‘Fundamentality’ as a Linguistic Paradigm and Linguistics as a Fundamental Paradigm

Aditya Dwarkesh

Abstract The following article is my attempt to analyze the connotations of the word ‘Fundamentality.’ I have given as much emphasis to the nature of language and linguistics as I have to our current position as far as the physical sciences are concerned. By the end of it, it is my hope that the reader knows exactly what he is talking about when he uses the aforementioned word, and that the knowledge which was made in him extremely implicit becomes explicitly known.

1 Language and Meaning

The mysteries surrounding language have been left to the cobwebs for long. We employ it during our every waking second, our dearest ally in a world of chaos, oblivious to its towering mysticality until our plight hits us one day; we are not much unlike a captain aboard a storm-struck ship, relying almost entirely upon our intuition to keep ourselves floating.

Language is what we make it, and we have made it such that it has reduced us to questioning the meaning of the very words we utilize on a day-to-day basis; such is its infinite strangeness. Language not only evolves, but is also public property, and the societal warping of word-meanings is a process that often confounds one in this manner. In this article, our primary goal will be to un-warp the given word and expose it bare; to extricate purity from this word. We shall free it by decimating those extraneous implications we never intend, for the truest meaning of a word is the intuitive, inarticulable one one has; an intuition shaped and molded by society itself.

But language is a wily thing. The precise connotations of any given word differ from time to time and place to place. Is it, one wonders, possible to restrain and quantify any aspect of something like this?

Let us turn towards the aspect in question: Meaning. Here is a word that has been sending mankind’s collective intellect into turmoil with its ceaseless production of

A. Dwarkesh (✉)
R. N. Podar Institute, Jain Derasar Marg, Mumbai, India
e-mail: aditya.dwarkesh@gmail.com

A. Aguirre et al. (eds.), *What is Fundamental?*, The Frontiers Collection,
https://doi.org/10.1007/978-3-030-11301-8_16

insoluble quandaries since time immemorial. When the meaning of a word is spoken of, the prevalent picture in one's mind is that of a connotation that is common between the seemingly disparate utterances of the word; this is, in fact, a rough rephrasing of the *Wittgensteinian* sense of meaning, which is again a rather teleological one: The meaning of a word, says he, is equivalent to its use in communication [1].

This is a most agreeable notion that can fit into almost any conceptual scheme of meaning; all that is left is to be more explicit about the word "use" over here. This statement was, however, followed by a precaution: Wittgenstein added that while this was applicable to a large class of cases, it was not true for all of them. And where Wittgenstein feels the need for caution, so should we. What are those fringe cases wherein the meaning of a word is *not* its use in communication?

Consider this situation. A group of people find an old coin during a trek. It is reminiscent of the currency used in their native land and they deem it to be just that. One of them keeps it and it goes into circulation. One day, it falls into the hands of a numismatist. He spots certain intricate symbols that the untrained eye would find it hard to not miss and immediately recognizes it to be a rare coin that was used in ancient India, despite the appearance that makes it look like an everyday coin.

Now the question arises: Is the meaning of the utterance 'The coin'—the object referred to by it—an everyday coin or a rare coin used in ancient India? Certainly the latter—if I uttered 'The coin' with reference to it with the image of an everyday coin in my head and later realized what it actually was, I would undoubtedly say that *I* had been mistaken in thinking that the coin was an everyday one; I do not think anybody would make the claim that the *meaning* of the utterance changed after they learnt the true identity of the coin. And thus its meaning is 'rare coin' as opposed to 'everyday coin' despite the fact that most people mistake it to be the latter; despite the fact that its use in communication is usually as that of an everyday coin.

This societal aspect of meaning was exposed more fully by Hilary Putnam in his landmark paper, 'The Meaning of "Meaning"' [2] in which he first postulated his hypothesis of the division of linguistic labor. The essential claim is that the meaning of a word is determined by the *experts* in the relevant field. In most cases, the meaning determined by the expert becomes general knowledge and the word is used accordingly—and so the usage of the word matches with the usage of it the expert expects. However, in some cases, the expert is either misunderstood or not heard at all, and there arises a disparity between him and the society—and of course it is the expert who must be having the right of the matter: That is what makes him an expert.

Now, with these matters settled in our minds, let us turn towards the word 'Fundamental'. In this article, my duty will be to view the given word in the way an expert would; I shall attempt to analyze and integrate its connotations in the way an expert would; my primary objective will be to produce a satisfying and precise explication of its meaning not very much unlike how an expert would.

2 Theories

Let us now examine those factors which cause differences in connotation from utterance to utterance of the word 'Fundamental.'

When two people end up referring to different objects by this word, we may extrapolate from our everyday notion of the word the fact that they are giving a certain degree of importance to two different objects; they will disagree over which object has that certain degree of importance. (If, in a conversation, I call x more fundamental than y, I may rephrase with no violence to say that I am calling x more important than y.) What does this entail? A difference in worldview, evidently; if I claim that strings are more important/more fundamental than fields, it is because my worldview is at loggerheads with the one which gives fields fundamentality.

A difference in *theory*, then: One reason for difference in connotation from utterance to utterance is the theory which the person making the statement is working within. Any loosely connected set of propositions that purport to explicate the past and predict the future is called a theory. Due to reasons that may perhaps be evolutionary and survival-oriented in nature, the rationality in all of us begins forming for us theories about the way the world works. We eat empirical data and perform filtration and data-compression processes to explain as much of it in as little words as possible. It is doubtful that there exists any disposition of ours that is not a direct result of the theories we subscribe to-often the theory may lurk in our subconscious without coming forth and proclaiming itself to be the mastermind, but I cannot see how any disposition could be that no theory had anything to do with.

As a result, the connotations of any utterance we produce is a function of the theory within which we are working. Discrepancies between people for any given word may be said to be due to a difference in theory (It may admittedly also be due to a difference in symbolism—My opponent may be perversely but obstinately actually referring to strings by the utterance 'fields'—but this is a superficial schism which we shall pass over). We eliminate a great degree of the slipperiness of words once we open our eyes to this dependency that they have. Often, at the point of disagreement, one of the persons involved claims the ultimate: The superiority of his theory. Here is an illustration: Perhaps I am arguing with someone over whether a tomato is a fruit or a vegetable. Realizing that I am subscribing to a different theory wherein a tomato is, indeed, a vegetable, I may be shown by my opponent certain empirical evidence which my brain forcibly interprets (due to, as suggested before, a deep-seated rationalism brought on by evolution, perhaps?) as evidence of the fact that tomatoes are fruits, thus compelling me to discard my previous theory as flawed or insufficient and adopting a new theory. This explanation does not yet completely account for the great degree of variability in a word's connotations, though. Even post the presentation of the aforementioned empirical data, I may casually refer to tomatoes as vegetables. We certainly do not usually speak austerely, as if we are at a philosophy conference. We throw around our words quite freely. Does this mean that I have immediately gone back to my previous theory? Surely not!

The process I will now attempt to explicate is a rather subtle one. What must be happening is this:

While I certainly continue believing the proposition 'Tomatoes are fruits', I also believe that most people mistake tomatoes to be vegetables, and that I must communicate as clearly as possible to get my tomatoes. As a result, when conversing with, say, the vegetable vendor, I speak of tomatoes as if they fall under the class of vegetables. My theory of clear communication and the misconceptions of people has temporarily won my dispositions over from my theory of tomatoes being fruits, and as a result, I refer to tomatoes as vegetables instead of fruits. I may go back to calling them fruits when no other proposition is overriding that theory, and then again to vegetables when there is, and alternate so.

Or take, for example, the biologist who alternates between calling cells fundamental and calling, say, the standard model of particle physics fundamental. This alternation is again due to a difference in context causing interplay and shuffling between theories. With respect to a theory of neurobiology, neurons would be fundamental. With respect to a theory of society, people would be fundamental. Coins, perhaps, for numismatics. (These are idealizations, but I hope my point is being delivered.)

And so I say that before one asks the question 'What is fundamental?' one must select a fixed theory to work within. The theory is antecedent; the question is senseless when posed without a theory to stand atop. The *Quinean* notion of how statements may only be said to be true with respect to a given theory extends to this. Blindly and obliviously asking such a question to ten people from wildly differing backgrounds will lead only to confusion and chaos.

3 Indispensability

With this variable in place, we may finally pose a well-defined question: "*With respect to a given theory, how may we determine those objects which are fundamental?*" And furthermore, what does it mean to call a given object fundamental?

Let us examine an object which a large part of the scientific and philosophic community holds to be highly fundamental in nature: Mathematics.

Mathematical objects blatantly fail spatiotemporal existence. Despite this, its fundamentality is deeply believed in. There have been numerous arguments attempting to prove its a priori existence. Let us take, for example, Hilary Putnam's and W. V. O. Quine's indispensability thesis [3]. The argument ran thus:

1. We ought to have ontological commitment to all and only the entities that are indispensable to our best scientific theories.
2. Mathematical entities are indispensable to our best scientific theories.
3. We ought to have ontological commitment to mathematical entities.

This seems to me to point the way towards the answer to our query; our solution-statement suggests itself thus: *That which is indispensable to a theory is fundamental*

to it. I shall show how this, in one fell swoop, integrates all our scattered notions of fundamentality.

An entity may be said to be indispensable to a theory if it is *necessary* for the complete explication of that theory; if one *cannot* explicate the theory in terms independent of such an entity. The physical dimensions, mathematical implications, etc. of the entity do not matter, for they have no direct influence on its indispensability to the theory; indispensability is an abstraction birthed from language. If a proponent of the theory claims that he cannot describe his theory without referring to a certain entity, that entity is indispensable to it; it is fundamental to it. (Something to note here is that it is only the proponent himself who is in a position to decide which entities are required and which ones are not.)

It follows that we are not making any *ontological* comments on the nature of fundamentality but purely epistemological ones, because fundamentality becomes entirely determined by and dependent on communication and language. While such an analysis of fundamentality may feel unsatisfactory at first—for it is a word heavily laden with potential ontology and objectivity—it seems perfectly reasonable once we take into consideration the intersubjective nature of language and the centrality of language to life itself, along with the fact that it is language that marks the boundaries to our world. No notion of fundamentality can transcend it. Ludwig Wittgenstein understands this centrality to our life language possesses when he asserts in his masterwork Tractatus-Logico Philosophicus [4]:

> "*Die Grenzen meiner Sprache bedeuten die Grenzen meiner Welt.*" The limits of my language mean the limits of my world.

Some reflection exposes this statement to be tautological in nature (something which would greatly appeal to Wittgenstein, for he is one who has maintained that all the statements one can make about the world are tautologies). That which we cannot describe, we cannot comprehend. Language is antecedent to everything. As far as an individual as concerned, nothing that transcends language can be said to exist; it cannot even be said to *not* exist, for it fails description. It is simply beyond the boundaries of the individual's logic.

Coming back to Indispensability: It is known that one cannot reduce a theory down to a set of independent statements; that a theory is a set of interconnected, interdependent statements that lose meaning when isolated from one another. To speak of forces is meaningless without speaking of bodies in parallel; to speak of bodies is meaningless without speaking of forces in parallel. And so, in accordance with our reduction of a theory with respect to indispensability, we may reduce a theory to nothing less than a *set* of fundamental entities: A fundamental set whose interdependent, inter-determining elements would be the fundamental entities. This *set* would then be a necessary condition to describe the theory in question. (I do not even claim such a fundamental set to be unique to a theory, something which will become evident as we move on.)

But we must also take care not to admit too much in: This set's elements should not only be necessary and sufficient, but there should also not be a single non-necessary

entity, for otherwise, we would not be true to the intuitive notion of fundamentality we have by letting a horde of other non-necessary entities into that class.

The fundamental entities in a theory are, then, that core set of pointers required to describe a theory. Thus, for example, we may say that forces and bodies are fundamental with respect to classical mechanics.

To refrain from *Hegelian* labyrinths in communication is always a virtue. In this spirit, I shall illustrate my point with one of the most simplistic mathematical frameworks known to us; it is its very simplicity that heightens its illustrative power. Let us represent our theory as an n-dimensional vector. When resolved, the orthonormal vectors we obtain are analogous to the fundamental entities of that theory.

When working with vectors, we have the freedom to select any arbitrary basis. It is known that there are an infinite number of other basis (with increasing convolution which make them harder to work with) that have the same representational power as (x, y). Correspondingly, it is the case that there exist an arbitrarily high number of fundamental sets to choose from from which we may construct our theory. Selecting a basis is analogous to selecting a fundamental set.

It is known that back when quantum mechanics was still young and busy clobbering physicists over their heads with its shocks, Erwin Schrödinger and Werner Heisenberg developed, in a roughly parallel manner, two completely independent and equally powerful mathematical representations for it: Heisenberg's matrix-mechanics and Schrödinger's wave mechanics.

However, as far as conversations go, it is wave mechanics that dominates; when one explains quantum mechanics to a layman, it is wave mechanics that is explained. Why do we instinctively go to this particular explanation, despite the fact that matrix mechanics does not lack in comparison to it in any way?

We do this due to the simple reason that wave mechanics is easier to deal with and communicate as opposed to its matrix counterpart. *Why* it is easier to communicate using waves is a different question altogether; presently, all I am concerned with is the fact that it *is* easier to communicate using them.

And so similarly, our selection of the fundamental set is based on its relative ease of communication and computation; and as a result, our choices of the fundamental set generally end up converging.

The analogy with vectors happens to be quite extensive—the dot product of two theory-vectors can tell us how similar two theories are, while the cross product may be said to give a third theory based on the previous two but yet distinct from them, for e.g. quantum biology from quantum mechanics and biology—but exploring it further is not relevant to our current purposes.

There a very interesting observation to be made here, a bootstrapping-like phenomena occuring: We obtain our theory vector first and work our way down resolving it to see what it is made up of. The observant reader may have noted that this is, in fact, exactly what is being done in this article! I am standing atop our everyday notion of fundamentality in order to define that very notion more precisely. These bootstrappings happen to occur quite frequently in language, although dissecting the workings of such phenomena will also take us away from our agenda.

Now, when it comes to the word fundamentality, there is an added quirk: We speak of *theories* themselves being more fundamental than one another! How do we account for this?

The same process and product suffices. What is the main aim of any theory? To explicate a certain set of phenomena, we have said previously. Therefore, a theory may be said to be more *important*, or to be more indispensable, or to be more fundamental, with respect to a given question we wish to answer. If we are looking for a framework which will allow us to make physical predictions—if all we are bothered about is the empirical behavior of the Universe—physics satisfies the criterion sufficiently, and we may call physics more fundamental than numismatics. Otherwise, depending on the specifications on our quest, it may be logic, or mathematics, or philosophy. And so on.

4 Tertiary Considerations

Going back to vectors: We may consider updating our theory to include or exclude an object to be analogous with adding or subtracting a vector to our n-dimensional theory-vector.

Let us turn towards the fact that there are two kinds of vectors that may be added: One that has a component orthogonal to all the n dimensions of our theory-vector, and one that is writeable in terms of the n-dimensional basis.

This dichotomy has some important implications.

Adding a vector without any orthogonal component corresponds to updating our theory in a manner such that the update, whatever it may be, was something that was derivable from the fundamental set that was at hand without any external help or knowledge. In other words, it corresponds to updating a theory by means of *introspection*: An internal update that was already implicitly present.

Adding a vector that does have an orthogonal component is a bigger step. It refers to an update that was not derivable from the fundamental set that was at hand. We needed something *external*.

You are a mathematician. You have just constructed a proof for Fermat's Last Theorem. One week after you first thought of it, as you were working out the finer points on your way home from McDonalds', you realize that there is a flaw. This is an update of the first kind: The flaw was present all along, and you required no extra knowledge or experiments to know of its existence. Just some introspection. Some may even say that, in some sense, you *knew* that this flaw existed, and that it merely did not come up to conscious reflection until now. This is an update wherein the vector added had nothing orthogonal to the vector corresponding to the previous theory.

Suppose, now, that you are a biologist attempting to ascertain whether a tomato is a vegetable or a fruit. You examine it under a microscope and observe certain telling features enabling you to classify it as a fruit. This is an update of the second kind.

An observation external to you enabled you to make this update. Without it, you would not have known that a tomato is a fruit.

I hope I have made this rather subtle distinction clear. The evolution of a theory can be accounted for in terms of these two phenomena.

We also often speak of *degrees* of fundamentality. To account for this disposition, we need to consider the real world situation in all its ambiguity and apply our reflections to such a situation. To the best of my knowledge, no theory of practical use has yet been constructed such that we could explicitly pick out its fundamental sets. Even when it comes to the relatively straightforward Newtonian theory of mechanics, there is much more to it than just forces and bodies. We still do throw the word fundamental around with reference to them with a great degree of confidence, however.

One obtains some notions of what is more indispensable and important and what is less while in conversation by our implicit observations: If I see that I am able to explicate a greater number of things with the help of a given object, it obtains a greater degree of fundamentality. This is how the word 'fundamental' is used in everyday communication.

5 Conclusion

There remain a myriad of questions to be asked, each one more provocative than the last. For example: I spoke of the evolution of a theory in order to determine the connotations of the word in question. However, the question may be asked as to when a theory becomes distinct from the antecedent from which it evolved. Certainly all of us began at the same point from the Big Bang, and so we may all be said to follow one big theory in a certain sense. But that is not how we look at it. At some point, as our theories evolved, they split off from their parents and became mature adults in their own right. There is a certain sense in which we may call relativity a highly evolved version of classical mechanics. Where do we draw the line, then? When is a theory the same as that from which it evolved, and when is it a separate one in its own right? Or is this distinction as illusory as a distinction between 'good' fundamental sets and 'bad' fundamental sets? Perhaps we need to speak of a continuum of theories, thus making the number of theories in question infinite. However, we do not need this particular continuum, for we already have a generally accepted continuum handy which will work for this purpose: That of time. We shall then speak of a theory at a given time t.

Furthermore, the distinction I made between updating a theory externally and updating it internally is also no clearcut matter; the line is just as blurred as the line between the self and the world—a line which many philosophical perspectives dismiss as illusory. We may save ourselves from the wrath of those holding such viewpoints by considering the distinction to be purely operational and having no deeper connotations.

Then there is the question of how to practically construct fundamental sets. As I have said before, nothing of the sort has ever been done. There have been efforts to axiomatize mathematics (later annihilated by Kurt Gödel, of course), but that is not precisely what I am suggesting. Russell attempted to bring together a set of statements from which he hoped he could derive mathematics in its entirety. In my scheme, we arrive at the scene only after the entire theory has been constructed; after that, we look down onto what we are standing atop and then try to see how far we can reduce it. A small-scale example of such a process is, as has been mentioned before, this very paper. A notion of fundamentality has been constructed in my mind by societal communication. By standing atop this notion, I have attempted to break it down to a sufficiently precise extent.

To some of the more observant ones, I may seem to have done nothing but performed one gigantic cheat in this paper!—for I seem to have done nothing but made the burden of meaning fall on the word 'indispensable' instead of 'fundamental', lavishly replacing the latter by the former. However, it requires little vision to see that, due to the nature of language, this is the only way the meaning of any word can be conveyed: In terms of other words. I made the meaning of 'fundamental' clearer by using a word which has connotations that are not quite as blurry as those of 'fundamental', and it has sufficed for our purposes; using it, we have succeeded in reconciling the various seemingly contradictory notions of fundamentality under one satisfactory criterion. The proposal is only bolstered by the fact that, even intuitively, fundamentality and indispensability feel like brothers.

To conclude:

With respect to a given theory at a time T, its fundamental entities are the elements of a set which is both necessary and sufficient for the construction and explication of the theory in its entirety and does not contain any non-necessary elements.

References

1. Wittgenstein, L., Anscombe, G.E.M.: Philosophical Investigations. Blackwell, Oxford (1997)
2. Putnam, H.: The Meaning of "Meaning". Language, Mind, and Knowledge. Minnesota Studies in the Philosophy of Science, vol. 7, pp. 131–193. University of Minnesota Press, Minneapolis (1975)
3. Putnam, H.: Indispensability arguments in the philosophy of mathematics (chap. 9). In: Putnam, H. (eds.) Philosophy in an Age of Science: Physics, Mathematics and Skepticism. Harvard University Press, Cambridge
4. Wittgenstein, L.: Tractatus Logico-Philosophicus. Routledge and Kegan Paul, London (1951)