Situated Knowing: On the Orthogonal Move and Reading Thomas Kuhn as a Kantian

L. K. Sabatier

University of Groningen

Theory and History of Psychology Master Thesis

Supervisor: J.T. Burman

24 November 2022

Abstract

Much has changed in history and philosophy of science since the publication of Thomas Kuhn's *The Structure of Scientific Revolutions* (1962) and his popularisation of the concept of theory-ladenness. Today the fact that context has some modicum effect on the genesis of scientific knowledge is relatively commonly accepted. Still, there remains a troubling narrative in the historical discourse around knowledge genesis and progression; psychologist and historian Jeremy Burman noted that the progression of knowledge is often framed in a way where theory is separated from evidence. Burman informally proposed an alternative form of knowledge progression and dubbed it the Orthogonal Move. This paper formalises such an orthogonal approach to knowledge progression, and the epistemological concerns it must address. In order to add further clarity, it also illustrates the move through an application: an orthogonal reading of Kuhn's *Structure*, which introduces historical influences such as Immanuel Kant and Jean Piaget. This expansion of knowledge reveals a non-essentialist approach to science, which through developmentally progressive ways of knowing remains deeply anchored in evidence and avoids social constructivism—illustrating a viable narrative of knowledge progression that properly takes theory-ladnness into account.

Keywords: Thomas Kuhn, Jeremy Burman, Immanuel Kant, Jean Piaget, non-essentialism, theory-ladenness, the orthogonal move

Preface

In a discussion in one of my very first masters courses in the theory and history of psychology unit at the University of Groningen, I (re-)encountered Thomas Kuhn. The discussion soon turned to his potential relativism, questionable commitment to scientific progress, and the contentious *incommensurability*. I was impatient with the confusion—I saw none of these aspects of his work as incompatible. When asked why, I obstinately said "well he's obviously a Kantian of some sort, isn't he?" Little did I know that I had just hit on one of my professor Jeremy Burman's many well loved (but too often left) side projects: this was my first academic encounter with what he has dubbed the Orthogonal Move. What follows is a formal expansion and exploration of an idea that has, thus far, lived only informally or indirectly. Along the way it has generated paper after paper, in all of which I found myself hitting the interpretative limits of various philosophical schools, individuals, and historical contextualisations. This minor obsession has led to persistent frustrations and insights in most classrooms I enter. It has travelled to many inboxes and across many kitchen tables, in musings between colleagues, friends and family. I am deeply relieved to finally put it to paper.

Intro: A Bloody Synthesis

My own theoretical background is largely in philosophy and psychology, with more minor excursions into biology and ethics. While methodologically I have a penchant for historical approaches. In other words, I am often observing knowledge cultures and their progression from the outside in—from the perspective of another discipline or another time. In this, a pattern emerged: across scientific disciplines, the discourse around the history of knowledge genesis often seems to have an antagonistic and binary nature, where theory is separated from evidence. This largely ignores theory-ladenness, or the real analytical and historical difficulty of separating empirical evidence from the scientific theory in which it is couched—as famously illustrated in Thomas Kuhn's *The Structure of Scientific Revolutions* (1962).

University of Groningen psychologist and historian Jeremy Burman also took note of the continual prevalence of just the narrative that I had begun to notice, and had informally been commenting on, and problematising it for many years. He notes that scientific progress is popularised as a clash between theories, that results in a 'more truthful' amalgam of both. All the while, evidence and facts progressively pile in the background, as if, independent entities. In short, the common narrative tells the story of two scientific camps, so at odds that they must necessarily fight and clash in a Fichtean moment of thesis versus antithesis, and knowledge then moves forward via their eventual bloody synthesis[1].

There is something amis in this Fichtean narrative, its historical accuracy, the levels at which it takes place, and the troubled epistemic stance underlying it. Namely, *what* is clashing on order to produce new knowledge—evidence, theory, or both? On a descriptive level, is theory and evidence really treated separately? On philosophical level, *can* theory and

[1] L.K. Sabatier, personal communication, December 24, 2019

evidence really be treated separately? Descriptively, this story to which Burman responds does not seem to reflect the course of history as per Kuhn (1962/2012), who is especially well-known as an opponent of cumulative knowledge progression (ie. the theory-independent piling up of empirical evidence). Many others have since echoed this sentiment; the theory-ladenness of facts and an at least minimal effect of context on knowledge, is commonly accepted at this point (see for example Brewer & Lambert, 2001; Franklin, 2015; Kordig, 1971). This particular paper delves more deeply into the more explicitly philosophical concerns about whether theory and evidence *can* be treated separately at all; it leaves popular understanding of Kuhn behind and assesses the theoretical issues that underly this Fichtean thesis-antithesis-synthesis story. It then proposes a contextually informed alternative that begins in the work of Burman, who informally discusses an alternative to the Fichtean model called *the orthogonal move* (from here on referred to as the OM).

The OM is very much influenced by the interdisciplinary nature that characterises much of Burman's work. The aim of this paper is to draw on several of these disciplines and conceptually formalise, and illustrate the merits of the OM. Namely, it makes use of historical and philosophical methods that are also grounded in a philosophical psychology. In order to make the informal formal, I begin by outlining the OM as it first formed in the correspondences and talks of Burman—using emails, lecture material, and course syllabi. This reveals a kind of non-essentialism that begins to touch on the problematic consequences of separating the how of knowledge from the what, the theory and broader context from the evidence, but still lacks philosophical rigour. In order to address such shortcomings, this paper inquires into his methods and commitments and deepens them: first, formalising the Kantian themes in his non-essentialism in more traditional Kantian terms.

Where these more canonical Kantian conceptual tools fall short, I propose that as an alternative history of knowledge, the OM is best understood through a *neo*-Kantian lens, namely that of Thomas Kuhn. I then expand the context of *The Structure of Scientific Revolutions* (from here on referred to as *Structure*) and Burman's OM with a dual purpose in mind: one to highlight the orthogonal nature of Kuhn's approach to the history of scientific knowledge, and two—because I believe that the meaning in a conceptual tool (in so far as it can be located) is in its use—to clarify the move by using it. In practice, the OM expands understanding of Kuhn's seminal characterisation of the history of science, and progression of knowledge, through hidden influences: *Structure* is in part Kuhn's interpretation of the genetic epistemology of psychologist Jean Piaget and the philosophy of Immanuel Kant. I expand the context of *Structure* to include these Kantian and Piagetian influences, which Burman in large part shares with Kuhn. This application of the OM takes us beyond more familiar, and continually controversial, narratives around Kuhn's work—such as those couched in his relationship to logical positivism or relativism. Here questions about how we can expand our understanding of Kuhn's relativism, his relationship to truth and to scientific progress, and Burman's non-essentialism, become question about how knowledges expand and build on one another at all. And the answer, it seems to me, is orthogonally

Burman's Orthogonal Move

In order to understand Burman's OM and the problems it responds to, I will begin on rather more informal grounds: a 2014 personal email in which he discusses US late night shows[2]. Burman notes that in a climate where Fox News can still call itself "news", hosts like Stephen Colbert necessarily found a way to transcend this type of media in parody. They do this by moving orthogonally to the mainstream media narrative, choosing to deliver

[2] J. Burman, personal communication, November 17, 2014.

commentary on world events that explicitly denies that it is, in fact, news at all. In this email Burman notes that this new category of reporting is much more self-reflective, and via comedy introduces concepts like 'truthiness.' Such concepts are funny, yes, but also reflexive in the sociological sense. They beg fundamental philosophical questions about the status of truth in a climate where these questions are becoming increasingly relevant. This type of transcendence, or progression *from* (as opposed to *towards*) is a theme in Burman's understanding of the OM. It entails creating new things by rejecting a common premise, while still being constrained by the evidence and assumptions that have been accumulated by those who hold that premise. Another concern for the OM is the necessary connection of knowledge (or in this case, news) to world, without which it becomes arbitrary at best and dangerous at worst. On to more formal grounds, where the workings of the OM can also be observed.

In a 2016 lecture for the master's course Controversies in Psychology at the University of Groningen, Netherlands, Burman addresses the contentious relationship between genes and memes[3]. He details how Richard Dawkins first popularised an analogy between the two, originally as a way of showing that genes—as we understand them—are not the only way to explore mechanisms of evolution. What is in fact most useful about our understanding of genes in relation to the process of evolution is that they are replicators. This means that they contain and then transfer qualities, or information, from one generation to the next by replicating themselves. This interesting core conceptual quality, he noted, is also a characteristic of memes.

Initially, this is is an interesting, though rather tentative comparison. From there, however, the likes of Daniel Dennett and Susan Blackmore (and eventually even Dawkins

---

[3] Burman, J. (2016, October 17). *The misunderstanding of memes* [Syllabus & PowerPoint].

himself) began to expand this analogy, and take it increasingly literally. The argument becomes that memes as a whole are so much like genes that insights about the latter can be used directly to explain cultural evolution (just as genes can be used to explain its presupposed biological counterpart). Let us call this analogy the thesis. The lecture then argues that William Wimsatt's contributions are often framed as exemplary of the antithesis to this analogy. In short, Wimsatt's position is that memes are not a sufficient explanation for cultural evolutions, and that factors such as development must also be considered[4].

The traditional view of the way forward, once both sides have exhausted their empirical or theoretical capacities and reached a sort of generative standstill, would be a synthesis between the two. Burman, however, sees this as missing the point; the context surrounding the meaning of genes and memes is just too different. He proposes another route that accommodates evidence from both sides, but rejects the common premise that memes exist at all (i.e. an orthogonal route). This is where Burman potentially begins to smuggle in radical philosophical ideas: on a more fundamental level, the OM seems to necessitate a rejection of the idea that things have meaning as a function of essence. Does he hold then that the meaning which makes up knowledge does not come primarily from the capacity of knowledge to capture the essence of the objects or phenomenon to which it refers out in the world?

This would indeed problematise the Fichtean approach; if meaning cannot be said to derive from a universal essence, then to commensurate meanings becomes more complicated than a synthesis of theories intimates. The Fichtean approach ignores that rather than being

---

[4] For a more in depth discussion of this case see the following article, which was not used in the writing of this paper: Burman, J. T. (2012). The misunderstanding of memes: biography of an unscientific object, 1976-1999. *Perspectives on Science*, 20(1), 75–104. https://doi.org/10.1162/POSC_a_00057

entities in space, in a straightforward realist sense, the concepts that make up theories seem to be things created in different milieus of meaning, in order to answer different kinds of questions. The concepts that together constitute theories and in turn knowledges, are made up of both evidence and theory in context. Are these simply simply difficult to untangle or would Burman go so far as to say that to untangle them is to lose meaning: remove the milieu and you remove the scaffold on which the meaning is built? This stance would be both ontological and epistemological, because it rejects the existence of an entity as such, and the hard boundary between the context of justification and the context of discovery in our conceptualisations of such entities.

Burman's stance thus far, seems less explicitly philosophical than this. When operating as a historian, he does however note that things do *not* maintain a constant identity throughout different moments in time, or even from different vantage points at one moment in time. What *can* be said about the above case specifically is that he explicitly rejects meaning essentialism by rejecting that memes can be said to exist with the same kind of explanatory or causal power that has been proposed for genes, and this is in part because they exist in relation to a different explanatory context. Genes as a concept may well facilitate statistically significant insight about the type of replication involved in inherited characteristics, but this does not necessarily make them a fitting mechanism to explain the type of meaning replication facilitated by memes.

How does the rejection of this premise move knowledge forward? Burman holds that understanding of memes, and of what is transferred when the things we call memes are passed along, can be more informatively conceptualised by looking at people and the context within which they interpret and transfer memes. This is as opposed to looking for something essential to memes themselves, and drawing on an analogy between this essence and that of

genes. In Burman's own words: "I traced the interactions of people over time, and saw that their beliefs were less a function of the texts they read [or memes they were exposed to] than their con-text (the "withtext")"[5]. A similar reworking has slowly been happening in the field of genetics, first with the introduction of epigenetics, and now behavioural epigenetics. Here knowledge has moved forward combining insight from different disciplines, made compatible not via synthesis, but primarily via the rejection of a common premise: genes are immutable entities, only altered via random mutation.

Working as an historian and an archivist, Burman consistently encounters new information that has the potential to shift contemporary narratives. He realised that this process is rarely one of straightforward negation (ex. discovering propaganda or falsified records) nor of synthesis. Instead, new information changes what we see as knowledge by coexisting with, and simultaneously changing understanding of, known evidence and events. This shift happens when known things are situated in their new, expanded context. In this sense historians are constantly generating knowledge and changing understanding by moving orthogonally to pre-existing narratives and evidence simultaneously. Our understanding of evidence is created anew within an interconnected, shifting evidential and theoretical landscape. Burman explains this in a comment on one of his own papers:

> The orthogonal move isn't about [Piaget and Kuhn (paper)] personally, but about history. To wit: when we can document an influence, but the audience has forgotten it (or understood differently), then this is a different kind of thing than when they haven't forgotten. … This in turn showed us something new about the[m] too[6].

In other words, the thing we knew becomes a new kind of thing within its expanded context.

---

[5] Burman, 2016, slide 23.

[6] J. Burman, personal communication, July 20, 2020.

This also points towards the last formal context in which Burman understood his orthogonal move at the time. Academics often wonder how to creatively contribute to their particular disciplines, and perhaps more fundamentally: "…how do we create new things?" (See footnote 5). To move orthogonally to a dominant conceptualisation of the world is one answer to this question: accept the evidence there is, but not what it means.

In our original example from Burman's course, he traces the analogy between genes and memes back to its beginning and shows that instead of using memes as a potential way of understanding what is so explanatorily powerful about genes (the fact that they replicate), the popularised uptake changed its meaning to: memes are functionally and structurally enough like genes to support a theory of cultural evolution that is as fruitful as pre-existing theories in evolutionary biology. In effect, the initial, more tentative analogy Dawkins made was removed from its context and led to theories built on inflated assumptions about likeness and essence. The OM, as per Burman, aims to avoid these discursive and interpretive traps. While it does not rule out distal analogies as generative interpretative tools, it seems weary of essentialism and aims to understand concepts and evidence through their more proximal context. It creates new things by situating them more deeply, instead of de-contextualising and dismantling them. Understanding is therefore moved forward by a historically informed re-reading of Dawkins' work. In summary, Burman's orthogonal move can be broken down into four central aspects: rhetorical, functional, methodological, and the more traditional epistemological. While all four bear further exploration, it is especially the last aspect that requires greater clarification. I do not propose hard boundaries between these aspects; they are tools to organise understanding and help the informal become formal.

The rhetorical and functional aspects are neatly laid out by Burman in this longer excerpt from an email to me:

> "Orthogonal move" is how I've been describing my favourite approach since grad school. It's the result of combining Derrida, the Neo-Gödelian turn, and "reading across the grain."… Briefly: I like to think of it as an alternative to Fichte's thesis-antithesis-synthesis. Instead of a combination of (or encounter between) two premises, it transcends them, it involves taking a turn and running parallel to them. Both are reflected, but in an unexpected way. I borrowed the term from chess. Rooks can go as far as they like forwards, backwards, or sideways. This is to say that they move orthogonally with respect to the pawn, which can only move forward. That then is the idea with this approach: rather than agreeing or disagreeing (forwards or backwards), to take the orthogonal move is to run sideways to an argument in order to develop a new perspective that both original positions ought to recognise and accept. This achieves the same sorts of goals as a synthesis. But it has the advantage being very hard to anticipate. And it also often leads to interesting new insights. It's related to "not accepting the premise," but it's also less disagreeable because you reflect them instead.[7]

This is to say that rhetorically, to move orthogonally in an argument is to maintain the evidence of two seemingly opposing sides, while rejecting a premise central to both. This is also a way to see historical expansion of knowledge or movement of intellectual discourse. Burman holds that while synthesis often cannibalises both sides to such an extent that neither is likely to agree to the result, moving orthogonally should maintain insights from both to such an extent that the result is much harder to argue with. While functionally, the OM effectively generates new insight by explaining previously mysterious and unpredictable

---

[7] L.K. Sabatier, personal communication, December 24, 2019

interactions with the world in a new way. This allows for new coherence between once contradictory theories.

Next, there is the question of Burman's method. As this section illustrates, the expanded context that allows for orthogonal understanding is introduced by historical methods that trace influences and the development of ideas in time. This can also be observed at work in the growing field sometimes referred to as the history of knowledge. The general takeaway is: the more proximal and contextualised the influence, the more exegetically powerful. So far so good. Lastly, the necessary epistemological concerns about the interaction between mind, object and knowledge that follow when seeing knowledge genesis as orthogonal. Burman begins to touch on these in his explicit non-essentialism; for him meaning making is a function not purely of object essence, but also of human context. In other words, epistemic objects are not discovered, so much as they are created in response to the real world. Perhaps because he primarily proceeds historically in his understanding (for example identifying a meaning change that occurred during popularisation), this act of creation remains vague.

In practice, it seems, that understanding of the world can effectively evolve by expanding and deepening the context of particular instances of meaning creation, but I believe that a version of Burman's non-essentialism also has the potential to touch on the fundamentally problematic consequences of separating the how of knowledge from the what. Philosophically, many questions remain in order to accomplish this: where and how do mind meet world in order to create formalised scientific knowledge, how can this knowledge be said to progress (if at all)? Without addressing such questions, the OM stands the risk of relativising knowledge without re-anchoring it in a meaningful connection to the world itself. In order to address this dilemma, the next section formalises my own uptake of the OM by

drawing on Immanuel Kant. Kant has had a profound influence on contemporary epistemology, it was his transcendental idealism through which I first began to better understand Thomas Kuhn's own theory of knowledge progression, and it seems that many of Kant's core concerns continue to play out in contemporary discourse. This approach enriches the non-essentialism at hand through philosophical discourse that has long problematised separating theory from evidence, or the *how* of knowledge from the *what*, while also attempting to meaningfully anchor knowledge in world.

Kant and the Orthogonal Move

The hypothesis on which Burman's OM rests may not seem profoundly controversial or new to a psychologist or a historian: the mind that facilitates the how of acquiring knowledge is steeped in many forms of context, and these then shape the resulting what ie. the thing called knowledge. Philosophically, however, there is a long history of struggle between epistemic traditions that favour either mind (theory) or world (empirical evidence) in understanding knowledge production. The canonical view is that one of Kant's major contributions to philosophy was his ambitious attempt to bridge the gap between two antagonistic camps that dominated discourse around this issue during his time: rationalism and empiricism. Rationalists, such as Leibnitz, held that there are certain truths we can know about the world by developing, and in turn examining, our own reason. Approaches in rationalist tradition focus on internal reason, or other words, organising structures imposed by mind and theory. This stance has been justified in several ways: for example, that the world is made of inherently logical structures, which can be understood via rigorous mental cultivation and study of the internal logical capacities of the mind, which mirror these in the outer world. To wit: to structurally understand one's own thoughts, is to structurally understand the world.

In today's intellectual climate one may critically note that this only applied to white, educated men of the time. Additionally, given contemporary focus on data and empirical experimentation, the practical pitfalls of this view hardly need elaborating. Regardless, remnants are still evident in the status of mathematics. Mathematics and logic are often dubbed as the language of the universe, despite their reliance on internally consistent systems, as opposed to empirical interaction with the natural world. More broadly speaking, theory-first knowledge progression is framed as the synthesis of old theories and their logical progression towards more truthful amalgams. Here we see the theory-centered approach of the Fichtean model of knowledge progression.

On the opposing side, empiricists such as David Hume firmly denied that any sound knowledge could be achieved without originating in observation or sensory experience. In short, this tradition focuses on world or empirical evidence. Incarnations of this approach are common today, and feed into ideals such as the neutral scientific observer, who hones his skills of empirical observation as a means to truth. Though popular, this approach is also not without its critics; see for example Eronen and Bringmann's 2021 piece on the theory crisis in psychology, Nagel's view from nowhere (Nagel, 1986), or Heather Douglas' commentary on objectivity and the role of values in the production of scientific knowledge (Douglas, 2007). One could well argue that psychology itself dedicates much of its time to the immense variety of ways in which mind shapes the world we perceive and respond to. In this way both philosophy and psychology have the potential to create problems for the Fichtean approach to empirical evidence, because empirical-facts first knowledge progression is framed as a cumulative progression of old evidence on top of new, to which theories and mind must constantly adjust. There is little room here for the impact of context on mind on evidence, which Burman's OM centres.

Neo-Kantian philosopher John McDowell aptly named the seeming bind brought on by the unsatisfactory consequences of rationalism and empiricism *The Anxiety* (McDowell, 2021). According to McDowell, the core issue is that both camps rest on the assumption that they have direct access to the world as it truly is (one empirically and the other logically). This assumption was famously characterised by another neo-Kantian, Wilfrid Sellars, as the M*yth of the Given*. This myth and the surrounding discourse provides nuanced language with which to discuss Burman's struggle against essentialism in the history of knowledge. Treating theory and evidence separately, just as focusing mind at the expense of world (or vice versa), rest on their own versions of essentialism; the possibility of unmediated access to nature (ie. nature's essential qualities).

In McDowell's words, to treat only mind or theory does not lead to a defensible notion of knowledge—or its progression—because it does not draw sufficient influence from the world itself, and becomes a sort of "spinning in the [psychological or theoretical] void" (McDowell, 1996, p. 11). On the other hand, to speak only of world or evidence in the progression of knowledge, is to make the mistake of privileging world at the expense of mind. This amounts to a game of pretend that ignores the different qualities of judgement of the individual, in more relevant terms; the psychological variable of perception and the varying forms of context that have historically influenced knowledge genesis.

This bind, which Kant famously encountered between rationalism and empiricism, and McDowell later expanded on, is just the bind that the Fichtean account of knowledge genesis in history of knowledge glosses over. To see knowledge as a progression of theory, disconnecting it from evidence, faces the same long-standing problems as rationalism, while a focus on evidence, disconnecting knowledge from its theory-ladenness, faces the same issues as hard empiricism. In short, the thesis-antithesis-synthesis model that assumes

theories or empirical facts can be combined in isolation in order to create new knowledge is incoherent, in part because it ignores the anxiety layed out by the neo-Kantian tradition, and its firm rejection of the myth of the given. How then does the OM circumvent this philosophical bind? In the initial stages of this analysis, I felt sure that Kant must have the answer.

Kant also sought to overcome the bind of what is now referred to as the anxiety, and in the process altered philosophy in a way that still deeply characterises the discipline today. His transcendental idealism (exemplified in the 1781 *Critique of Pure Reason)* takes the opposing stances of rationalism and empiricism, and consolidates them. It does this not by amending and synthesising their remnants, but by rejecting a premise common to both, and therefore removing their incompatibility. The rejected thesis is that we can have unmediated mind world interaction at all. In other words, what is now known as the myth of the given. His new theory granted that we do indeed attain knowledge via sense perception, but that this understanding is mediated by universal, mental categories and intuitions from the very beginning. *This* necessarily constitutes the underlying epistemological nature of all philosophical (and scientific) inquiry, therefore studying these categories would constitute the only first philosophy, and the closest one might come to pure knowledge of the world's constants. This means that with no direct access to the world as such, even empirical discoveries that seem to reveal universal natural laws are in truth revealing the universal mental categories that organise human perception.

In this way Kant maintained that empiricists were correct about having to look outward in order to understand the world, while rationalists were also correct about the existence and importance of mind dependent organising principles in this empirical process. With this, he is also thought to have introduced (to the western canon) the hard separation between the world

out there (noumena), and the world we are able to observe (phenomena). Granting this separation, Kant's epistemology still aims at meaningful interaction with the world. In his attempt to structure this interaction, he tried to deduce organising categories and intuitions that our mind must have so as to explain the logic of reality as we experience it. He proposed categories such as cause and effect, and intuitions such as space and time. With this Kant framed mediation as a necessary and unavoidable part of understanding and perception (to use more contemporary language). This shift allowed for a new narrative around knowledge production, an epistemological landscape that necessarily entangles mind and world, theory and evidence, in the production of knowledge. The positive necessity of this mediation was described rather poetically by psychologist William James, who famously remarked that a baby, who presumably has not fully developed any systematic principles to organise its perception,"assailed by eyes, ears, nose, skin, and entrails at once, feels it all as one great blooming, buzzing confusion" (1890/1981, p. 488).

This minor excursion into philosophy illustrates how Kantian scholars can illuminate problems in the Fichtean model and how theory and evidence seem fundamentally entangled in knowledge creation. However, I soon noticed that a glaring problem remained: Burman's OM aims to capture, not just knowledge creation, but also its situatedness in broader forms of context, *and* its historical progression. Kant held onto ideal forms of knowledge towards which we are progressing via the honing of universal forms of understanding. In psychological terms this may look like universal or at least hierarchical forms of perception. However, universality of this sort has been consistently historically thwarted by new research, while the latter often myopically places WEIRD ways of knowing at the top of this

hierarchy[8]. And more to the point, notions of universality clash with the non-essentialism of Burman's OM, which rest on methods that are sensitive to ways of knowing as changing through time. The OM must then also necessarily be made more complex, if it is to remain non-enssentialist *and* Kantian at once then mind dependent means of experiencing the world must be examined, at least in part as malleable, contextually sensitive entities.

Neo-Kantians and the Orthogonal Move

Throughout the time when Kant's categories themselves aligned with current knowledge, his universal categorical forms of understanding remained a rather elegant solution to the empiricist versus rationalist dilemma, and in terms of this paper, they provided a useful starting point for the relationship between theory and empirical evidence. But they soon hit their limits. As knowledge progressed, in particular with the introduction of non-euclidian geometry, philosophers following in Kant's footsteps also began to see the cracks in their epistemology. The development of spherical and hyperbolic geometry posed a challenge to Euclidian geometry as one of Kant's universal organising principle of the world. Instead of abandoning his ideas entirely, Kantian scholars chose to adjust the original theory. They posited contextual categories and ways of knowing. These *neo*-Kantian categories maintained their location in mind-world interaction, but were themselves no longer fixed in time and space—they evolved.

Michael Friedman is one neo-Kantian scholar who developed Kant's ideas into something which not only gives insight into knowledge genesis in the moment, but also its development and evolution through time. One of his books, D*ynamics of Reason* (2001), focuses specifically on historical knowledge progression in the sciences, namely through a

---

[8] See for example the Müller-Lyer Illusion in Smail, D. L. (2014). Neurohistory in Action: Hoarding and the Human Past. *Isis; an International Review Devoted to the History of Science and Its Cultural Influences*, 105(1), 110–22.

philosophical reconstruction of Kuhn's *Structure*. This version of Kantianism seemed a promising lead in advancing the OM, because it combined the clarity of necessary separation between noumena and phenomena, and the resulting entanglement of theory and evidence in our exploration of phenomena with malleable categories. As these categories change through history they could continue to facilitate and re-facilitate knowledge progression. Building on Friedman, this section explores Kuhn as a neo-Kantian who, like Burman, attempted to characterise the interaction between mind and world (theory and evidence), as progressive, yet shaped by psychological and historical context.

This is not only a continual exploration of the OM, but also an application on two fronts. One, because Kuhn also considered himself a neo-Kantian, meaning that a reading of *Structure* in accordance with this expands understanding by highlighting a less well known aspect of its context. This influence is revealed for example in a 1995 interview with Baltas, Gavroglu, and Kindi, where Kuhn explicitly called himself "a Kantian with movable categories" (2000, p. 264). In other words, a neo-Kantian. In the same interview he also describes taking his first and last philosophy class in more detail: his interest in philosophy was (momentarily) interrupted by the second world war's need of physicists, but the single class he did take, left him fascinated—in particular by Kant's synthetic a priori. In Kuhn's own words "Kant was a revelation." (p. 264). Two, to understand Burman's OM and its non-essentialism through Kuhnian scholarship also reflects Burman's interest in Kuhn's ideas regarding knowledge progression[9].

---

[9] See Burman, J. T. (2020). On kuhn's case, and piaget's: a critical two-sited hauntology (or, on impact without reference). *History of the Human Sciences*, 33(3-4), 129–159. https://doi.org/10.1177/0952695120911576
See also Burman, J. T. (2007). Piaget no `remedy' for kuhn, but the two should be read together: comment on tsou's `piaget vs. kuhn on scientific progress'. *Theory & Psychology*, 17(5), 721–732. https://doi.org/10.1177/0959354307079306

Friedman's reading seems to clarify common points of contention, often raised in class discussions and formal criticism of Kuhn and also non-essentialist approaches to knowledge more generally. He did this in innovative ways that felt new, yet which also seemed to be in alignment with Kuhn's own responses, especially in regards to three major themes: truth, his mixed responses to accusations of relativism, and his non-linear approach to knowledge progression. Truth is a tricky and long debated concept in philosophy, with numerous schools committed to different interpretations. Kuhn also struggled with the concept in his own ways, which are evident in his 1970 Postscript to *Structure*, in passages such as this one*:*

> A scientific theory is usually felt to be better than its predecessor not only in the sense that it is a better instrument for discovering and solving puzzles, but also because it is somehow a better representation of what nature is really like... generalisations like that refer... to its ontology, to the match, that is between the entities with which the theory populates nature and what is "really there." Perhaps there is some other way of salvaging the notion of 'truth' for application to whole theories, but this one will not do. There is, I think, no theory independent way to reconstruct phrases like "really there"; the notion of a match between the ontology of a theory and its "real" counterpart in nature now seems to me illusive in principle. (1962/2012, p. 205)

What Kuhn is struggling against here is also known as the correspondence theory of truth. This theory holds that a belief is true in so far as it can be said to correspond to an entity in the world itself. Kant, Kuhn, and Burman's approaches to 'truth,' as removed from a directly accessible counterpart in nature, naturally clash with such notions.

Where do approaches that reject the myth of the given and deny the correspondence theory of truth find their grip on the "real" world then? Kant agrees with empiricism in that knowledge is attained though sense perception, which in a universally, categorically,

mediated way does interact with the world itself. Kuhn carries this commitment forward and holds that scientific knowledge is produced in part through non-arbitrary perception and categories, which are relative only in the sense that they change in ways which are responsive to context. But is this enough in order for Kuhn to effectively dispense with the strong forms of relativism he has often been associated with, and that would also plague the OM? Again, our neo-Kantian lens can be of use here.

As noted above by Baltas, Gavroglu, and Kindi, "Kuhn believed in the special position of science, and in this respect, declared himself decidedly *not* a relativist" (2000, p. 307). Yet, Kuhn also wrote "Conversely, if [my] position be relativism, I cannot see that the relativist loses anything needed to account for the nature and development of the sciences" (1962/2012, p. 205). Such remarks become less contradictory after Friedman's neo-Kantian intervention. Just as Kant's epistemology moves orthogonally to empiricism and rationalism by rejecting unmediated knowledge, so does Kuhn in modern terms reject the myth of the given while maintaining many of the concerns central to logical empiricism and relativism. His relativism, if it be that, is not a rejection of meaningful and describable mind and world interaction, but a placing of knowledges in their proper relation to the two. This at least, was my was my first enthusiastic reading; I saw Kuhn and the OM as best supported by a neo-Kantian epistemology akin to Friedman's reading of Kuhn. However, the enthusiasm did not last—again, there was a problem.

Many social constructivists deny the existence of scientific progress altogether, while a group known as the logical positivists see it as a linear progression following from the rigorous application of logic to empirical enquiry. Kant on the other hand secures progress by allowing knowledge to move towards his ideal categorical forms, and Friedman in turn towards ideal scientific knowledge communities. This is a crucial point because Kuhn, who

held fast to scientific progress, but saw knowledge progression neither as linear nor as moving *towards* hypothesised ideal forms of understanding, could use none of these explanations. He, like Burman, is expressly interested in the progression of knowledge *from*, not the progression of knowledge *towards*[10]. This is where the canonically neo-Kantian interpretation of both begins to meet its own limits.

In summary, the basic noumena-phenomena split serves us well in interpreting Kuhn and Burman's work. More specifically, separating approaches to the space of interpretation organised by reason/logic, principles that guide much of analytic philosophy, and are capable of linear progression towards truth; from approaches to the space of perception, organised by family relations, which guide the empirical enquiry seen as so central to the sciences. Lastly, this places a focus on Kuhn's life-long attempts to place mind and world into a coherent and fruitful relationship to each other, and to the space of nature itself—whether in terms of perception and interpretation or evidence and theory. However, as we move further away from the known context of *Structure* itself and lean into the details of Friedman's analysis, his neo-Kantian lens begins to obscure more than it illuminates. The next section follows and builds on a 2016 paper by Thodoris Dimitrakos. His piece critically details a fundamental interpretative breakdown and—in terms of this paper—the place where a Kuhnian OM must differentiate itself from its classically neo-Kantian themes, if it is to achieve the counter narrative that Burman seems to aim at: a narrative that can allow for meaningful knowledge progression through a coherent relationship between theory, evidence, and world.

Where Friedman's Kuhn Meets His Limits

---

[10] See Burman, J. T. (2007). Piaget no `remedy' for kuhn, but the two should be read together : comment on tsou's `piaget vs. kuhn on scientific progress'. *Theory & Psychology*, 17(5), 721–732. https://doi.org/10.1177/0959354307079306

As is the case for so many scholars who have sought to amend or criticise Kuhn's work, a point of focus for Friedman is Kuhn's approach to truth and the meaningful progression of scientific knowledge through history, and how these might be disabused of their relativism. Friedman's particular remedy first evokes transcendental ideals and then turns philosophy into a meta-paradigm of unassailable rationality. Upon closer examination, both seem to create more problems than they solve. This is because one aspect of Kuhn's scientific progress that remains consistent through many amendments over the years is that it is a progress *from,* not a progress *towards*. This is also reflected in the analogies between paradigm change and species evolution, which result in a sort of theory fitness (see Kuhn, 1962/2012, p. 194).

Contrary to this, Friedman's transcendental idealism justifies progress and frames truth in science in terms of a movement *towards* an "ideal state of maximally comprehensive communicative rationality in which all participants in the ideal community of inquiry agree on a common set of truly universal, trans-historical constitutive principles" (Friedman 2001, p. 67). This has a clear Hegelian flavour, intimating, if not an end, at least an ideal result to the history of scientific progress. If incorporating this application of transcendental idealism into our analysis of Kuhn is the necessary cost of using the neo-Kantian label, then that cost is too high. While it maintains the important distinction between noumena and phenomena, it also predicates the existence of an ideal form of scientific knowledge communities, removed from all historical context. This makes it equally unfitting for Burman's OM, which methodologically rests (at least in part) on meaning making through situating concepts in their historical context.

Friedman's next worrying move is to use philosophy as a meta-paradigm to ensure the rational progression of knowledge towards this ideal. Using Quinean language, he states that

different realms of knowledge do not all face the tribunal of experience in the same way. In this respect Friedman does initially seem to follow Kuhn. He maintains philosophy and science as different ways of knowing, but his analysis steps fundamentally outside of Kuhn's theory as he tries to tease apart the different ways in which aspects of scientific and philosophical knowledge face the tribunal of experience, going so far as to claim that one form of knowledge justifies the other. Specifically Friedman posits philosophy as capable of a trans-paradigmatic rationality that assures a coherent notion of progress. Friedman explains his position as follows:

> In accordance with our threefold perspective on inter-paradigm convergence we can now say the following: first, that the new conceptual framework or paradigm should contain the previous constitutive framework as an approximate limiting case, holding in precisely defined special conditions; second, that the new constitutive principles should also evolve continuously out of the old constitutive principles, by a series of natural transformations; and third, that this process of continuous conceptual transformation should be motivated and sustained by an appropriate new philosophical meta-framework, which, in particular, interacts productively with both older philosophical meta-frameworks and new developments taking place in the sciences themselves. This new philosophical meta-framework thereby helps to define what we mean, at this point, by a natural, reasonable, or responsible conceptual transformation. (2001, p. 66)

In short: scientific development must be described in terms of the empirical laws and constitutive principles which make up paradigms, *and* the action of philosophical meta-paradigms. Where this conceptualisation goes awry is in claiming philosophy as a rational language that transcends scientific paradigms. This becomes a philosophy-first position, and

it reduces the radical and interesting aspects of incommensurability so much so as to render it nearly inconsequential. It is the latter which Dimitrakos (2016) reveals so neatly.

Dimitrakos holds that Friedman's analysis—even if only meant as a philosophical reconstruction—shrinks incommensurability into a phenomena within science, which requires only a wise philosopher or theoretician to step in. Incommensurability is effectively reduced to a momentary myopathy, and philosophy, as Vasso Kindi noted, is elevated to a realm of *ipso facto* rationality (Kindi, 2011, p. 342). This status is difficult to coherently incorporate into Kuhn's work. One of the radical aspects of Kuhn is his blurring between the context of discovery and the context of justification. He considered ontological and epistemological commitments—in other words, philosophical knowledge—as part and parcel of scientific research. What Friedman makes external to scientific knowledge, Kuhn famously made internal to its production.

Just as Burman's OM proposes that theory and evidence are fundamentally entangled, so are philosophical assumptions about what there is, what there can be, and how we can know about it, structurally a part of Kuhn's scientific inquiry. Despite the disciplinary lines we now draw, philosophy is a part of science, and the one central distinction that I myself have made in my reading of *Structure* is not so much between philosophy and science broadly speaking, but between perception and interpretation. These should ideally be studied in different contexts according to their genesis and use. Perception being acquired tacitly and more integral to the empirical scientific methods, and interpretation being acquired explicitly, and more integral to classical philosophical methods. However, even this is no hard line, and the complex interaction between these two ways of knowing occupied Kuhn for most of his professional life.

It seems Friedman's canonical neo-Kantain approach to truth and knowledge progression smuggles in a few too many troubling epistemological assumptions to serve as a satisfying lens for Kuhn and Burman's picture of knowledge progression. It was at this stage in my analysis that I wrote an entire second thesis which attempted instead to make use of the Pittsburgh School neo-Kantians, but this in turn required me to surrender the empirical and psychological aspects of Kuhn's work that struck me as too central. I was looking for an approach to the interaction between, and evolution of, theory and evidence that believed in its own method, meaning that it was also in itself a conscious fusion of philosophy and science. In the process I nearly dropped the neo-Kantian label altogether. First, however, I decided to take one last look back at a line in Friedman's book that I found I had highlighted in every copy, version, and analysis that of the book I'd read over the years. Before things go awry in the paragraph quoted above, Friedman strikingly describes paradigms as containing constitutive frame works that should "evolve continuously out of the old constitutive principles, by a series of natural transformations" (Friedman 2001, p. 66).

Natural is a contentious term (an issue which turned into yet another paper of its own), but it is generally assigned to the realm of the empirical sciences. And so after feeling I had reached the limits of strictly philosophical Kantian interpretations, I leaned into these more empirical, "natural" influences. Accordingly, the next section turns to Jean Piaget, a developmental psychologist and a much less canonical neo-Kantian. His empirical epistemology attempts to capture knowledge progression via empirical *and* philosophical methods, and characterising it as a top down (theory acting on evidence) *and* bottom up process (evidence acting on theory).

Piaget was an important inspiration for Kuhn's most famous "series of natural transformations" (Friedman 2001, p. 66); the stages of scientific development and the

exemplars they contain (Galison, 2016). He also happens to be one of Burman's favourite tools to think with (see references and footnote[11] for examples), making him relevant for an informed understanding of both. I saw potential here for an approach to knowledge that was coherent with Kuhn's philosophical use of developmental psychology and evolutionary biology, and Burman's own fusion of empirical and theoretical. While Kuhn's categories are macro, historical paradigms, the contents of which make up scientific knowledge and practices, Piaget's are the micro developmentally contingent categories that structure the individual's space of conceptual possibility. Piaget and Kuhn in their own ways try to make sense of the split between the accessible phenomena and the impenetrable noumena that perception is catalysed by, and science then aims to describe (and organise). Equally, Burman's OM must find a feasible way for theory to act on evidence, and vice versa, that touches the world itslef, so that the resulting knowledge can avoid the same accusations plaguing Kuhn: arbitrary theory change.

Piaget's Genetic Epistemology

First, tracing the thread from Kant to Piaget to Kuhn. In the English speaking world, the Swiss researcher Jean Piaget is primarily associated with his early stage theory of childhood development. According to Burman, however, Piaget's years of research with children are best understood as part of an effort towards an empirical epistemology, one with a definite Kantian tone (Burman, 2021). The Kantian nature of Piaget's approach is evident in the categorical forms of understanding he explored, and in the way he conceptually understood

---

[11] Müller, U., Burman, J. T., & Hutchison, S. M. (2013). The developmental psychology of jean piaget: a quinquagenary retrospective. *Journal of Applied Developmental Psychology*, 34(1); Burman, J. T. (2022). Meaning-change through the mistaken mirror: on the indeterminacy of "wundt" and "piaget" in translation. *Review of General Psychology*, 26(1); Burman, J. T. (2012). Jean piaget: images of a life and his factory. *History of Psychology*, 15(3), 283–288. https://doi.org/10.1037/a0025930

them. His books explicitly centre around Kantian categories and intuitions, such as modalities (space and time) and relations (cause and effect). Such books include *The Child's Conception of Space* (1948/1967) and *The Construction of Reality in the Child* (1937/1971), which explore modalities via the development of spacial and temporal understanding in children. While *The Psychology of the Child (1966/1969),* a collaboration with psychologist Bärbel Inhelder, also uses relations as an experimental variable to explore childrens' understanding of cause and effect.

These Kantian themes also come through in Piaget's focus on logic and mathematics. Notably in the collaboration with Dutch philosopher of mathematics Evert Beth *Mathematical Epistemology and Psychology* (1961/1966), a volume of the *Études d'Épistémologie Génétique* series. In this particular volume Piaget elaborates on how studying the development of logico-mathematical entities in children via psychological means can contribute to the study of knowledge acquisition generally, both practically and philosophically. He thought that it may even answer the age old question—are numbers innate categories of understanding, or social constructs? These are only a few examples of thematic ties to Kant, and for a more exhaustive list of related books see table 1 in the appendix[12].

Now, from Piaget to Kuhn. While there are other empirical references in *Structure*, for example those to Gestalt switches and Bruner and Postman's playing card experiment, neither seem to have added great foundational theoretical insight—often yielding more

---

[12] This list of titles is sourced from the lecture slides of a talk given at York University's Department of Psychology: Burman, J. (2011, June 2). *Epistemic categories are* necessary, but not innate: Piaget's response to Kant, 1925 [PowerPoint].

inconsistencies than parallels[13]. Their less than constitutive quality is likely a result of the fact that they were added rather late in the writing process, and serve largely as simplified analogies. Piaget's work on the other hand is a part of the book's very foundation, increasing its exegetical potential. The connection has in part gone unnoticed because it was only later confirmed by historians like Peter Galison, whose reading of Kuhn's personal notebooks illustrate the connection between *Structure* and Piaget.

According to Kuhn's private notebooks, Piaget's stage theory of childhood development informed the first attempts at Kuhn's own stages of scientific development. The psychologist's research on the development of children facilitated Kuhn's modern take on Kant, whereby the physical real world of noumena is separated from the psychological real world of the phenomena, which we experience via mind dependent, developmentally-acquired categories (see Galison, 2016). This is why Kuhn's stance on scientific progress, in *Structure,* can be understood in a more complete sense only by re-introducing aspects of Kant and Piaget in tandem. To move orthogonally here means to recognise Kuhn is an atypical Kantian twice over: first through his own partial reading of *The Critique of Pure Reason* (Galison, 2016, *p.50)* and second through his exposure to Piaget's psychological take on Kant's categories and intuitions.

It is useful to recall that Harvard in the 1950s, not Kant, but logical positivism loomed large, as did their ideas about the logical, linear progression of scientific knowledge. Kuhn famously began to struggle with this picture while teaching history of science courses during this time. After encountering Piaget's work, Kuhn saw how a psychological framework of

---

[13] For commentary on the playing card experiments see Horner, J. M., & Tung, S. K. (2011). Playing Cards with Thomas Kuhn: a Critical Reexamination of the Bruner and Postman (1949) Experiment. *Review of General Psychology*, 15(2), 175–185. https://doi.org/10.1037/a0023597.
For limits of the gestalt switch analogy see Kuhn himself (1962/2012, p. 96, 116-117).

mind dependent forms of understanding could make more sense of the historical transformations of meaning that he observed than any of the strictly logical approaches of his contemporary. He felt so fundamentally unable to relate to the physics of the past, that he began to entertain the idea that perhaps perception itself changes during the progression of scientific knowledge. If this was true, then beyond honing in on a logical, linear progression of interpretive tools, understanding knowledge progression would require empirical investigation of perception and the cognitive categories. Kuhn was left fascinated with the necessary relationship between psychology and the historical development of scientific knowledge. A hand-written note on the script for Kuhn's 1951 Lowell Lectures reads:

> It is because of parallels like this, parallels susceptible of a far more detailed development, that I suggest we equate the notion of scientific orientation with that of a behavioral world. And it is in part the psychological necessity of some behavioral world as a mediator and organize[r] of the totality of perceptual stimuli that I suggest we will never be able to eliminate from the scientific process orientations which originate in experience but which subsequently transcend it and legislate for it. (Galison, 2016, p. 62)

Kuhn first became convinced by the parallels between and Piaget's stages of early life development for speed and movement and the development of knowledge orientations in any stage of life. Eventually he expanded these parallels to the history of scientific knowledge itself. Galison (2016) aptly summarises this initial fusion between Kuhn, Kant, and Piaget, in part by using quotes from Kuhn's personal notebooks:

> There is the 'physically visible world' consisting of what we can see with our available sensory & technical equipment. This phys[ical] v[isible] w[orld] is the pure raw flux, unorganized." We structure this flux by creating gestalts or

> conceptualizations to which we assign symbols and phrases that constitute our "psychologically visible world that 'may contain all or part'" of the physical visible world. Kuhn's layered account starts with the raw input of experience, but only when this input is structured psychologically does it begin to count as objects and their relations: "To 'see' a tree or a velocity difference is to 'see' something in the psych[ological] v[isible] w[world] which is in turn a creation from the phys[ical] real world. (p. 52)

If mind and theory shape evidence, where does new information about the world enter? In Kantian term, how do we avoid the anxiety (ie. neither mind nor world being sufficient in and of themselves to create meaningful knowledge)? In psychological terms how do the family relations that make up our perceptual worlds progress? The answer according to Kuhn, seems to fall on perception. Galison writes, again, in part using Kahn's own words: "physical science, social science, and Piagetian child psychology all exhibit moments of 'formal contradiction'" (2016, p.53). These are moments of contradictions between the perceived psychological world as per the child's current stage and the child's manipulations of the world itself. It is here where new information about the world slowly enters and is able to facilitate the expansion of knowledge. According to Kuhn's reading of Piaget it is these contradictions that trigger the re-orientation which then leads to the next formal developmental stage. In this reading are also the beginnings of Kuhn's crisis, revolution, and return to normal science—all happening in part within the realm of tacitly acquired, family relations.

The use of controversial terms such as 'revolutions' and 'leaps of faith' also makes more sense in a psychological context, because the totality of psychological orientation (or perceptual experience) naturally makes their reconfiguration a destabilising experience. If

theories not only describe but also partially create the psychological worlds we live in, then adoption of a new theory (and its constitutive family relations) co-creates a new world. Equally this totality *necessitates* a perceptual rupture or revolution in order to develop, and progress at all. And this progression requires a real leap of faith, into a world which we physically cannot yet see. A leap of faith then ceases to be a pejorative description of science or an attack on the validity of scientific knowledge. Instead Kuhn simply seems sensitive to the psychological fact of how people experience major categorical re-orientation of the family relations that constitute their perceptual world—a process that cannot be separated from scientific progress. Though not as objective or logical as some may like, it is this very process of using the senses in order to observe the world and experiment on it that allows science to be responsive to the the noumenal world. Even if tacitly, this is where new information enters.

This perceptually facilitated process of empirical investigation that is so central to the sciences also maps neatly onto Piaget's observations of child play. Both involve the physical manipulation of the world, in accordance with—as Kuhn (1962/1970) put it—a matrix of categorical descriptions of said world. These matrixes perceptually, and in part conceptually, organise the world they see. Think, for example, of Piaget's popular water conservation task; this experiment illustrates how children at certain developmental stages perceive water that has been poured into differently shaped containers as having lost or gained volume in accordance with the height of the container. Later the children learn that the water has simply changed shape in accordance with the volume of its container. Or take the learned practice of inspecting x-ray images; initially such images mean very little, but eventually professionals learn to perceive complex medical issues in them. In both cases we can assume that the stimuli themselves did not change, and yet, the individuals' perceptual worlds and

understanding of them did: the perceived object meant something different, even though the object did not change. Neither Burman nor Kuhn, however, are physical historians; they generally concerned themselves with the concepts directly. Can such the progression of such analyses still be meaningfully anchored in experience, in the world itself?

It seem that in accordance with changing demands, and increasing cognitive capacity to abstract and mentally manipulate the psychological world, Piaget's children and scientific disciplines both progress from their previous understanding of the physical world. Both in the development of children and science, the process begins to lose some of its physicality and rely less and less on the tactile aspects of perception. In this way knowledge, whether it be that of children or historians (or biologists for that matter) is necessarily relative, because it happens in relation to the perceptual groupings and interpretative logic through which it is produced. And especial these perceptual groups are shaped by the demands of the world as they are perceptually understood at that historical and physical moment in time. This means that progress, also, is relative to the previous arrangement of groupings from which the current one initially re-oriented itself. There can be no cumulative piling of unmediated, context-free facts, not in history or otherwise. As Kuhn remarks in the postscript (1962/2012), the underlying assumptions do not remain stable, and therefore give us no ground for linear comparison or stable piles of facts.

Piaget's work indicates that our continual empirical investigation and manipulation of the world, shapes our perceptual groupings, and allows meaningful knowledge. Even if we do not have full conscious control over how this occurs. And as Kuhn adds, evolution would hardly favour perceptual and interpretative structures that lead to ineffective interaction with the world[14] (though, what is considered effective, of course changes through history). Note

[14] See Kuhn, 2012, p. 205

that there is *not* only one world, one purpose one problem, and so in terms of both Kuhn and Burman's orthogonal move; there need not be one true lineage of knowledge progression, for knowledge to meaningfully progress. Different scientific disciplines, in different countries, and at different moment in time have all developed within their own intellectual, physical, and temporal niche, responding to problems relevant to that particular niche. Equally, the incommensurability between the resulting theories that disallows their direct Fichtean clash does not have to indicate any troubling relativism. What it does seem to indicate is a sort of epistemic contextualism, due simply to the unavoidable fact that even scientific knowledge operates in the realm of phenomena**.** While I find this an extremely functional version of relativism (or epistemic contextualism) that innovatively connects noumena and phenomena, Kuhn and Piaget both ride an uneasy line between the empirical and the philosophical, and this is not without its critics—Burman may well need to be weary of the same.

A Nod to the Critics

The philosophical community is often keen to dismiss approaches that blend philosophy and science as reductive naturalism[15], while the scientific community ignores much of Piaget's philosophical efforts. Note also Masterman's treatment of Kuhn, who once framed him as a lost social scientist that perhaps ought to leave philosophy *proper* alone. She reads the paradigm as a sociological notion, which "philosophically speaking… is an artefact which can be used as a puzzle-solving device; not a metaphysical world-view" (1970, p. 59). There is of course more to philosophy than metaphysics, as our excursion into Kantian philosophy has illustrated, epistemologists are perfectly capable of operating without firm

---

[15] See Keil, G. (2008). Naturalism. In *The Routledge Companion to Twentieth Century Philosophy* (Ser. Routledge philosophy companions). Routledge.

commitments on the structure of the universe itself. In other words, on this account at least, Kuhn may remain a philosopher, even if not a metaphysicist.

Alternatively, there is Chalmers' 2013 book in which he advises Kuhn in the following manner:

> If our concern is the nature of science and the sense in which science can be said to progress, as Kuhn's seems to be, then my suggestion is that all the talk of gestalt switches and religious conversions be removed from Kuhn's account and that we stick to an objective characterisation of paradigms and the relationship between them. (p. 119)

The common consensus between these critics and many philosophers (see footnote 15): keep the empirical and the philosophical separate.

Psychology in particular, is not always welcome in philosophy[16]. When taken seriously, Kuhn's use of psychological examples have often been dismissed as psychologism[17], and when read as a philosopher, Piaget faced similar accusations. This is perhaps understandable; take for example a 1953 paper called *How Children Form Mathematical Concepts*, where he likens logic to cognitive knowledge generating structures. This might be misinterpreted as reducing one to the other (as a psychologism or vice versa). However, even in this brief article Piaget is careful and sober about positive *and* negative aspects of his analogy. In other words, he seems fully cogent of the limits of an analogy between arithmetic and the changing, categorical ways in which children generate knowledge. He neither equates logical

---

[16] For an overview of the issue see the following: Kusch, Martin, "Psychologism", The Stanford Encyclopedia of Philosophy (Spring 2020 Edition), Edward N. Zalta (ed.), URL = <https://plato.stanford.edu/archives/spr2020/entries/psychologism/>.

[17] The term psychologism is here used in the pejorative sense, meaning to mistakenly identify non-psychological entities with psychological ones.

structures with the organisation of the mind, nor the organisation of the mind with logical structures. Logicians must not fear that their work be passed on to their colleagues in psychology, and I believe that accusations of social relativism, psychologism, and naturalism miss the mark and distract form what is uniquely interesting about Piaget and Kuhn. This is also well-captured in a 2007 article by Burman:

> [Piaget] might be more appropriately understood as a 'meta-epistemologist' (Kitchener, 1986, p. 143): an empirically informed 'philosopher of knowledge' (see e.g., Youniss, 1980, p. xii), where 'knowledge' is defined more generally as an extension of the natural organizational processes of organisms (Piaget, 1967/1971a, 1974/1980a, 1976/1979) and 'empirically informed philosophy' is defined at least in part by the attempt to interpret sets of experimentally derived 'facts' and synthesize coherent discipline-spanning narratives (Piaget, 1965/1971d, 1970/1973b). (p. 722)

When appreciated more fully, and outside of strict disciplinary boundaries, the parallels between their work become much more clear, and an uncanny interest in knowledge as the product of natural transformation and extension emerges.

Conclusion: Situated Knowing

To conclude this paper's application of the OM; on an explanatory level Piaget makes up for Kuhn's lack of detailed empirical rigour, while Kuhn makes up for Piaget's lack of scope and perhaps also readability[18]. And as far as attempts at truth, or exegetical accounts go; we will never know what Kuhn himself truly thought while writing *Structure*. Not even in speaking to others can we truly know how they know, as beings situated in their particular

---

[18] Piaget's lack of scope, and little explicit treatment of broader social variables in knowledge genesis is partially remedied in the following publication: Piaget, J., & García Rolando V. (1982). *Psychogenesis and the history of science*. Columbia University Press.

interpretative and perceptual world. Scientists do their best as they interact with the world and others to create psychological worlds that functionally overlap and solve the particular problems at hand in their discipline. We must accept incommensurably, but as Kuhn noted, this does not mean untranslatability—It means becoming bilingual, trusting skilled translators, and accepting that there is always meaning loss between worlds or meaning shifts across time.

For Burman and other historians it also means that to read Kuhn with Piaget and Kant in mind, is one way to 'climb into his head' (Baltas, Gavroglu, & Kindi 2000, p. 280), and situate ourselves as closely as we can. This expands knowledge and situates Kuhn more deeply in the context of his influences, and achieves insight through simultaneously reconsidering evidence in terms of new theory and theory in terms of new evidence. In doing this we move orthogonally to popular discourse, which has a tendency to interpret Kuhn either as logical positivist or social constructivist[19]. More broadly speaking we surrender the premise that relative knowledge is arbitrary, instead it is contextual (not only in history). This leads us to why this lens also holds much potential as an exploration of the OM's underlying epistemological structure.

It is in *Structure* where philosophy, history, and the empirical (namely psychology), collide, and begin to sketch a compelling way to understand the progression of scientific knowledge as orthogonal, or continually re-situated in its own context. The approach strikes me as more philosophically viable, historically plausible, and supportable through psychological research than a Fichtean fusion between floating theory. This particular analysis also maintains science as progressive and contextual *both*, something which is too

---

[19] See The Edinburgh School and Gattei, S. (2016). *Thomas Kuhn's 'Linguistic Turn' and the Legacy of Logical Empiricism : Incommensurability, Rationality and the Search for Truth* (Ser. Ashgate new critical thinking in philosophy). Routledge.

often lost when Kuhn is characterised as an abashed logical positivist or an unwilling social constructivist. In the case of this paper, to move knowledge forward orthogonally is to situate; it is to acknowledge that calling Kuhn a Kantian is most useful in so far as we situate his Kantianism in its closest influences. And so while the canon, as it is known to philosophers like Friedman, certainly provides conceptual tools and clarifies the issues at hand, it also has its limits. This is not surprising to the historian who sees into context and finds that when Kuhn called himself a Kantian, he had quite different frameworks in mind than more classically trained philosophers. Instead, his Kantianism is made up of a presumably shallow reading of *Pure Reason*, a commitment to a noumena phenomna split, and movable categories that are best understood in empirical terms, namely developmental (Piagetian) and historical.

We are left with a sort of psychological neo-Kantianism. The addition of Piaget's empirical work yields an interesting non-canonical neo-Kantianism that maintains a contextualised, incommensurable, and yet progressive development of knowledge, that is made up of tacitly acquired family relations and cognitive tools. These directly interact with the shifting physical world, and therefore allow for adaptive knowledge progression. This lens now allows us to read Kuhn's scientific progress, and the categorical forms of organisation that facilitate it, as historically situated matrixes continually created, and re-created, via perception and interpretation. Through time, both processes act on one another—perception provides the content for interpretation and interpretation alters the structure of that content. This reading also brings Kuhn's Kantian categories and intuitions into the rest of the cognitive faculties that psychology now explores, which avoids the exegetical pitfalls of Friedman's approach (as per Dimitrakos), and unwanted philosophical tension (as per McDowell's *anxiety*). All the while this analysis also creates what might be dubbed a

developmental epistemology; a potentially fruitful collaboration between psychology and philosophy that builds on Kuhn's reading of Piaget.

Now let us leave the realm of Kuhn's understanding of scientific knowledge progression, and return more concretely to the OM. The process of chasing meaning, whether in *Structure*, or in conceptualising my own orthogonal move, felt like an endless task of shifting context and imperfect analogies. I cannot help but think of Ian Hacking's *Moving Targets*, a term he uses to describe notoriously ontologically tricky psychological disorders categories[20]. Far from being distressing, this only affirms my commitment to non-essentialism in historical knowledge, as well as all the other more classically empirical sciences. In the process of writing this paper I continually met the ends of my own conceptual tools. These tools broke down the further I attempted to move away from the context and towards the thing itself (ie. the terms Kuhn used to conceptualise knowledge progression in *Structure)*. The method, I believe, encountered the limits of the very non-essentialism, contextualism, and situated approach to truth that its multiple iterations posit.

In short, there are many ways to interpret the phenomena around us, many tools we might use to approximate the noumenal world itself. However, because we cannot truly know the noumena, there are in a psychologically real way, *many* possible worlds. Such worlds might be revealed through history of science as much as through psychology, and their progression is more than a Fichtean collision of theories, spinning in a conceptual voids or a pilling up of insular empirical evidence. The OM takes a note from Kuhn's struggle against the social constructivist label and, enriched by naturalistic neo-Kantian themes, emerges as a strong alternative to the Fichtean model.

---

[20] Hacking, I. (1998). *Mad Travelers: Reflections on the Reality of Transient Mental Illnesses* (Ser. Page-barbour lectures, 1997). University Press of Virginia.

The OM properly acknowledges the entangled nature of theory and evidence, mind and world, in this thing we call knowledge. It is a non-essentialist approach to science that through developmentally and evolutionarily acquired ways of knowing is nevertheless deeply anchored in evidence. We may take knowledge as a natural extension of human faculties, which develop and evolve in response to their environment. In this way it avoids many of the common pitfalls of models that separate the creation and progression of theory from that of evidence. In other words, the boundary between Colbert's "not-news" and Fox News must not be purely maintained by a social code of integrity or honourable conduct, and going forward, my hope for the OM as a way of generating knowledge is that it contributes to more coherent pluralistic accounts of scientific knowledge(s) and their meaningful progress. While my hope for it as a discursive practice is that it might aid more cooperative academic discourse. It is perhaps true that the less-combative OM, which focuses on understanding first, is more complicated and more time consuming, but I also see it as a more worthwhile social practice: it requires an earnest attempt to step into another context, speak another language, or perhaps something akin to a gestalt switch.

References

Beth, E. & Piaget, J. (1966). *Mathematical Epistemology and Psychology.* (W. Mays, Trans.). Springer. (Original work published 1961)

Baltas, A., Gavroglu, K., & Kindi, V. (2000). A discussion with Thomas Kuhn. In J. Conant & J. Haugeland (Eds.), *Thomas Kuhn: The Road Since Structure* (pp. 255-323). Chicago: University of Chicago Press. (Original work published 1997.)

Brewer, W., & Lambert, B. (2001). The Theory-Ladenness of Observation and the Theory-Ladenness of the Rest of the Scientific Process. *Philosophy of Science, 68*(S3), S176-S186. doi:10.1086/392907

Burman, J. (2007). Piaget no `remedy' for kuhn, but the two should be read together. *Theory & Psychology*, 17(5), 721–732.

Burman, J. T. (2021). The Genetic Epistemology of Jean Piaget. In W. Pickren, P. Hegarty, C. Logan, W. Long, P. Pettikainen, & A. Rutherford (Eds.), *Oxford Research Encyclopedia of the History of Modern Psychology.* Oxford University Press. https://doi.org/10.1093/acrefore/9780190236557.013.521

Chalmers, A. F. (2013). Science as knowledge derived from the facts of experience. In *What is this Thing Called Science?*. University of Queensland Press.

Dimitrakos, T. (2016) Kuhnianism and Neo-Kantianism: On Friedman's Account of Scientific Change. *International Studies in the Philosophy of Science*, 30:4, 361-382, DOI: 10.1080/02698595.2017.1331977

Driver-Linn, E. (2003). Where is psychology going? Structural fault lines revealed by psychologists' use of Kuhn. American Psychologist, 58(4), 269-278. doi: 10.1037/0003-066X.58.4.269

Douglas, H. (2007). Rejecting the ideal of value-free science. In H. Kincaid, J. Dupré, & A. Wylie (eds.), *Value-Free Science? Ideals and Illusions*. Oxford University Press.

Eronen, M. I., & Bringmann, L. F. (2021). The Theory Crisis in Psychology: How to Move Forward. *Perspectives on Psychological Science*, *16*(4), 779–788. https://doi.org/10.1177/1745691620970586

Franklin, A. The Theory-Ladenness of Experiment. *J Gen Philos Sci* 46, 155–166 (2015). https://doi.org/10.1007/s10838-015-9285-9

Friedman, M. (2001). *Dynamics of Reason* (Ser. Stanford Kant lectures). CSLI Publications.

Galison, P. (2016) 'Practice All the Way Down', in R. J. Richards and L. Daston (eds) *Kuhn's Structure of Scientific Revolutions at Fifty: Reflections on a Science Classic*. Chicago, IL: University of Chicago Press, pp. 42–69.

James, W. (1981). *The Principles of Psychology.* Harvard University Press. (Original work published 1890)

Kant, I. (2008). *Critique of Pure Reason*. Penguin Classics. (Original work published 1781)

Kindi, V. 2011. "The Challenge of Scientific Revolutions: Van Fraassen's and Friedman's Responses." *International Studies in the Philosophy of Science* 25: 327–349.

Kordig, C.R. (1971). The Theory—Ladenness of Observation. In: The Justification of Scientific Change. Synthese Library, vol 36. Springer, Dordrecht. https://doi.org/10.1007/978-94-010-1734-3_1

Kuhn, T. (1970). *The Structure of Scientific Revolutions* (2nd ed.). The University of Chicago Press. (Original work published 1962).

Kuhn, T. (2012). *The Structure of Scientific Revolutions* (4th ed.). The University of Chicago Press. (Original work published 1962).

McDowell, J. (1996). *Mind and World: With a New Introduction by the Author.* Harvard University Press. https://doi-org.proxy-ub.rug.nl/10.4159/9780674417892 (Original work published 1994)

Nagel, T. (1986). *The View From Nowhere.* Oxford University Press, Inc..

Piaget, J. (1953). How Children Form Mathematical Concepts. *Scientific American, 189*(5), 74-79. https://www.jstor.org/stable/10.2307/24944400

Appendix

Table 1.

1927: *La causalité physique chez l'enfant*
1941: *Le développement des quantités chez l'enfant*
1941: *La genèse du nombre chez l'enfant*
1942: *Classes, relations et nombres*
1946: *Le développement de la notion de temps chez l'enfant*
1946: *Les notions de mouvement et de vitesse chez l'enfant*
1948: *La représentation de l'espace chez l'enfant*
1949: *Traité de logique*
1951: *La genèse de l'idée de hasard chez l'enfant*
1952: *Essai sur les transformations des opérations logiques*
1955: *De la logique de l'enfant à la logique de l'adolescent*
1957: *Logique et équilibre* (EEG2)
1957: *Les liaisons analytiques et synthétiques dans les comportements du sujet* (EEG4)
1958: *Logique et perception* (EEG6)
1959: *L'apprentissage des structures logique* (EEG9)
1959: *La logique des apprentissages* (EEG10)
1959: *La genèse des structures logiques élémentaires*
1960: *Problèmes de la construction du nombre* (EEG11)
1961: *Les mécanismes perceptifs*
1962: *Structures numériques élémentaires* (EEG13)
1962: *Implication, formalisation et logique naturelle (EEG16)*
1962: *Le développement des quantités physiques chez l'enfant*
1964: *L'épistémologie de l'espace* (EEG18)
1966: *L'épistémologie du temps* (EEG20)
1967: *Perception et notion du temps* (EEG21)
1968: *Épistémologie et psychologie de l'identité* (EEG24)
1971: *Les théories de la causalité* (EEG25)
1971: *Les explications causales* (EEG26)
1972: *La transmission des mouvements* (EEG27)

1972: *La direction des mobiles lors de chocs et de poussées* (EEG28)
1973: *La formation de la notion de force* (EEG29)
1973: *La composition des forces et le problème des vecteurs* (EEG30)
1981: *L'évolution du possible chez l'enfant*
1983: *L'évolution du nécessaire chez l'enfant*
1987: *Vers une logique des significations*