Interpreting Thomas Kuhn as a Response-Dependence Theorist

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Abstract

Thomas Kuhn is the most famous historian and philosopher of science of the last century. He is also among the most controversial. Since Kuhn’s death, his corpus has been interpreted, systematized, and defended. Here I add to this endeavor in a novel way by arguing that Kuhn can be interpreted as a global response-dependence theorist. He can be understood as connecting all concepts and terms in an a priori manner to responses of suitably situated subjects to objects in the world. Further, I claim, this interpretation is useful for three reasons. First, it allows us to systematize and defend Kuhn’s views. We can therefore better appreciate him as a thinker in his own right. Second, it deepens our understanding of both the uniqueness of Kuhn’s views and the continuity of those views with those of others. We can therefore better appreciate his place in history. And third, as I explain in the paper, my interpretation affords us the only example of an ethnocentric global response-dependence theory. We can therefore better appreciate the versatility of response-dependence itself.

Keywords: Thomas Kuhn; response-dependence; incommensurability; non-rationalism; non-realism; ethnocentrism

Thomas Kuhn (1922–96) is probably the most famous historian and philosopher of science of the last century. He is also among the most controversial. Since Kuhn’s death, his corpus has been interpreted, systematized, and even on occasion defended (see e.g. Goldberg, 2009c, Andersen, 2001, Bird, 2002, Friedman, 2001, Fuller, 2002, Marcum, 2008, Nickles, 2002, Preston, 2008, Sardar, 2000, Sharrock and Read, 2002, and von Dietze, 2001). Here I add to this endeavor in a novel way. I argue that Kuhn can be interpreted as a global response-dependence theorist. By this I mean that he can be understood as connecting all concepts and terms in an a priori manner to responses of suitably situated subjects to objects in the world. Response-dependence theories have recently captured the attention of aestheticians, ethicists, metaphysicians, philosophers of language, and philosophers of mind. If I am right, then such a theory can be understood as having (implicitly) captured the attention of a historian and philosopher of science.
Let me clarify my aim. In what follows I will not be claiming that mine is the only possible interpretation of Kuhn, nor that it handles all aspects of his work. I will instead be claiming that my interpretation is useful for four reasons. First, it allows us to systematize and defend Kuhn’s views. We can therefore better appreciate Kuhn as a thinker in his own right. Second, it deepens our understanding of both the uniqueness of Kuhn’s views and the continuity of those views with those of others. We can therefore better appreciate Kuhn’s place in the history of philosophy. Third, it adds to and improves upon a family of related interpretations of Kuhn. We can therefore flesh out points that these others pass over. And fourth, as I explain momentarily, my interpretation affords us the only example of an ethnocentric global response-dependence theory. We can therefore better appreciate the versatility of response-dependence itself.

I proceed as follows. In §1 I explicate the notion of response-dependence. In §2 I introduce the only explicit example of a global response-dependence theory, Philip Pettit’s. In §3 I show that though Pettit explicitly offers a global response-dependence theory that is anthropocentric, or centered on paradigmatic responses of human beings qua human, Kuhn can be understood as implicitly offering a global response-dependence theory that is ethnocentric, or centered on paradigmatic responses of members of human communities qua members of such communities. In §4 I show how Kuhn’s ethnocentric global response-dependence is linked to the possibility of incommensurable terms. In §5 I show why this incommensurability is itself thought to entail a form of metaphysical non-realism, and how Kuhn’s theory, interpreted as an ethnocentric variant of Pettit’s, prevents the non-realism from following. In §6 I show why incommensurability is likewise thought to entail a form of epistemic non-rationalism. In §7 I propose a way of supplementing Kuhn’s own reply to the non-rationalism charge to prevent it from following. In §8 I consider whether my interpretation of Kuhn is in fact useful for the reasons suggested.

1. Response-Dependence

Schematically a response-dependence theory of $x$ maintains that $x$ is connected in an a priori manner to responses of suitably situated subjects to objects in the world. Response-dependence theories trace to John Locke (1979), who can be interpreted as maintaining that secondary qualities are connected in an a priori manner to paradigmatic human responses to just such objects. As I read Locke, the following biconditional about the property (his ‘quality’) red would be true:
An object is red just in case paradigmatic human beings would respond to it by perceiving it as red. Locke can also be interpreted as providing a response-dependence theory of secondary-quality concepts. Here, as I read him, the following biconditional about the concept (his ‘idea’) RED would be true:

\[(C) \text{An object falls under the concept RED just in case paradigmatic human beings would respond to it by conceiving of it as falling under RED.}\]

Now, as I read Locke, these biconditionals are a priori insofar as they are definitive of what it is for something to be red and to fall under RED, respectively. They analyse or express a conceptual truth about the property and concept. For Locke, though secondary qualities and secondary-quality concepts – like all properties and concepts – are empirical, the connection between them and paradigmatic responses to objects is not itself empirical. There is on his view no empirical test to determine whether an object is red just in case the right sort of subjects would respond to it by perceiving red; the correlative claim is true for RED. Secondary qualities and secondary-quality concepts, according to Locke, just are the properties and concepts that they are in virtue of paradigmatic responses to objects instantiating and falling under them. To demand empirical confirmation of this is to misunderstand Locke.

Tracing the history of response-dependence forward, on one interpretation of Immanuel Kant (1999) all (cognizable) properties and concepts are connected in an a priori manner to responses of suitably situated subjects to objects in the world. Further, because he understands all such properties and concepts in terms of their relation to human beings, Kant is the first to give a thoroughgoing anthropocentric theory of knowledge (see Allison, 2004: p. 34). All such properties and concepts are, for Kant, connected in an a priori manner to paradigmatic anthropocentric responses. Now, as I read Kant, these claims are themselves a priori insofar as they too are definitive of what it is for objects to have those properties and fall under those concepts. The claims again analyse or express conceptual truths about the properties and concepts. That there are no (cognizable) response-independent properties and concepts is one formulation of transcendental idealism. To demand empirical confirmation of transcendental idealism is to misunderstand Kant.

Recently Mark Johnston (1989, 1993), who devised the name ‘response-dependence’, has revived the notion by arguing that both value and VALUE are response-dependent like Locke’s secondary qualities and secondary-quality concepts, respectively. Crispin Wright (1988, 1993, 1999) has likewise offered a response-dependence theory of value, and
Michael Smith (1989) has described a response-dependence theory of rightness. John McDowell (2001: essays 6, 7, 10) and David Wiggins (1998: essays 3, 5) have analysed ethical and aesthetic properties, concepts, and terms as depending on responses of paradigmatic human beings to objects in the world. Further, Peter Menzies and Huw Price (1993), and James Woodward (2005), regard cause and CAUSE as depending on just such responses to just such objects. Finally, Alex Byrne (1998) and Johnston (1991: pp. 171–3) have argued that Donald Davidson (2001) and Daniel Dennett (1989) treat propositional attitudes and propositional-attitude concepts as response-dependent, while I (forthcoming) have argued that Davidson (2001, 2002) treats sentences as response-dependent.5

Now most contemporary response-dependence theories tend to be local like Locke’s. They concern only some properties, concepts, or terms. One prominent theory, however, takes its cue not from Locke but from Kant. Philip Pettit (2005b) has proposed a global response-dependence theory, according to which all concepts and terms are connected in an a priori manner to paradigmatic human responses to objects in the world. In fact Pettit calls all concepts and terms ‘anthropocentric’ (2005b: pp. 13–7, 53–8). Because Kuhn’s response-dependence theory most closely resembles Pettit’s, Pettit’s can serve as our primer.

2. Pettit’s Anthropocentric Global Response-Dependence

Pettit offers a global response-dependence theory jointly of concepts and terms, though as becomes clear below his concern is not with their content or meaning but with their mastery. Because what Pettit says about concepts and terms is essentially the same, consider the latter. (The following draws from Pettit, 2005b: pp. 3–10, 35–48, 65–7, 97, 142–9.) Pettit’s global response-dependence theory of terms originates in an account of language learning. He begins that account by acknowledging that any finite set of examples instantiates an infinite number of properties. A fire engine, ripe strawberry, and oxygenated blood all instantiate the properties of being red, being material, being disposed to fall if dropped from a skyscraper, and countless others. Pettit next postulates that all human beings have a ‘ground-level disposition . . . to extrapolate spontaneously in a given direction, taking the examples to be instances of a kind’ (2005b: p. 142). While the fire engine, strawberry, and blood all do instantiate all these properties, we tend to extrapolate spontaneously in the direction of taking them to be examples of red objects. If Anglophonic we would call them ‘red’. As Pettit explains, any such set of examples instantiates an infinite number of properties, yet human beings are disposed take it to exemplify a finite set of properties based on what we find salient. Exemplification, unlike instantiation, is relative to our
interests and abilities, and so ultimately to our responses. Finally, Pettit postulates that human beings have a higher-order disposition to refuse to endorse extrapolations if discrepant across persons or times, and a practice to explain discrepancies. Suppose that someone takes the fire engine, strawberry, and blood to exemplify green. We would be disposed to reject that extrapolation, trying instead to figure out what went wrong.

How does this lead to a global response-dependence theory of terms? Pettit asks us to suppose that ‘P’ (in English) is learned via exposure to ostensible objects exemplifying the property P, as just outlined. Pettit calls such terms ‘semantically basic’. ‘Red’ is semantically basic for him. Generally, according to Pettit, ‘something is P if and only if it is such that it would seem P – people would be disposed to use ‘P’ to describe the corresponding property to it – under normal conditions’ (2005b: p. 136). Emphasizing Pettit’s account of language learning entails this for the term ‘red’:

(T) An object is red just in case paradigmatic human beings would (in English) call it ‘red’.

Semantically basic terms are then response-dependent, for Pettit, because their mastery depends on ‘contingencies of subjective response’ (2005a: p. 181) of paradigmatic human beings. Further, these paradigmatic human responses would be to objects – or as he calls them ‘pre-existing things’ (2005b: p. 75) – in the world. Pettit also maintains that terms that are not semantically basic are defined via those that are. All terms are connected to anthropocentric responses to pre-existing objects. Finally, these connections, for Pettit, are a priori insofar as they are definitive of what it is for something to be called the name of the property that it exemplifies. Though red is an empirical property, red objects just are those which paradigmatic human beings would call ‘red’. This is a conceptual truth for Pettit. It is not open to empirical confirmation.6

Whether Pettit’s theory is workable is not our concern.7 We have considered Pettit purely as a primer for Kuhn.

3. Kuhn’s Ethnocentric Global Response-Dependence

Kuhn begins his discussion of the first set by observing that ‘a given stimulus can evoke a variety of sensations’ (1979: p. 308). This is of a piece with Pettit’s point that objects instantiate multitudes of properties, some irrelevant to our categorizations. Unlike Pettit, however, Kuhn claims that teaching, rather than spontaneous extrapolation, is responsible for the learner’s learning which properties (or stimulations due to them) are relevant. Kuhn illustrates:

I ask that you imagine a small child on a walk with his father in a zoological garden . . . During the afternoon now at hand, he will learn for the first time to identify swans, geese, and ducks. Anyone who has taught a child under such circumstances knows that the primary pedagogic tool is ostensions . . . Father points to a bird, saying, ‘Look, Johnny, there’s a swan.’ A short time later Johnny himself points to a bird, saying, ‘Daddy, another swan.’ He has not yet, however, learned what swans are and must be corrected: ‘No, Johnny, that’s a goose.’ Johnny’s next identification of a swan proves to be correct, but his next ‘goose’ is, in fact, a duck, and he is again set straight. After a few more such encounters, however, each with its appropriate correction or reinforcement, Johnny’s ability to identify these waterfowl is as great as his father’s. (1979: p. 309)

Kuhn concludes that Johnny

has learned all this without acquiring, or at least without needing to acquire, even one criterion for identifying swans, geese, or ducks . . . Johnny, in short, has learned to apply symbolic labels to nature without anything like definitions or correspondence rules. In their absence he employs a learned but nonetheless primitive perception of similarity and difference. (p. 313)

After discussing how such socialization applies to amateur ornithologists and professional physicists alike, Kuhn continues: ‘. . . Despite its excessive simplicity, Johnny’s case should suggest why I continue to insist that shared examples have essential cognitive functions prior to a specification of criteria with respect to which they are exemplary’.

We can draw the following comparisons between Kuhn’s and Pettit’s views. Kuhn, like Pettit, thinks that learning his privileged class of terms occurs through dispositions to extrapolate in response to ostended examples. Johnny is disposed to extrapolate in response to the birds in the zoological garden. Kuhn, like Pettit, also thinks that there are higher-order dispositions that enforce conformity in these extrapolations. Kuhn
maintains that if Johnny exhibited inconsistent identifications of water-fowl, then his community members – Father or otherwise – would correct him. More generally, Kuhn, like Pettit, thinks that individual learning is done in a social environment. The example is simplistic, but Johnny and Father are constitutive of just such an environment. Further, Kuhn, like Pettit, thinks that learning ostensibly via extrapolation is psychologically and logically prior to following explicitly articulated rules. This in fact is Kuhn's conclusion. Finally, though he is not explicit about this, Kuhn, like Pettit, thinks that concepts are learned along with terms in just these ways. Ultimately Johnny can think to himself, as much as he can communicate with Father, what is and is not a swan.

Nonetheless, as we saw at the outset, Kuhn's account of language learning, unlike Pettit's, is ethnocentric in nature. Though Pettit urges that community conformity becomes important when deciding whether an individual's extrapolation is adequate, Kuhn maintains that the community (or *ethnos*) teaches the individual how to extrapolate directly. Thus Kuhn talks about the teacher as a member of a community ostending to objects for the learner of that community rather than the learner extrapolating without initial guidance. Father's role is indispensable from the start. Further, on Kuhn's view, different communities can teach their learners to extrapolate differently and so to categorize the same objects as different kinds. This is more easily seen by shifting from Kuhn's discussion of 'swan', 'goose', and 'duck', to those of 'pendulum', and 'planet' and its peers.

Kuhn early on (1996b: pp. 118–20, 150) urges that after Galileo paradigmatic human beings would respond to a tethered weight by conceiving of it as falling under PENDULUM and (if Anglophonic) calling it a 'pendulum'. Before Galileo these same sort of human beings would respond to the same object by taking it instead to be a constrained body with a slow descent. Kuhn later (2002: pp. 15, 94) explains that the (Anglophonic) Ptolemaic teaches learners in his community to respond to the sun, the moon, Venus, Mercury, Mars, Jupiter, and Saturn, by constructing a lexical taxonomy (or 'lexicon') in which the terms 'the sun', 'the moon', 'Venus', 'Mercury', 'Mars', 'Jupiter', and 'Saturn' figure under 'planet'. On Kuhn's view, the Ptolemaic thereby taxonomizes these objects by treating planet as the genus whose species include the sun, the moon, Venus, etc. He conceptualizes them likewise. Conversely the (Anglophonic) Copernican teaches learners in her community to respond to the same objects with the terms 'the sun', 'the moon', 'Venus', 'Mercury', 'Mars', 'Jupiter', and 'Saturn' also. Yet the Copernican structures the last four terms under 'planet', the first under 'star', and the second under 'satellite'. The Copernican thereby taxonomizes these objects by treating planet as the genus whose species include Venus, Mercury, Mars, Jupiter, and Saturn; while star and satellite
themselves are the genera whose species include the sun and moon, respectively. She conceptualizes them likewise too. 8

Hence, on Kuhn's view, for members of a community to master a concept or term, they must master how that concept or term is connected to responses of paradigmatic members of that community to objects in the world. Moreover, for Kuhn, these objects are tantamount to Pettit’s ‘pre-existing things’ (Pettit, 2005b: p. 75). Whatever object the pre-Galilean and post-Galilean conceptualize differently must ‘pre-exist’ their conceptualizations lest there be no object to conceptualize differently. Likewise, for Kuhn, before Copernicus human beings taxonomized the sun as a planet by conceiving of it as falling under PLANET and calling it a ‘planet’. After Copernicus human beings taxonomized the sun as a star by conceiving of it as falling under STAR and calling it a ‘star’. The sun itself must pre-exist too.

Finally, as I read Kuhn, the connection between concepts and terms on the one hand and paradigmatic responses to objects on the other is a priori insofar as it is definitive of what it is for something to be conceived of as falling under that concept and called that term. Thus, as I read Kuhn, he would endorse the following:

(C & T) A pendulum for a community just is an object that paradigmatic members of that community would conceive of as falling under PENDULUM and call a ‘pendulum’.

(C & T) A planet for a community just is an object that paradigmatic members of that community would conceive of as falling under PLANET and call a ‘planet’.

Now the taxonomic concepts and terms mentioned in these biconditionals are all empirical. They are learned in response to ostended examples in the world and refer to objects in it. In fact, for Kuhn, terms like ‘planet’ (to focus on this) embody the empirical content for the lexica in which they are embedded. Nonetheless the connection between their mastery and the responses of paradigmatic members of a community to objects is not itself empirical. As I read Kuhn, there is no sense to be made of a paradigmatic Copernican’s being unable to identify which objects according to her community are to be conceived of as falling under PLANET and called ‘planet’. That the responses of paradigmatic community members to objects are definitive for their community of what objects fall under a particular concept or are called a particular term is, for Kuhn, a conceptual truth. It is not open empirical confirmation. In that sense the correlative biconditional is a priori. To suppose otherwise would be to maintain that there is some ahistorical, non-ethnocentric (and ultimately response-independent) reality that makes
claims ultimately true or false – a view that Kuhn (1996a, 1996b: Ch. 13) rejects. Hence, as I read them, just as for Locke RED is connected in an a priori manner to paradigmatic anthropocentric responses to objects in the world yet is itself empirical, so for Kuhn PLANET and ‘planet’ are connected in an a priori manner to paradigmatic ethnocentric responses to objects in the world yet are themselves empirical too.

Now Kuhn’s theory, like Pettit’s, is also global. The historicist turn that Kuhn helps inaugurate brings with it the broader lesson that what we scientists and laity alike can think or say about the world just does depend on how our historically situated community’s practices, theories, and values teach us to respond to that world. In fact in the concluding chapter of Kuhn (1996b: Ch. 13) and its postscript (1996a) Kuhn argues against the very intelligibility of seeing ourselves as coming closer to describing reality independently of our community’s historical perspective. All our concepts and terms, for Kuhn, are connected in an a priori manner to ethnocentric responses to objects.

Hence Kuhn can be interpreted as an ethnocentric global response-dependence theorist. Nonetheless two challenges to this interpretation suggest themselves. The first concerns the scope of Kuhn’s ethnocentrism. While Kuhn does connect terms like ‘pendulum’ to ethnocentric responses, those like ‘red’ might still be anthropocentric for him. Any paradigmatic (Anglophonic) human being, not necessarily one from a particular community, would call the same objects ‘red’. Nonetheless Kuhn can maintain that while ‘pendulum’ is connected in an a priori manner to responses of our post-Galilean community to objects in the world, ‘red’ is connected in an a priori manner to responses of many if not most human communities to objects in the world. ‘Red’ is simply linked to more communities than ‘pendulum’ is. Further, even if paradigmatic members of every community would have the same responses to objects that are red, and would call the objects ‘red’ accordingly, semantic usage remains checked at the community level. The community, not humanity at large, establishes the correct use of terms. ‘Red’ is connected to responses of members of many if not most communities, not to responses of human beings qua human independently of their communities. Kuhn can be a consistent ethnocentrist.

The second challenge concerns grammatical and ultimately ontological priorities. While Pettit’s terms, like ‘red’, are adjectives referring to properties, Kuhn’s terms, like ‘pendulum’, are nouns referring to objects that instantiate properties. Hence they seem importantly different. Nonetheless they are not. Pettit himself (1998: p. 63) suggests that we learn the noun ‘water’ response-dependently. ‘Pendulum’ can work that way also. Further, nouns are readily convertible into adjectival phrases and vice versa: ‘red’ to ‘red object’, and ‘pendulum’ to ‘pendular’ or ‘being a pendulum’. More importantly, Kuhn’s terms are response-dependent in
Pettit’s sense: they are learned in response to objects in the world. This is true even of terms that others might think are not so learned. Kuhn writes:

Rather than being defined, these terms [from Newtonian physics] are introduced by exposure to examples of their use, examples provided by someone who already belongs to the speech community in which they are current. (2002: p. 66)

In particular the learner is exposed to, and through her training as a Newtonian learns the appropriate way to respond to, exemplary instances of force. Kuhn elaborates:

The situations which exemplify a force’s presence are of varied sorts. They include, for example, muscle exertion, a stretched string or spring, a body possessed of weight . . . or, finally, certain sorts of motion. (2002: pp. 67–8)

Kuhn turns to how force relates to weight and mass: ‘The learning process [for terms for these properties] requires the juxtaposition of statements involving the terms to be learned with situations drawn directly or indirectly from nature’ (2002: p. 69). Though the Newtonian learns terms like ‘weight’ and ‘mass’ partly by learning statements that relate them to ‘force’ – ‘weight’ is perhaps learned to name a kind of force, while ‘weight’ and ‘force’ might both be learned to name something that is a function of mass – those statements are themselves learned in the context of ostensible objects to which the learner is responding. All terms are learned in response to ostended examples or via other terms that are themselves so learned.

4. From Ethnocentric Global Response-Dependence to Incommensurability

Besides his ethnocentrism, Kuhn differs in another significant way from Pettit. Though they both maintain that mastery of terms and concepts depends on ‘contingencies of subjective response’ (Pettit 2005a: p. 181) to ‘pre-existing things’ (2005b: p. 75), unlike Pettit’s account of language learning which is merely of mastery, Kuhn’s is of mastery and meaning. According to Kuhn, the (Anglophonic) Ptolemaic and Copernican, having mastered ‘planet’ in different ways, mean different things by it. The Ptolemaic means an object that orbits the earth; the Copernican, one that orbits the sun. For Kuhn, all concepts and terms for a community are connected in an a priori manner to paradigmatic responses of members of the community to objects, where this a priori connection is definitional.
Concepts and terms for a community are defined with reference to responses that paradigmatic members of that community would have to objects. That is why Kuhn makes so much of differences in the meaning of terms between communities and the inability of some terms from different communities (like before and after a revolution) to be intertranslatable. Kuhn calls such intranslatability ‘incommensurability’.¹⁰

One of Kuhn’s favorite examples of incommensurability occurs between the Ptolemaic and Copernican lexica. Recall that, on Kuhn’s view, the Ptolemaic masters a lexicon in which ‘the sun’, ‘the moon’, ‘Venus’, ‘Mercury’, ‘Mars’, ‘Jupiter’, and ‘Saturn’ figure under ‘planet’. The Copernican, conversely, masters a lexicon in which ‘Venus’, ‘Mercury’, ‘Mars’, ‘Jupiter’, and ‘Saturn’ figure under ‘planet’, while ‘the sun’ figures under ‘star’ and ‘the moon’ under ‘satellite’. Hence not only do the species terms ‘the sun’ and ‘the moon’ figure under different genus terms for the Ptolemaic and Copernican: for the former they figure under ‘planet’; for the latter, ‘star’ and ‘satellite’, respectively. But also, for the Ptolemaic, ‘planet’, ‘star’, and ‘satellite’ do not name categories at the same taxonomic level, while, for the Copernican, they do. Differences in how members of different communities learn these terms therefore cause differences in how their respective lexica are taxonomically structured.

Kuhn draws three lessons (see Kuhn, 2002: p. 53 for the first two and Kuhn, 2002: p. 36 for the third). First, because the Ptolemaic and Copernican lexica taxonomize objects in ways that are non-isomorphic with one another, it is impossible systematically to correlate terms like ‘planet’ from the Ptolemaic and Copernican lexica while respecting the taxonomic structures in which these terms are embedded. Second, since Kuhn regards the possibility of such correlation as a necessary condition on translatability, he maintains that the Ptolemaic’s and Copernican’s ‘planet’ are mutually intranslatable and therefore incommensurable.¹¹ And third, rather than being widespread between the Ptolemaic and Copernican lexica, incommensurability is local. It arises for only a relatively small number of terms. Since many early Copernicans were schooled in variants of the Ptolemaic lexicon, they would have retained those parts of the lexicon not in conflict with the Copernican one. While terms like ‘planet’ are incommensurable, those like ‘horizon’ and for various units of measure or days of the week are not. Terms for observable points of light, not understood qua planet or star but qua point of light, are not incommensurable either, because ‘light’ (or ‘point of light’) is not embedded in taxonomically disparate ways in the Ptolemaic and Copernican lexica as ‘planet’ is. The Ptolemaic’s and Copernican’s disagreement concerns the taxonomization of celestial bodies and not these others. As we saw in §3, Kuhn’s ethnocentric global response-dependence theory of terms allows overlap between different communities’ terms. ‘Horizon’ would be more like ‘red’ than ‘planet’.
Hence, for Kuhn, ethnocentric differences in how members of the Ptolemaic and Copernican communities learn terms cause non-isomorphism between the Ptolemaic and Copernican lexica. The non-isomorphism in turn causes their lexica to be locally incommensurable. Now incommensurability has been thought to entail two unsavory consequences. I consider each in turn.

5. From Incommensurability to Non-Realism – and Overcoming the Non-Realism Charge

The first unsavory consequence thought to follow from incommensurability is metaphysical. Incommensurability has been said to bring with it a non-realism according to which the world is purely constructed. Terms from different communities are incommensurable on this view because they refer to different objects or perhaps even different objects in different worlds existing at the behest of their observers.

Nonetheless I claim that Kuhn's view, interpreted as a kind of ethnocentric global response-dependence, prevents the non-realism from following. As we saw in §3, as I interpret Kuhn it is not the world but our ways of taxonomizing its objects that are constructed. The world itself is real. It is populated by Pettit's 'pre-existing things' (2005b: p. 75). For Kuhn, it has to be. He takes members of different communities to respond to the same objects – objects that are really in the world – in different ways. Insofar as realism is the thesis that there are mind- (or response-)independent objects, Kuhn's realism is on my interpretation indisputable. In fact Kuhn (2002: pp. 101–2) considers himself a realist, just not Hilary Putnam's (1978: part 4, 1981: Ch. 3) metaphysical realist.

That kind of realist presupposes what Putnam calls a 'God's-eye', and Pettit calls a 'cosmocentric', point of view. That would be a point of view independent of any responses, generically human or specifically communal. It would be a point of view sub specie aeternitatis and so response-independent. As I interpret him, Kuhn is instead a realist of an ethnocentric response-dependence sort. According to him, though there are (and in fact need to be) pre-existing objects, all terms remain connected in an a priori manner to paradigmatic ethnocentric responses to those objects.12

Admittedly there are passages in which Kuhn seems not to be a realist at all. By saying early on that members of different communities ‘are responding to a different world’ (1996b: p. 111), that they ‘lived in a different world’ (pp. 116–17), and that ‘though the world does not change with a change of paradigm, the scientist afterwards works in a different world’ (p. 121), Kuhn seems to be implying that they are not responding to pre-existing things by taxonomizing them differently. They are instead creating those things themselves.
Though his aim differs from mine, Ian Hacking (1983: pp. 108–11, 2009) interprets Kuhn in a way that reconciles these passages with my own ethnocentric global response-dependence interpretation. Hacking calls Kuhn not a ‘global response-dependence theorist’ but a ‘revolutionary transcendental nominalist’. Kuhn is a *transcendental nominalist*, Hacking maintains, because Kuhn thinks that (as I would put it) our responses to the world are structured, not by Kantian forms and categories, which are ideal, but by lexical taxonomies, which are nominal or linguistic. While the world is one of individual objects, the way in which these objects are taxonomized depends on responses that we would have to them. Kuhn’s transcendental nominalism is *revolutionary*, Hacking continues, because Kuhn thinks that our taxonomies change radically over time. Hacking thus explicates Kuhn’s statement about ‘different worlds’:

The world does not change, but we work in a new world. The world that does not change is a world of individuals. The world in and with which we change is a world of kinds. The latter changes; the former does not. After a scientific revolution, the scientist works in a world of new kinds (2009: p. 306)

but not a new world *simpliciter*. The world is therefore real, but (as I would put it) for any community its terms mean what they do – and so objects in the world are taxonomized by those terms in the way in which they are – in virtue of responses of paradigmatic members of that community to those objects. Members of different communities are responding to the same world (‘the world does not change’) but do so by taxonomizing objects in it differently (and so ‘work in a new world’, i.e. ‘a world of new kinds’). Kuhn’s ethnocentrism is epistemic and semantic. It concerns how communities taxonomize – conceive of and name – pre-existing things in it. Hence if Kuhn’s view is interpreted as an ethnocentric variant of Pettit’s, then the first unsavory consequence thought to follow from incommensurability, non-realism, does not follow.14

6. From Incommensurability to Non-Rationalism

The second unsavory consequence thought to follow from incommensurability is epistemic. One might worry that if members of different communities, like our Ptolemaic and Copernican, employ incommensurable lexica, then they lack any rational basis on which to change communities by adopting the other community’s lexicon. Now some Ptolemaics did come to adopt the Copernican lexicon, thereby becoming Copernicans. On this view, however, they did so based on persuasion, coercion, or something ineliminably subjective, not rational adjudication. The second
alleged consequence of incommensurability is therefore non-rationalism concerning the basis for community changes.  

There are two reasons that this consequence has been thought to follow. First, incommensurability seems to prevent the Ptolemaic and Copernican from communicating with one another the full panoply of experiences that each has in the way in which each has them. Individuals with incommensurable lexica, Kuhn explains, ‘will be unable to communicate all of their experiences across the lexical divide. Though individuals may belong to several interrelated communities (thus, be multilinguals), they experience aspects of the world differently as they move from one to the next’ (2002: p. 101).

According to Kuhn, the Ptolemaic cannot fully communicate to the Copernican his experiences of seeing planets move across the sky, because the Copernican, unlike the Ptolemaic, does not experience the sun and moon as planets. Further, though Kuhn treats the sun as tantamount to one of Pettit’s ‘pre-existing things’ – that is how the Ptolemaic and Copernican can categorize the same object differently – neither the Ptolemaic nor Copernican can categorize the sun in shared terms. Even we can categorize the sun as a planet as according to the Ptolemaic or a star as according to the Copernican. Even we must choose some ethnocentric category. Nor, according to Kuhn, can the Ptolemaic and Copernican appeal to an anthropocentric perspective to see what human beings generally take ‘the sun’ to mean because there is no such a perspective. Yet unless members of different communities can fully communicate their experiences, they seem unable fully to weigh reasons for and against changing communities. Since community changes do occur, they must be based on something non-rational.

The second reason that this consequence has been thought to follow is due not to different experiences that proponents of different lexica have but to different laws that such lexica support. For Kuhn, scientific kind terms are meant to be projectible in norm-governed, lawlike ways. That is because they are meant to function in general claims concerning actual as well as counterfactual situations. On Kuhn’s view, however, the Ptolemaic and Copernican employ ‘planet’ as projectible in inconsistent ways. In fact each one’s term figures in laws inapplicable to the other’s. Whatever law the Copernican proposes to describe the earth’s motion around the sun would not apply to the Ptolemaic’s taxonomization of the sun, according to which the sun is a planet that revolves around the earth. Whatever law the Ptolemaic proposes to describe the sun’s motion around the earth would not apply to the Copernican’s taxonomization of the sun, according to which the sun is a star around which the earth itself revolves. Because terms like ‘planet’ are projectible only in
ethnocentric ways, there is no shared perspective from which to evaluate laws in which these terms are contained. For there is no common lexicon into which the laws could be translated while respecting the taxonomic differences on which each rests. Hence the laws themselves are in this sense incommensurable. But then it would seem impossible to decide on a rational basis which lexicon, from which these terms and ensuing laws draw, to adopt. Since, on Kuhn’s view, adopting a lexicon just is changing a community, community changes would themselves have no rational basis.

While my interpretation of Kuhn was by itself able to overcome the non-realism charge, it cannot by itself overcome the non-rationalism one. That is no reason to reject the interpretation, however. As I show next there is another way to overcome it.

7. A Proposal for Overcoming the Non-Rationalism Charge

Here I offer a three-step proposal for how on Kuhn’s view lexicon adoptions can avoid the non-rationalism allegedly entailed by incommensurability. My proposal begins with Kuhn’s own, which figures as step one. Steps two and three provide important details that Kuhn omits. Though my proposal may be open to other interpretations of Kuhn as well, step three is particularly appropriate for my response-dependence interpretation of him. For step three involves a response-dependence theory of sentences.

Step one amounts to denying that the Ptolemaic and Copernican require an anthropocentric or cosmocentric perspective to compare lexica in the first place. Following Kuhn we can allow lexical adoptions (and so community changes) to be rational if mediated by those parts of lexica that are commensurable against values like accuracy, simplicity, fruitfulness, consistency, and efficiency that are more or less shared across lexica. Though Kuhn provides no developed example, he seems to be imagining that locally incommensurable lexica contain terms for observable objects that are commensurable. Thus we saw in §4 that the Ptolemaic’s and Copernican’s terms concerning a point of light, not understood qua planet or otherwise but merely qua a point of light, should be commensurable. So too should terms for the horizon, units of measure, and days of the week. Suppose that by employing these terms the Ptolemaic and Copernican can communicate predictions about the position of a point of light above the horizon on a particular day. Should the Ptolemaic repeatedly make less accurate predictions than the Copernican does, then the Ptolemaic would have reason to join the Copernican’s community by adopting her lexicon and relinquishing his own.

Step two goes beyond Kuhn to suggest how the Ptolemaic and Copernican might discern which parts of their lexica are commensurable
in the first place. I need to explain this because locally incommensurable lexica cannot be compared via their *incommensurable* parts, and Kuhn is silent on how scientists can identify *commensurable* parts. I suggest that members of different communities can discern whether terms for observables are commensurable by seeing whether the objects to which they refer as taxonomized by one lexicon can be mapped onto the same objects as taxonomized by the other lexicon without contorting the structure of either. The Ptolemaic and Copernican should be able to tell that each one’s ‘point of light’ and ‘horizon’ are commensurable, respectively. Each can say the phrase ‘point of light’ or ‘horizon’ and ostend to the phrase’s referent. Each can then utter related phrases and repeat osten- sions until it is clear that the two taxonomize referents in the same way.

Thus the Ptolemaic and Copernican each might taxonomize a point of light as a species of the genus visible thing, and the horizon as a species of genus line of demarcation. Of course objects belong to multiple genera, so the Ptolemaic and Copernican might taxonomize them in other ways also. Whatever the genera, however, their treatment of ‘point of light’ and ‘horizon’ contrasts with that of ‘planet’. The Ptolemaic and Copernican can ostend to what each takes to be a planet and via discussion realize that they neither taxonomize the same objects under the genus planet nor treat planet itself as having the same co-genera. *We* are Copernicans, and we were able to realize this above. So would any Ptolemaic. Ptolemaics and Copernicans generally can know that while each one’s ‘horizon’ is commensurable with the other’s, each one’s ‘planet’ is not. Nor should this be surprising. As noted in §4, many early Copernicans were schooled in variants of the Ptolemaic lexicon. Only innovations made by Copernicus and his followers would have displaced elements of the Ptolemaic lexicon, and their treatment of the horizon was no innovation.

Now suppose that the Ptolemaic and Copernican do know which of their terms are commensurable. The predictions that I attributed to the Ptolemaic and Copernican, about the position of a point of light above the horizon on a particular day, are expressed in sentences. And the meaning of a sentence is not reducible to the meaning of its terms. Otherwise ‘The sun orbits the earth’ would be synonymous with ‘The earth orbits the sun’. Having agreed with Kuhn that two locally incommensurable lexica can be compared against shared values via their commensurable parts, and having suggested a way in which members of different communities can determine which parts of their lexica are commensurable, I must now explain how the meaning of *sentences* formed from these commensurable parts can itself be determined and so compared.
Focusing on the commensurable parts of locally incommensurable lexica, step three of my proposal involves finding a theory of how the meaning of sentences depends on the meaning of component terms. To be useful to Kuhn, that theory must also allow some of those terms to be defined for communities with reference to responses of paradigmatic members of those communities to objects in the world, and other terms to be defined via them. Though other theories might yield these results, I adapt one ready-made and already familiar in the literature. The theory itself also turns out to be response-dependent, which adds to its attraction. It is what I have elsewhere (forthcoming) argued amounts to Davidson’s response-dependence theory of sentences.21

According to Davidson,22 a Tarski-style truth theory for a natural language can serve as a meaning theory for that language. On Davidson’s view, an interpreter devises a truth theory by systematically correlating a language’s sentences with their truth conditions. Though Davidson takes the sentence to be the basic unit of meaning, the systematicity of the correlation ensures that individual terms play similar roles in similar sentences. Davidson can then treat terms as meaning what they do given their compositional role in sentences. Moreover, Davidson privileges sentences whose truth conditions are sensitive to perceived changes in the environment (see Davidson, 2001: p. 26, n. 10 and 2002: p. 149)23 – where, he explains, terms for ostensible objects sometimes function as sentences (see Davidson, 2002: pp. 43, 86, 117, 200, 212). ‘Horizon’, perhaps elliptical for ‘This is the horizon’, counts as a sentence. Now, on Davidson’s view, truth conditions of these privileged sentences (whether individual terms or not) are determined by an interpreter when she and the sentence’s speaker triangulate – or jointly ostend to – objects in the world. Hence, for Davidson, the meaning of these privileged sentences depends on responses that the interpreter has to such objects.24 The meaning of other sentences can then be determined based on the meaning of these. Davidson’s theory is global. Finally, this global theory of sentences is response-dependent because Davidson maintains that the meaning of all sentences is connected to responses of language users to objects and that this connection is a priori insofar as it is definitive of what it is for a sentence to have the meaning that it does (see Goldberg, forthcoming).25

Consider now my three-step proposal in full. Step one assumes with Kuhn that communication about commensurable parts of two locally incommensurable lexica, given shared values, can provide a rational basis for changing communities. Step two argues that the Ptolemaic and Copernican can discern whether certain terms are taxonomically isomorphic and so commensurable. Suppose that the Ptolemaic and Copernican determine that each one’s ‘point of light’, ‘horizon’, and terms for units of measure and days of the week are commensurable.
Now when they employ sentences to make predictions about the position of a point of light above the horizon on a particular day, step three explains how the Ptolemaic and Copernican can understand these predictions. For it explains how the meaning of sentences depends systematically on the meaning of their component terms, some of which are themselves defined with reference to responses of suitably situated subjects – in this case the Ptolemaic and Copernican – to objects in the world. The Ptolemaic and Copernican each can then evaluate the other’s predictions as to their accuracy. Each can in turn have reasons to change communities. Whoever does change communities (here the Ptolemaic) would thereby adopt the other’s lexicon in its entirety, including those terms incommensurable with her own previous lexicon. The charge of non-rationalism concerning adopting incommensurable lexica is disarmed.

8. Usefulness of the Interpretation

In this paper I have claimed not only that Kuhn can be interpreted as an ethnocentric global response-dependence theorist but also that doing so is useful for four reasons. In this conclusion I explore whether these reasons obtain.

First, my interpretation was to allow us to systematize and defend Kuhn’s views. It accomplishes the former by showing why for Kuhn incommensurability arises, and the latter by showing how for him the non-realism and non-rationalism allegedly entailed by incommensurability can be handled. Interpreting Kuhn as an ethnocentric global response-dependence therefore provides an overarching theme by which to approach him as a thinker. Historians have a unifying way to make sense of his views.

Second, my interpretation was to deepen our understanding of both the uniqueness of Kuhn’s views and their continuity with the views of others. It accomplishes the former by illustrating that given its globalism Kuhn’s response-dependence sits apart from every view save Kant’s and Pettit’s, while given its ethnocentrism it sits apart from every view save none. In fact Kuhn’s revolution in the history and philosophy of science just is, on my interpretation, the a priori connection that he draws between what we can think and say about the world, and responses of paradigmatic members of our historically situated community to objects in the world. My interpretation accomplishes the latter by reminding us that Kuhn still joins Locke, Kant, Johnston, Pettit, and Davidson (to name a few) as a response-dependence theorist. Though Kuhn is a revolutionary, as I interpret him he has more in common with philosophers, past and present, than many have thought. Those concerned with Kuhn’s place in the history of philosophy should take note.
Third, my interpretation was to add to and improve upon a family of related interpretations of Kuhn. These interpretations are all Kantian. This should not be surprising as Kuhn self-identifies as a Kantian with ‘movable categories’ (2002: p. 264, see also p. 104): they move as people move between communities. What are these related interpretations? As I suggested in §5, Hacking interprets Kuhn as a Kantian whose conditions on the possibility of empirical knowledge are not conceptual, as they are for Kant, but linguistic, in the form of lexical taxonomies – where such taxonomies change radically over time. Michael Friedman (2001) urges that Kuhn’s lexica embody relativized Kantian a priori principles: they play the constitutive role of Kant’s own synthetic a priori judgments though their domain of application is relative to only specific bodies of empirical knowledge. And Paul Hoyningen-Huene (1993: Chs. 2–3) claims that Kuhn allows for the creation of a plurality of Kantian phenomenal (in my terms ‘response-dependent’) worlds.

Now while Hacking focuses on the formal structures of lexica and Friedman highlights the abstract mathematical and conceptual claims that lexica embed, neither emphasizes the centrality of language learning to – and specifically the role that responses to ostensible objects play in – Kuhn’s epistemology of science. In particular Hacking and Friedman pay too little attention to how response-dependent language learning is responsible on Kuhn’s view for lexica having empirical content. Conversely, while Hoyningen-Huene does recognize the importance for Kuhn of language learning, my interpretation illuminates the sense in which the empirical content of a theory is nonetheless grounded on the a priori link between concepts and terms on the one hand ethnocentric responses to objects on the other. Hence my interpretation more fully explains how Kuhn’s ‘phenomenal worlds’, though phenomenal (or transcendentally ideal), are nonetheless still empirically real. I therefore flesh out in richer detail how the a priori and the empirical are intertwined in Kuhn’s account as they are in Kant’s. Finally, my interpretation improves upon all these others by recognizing that the account of language learning on offer makes Kuhn’s views a member of a broader family than merely the Kantian. For my interpretation shows Kuhn’s affinities with not only Kant but also Locke, Davidson, Pettit, and other response-dependence aestheticians, ethicists, metaphysicians, philosophers of language, and philosophers of mind, mentioned in §1. Moreover, once Kuhn is seen as a response-dependence theorist, I can argue by analogy from Pettit’s response-dependence theory that Kuhn can avoid charges of non-realism. I can also appeal to what I take to be Davidson’s response-dependence theory to show how Kuhn can avoid charges of non-rationalism. Though Pettit’s and Davidson’s theories are available to Hacking, Friedman, and Hoyningen-Huene as well, they fit more naturally with my already response-dependence interpretation of Kuhn.
And fourth, my interpretation of Kuhn was to help us appreciate the versatility of response-dependence itself as a philosophical program. It accomplishes this by illustrating how Kuhn’s views can serve as a unique study in how we might develop response-dependence theories further. Instead of following Locke by identifying suitably situated subjects with paradigmatic human beings, we, insofar as we find response-dependence appealing, can follow Kuhn by identifying them with paradigmatic members of communities. We can also go beyond Kuhn to identify suitably situated subjects with one particular person (if we want an idiocentric response-dependence theory), with members of other species (if we want to eschew human beings altogether in our theory), or perhaps with other sorts of responders entirely. Kuhn teaches us that the anthropocentric limits to which Locke and those since have adhered need not limit us.27

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Notes

1 Paradigmatic human responses are those had by normal human beings under ideal observing conditions. See Pettit 2005b (essay 5) for elaboration. Response-dependence theories trace ultimately to Galileo: see Galileo 1957.

2 Locke does not always distinguish properties from concepts, partly because of ambiguity in his ‘idea’ between a mental state and its content.

3 For Kant, cognizable properties and concepts are phenomenal – whether categorical (which follow from our concepts of the understanding, which are phenomenal), mathematical (which follow from our forms of intuition, which are phenomenal), or empirical (which are directly of appearances). Such properties and concepts are ultimately all governed by the understanding not reason. Nonetheless see Goldberg 2004a for how concepts of the understanding and reason relate.

4 Johnston (1989: p. 148) and Pettit (2005b: p. 90), and if Pettit (p. 50) is right Putnam, also take Kant to be a response-dependence theorist. See Goldberg 2008b.

5 I return to Davidson in §7.

6 What sort of theory would maintain a non-priori connection between properties, concepts, or terms and paradigmatic responses to objects in the world? It would be any that claims that there is no necessary connection between how suitably situated subjects respond to objects in the world and properties of, or terms or concepts for, those objects. In §5 I mention Putnam’s metaphysical realism, which presupposes what Putnam calls a ‘God’s-eye’, and Pettit calls a ‘cosmocentric’, point of view. That would be a point of view sub specie aeter nitatis and so response-independent. According to that view, it is possibly not the case that something is x (falls under x, would be called ‘xi’) just in case suitably situated subjects would perceive it as x (conceive of it as falling under x, call it ‘xi’). So metaphysical realism would contrast with the a priori view. So too would views according to which inverted spectra are possible. According to them, it is in particular possibly not the case that something is red (falls under RED, would be called ‘red’) just in case suitably situated subjects would perceive it as red (conceive of it as falling under RED, would call it ‘red’). There would be no a priori connection there either.
7 Nonetheless see Goldberg (2008b), from which §§1–2 draw, for more on Pettit.
8 Kuhn’s (1990, 2002) notion of a lexicon replaces his earlier notions of a paradigm (1996b) and disciplinary matrix (1979, 1996a). See Bird (2002: Ch. 3) and Hoyningen-Huene (1993: Ch. 4).
9 That Kuhn intends his analysis to extend to non-scientific terms is evidenced by his non-scientific examples. See note 11.
10 Kuhn’s incommensurability ‘thesis’ begins (1996b: Chs. 9–11) as a series of related theses concerning the inability of members of one community to compare observations, values, and the meanings of terms from members of different communities. Kuhn later (1996a and after) concentrates on meaning incommensurability, which later still (2002) takes on a lexical-taxonomic form. See Hoyningen-Huene (1993: Ch. 6) and Sankey (1994).
11 Kuhn offers the similar intranslatability of the English ‘mat’ into French (2002: p. 93), French ‘esprit’ and ‘doux’ into English (p. 48), and English ‘sweet’ into French (p. 56) as examples of incommensurability outside science.
12 See Goldberg (2008b) for discussion of forms of realism.
13 Thus, McDonough explains, on Hacking’s understanding of Kuhn: ‘Scientific revolutions alter the existence of mind- [or response-]dependent kinds, but leave untouched the existence of metaphysically independent individuals’ (McDonough, 2003: p. 346), i.e. Pettit’s ‘pre-existing things’ (2005b: p. 75). See Goldberg, 2008a, 2008b, 2009c and §8 for connections between Kant and Kuhn.
14 I return to Hacking in §8.
15 For Kuhn, there are other sources of non-rationalism besides incommensurability, which follow instead from his analysis of the sociology and psychology of science. Nonetheless I focus here on the non-rationalism that follows from incommensurability.
17 Hacking is again helpful: “‘Projectible’, for Kuhn, he explains, ‘doesn’t mean rightly projected from some cosmic point of view: it is a humane concept implying only that a class of terms is used by a community for making lawlike statements’ (Hacking 2009: pp. 295–6, my emphases).
18 See Kuhn 1979: pp. 321–2, 1996a: pp. 185, 199, 206, and 2002: pp. 36, 113, 119, 251. But see Goldberg, 2009c for the extent to which Kuhn can maintain that such values are shared.
19 Worries may arise concerning what Quine calls ‘inscrutability’ (see 1964: Ch. 2) or ‘indeterminacy of reference’ (2004: pp. 50–2). There are two things to say. First, if worries arise here, then they arise for philosophers generally. Neither Kuhn nor I need dispel them. Second, indeterminacy is not necessarily problematic. The distinctions that Quine draws, like a rabbit and undetached rabbit parts, do not matter for discourse. That in fact is Quine’s point. See note 24.
20 Kuhn never recognizes the problem of determining the meaning of sentences when one has a way of determining the meaning only of individual terms. Further, the problem arises on Kuhn’s view for completely commensurable lexica too. In fact even if two persons have the same lexicon, Kuhn provides no insight into how they would know the meaning of one another’s sentences.
21 Davidson does not take himself to be offering a response-dependence theory of anything.
22 Davidson (2001: essay 9) is the locus classicus of his theory of meaning, though he modifies it elsewhere (e.g. 2002: essay 10, 2005). See Goldberg 2008b and 2009a for how triangulation supplements that theory.

23 Essential to this is Davidson’s principle of charity: see Goldberg, 2004b, 2008b, and 2009a.

24 Nor is Davidson’s indeterminacy of meaning a worry: ‘Indeterminacy of meaning or translation does not represent a failure to capture significant distinctions; it marks the fact that certain apparent distinctions are not significant’: see Davidson 2001: pp. 153–4.

25 Admittedly Davidson (2002: p. 202), like Pettit and unlike Kuhn, invokes anthropocentric responses, this time shared by speakers and interpreters. We can, however, adapt Davidson’s theory to invoke ethnocentric responses. Now because Davidson (2001: essay 13) thinks that his theory entails that there can be no Kuhnian incommensurability, one might think that my turning to Davidson precludes my being able to demonstrate how Kuhn can live with incommensurability. It does not. I have shown elsewhere (Goldberg, 2004b, 2008b, 2009a) that Davidson’s theory is consistent with Kuhnian incommensurability. Further, Davidson’s argument does rely on anthropocentric responses. Allow that communities can themselves inculcate responses and incommensurability becomes possible.

26 See Goldberg, 2009b and 2009c for more on Friedman, and Goldberg, 2009c for more on Hoyningen-Huene. See also Goldberg, 2008a, 2008b, and 2009c for further connections between Kant and Kuhn.

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