<u>Perception, Physics and the Role of Light in Philosophy</u>

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Reality, as we sense it, is not quite real. The stars we see in the night sky, for instance, are not really there. They may have moved or even died by the time we get to see them. This unreality is due to the time it takes for light from the distant stars and galaxies to reach us. We know of this delay.

Even the sun that we know so well is already eight minutes old by the time we see it. This fact does not seem to present particularly grave epistemological problems - if we want to know what is going on at the sun now, all we have to do is to wait for eight minutes. We only have to 'correct' for the distortions in our perception due to the finite speed of light before we can trust what we see. The same phenomenon in seeing has a lesser-known manifestation in the way we perceive moving objects. Some heavenly bodies appear as though they are moving several times the speed of light, whereas their 'real' speed must be a lot less than that.

What is surprising (and seldom highlighted) is that when it comes to sensing motion, we cannot back-calculate in the same kind of way as we can to correct for the delay in observation of the sun. If we see a celestial body moving at an improbably high speed, we cannot calculate how fast or even in what direction it is 'really' moving without first having to make certain further assumptions.

Einstein chose to resolve the problem by treating perception as distorted and inventing new fundamental properties in the arena of physics - in the description of space and time. One core idea of the theory of Special Relativity is that the human notion of an orderly sequence of events in time needs to be abandoned. In fact, since it takes time for light from an event at a distant place to reach us, and for us to become aware of it, the concept of 'now' no longer makes any sense, for example, when we speak of a sunspot appearing on the surface of the sun just at the moment that the astronomer was trying to photograph it. Simultaneity is relative.

Einstein instead redefined simultaneity by using the instants in time we detect the event. Detection, as he defined it, involves a round-trip travel of light similar to Radar detection. We send out a signal travelling at the speed of light, and wait for the reflection. If the reflected pulse from two events reaches us at the same instant, then they are simultaneous. But another way of looking at it is simply to call two events 'simultaneous' if the light from them reaches us at the same instant. In other words, we can use the light generated by the objects under observation rather than sending signals to them and looking at the reflection.

This difference may sound like a hair-splitting technicality, but it does make an enormous difference to the predictions we can make. Einstein's choice results in a mathematical picture that has many desirable properties, including that of making further theoretical development more elegant. But then, Einstein believed, as a matter of faith it would seem, that the rules governing the universe must be 'elegant.' However, the other approach has an advantage when it comes to describing objects in motion. Because, of course, we don't use Radar to see the stars in motion; we merely sense the light (or other radiation) coming from them. Yet using this kind of sensory paradigm, rather than ‘Radar-like detection,’ to describe the universe results in an uglier mathematical picture. Einstein would not approve!

The mathematical difference spawns different philosophical stances, which in turn percolate to the understanding of our physical picture of reality. As an illustration, suppose we observe, through a radio telescope, two objects in the sky, with roughly the same shape, size and properties. The only thing we know for sure is that the radio waves from these two different points in the sky reach us at the same instant in time. We can only guess when the waves started their journeys.

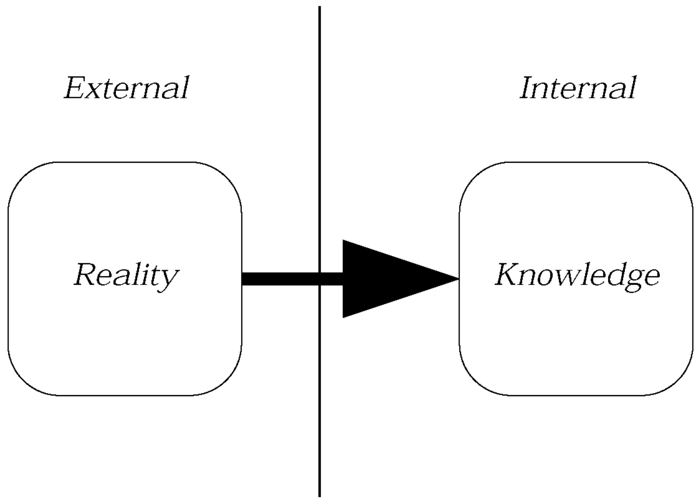
If we assume (as we routinely do) that the waves started the journey roughly at the *same* instant in time, we end up with a picture of *two* ‘real’ symmetric lobes more or less the way see them. But there is another, different possibility and that is that the waves originated from the *same* object (which is in motion) at *two* different instants in time, reaching the telescope at the same instant. This possibility would additionally explain some spectral and temporal properties of such symmetric radio sources. So which of these two pictures should we take as real? Two symmetric objects as we see them or one object moving in such a way as to give us that impression? Does it really matter which one is ‘real’? Does ‘real’ mean anything in this context?

Special Relativity gives an unambiguous answer to this question. The mathematics rules out the possibility of a single object moving in such a fashion as to mimic two objects. Essentially, what we see is what is out there. Yet, if we define events by what we perceive, the only philosophical stance that makes sense is the one that disconnects the sensed reality from the causes lying behind what is being sensed.

This disconnect is not uncommon in philosophical schools of thought. Phenomenalism, for instance, holds the view that space and time are not objective realities. They are merely the medium of our perception. All the phenomena that happen in space and time are merely bundles of our perception. In other words, space and time are cognitive constructs arising from perception. Thus, all the physical properties that we ascribe to space and time can only apply to the phenomenal reality (the reality of ‘things-in-the-world’ as we sense it). The underlying reality (which holds the physical causes of our perception), by contrast, remains beyond our cognitive reach.

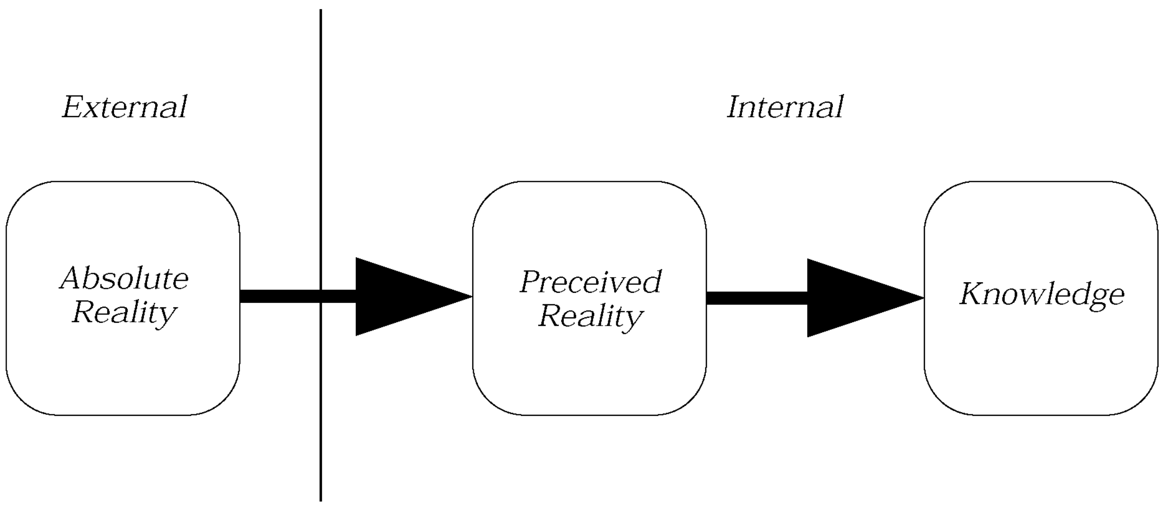
Yet there is a chasm between the views of philosophy and modern physics. Not for nothing did the Nobel Prize winning physicist, Steven Weinberg, wonder, in his book ‘Dreams of a Final Theory’, why the contribution from philosophy to physics had been so surprisingly small. Perhaps it is because physics has yet to come to terms with the fact that when it comes to seeing the universe, there is no such thing as an optical illusion - which is probably what Goethe meant when he said, ‘Optical illusion is optical truth.’

The distinction (or lack thereof) between optical illusion and truth is one of the oldest debates in philosophy. After all, it is about the distinction between knowledge and reality. Knowledge is considered our view about something that, in reality, is "actually the case." In other words, knowledge is a reflection, or a mental image of something external, as shown in the figure below.



In this picture, the black arrow represents the process of creating knowledge, which includes perception, cognitive activities, and the exercise of pure reason. This is the picture that physics has come to accept. While acknowledging that our perception may be imperfect, physics assumes that we can get closer and closer to the external reality through increasingly finer experimentation, and, more importantly, through better theorization. The Special and General Theories of Relativity are examples of brilliant applications of this view of reality where simple physical principles are relentlessly pursued using formidable machine of pure reason to their logically inevitable conclusions.

But there is another, alternative view of knowledge and reality that has been around for a long time. This is the view that regards perceived reality as an internal cognitive representation of our sensory inputs, as illustrated below.



In this view, knowledge and perceived reality are both internal cognitive constructs, although we have come to think of them as separate. What is external is not the reality as we perceive it, but an unknowable entity giving rise to the physical causes behind sensory inputs. In the illustration, the first arrow represents the process of sensing, and the second arrow represents the cognitive and logical reasoning steps. In order to apply this view of reality and knowledge, we have to guess the nature of the absolute reality, unknowable as it is. One possible candidate for the absolute reality is Newtonian mechanics, which gives a reasonable prediction for our perceived reality.

To summarize, when we try to handle the distortions due to perception, we have two options, or two possible philosophical stances. One is to accept the distortions as part of our space and time, as Special Relativity does. The other option is to assume that there is a 'higher' reality distinct from our sensed reality, whose properties we can only conjecture. In other words, one option is to live with the distortion, while the other is to propose educated guesses for the higher reality. Neither of these choices is particularly attractive. But the guessing path is similar to the view accepted in phenomenalism. It also leads naturally to how reality is viewed in cognitive neuroscience, which studies the biological mechanisms behind cognition.

The twist to this story of light and reality is that we seem to have known all this for a long time. The role of light in creating our reality or universe is at the heart of Western religious thinking. A universe devoid of light is not simply a world where you have switched off the lights. It is indeed a universe devoid of itself, a universe that doesn't exist. It is in this context that we have to understand the wisdom behind the statement that 'the earth was without form, and void' until God caused light to be, by saying 'Let there be light.'

The Koran also says, 'Allah is the light of the heavens and the earth,' which is mirrored in one of the ancient Hindu writings: 'Lead me from darkness to light, lead me from the unreal to the real.' The role of light in taking us from the unreal void (the nothingness) to a reality was indeed understood for a long, long time. Is it possible that the ancient saints and prophets knew things that we are only now beginning to uncover with all our supposed advances in knowledge?

There are parallels between the noumenal-phenomenal distinction of Kant and the phenomenalists later, and the *Brahman-Maya* distinction in *Advaita*. Wisdom on the nature of reality from the repertoire of spirituality is reinvented in modern neuroscience, which treats reality as a cognitive representation created by the brain. The brain uses the sensory inputs, memory, consciousness, and even language as ingredients in concocting our sense of reality. This view of reality, however, is something physics is still unable to come to terms with. But to the extent that its arena (space and time) is a part of reality, physics is not immune to philosophy.

In fact, as we push the boundaries of our knowledge further and further, we are discovering hitherto unsuspected and often surprising interconnections between different branches of human efforts. Yet, how can the diverse domains of our knowledge be independent of each other if all knowledge is subjective? If knowledge is merely the cognitive representation of our experiences? But then, it is the modern fallacy to think that knowledge is our internal representation of an external reality, and therefore distinct from it. Instead, recognising and making use of the interconnections among the different domains of human endeavour may be the essential prerequisite for the next stage in developing our collective wisdom.

Box: Einstein's Train

One of Einstein's famous thought experiments illustrates the need to rethink what we mean by simultaneous events. It describes a high-speed train rushing along a straight track past a small station as a man stands on the station platform watching it speed by. To his amazement, as the train passes him, two lightening bolts strike the track next to either end of the train! (Conveniently, for later investigators, they leave burn marks both on the train and on the ground.)

To the man, it seems that the two lightening bolts strike at exactly the same moment. Later, the marks on the ground by the train track reveal that the spots where the lightening struck were exactly equidistant from him. Since then the lightening bolts travelled the same distance towards him, and since they appeared to the man to happen at exactly the same moment, he has no reason not to conclude that the lightening bolts struck at exactly the same moment. They were simultaneous.

However, suppose a little later, the man meets a lady passenger who happened to be sitting in the buffet car, exactly at the centre of the train, and looking out of the window at the time the lightening bolts struck. This passenger tells him that she saw the first lightening bolt hit the ground near the engine at the front of the train slightly ahead of when the second one hit the ground next to the luggage car at the rear of the train.

The effect has nothing to do with the distance the light had to travel, as both the woman and the man were equidistant between the two points that the lightening hit. Yet they observed the sequence of events quite differently.

This disagreement of the timing of the events is inevitable, Einstein says, as the woman is in effect moving towards the point where the flash of lightening hit near the engine -and away from the point where the flash of lightening hit next to the luggage car. In the tiny amount of time it takes for the light rays to reach the lady, because the train moves, the distance the first flash must travel to her shrinks, and the distance the second flash must travel grows.

This fact may not be noticed in the case of trains and aeroplanes, but when it comes to cosmological distances, simultaneity really doesn't make any sense. For instance, the explosion of two distant supernovae, seen as simultaneous from our vantage point on the earth, will appear to occur in all possible combinations from other perspectives.

In *Relativity: The Special and General Theory* (1920), Einstein put it this way:

"Every reference-body (co-ordinate system) has its own particular time; unless we are told the reference-body to which the statement of time refers, there is no meaning in a statement of the time of an event."

About the Author

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Much of the philosophical tradition has viewed the central epistemological problems concerning perception largely and sometimes exclusively in terms of the metaphysical responses to skepticism. For that reason, these will be addressed before moving on to the more explicitly epistemological concerns. 1. The Problem of the External World.Â 3.3.1 The Isolation Objection and the Role of Experience. 3.4 Modest Foundationalism. 3.4.1 Internalist Modest Foundationalism. The philosophy of perception is concerned with the nature of perceptual experience and the status of perceptual data, in particular how they relate to beliefs about, or knowledge of, the world. Any explicit account of perception requires a commitment to one of a variety of ontological or metaphysical views. Philosophers distinguish internalist accounts, which assume that perceptions of objects, and knowledge or beliefs about them, are aspects of an individual's mind, and externalist accounts, which