makes about paradigms) it seems that the best examples of Kuhnian paradigms are Aristotelian, Newtonian, and Einsteinean mechanics; or the alchemists theory of matter, and the atomic theory of matter. These are general theories and may be contrasted with more specific ones such as theories of the chemical constitution of compounds that occur within the paradigm of Dalton's atomic theory.

Kuhn considers that all observations are theory laden and scientists working within a paradigm frame their questions and express their findings from within the paradigm (1962, pp. 16-17). As an example, we may consider that one scientist may record a certain amount of caloric fluid flowing from one substance to another, while another may record one objects molecular motions causing another object to start vibrating as well. Kuhn considers that scientists working within two different paradigms are thus living in (observing and experimenting on) two different worlds. He notoriously makes the following claims regarding paradigms:

- (1) Paradigms do not share any facts in common.
- (2) They do not share any of their problems or standards of solution.
- (3) They do not share any terms (with the same meaning).
- (4) They do not share statements or subject matter.

Kuhn considers that accumulation of data only occurs within a paradigm. Once a revolution has occurred the scientists have to start again (1962, p.13). Because there is (according to Kuhn) no theoretically neutral observation language, and the language of one paradigm is not translatable into another paradigm, he considers that science starts anew each time a new paradigm is adopted by the scientific community (Kuhn, 1962 pp. 95-96). We may consider that scientists are not currently schooled in the findings of the alchemists, or Aristotelian mechanics and thus there would seem to be some truth in this notion.

Although it is widely acknowledged that Kuhn was a brilliant scientific historian with a tremendous knowledge of the history of science, philosophers have been puzzled by his philosophical remarks about incommensurability and the notion of science as being non-cumulative. If scientists are only productive

when governed by a paradigm and if different paradigms influence our worldviews so much then how can we hope to discover objective (existing in the world) natural necessity? It seems hard to see how we can consider that we are progressing towards an adequate model of reality if each paradigm needs to start afresh. Kuhn seems to embrace relativism at times and he considers that the notion of objective natural necessity is something that is beyond the reach of scientists.

Such an account has inspired the schools of conventionalism, which I shall just touch on briefly. According to conventionalists there is no objective necessity or causal connection to be found in the world (as Hume maintained). Our theories are constructs, and truth is relative to a theory (in Hung, 1997 ch.9). I shall not consider this further as it seems to me that this account of necessity is giving up on explaining why some phenomena can and cannot occur. While a strictly realist take on necessity (of the sort that the Empiricists or direct reference theorists adhere to) would seem not to be forthcoming, complete relativism or conventionalism should be saved as a last resort strategy with respect to attempting to explain necessity. It is not so much an explanation as an admission of failure.

Despite Kuhn's claim that different theories are different worldviews and thus cannot be compared, he also considers the grounds that we have for choosing one theory over another. He considers criteria such as predictive power, simplicity, and consistency however it seems contradictory for Kuhn to consider that we may need to choose between different theories if they are not even theories of the same thing. While the implications of Kuhn's incommensurability thesis are hotly debated, it seems unanimous that Kuhn's ability as a historian was remarkable and thus his views cannot lightly be dismissed even though he seems in danger of lapsing into relativism.

Let us now consider an alternative functional explanation of the counter-parts behaviour.

- (i) *initial condition* counter-parts are made of light corpuscles
- (ii) *laws of nature* light corpuscles are governed by the 3 laws of motion
- (iii) *explanandum* The children will always conclude that Counter-parts always appear to mimic. (or, more perspicuously, the children will **never** encounter an experience that would falsify (a)).

Explanation 2. Newton's Corpuscular Theory of Light

Explanation 1 and 2 are two radically different theories of the children's observations of the counter-parts. Do the Corpuscular theory of light and

the Functional psychology theories constitute different paradigms? It would seem to me that they are good candidates for paradigms or world-views: The psychologists consider counter-parts to be real people, with body and mind, whereas the Newtonians consider them to be light images. While the psychologist would record 'counter-part n_1 duplicating the movements of child n_1' the Newtonian would record 'the light image of child n_1 reflecting off the mirror'.

It is interesting to consider that these two alternative theories would indeed be rival explanations of the same *phenomena*. While the scientists recording their observations would record them in different terms, indeed they would not seem to see the same things in this sense, intuitively they seem to be two alternative explanations of the same phenomena. Both theories are attempts to explain why the children will always observe that a counter-part mimics. Hung, (personal communication) considers that while there may be no theoretically neutral language, there is the language of common sense. If we are attempting to explain our experiences in the natural world with a paradigm theory then the language of common sense (while not theoretically neutral) would seem to be a middle ground with which we may compare paradigms in some cases[9].

Mapmakers and conceptual spaces

Hung (forthcoming pp.12-14) considers another parable that is designed to illustrate the notion of a scientific theory as a conceptual space, and to show that some phenomena are naturally impossible because they are unable to be represented due to the structure of the scientific theory and the limits of the representational space that it provides. I will need to consider this example so as to assist us in making sense of the differences between Newton's theory of light corpuscles and the Folk- Psychologists theory of the functional interaction of mental states.

> Once upon a time four ET's landed on earth. They told the earthlings the distances between their homes, A, B, C, and D, satisfy the following equations:

1. (D1) AB = BC = CD = DA = 2 unit lengths.

[9]While this would seem to me to apply to the case of the Newtonians and the functional psychologists in this case (given what they are seeking to explain) Hung considered that Newtonian and Einsteinean mechanics may not be so compared as there is no 'common sense' theory of the phenomena that Einstein was seeking to explain.

Mapmaker one (MMI) came up with the Square Hypothesis and drew a 2 unit sided square marking each corner clockwise with A, B, C, and D to satisfy the hypothesis (Hung, forthcoming, p.12).

MMI was then informed that:

1. (D2) AC = AB

So he changed it to a rhombus in accordance with the Rhombus Hypothesis. MMI was then informed that:

1. (D3) BD = 2 units length.

Hung considers that 'to map four mutually equidistant points on a piece of paper seemed an impossibility'. Within the conceptual framework of MMI it would be naturally impossible for (D3) to occur. Mapmaker II (MMII) changed the flat (2D) medium of representation (or conceptual space) to a three-dimensional space, and came up with the Ellipsoid Hypothesis where the distance between each pole and the equator is one-third the length of the equator. One ET lived at a pole and the others were spaced out around the equator.

The notion is that a flat piece of paper would not seem to be particularly theory-laden, and yet it restricts the range of phenomena that can be represented by that medium. Hung considers that theories are Category Systems (ch. 3), Representational Spaces (ch. 4), and Languages (to be distinguished from sets of statements (ch.5). Scientific theories are designed so as to represent the structure of the natural world. Structures rule out the possibility of certain phenomena occurring (Hung, forthcoming, p.31). If we want an explanation as to why a phenomena cannot occur ('why will we never observe a counter-part to not mimic?') then a structure, or a theory can provide limits as to what is possible and thus provide an explanation as to the natural necessity of the phenomena. If we take the structure to be an adequate representation of reality then we can understand why that phenomena cannot occur.

Hung (forthcoming) considers that natural necessity is relative to a theory. We start with the explanandum. The explanandum seems to be contingent, which is why we want it explained. The necessity does not come from the covering law in the sense that we stipulate that the law is necessary and use it to deduce the explanandum, rather we accept the framework that the theory provides and we thus understand why we will never have an experience that would have us conclude that the explanandum was false. If we take the logic of explanation to be D-N then the problem is pushed back one step

to the problem of the necessity of the law. Hung considers Wittgenstein's distinction between saying and showing and considers that a conceptual space can show us why the phenomenon is necessary.

If we consider (iii) in both explanation 1 and explanation 2 it becomes apparent that they are not really of traditional D-N form. We have attempted to argue that traditional D-N form is not sufficient to explain the natural necessity of the explanandum because the problem is merely pushed back a single step. Hung considers that instead of explaining (a), scientific theory proceeds by denying the explanandum. The scientist does not seek to explain why the explanandum is necessary, rather the scientist proceeds to explain why it is necessary that the children will never encounter an experience in the natural world that would have them conclude that the explanandum is false (Hung, forthcoming, p.10).

Hung considers that the scientist proceeds by denying the ontology of the explanandum. Instead of seeking to explain why the children conclude that (a) the Newtonian's deny that there are such things as counter-parts. If we accept the Newtonian framework then what is necessary is not (a), rather it is naturally necessary that the children will never have an experience that would have them conclude that (a) is false.

I initially intended to extend the psychologists first attempt at an explanation (the mimicking disposition) to a functional explanation of interacting postulates such as 'belief' and 'desire' in a way that was comparable to Newton's interacting postulates such as 'force', 'velocity' etc for this example. Perhaps intentional psychology could be a real science *just like physics*. The functional psychologists do not deny the ontology of the explanandum in the sense that there are no counter-parts, but they do deny that they mimic (they only *appear* to mimic, but they do not really mimic, they duplicate). While it is clear that once the children find a way to get beyond the bars, or otherwise interfere with the mirror Newton wins with respect to explanation to draw no greater moral from this example may be to pass up an opportunity.

The functional psychologists do not really make a conceptual shift to a new space of possibilities; rather they attempt to reduce the space provided by common sense with the addition of their laws. A greater problem in this case would seem to me to be that there is no independent test of the mental state terms and thus of the laws of functional relations between mental states. While cashing out independent tests of belief and desire states may be problematic for intentional psychology in general, it would seem that in this example it is the crucial problem. If the counter-parts are considered to

have duplicate bodies, which support their mental states, then this theory is simply wrong in that counter-parts have no bodies.

I am also led to consider the prospects for intentional psychology in general, as to whether there can be psycho-physical laws similar to those in the above example that are naturally necessary or not. It would seem that intentional psychology is a theory that stays on the level of appearances, however. In so far as we 'reductively explain' intentional phenomena by conceptual shift in terms of physiology there may be cross-theoretic natural necessity. If we stay on the intentional level, however, there would seem to be generalisations of the sort that the empiricists favoured, but no explanation of the natural necessity of the phenomena.

The shift to Newton's theory of light images, on the other hand does provide a radical change in the conceptual space. *There are no such things as counter-parts.* I think that what this shows us is that while it may be possible to make a verbal manoeuvre to render explanations in Hung's variation on the D-N form of explanation, it is indeed the conceptual space provided by the framework that renders the explanation satisfactory. While some consider laws of functional interactions to provide natural necessity it would seem that this is not so much a requisite for natural necessity as conceptual shift. While in a sense the conceptual shift from MMI to MM2 could be considered a matter of degree (just the addition of another dimension) the significance of this shift is attested to by the alterations phenomena that each theory allows for and prohibits.

Intra-Theoretic laws

While some theorists consider that theories cannot be true or false as it is only statements that can be true or false it would seem that conceptual spaces or theories can be more or less adequate for the task we put them to. If the task is to provide an adequate space for the representation of our experiences in the natural world then it would seem that theories can be assessed by whether the 'impossibilities' ever occur, or whether what is supposed to be 'necessary' does not. MMI was faced with a phenomenon that was impossible according to her framework. The phenomenon was an anomaly for that theory which showed that the theory was inadequate for its purpose.

The question would seem to arise as to whether this notion of necessity is subject to the problem faced by the covering law thesis. If the necessity of

the explanandum is due to the necessity of the laws then we would seem to need a further account of the necessity of the laws. Here, though it is not the laws that provide the necessity in an absolute fashion, rather it is that if we accept the framework (and the laws entailed by that framework) then it is inconceivable (from within that framework) that the experience that would falsify the explanandum could occur.

The intra-theoretic laws are thus not necessary in an absolute fashion. They can be more or less adequate, more or less simple etc, but not absolutely true. What is meant by this absolute notion of necessity, though, would seem to be mind- independent reality that is beyond us in principle. We cannot discover necessity in the world, but we can provide a cross-theoretic notion of natural necessity that is subject to the reality constraints of the experiences that we have in the natural world. Hung considers framework truths (or laws of nature considered from within the framework) in much the way that there are framework truths to common sense; such as nothing can be both red and green all over at the same time.

Hung likens this to Wittgenstein's notion of the limits of sense. It would thus seem that framework laws are rather similar to analytic truths, or as Hung maintains they are 'true by convention'[10]. This is why necessity cannot be provided within a framework, but instead is cross-theoretic, the result of a conceptual shift. There is nothing that compels one to adopt the framework truths or the framework itself. The children could have accepted the functional explanation and been satisfied; it is not that they were simply wrong. We may consider, though that anomalies for this theory are likely to arise in the future, and as such it is not a particularly adequate framework for the explanation of the necessity of the phenomena.

When we consider the necessity of the intra-theoretic laws then they are true by convention, and thus are not naturally necessary though they can be more or less adequate for the representation of reality. The necessity of any given phenomenon thus is relative to a theory, so is cross-theoretic. If we apply this theory to that phenomenon then this theory tells us that this phenomenon cannot occur as a matter of natural necessity. It is not that the framework truths are totally arbitrary, as we are attempting to construct adequate frameworks for the representations that we make of the experiences that we encounter in the natural world. The framework shows us that if the

[10]Analytic truths would seem to be true as a matter of logical necessity whereas the cross- theoretic account of natural necessity is distinguished from this in virtue of its being about the experiences that we can and cannot have in the natural world.

representation is adequate then we will never encounter such experiences in the natural world. Such is the nature of natural necessity.

References

Baum, William, M., (1994). Understanding Behaviourism: Science, Behaviour, and Culture, HarperCollins.

Carnap, Rudolph, (1960). 'Elementary and Abstract Terms' 1937 in Danto, Arthur; Morgenbesser, Sidney (Eds), Philosophy of Science, The World Publishing Company.

Caws, Peter, (1965). The Philosophy of Science: A Systematic Account, D. Van Nostrand Company Inc.

Frege, Gottlob, (1997). 'On Sense and Meaning', in Baillie, James Contemporary Analytic Philosophy.

Hempel, Carl G., (1966). Philosophy of Natural Science, Prentice-Hall.

Hempel, Carl G., Oppenheim, Paul, (1970). 'Studies in the Logic of Explanation', in Brody, Baruch A., Readings in the Philosophy of science, pp.8-28, Prentice-Hall, Inc.

Holton, Gerald; Roller, Duane, (1958). Foundations of Modern Physical Science, Addison- Wesley Publishing Company Inc.

Hume, David, (1978). A Treatise of Human Nature, Oxford University Press.

Hung, H.-C., (1997). The Nature of Science: Problems and Perspectives, Wadsworth Publishing Company.

Hung, H.-C., (forthcoming). Beyond Kuhn: Scientific Explanation, Theory Structure, Incommensurability and Physical Necessity.

Kockelmans, Joseph J (Ed.), (1968). Philosophy of Science: The Historical Background, The Free Press.

Kripke, Saul, A., (1972). Naming and Necessity, Harvard University Press.

Kuhn, Thomas, S., (1962). The Structure of Scientific Revolutions, University of Chicago Press.

Kuhn, Thomas S., (1977). The Essential Tension, University of Chicago Press.

Mill, J, Stuart, (1956). A System of Logic, Longmans, Green and Co Ltd.

Newton, Sir Isaac, (1966). Mathematical Principles of Natural Philosophy and his System of the World, Vol.1 The Motion of Bodies, 1686 translated in University of California Press.

Quine, W.V.O, (1953). 'Two Dogma's of Empiricism', in (1997) Baillie, James, Contemporary Analytic Philosophy, Prentice-Hall Inc.

Salmon, Nathan U., (1981). Reference and Essence, Princeton University Press.

Sankey, Howard, (1994). The Incommensurability Thesis, Avebury.

Scheffler, Israel, (1982). The Anatomy of Inquiry, Routeledge & Kegan Paul Ltd., 1964. Scheffler, Israel, Science and Subjectivity, 2nd Ed. Bobbs-Merrill.

Schilpp, Paul Arthur (Ed.), (1963). The Philosophy of Rudolph Carnap, The Library of Living Philosophers Inc.

Weinert, Friedel (Ed.) (1995). Laws of Nature Essays on the Philosophical, Scientific and Historical Dimensions, Walter de Gruyter.

Wittgenstein, Ludwig, (2001). Philosophical Investigations, Blackwell Publishers.