

Opinion Page

Thomas Kuhn: Incommensurability and the Resources of Reason

KEITH M. PARSONS, PHILOSOPHY, UNIVERSITY OF HOUSTON-CLEAR LAKE, TEXAS

Keith M. Parsons is an Emeritus Professor of Philosophy and Humanities at the University of Houston-Clear Lake, Texas. He graduated with a PhD in philosophy from Queen's University, Canada (1986) and a PhD in History and Philosophy of Science, University of Pittsburgh (1996).

His books include: *God and the Burden of Proof*, Prometheus Books (1989); *Drawing Out Leviathan: Dinosaurs and the Science Wars*, Indiana University Press (2001); *Bombing the Marshall Islands: A Cold War Tragedy* (coauthored with Robert A. Zaballa), Cambridge University Press (2017); [Why It's OK to Trust Science](#), Routledge (2023).



1.

Thomas Kuhn's *The Structure of Scientific Revolutions* was first published in 1962. However, it appeared in an obscure reference work and drew the attention only of a limited number of scholars. It was only the publication of the second edition as a stand-alone work in 1970 that made it widely available. The reception was overwhelming, and *Structure* became one of the most influential books of the twentieth century, impacting the behavioral, social, and political sciences, as well as science policy, science education, and legal studies (Marchum 2015: 201-231). Some have documented its deleterious impact on science education theory and pedagogy (Matthews, [2022](#), [2023](#)).

The pervasive influence of *Structure* has been both fortunate and unfortunate. In many ways it was unfortunate for Kuhn himself. He lived for another 34 years after the first appearance of *Structure*, and published copiously during that time, including a distinguished history of quantum mechanics. In his later writings he clarified, qualified, and, perhaps, stepped back from some of the more provocative elements of *Structure*. W.H. Newton-Smith characterizes Kuhn's philosophical development after *Structure* by saying that Kuhn went from revolutionary to social democrat (Newton-Smith, 1981). Certainly, Kuhn reacted against what he regarded as misinterpretations of his work both by critics and would-be friends.

Kuhn's Relativist Challenge

The impact of *Structure* was fortunate in that, though its main themes had been anticipated by a number of previous thinkers, it vigorously highlighted ideas that challenged—and continue to challenge—our understanding of the nature of science and of rationality in general. In the sometimes-acrimonious debates over the rationality of science during the “science wars” of the 1980’s and ‘90’s, the academic science critics, frequently referred back to Kuhn to justify their claims about the failure of traditional concepts of scientific objectivity and progress.

Kuhn’s work was taken as supporting postmodernism, the strong program in the sociology of knowledge, social constructivist interpretations of science, and radical feminist science critiques. As recently as 2018, Steven Pinker reported that *Structure* was, after a popular biology textbook, the second-most assigned book on science in American universities (Pinker 2018: 395). So, the book remains a living presence.

What were the elements of *Structure* that were appropriated (or misappropriated) by the academic science critics of the “science wars?” *Structure* was read as a defense of conceptual relativism, the idea that truth or justification is relative to standpoint, worldview, or conceptual scheme. Kuhn’s analysis of scientific change in terms of “paradigm shifts”—wholesale replacements of theory, observation, and epistemic standards—implied that “true” could be predicated only within paradigms and not across them.

Further, the radical discontinuity between theories, extending even to the observational evidence that could be adduced to support them, appeared to imply that theory change was irrational, and that the scientific shift to a new theory was like a “gestalt switch,” a religious “conversion,” or “mob psychology,” as one critic put it (Lakatos, 1970: 178).

Was Kuhn a relativist or irrationalist? Ian Hacking, in his Introduction to the fiftieth anniversary edition of *Structure* calls such charges “absurd” (Hacking 2012: xxxi). However, I think that we have to be more charitable to those who read Kuhn in that way. In fact, it is fair to say that if *Structure* is not a defense of relativism and irrationalism, it is a very good impersonation. Kuhn says that when radical theory breaks occur, it is as though the world changes, as if the scientific community had been transported to a different planet (Kuhn 2012: 111). And such language is not merely metaphorical; to take it as such is to fail to take Kuhn seriously.

For instance, the realities of Galileo and Aristotle were so divergent that even their visual experience was different. While Galileo saw pendulums, Aristotle saw only constrained fall (Kuhn 2012: 121). Kuhn emphasizes that it was not simply that they saw the same things and understood them differently or that Galileo saw something *as* a pendulum while Aristotle saw it *as* constrained fall. No, Galileo *saw* a pendulum and Aristotle did not. Likewise, Franklin *saw* a condenser where others had seen a Leyden jar, and after Herschel’s discovery of Uranus, astronomers *saw* one new planet and one less star. Further, the views of Galileo and Aristotle were simply at cross-purposes and their proponents talked past each other (Kuhn 2012: 132).

In such a situation, when paradigms clash, experiment cannot settle the issue and proponents will cite circular arguments and employ propaganda techniques (Kuhn 2012: 94).

Incommensurability

Of the various claims that seemed to imply the irrationality of theory choice, the one that probably received the most discussion was the idea of incommensurability.

“Incommensurability” is a concept borrowed from mathematics. For instance, no matter what units you use to measure the side of a square, the measure of the diagonal of that square cannot be expressed by any whole number of those units. The side and the diagonal of a square thus lack a common measure; they are incommensurable. What exactly Kuhn meant by the term is problematic. His remarks in *Structure* are rather sketchy and, as Muhammad Ali Khalidi notes, he offered various characterizations of the concept at various times (Khalidi 2000:172-173).

Newton-Smith identifies three different senses in which Kuhn held that theories could be incommensurable (Newton-Smith 1981: 148-151): incommensurability of values, incommensurability of standards, or incommensurability due to radical meaning variance. Scientists justify their theories by appealing to such values as simplicity, accuracy, or fruitfulness, but may irreconcilably disagree about which of these values is to take precedence in comparing rival theories.

Also, scientists might disagree about the very standards of good science. For Aristotle, science had to explain the causes of things, and, for instance, he explained the fact that rocks fall down by positing an innate motive force that propels objects downward. Newton, on the other hand, famously declared “*hypotheses non fingo*” (I frame no hypotheses) about *why* gravitational force exists and thought that physics should provide the mathematical description of *how* it worked.

Newton-Smith says that Kuhn’s most controversial proposal was that opposing theories might have terms that are homonyms but are given entirely different meanings in the contexts of those theories. For instance, to cite the standard example, Newton and Einstein both employed the term “mass,” but, supposedly, each meant something incomparably different by that term. Thus, proponents of Newtonian and Einsteinian theory could appear to be disagreeing but are really just talking past one another because they have such disparate understanding of the common terms they employ. So, scientists can be like politicians who both profess devotion to “freedom” but have wholly different conceptions of the meaning of that term.

In his Postscript written in 1969 for the second edition of *Structure*, Kuhn complains that philosophers—and *only* philosophers, he says—misunderstood his remarks on incommensurability as implying that scientists cannot rationally communicate in their debates over theory choice (Kuhn 2012: 197-198). He says he never denied that scientists can offer good reasons for preferring one theory over another. However, it is hard to read Kuhn’s few and rather vague remarks on incommensurability in *Structure* without taking him as claiming a considerable degree of inevitable miscommunication, misunderstanding, or incomprehension between proponents of opposing paradigms.

Translatability

So, did Kuhn ever settle on a definite and clear conception of incommensurability? Khalidi identifies what he regards as Kuhn’s “mature” understanding of the term. He says that Kuhn eventually focused entirely on the linguistic sense of incommensurability and came to equate

the term with untranslatability (Khalidi 2000: 173). That is, there is no language into which the sentences of a theory may be translated so that its meaning is entirely preserved.

Therefore, opposing theories cannot be translated into a shared language that preserves entirely the meaning of each theory. Point-by-point comparison of the theories is therefore impossible, because where theories appear to clash head-on, they inevitably equivocate. Newton is talking about mass_N and Einstein is talking about mass_E.

Khalidi says that Kuhn identifies two distinct problems that account for such untranslatability (Khalidi 2000: 173-175). The first sort of problem I call the “holism” issue and the second the “disparity” difficulty.

First, for Kuhn, the terms of theories must be understood holistically, that is, in relation to the other terms of the theory and how they are employed within that theory (Kuhn 2012: 148). If then, the terms of a theory are detached from their original context and translated into the language of a different theory, their original meaning is distorted. The meanings of a theory’s terms must be understood *as a whole* and cannot be understood by piecemeal translation into a different language.

The second sort of problem is that a term in one language may have no precise equivalent in another language so that no exact translation is possible. The meaning of the term can be rendered by clumsy paraphrases, but this breaks up what for one speaker was a unitary concept into a number of concepts. For instance, the French word *doux* has no precise equivalent in English and the translator must use a number of different words to capture its nuances (Kuhn 2000: 48-49). The problem with this is that for a native French speaker *doux* has a consistent meaning across its various applications, whereas for an English speaker it must receive different translations in different places. So, translation distorts by fragmenting a unitary concept in French to a cluster of concepts in English.

Something very much like these problems of translation is encountered in pedagogical contexts. Any instructor who has attempted to communicate the thought of a vastly different age and culture to an audience of undergraduates faces problems very similar to those besetting the translator. Therefore, examination of how these difficulties are addressed in a classroom might shed some light on the mitigation or circumvention of the proposed problems of incommensurability.

A pedagogical lesson from teaching Aristotle

In teaching introductory ethics classes, I have often had the task of explicating Aristotle’s *Nicomachean Ethics* to students with no previous experience of philosophy. One essential task is to familiarize them with the Aristotelian term *eudaimonia*. One problem is that *eudaimonia* needs to be understood holistically in its connection to other terms such as *arete* and *ergon* and in relation to the teleological cast of Aristotle’s thinking as a whole.

Further, no one English word captures the richness of *eudaimonia*. It is generally translated as “happiness,” which, for various reasons, is unfortunate. “Thriving,” “flourishing,” and “well-being” are better, but still not quite right. How to communicate Aristotle’s meaning?

The process has three stages. The first job is to disabuse students of their ordinary associations with the translated terms. For us, “happiness” is subjective and idiosyncratic. It

is different things for different people. Happiness also connotes a temporary feeling of elation or satisfaction. It can be brought on by turn of good fortune, a rewarding experience, the completion of a difficult task, or any number of other circumstances. Likewise, any number of circumstances can spoil our happiness. Maybe someone's boorish behavior ruins our big day. Happiness, then, for us is mostly a matter of our mood at a given time, or in particular circumstances. I saw an advertisement for a car dealership that said, "We sell happiness." Yes, a new car can be exciting—until the first payment is due.

For Aristotle, on the other hand, *eudaimonia* is not a transient mood or feeling or any subjective quality. It is an objectively desirable state, characterizing a whole life, and comprising a way of living in which our rational and moral faculties are fully actualized. *Eudaimonia* is not sensitive to the vagaries of circumstance, and, unlike honors, is not dependent upon others to grant or deny. Aristotle admits that one in dire poverty, sickness, or other deep distress cannot thrive. Yet if life's gravest misfortunes can be avoided, the person who has achieved *eudaimonia* will face life's vicissitudes with equanimity and poise. The life of the mind, intellectual contemplation, plays a preeminent role in the achievement of *eudaimonia*. Those who have achieved such a life are blessed indeed.

The second task is to explicate *eudaimonia* with reference to the associated ideas with which it seamlessly joins in the thought of Aristotle. What sort of life is the most satisfactory and fulfilling for human beings? What is the characteristic human good? To answer that question, Aristotle—always the biologist—has to ask what kind of organism a human being is. The good of any organism is determined by its *ergon*, its particular function, that is, what its nature has adapted it to do and do well. In the movie *Jaws*, the marine biologist played by Richard Dreyfuss explains that the great white shark is supremely adapted to do three things—swim, eat, and make little sharks. A shark is thriving when it is doing well what it is designed to do—swim, eat, and make little sharks.

What is the human *ergon*, the characteristic function that nature has adapted humans to perform and perform well? For Aristotle, a human is obviously a social animal. In his *Politics* he says that the human being is a "political animal," that is, nature has equipped human beings to thrive in a *polis*, the Greek city-state, but we may generalize and say "polity" instead of "*polis*." Further, the human being is preeminently the *rational* animal, capable of rational thought and gifted with a unique capacity for learning. So, the *ergon* of a human being is to live the life of a rational social animal.

Genuine thriving involves not just performing a function but performing it superlatively. *Arete*, normally translated as "virtue," is the state of excellence whereby any organism or thing optimally performs its distinctive function. The Greeks could therefore speak of the *arete* of a non-human animal or even an inanimate object. The hardness and sharpness of an axe is its *arete*, the speed, endurance, and courage of a war horse is its *arete*. Since humans are both rational and social creatures, humans must possess both intellectual and moral *arete* if they are to best fulfill their functions as thinkers and as participants in political and social life.

Now that students have been instructed as to the inadequacy of our ordinary notions of happiness for understanding Aristotle and guided through the intricacies of the connections between *eudaimonia*, *ergon*, *arete*, and Aristotelian teleology in general, the final task is to put everything back together so that *eudaimonia* can be seen as a unified and coherent concept.

Students finally can see that for Aristotle *eudaimonia* is possessed by those who enjoy mental and physical health and a modicum of material prosperity while exercising their intellectual and moral faculties in accordance with the highest standards of excellence. Such a person will excel at fulfilling the human *ergon*, thinking clearly, learning eagerly, judging and acting rationally, and interacting successfully, or as successfully as circumstances permit, with fellow human beings.

Once such an understanding is grasped, can we rationally compare Aristotle with thinkers of a very different hue, such as Kant? We cannot minimize the differences between the two. Aristotle and Kant would no doubt see the other's project as pervasively and irremediably flawed. Indeed, as Jonathan Lear notes, Kant would not even regard Aristotle as offering a system of morality, and Aristotle would similarly fail to see Kant's theory as an ethical outlook (Lear 1988: 154-155).

Clearly, Aristotle and Kant would be at cross purposes as much as any of Kuhn's conflicting paradigms. Yet there is no reason to think that that we cannot adequately understand each, *on his own terms*, and then make rational comparisons, even point-by-point comparisons between them. Scholars do it all the time.

For instance, here are two passages from Lear:

Kant severed the tie between morality and the pursuit of happiness because, he argued, morality cannot be binding on an agent in virtue of desires he just happens to have. The agent might have lacked those desires and, Kant argued, it is intolerable that an agent should be bound to morality by so slender a thread. (Lear 1988: 153-154).

Happiness [for Aristotle] is not based on the satisfaction of desires which a person just *happens* to possess. According to Aristotle, man has a nature: there is something definite and worthwhile that it is to be a human being (Lear 1988: 155; emphasis in original).

Recognizing such a fundamental difference is not a barrier to rational communication and comparison; rather, it enables it. It is the recognition of the full depth of disparity between theoretical concepts that *prevents* equivocation and question begging and permits fair and unbiased critique. Kant would be forced to realize that Aristotle *did* have a very different understanding of "happiness" and he would have to address Aristotle's concept *on its own terms*. Doing so would clarify further differences between the two and point to other means of rational encounter. So, the recognition of fundamental conceptual differences does not indicate an epistemic cul-de-sac, but a stimulus and opportunity for deeper understanding.

Incommensurability and comparability

The upshot, as I see it, is that the issues raised by Kuhn's "mature" understanding of incommensurability, once recognized, can guide us to deeper and more complete understanding of opposing theories. We learn not to carelessly identify the concepts of one theory with those of another—even if they are named by the same term—but to interpret those concepts in their own contexts. Further, we learn that what for us might be a cluster of concepts could be a single concept for someone else, and we have the burden of attempting to understand it as that person does. Such caveats are not terribly profound and are, in fact, fairly commonplace considerations for translators and historians of ideas.

Actually, by the time Kuhn presented his paper “Commensurability, Comparability, Communicability,” at the 1982 meeting of the Philosophy of Science Association, he probably would have agreed with most of what is said above about understanding a foreign language (or theory) (Kuhn 2000: 33-57). The sort of translation he is addressing seems to be “radical translation,” the creation of translation manuals in which the terms of one language are replaced item-for-item by the translator with co-referring terms of another language.

Thus, to employ W.V.O. Quine’s classic scenario, if the native speaker of another language uses the term “gavagai” on all and only those occasions on which we use the term “rabbit,” we would translate “gavagai” as “rabbit” in our manual. For radical translators such as Quine, all that counts is that the two terms have the same extensions, that is, that they are employed in the exact same circumstances. Meanings are irrelevant. Indeed, for the native speaker “gavagai” might mean “undetached rabbit parts” and not “rabbit.”

For Kuhn, translations that merely substitute co-referring expressions and ignore meanings inevitably distort. The point of the “holism” issue mentioned earlier is that piecemeal and automatic replacement of terms with others of the same extension will obscure the fact that the characteristic terms of a theory must be grasped *as a whole*, i.e., as inter-defined with other terms, or they simply will not be understood. Indeed, in learning an unfamiliar theory, like learning a foreign language, we truly know it when we don’t have to translate but can speak like a native (Kuhn 2000: 40).

Kuhn makes what I consider to be an obvious and necessary distinction between interpretation and translation (Kuhn 2000: 37-40). Interpretation is understanding how different languages or theories “structure the world” (Kuhn 2000: 40). In explicating a past theory, a historian of ideas is not merely a language *user* but a language *teacher*, one who shows how terms were understood holistically in their original context (Kuhn 2000: 42-45). For the interpreter, identifying the common extensions of terms is not enough; intensions (meanings) must also be identified and explicated. We need to know what Newton *meant* by “mass” and “force” (and you cannot understand the one without the other) and not just whether he employed those terms in the circumstances where a current physicist would.

I fully agree with Kuhn that understanding has to involve both interpretation and translation, and that the former cannot be reduced to the latter. Indeed, interpretation must often work *against* translation. As I note above, Aristotle cannot be understood without challenging the usual translations of “*eudaimonia*.”

If then, incommensurability is equated with untranslatability, then radical translation cannot adequately translate the content of theories. However, the failures of the radical translator are grist for the historian’s interpretive mill, and what the historian can know, the scientist can know.

What about point-by-point comparisons between theories? What does “point-by-point” mean? If the question is whether each concept of a theory can be matched one-to-one with its corresponding concept in an opposing theory, then, obviously, the answer is “no.” I take it as true, indeed trivially true, that different theories will employ quite different conceptual toolkits in their different models of the world.

To take a glaring example: Darwinian evolutionary theory has no parallel to the divine speech-acts—“Let there be...”—of the creationist. Yet, empirical claims of theories, even

ones as different as evolution and creation, may be directly compared. Young-earth creationism entails that the earth is six to ten thousand years old. For over two centuries, there has been overwhelming evidence that this is not so, and we now know that biblical chronology is off by six orders of magnitude.

Conclusion

In conclusion, I think that much of the initial excitement generated by the term “incommensurability” was largely, perhaps mostly, due to the vague but provocative way that it was presented in *Structure*. In fact, I think that much of the book’s impact was not so much due to its ideas—many of which, as noted earlier—were unoriginal, but to its style of presentation. Some have said that the book is written in aphorisms. To his credit, Kuhn later attempted to clarify, qualify, and specify his meaning. However, the result of such efforts was to reduce incommensurability from a seemingly formidable challenge to scientific rationality to a much more modest and tractable problem, arising only in certain limited contexts. In the end, incommensurability, to the extent that it exists at all, only succeeds in underscoring the actual richness of reason’s resources.

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