The Mechanics of Perception

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Perception is a very complex process. Physics examines not only the mechanism of communication of information but also the role of mind/consciousness in the process of perception. Medical science assumes that the brain processes and analyzes the information it receives from the sense organs. It also suggests that the brain is the decision-making authority. Medical science assumes that the mind and consciousness do not play any role in the process of perception.

In this paper, we have analyzed all aspects of the process of perception. We have shown that the information is not communicated physically. We have also shown that the information is projected in physical form only in the state of mental alertness. This paper also shows that the mind, not the brain, is the decision-making authority.

This paper resolves several major theoretical problems in physics and offers clues to the solutions to some other unresolved issues like measurement problem and entanglement problem. It also adds a new dimension to the world of neuroscience by showing that the mind is the key player in the process of perception.

Perception is generally defined as the knowledge gained by perceiving or becoming aware of something via the senses. Perception is not just about seeing or hearing something; perception involves making sense of the information.

Physics assumes that the communication of information involves real, local particles like photons but nonlocality suggests that the communication of information may not involve any real, local particles. We will examine the role of light and sound in the communication of information.

According to medical science the brain is the essence of our being. Medical science suggests that the entire process including the projection of information happens inside the brain. Medical science assumes that the mind is nothing more than the sum of all brain activity; therefore, it does not play any active role in the process of perception. Medical science suggests that even feelings and emotions are nothing more than sensations or physical reactions caused by the release of certain hormones. It assumes that the brain not only receives the information from the sense organs but also processes it, and draws conclusions. On the other hand, quantum mechanics suggests that a *conscious* act of observation is required to produce what is being observed.

Surprisingly, even at the purely physical level, the process of perception is so complex that there is no clarity on the mechanism of perception.

In this paper, we will discuss and explain all the aspects of the process of perception.

Results

We have shown that the communication of information does not involve real, local particles. We have shown that the light and sound are manifestations of information. Light and sound do not transmit information.

Nerve impulses, vibrations, waves, are all manifestations of information. The light, sound, touch, taste, and smell are projections of information. Feelings and emotions are the projections of the state of the mind.

Manifestation of information is observer-dependent; therefore, light may manifest both

as a wave as well as a particle. We have shown that an act of observation only manifests information; it does not cause collapse of the wavefunction.

The purely physical sensations of touch and pressure are communicated to the somatosensory cortex in the brain. A dysfunctional somatosensory system may cause temporary or permanent loss of ability to feel the touch. Therefore, we can say that the touch and even the pressure are also projection of information,

This paper shows that the information is projected only in the state of mental alertness. We have also shown that the perception is a mental process.

We have also analyzed a few important experiments conducted by the neuroscientists to show that the mind is the decision-making authority.

Methods

A team of scientists from the Massachusetts Institute of Technology (MIT) has developed a camera that captures one trillion frames/second. The team has recorded several movies to demonstrate the speed of the camera. We will analyze a part of a movie titled, 'multiple scenes.mp4'.*[1]*

The camera developed by the MIT team captures only one-pixel vertical image. Therefore, the team rotates a mirror to scan the line across the field of view to create the entire scene. Every frame is composed of many pulses, one for each vertical line of the image, which is stitched together to make the movie. However, we can analyze the movie assuming it is a normal movie.

The team has recorded normal events to show the motion of light. The movie has been slowed down the movie considerably to allow the viewers to make sense of the sequence of events.

In a part of the movie mentioned above, a light source emits a pulse for 2 picoseconds. The light illuminates a fruit kept between the light source and the camera. The camera records these events in the sequence they occur.

The distance between the light source, fruit, and the camera does not affect the nature of the analysis because the camera would record the events in the same sequence as they occur irrespective of the distance of fruit and camera from the light source. Therefore, we can analyze the movie assuming that the distance between the light source and fruit is 5 feet and the distance between the light source and the camera is 10 feet.

The sequence of events starting from the emission of the first set of photons by the light source to the illumination of fruit would last for about 5 nanoseconds.

The light source emits a pulse for only 2 picoseconds; therefore, the difference between the arrival time of the first set of photons and the last set of photons in any frame cannot be more than 2 picoseconds. Therefore, if the photons carry information then, the total length of the movie cannot be more than 2 picoseconds. Thus, the camera would not be able to record the entire sequence of events lasting 5 nanoseconds.

All the photons travel the same path in *the same setup in identical condition* within a span of just 2 picoseconds. However, the camera registers the last set of photons five nanoseconds after it registers the first set of photons. Therefore, the length of the movie is 5 nanoseconds, not 2

picoseconds.

Suppose the light source emits photons at 00.00 hrs. The Photons emitted by the light source would reach the fruit 5 nanoseconds past 00.00 hrs. These photons would reach the camera 10 nanoseconds past 00.00 hrs. The photons illuminate the fruit on their way to the camera.

As already mentioned, all the photons must reach the camera within a span of 2 picoseconds. Therefore, if communication of information involves any real, local particles or any physical entity then we would not be able to record the above sequence of events. It would not be possible to establish the causal relationship between illumination of the light source and illumination of the fruit. However, the camera records the entire sequence of events in the same order.

This analysis rules out the possibility that the information is communicated physically from the source to the observer.

The above analysis shows that the communication of information does not involve any real, local particles because the information manifests as light only in the form of images.

In this movie, we find the evidence of both the time delay in the communication of information and absence of time delay in the communication of information. The time delay in communication of information depends on the distance between the source and observer at the time of initiation of communication.

Suppose a light source emits signals in all directions. If a camera located at a distance of 10 feet from the light source records the motion of photons then, we will have photons moving towards the camera and away from the camera simultaneously. After 5 nanoseconds, the photons moving

towards the camera will be five feet away from the camera and photons moving away from the camera will be 15 nanoseconds away from the camera. However, the camera will record both the sets of photons simultaneously. In fact, in the same movie, we see the photons moving away from the camera without any corresponding increase in the time delay observed in the recording.

The theory of relativity assumes that the light communicates the information. The theory of relativity suggests that two observers located at different distances from an event would perceive the event at different times; therefore, it constitutes failure of simultaneity. The theory of relativity does not explain why the observer must treat the time they perceive the event as the actual time of events. [2]

However, a scientist having the required information would be able to explain why the observers perceived the same event at different times. Therefore, he will be able to prove that there is no failure of simultaneity.

In the MIT movie, the light source illuminates at 10 nanoseconds past 00.00 hrs and fruit illuminates at 15 nanoseconds past 00.00 hrs for the camera located at a distance of 10 feet from the light source.

By the same logic, a camera located at a distance of 20 feet from the light source would record these events between 20 nanoseconds past 00.00 hrs and 25 nanoseconds past 00.00 hrs.

This will be the actual time of events for this camera.

The only way we can establish the causal relationship between the illumination of the light source and illumination of fruit is by treating the time the observer perceives an event as the actual time of

events for that observer.

The event occurs only at one particular time, but for every observer the time he perceives the event is the actual time of events.

This is the fundamental basis of failure of simultaneity.

Doppler Effect predicts a change in the frequency/wavelength of the signals due to a change in the distance between the source of the signals and observer.

We simply have to hear the sound of a siren moving towards/away from us to realize that the received frequency is always the same as the emission frequency of the signals. In other words, a change in the distance between the source of the signals and observer does not affect the frequency of the wave. We do not observe any distortion of signals.

It shows that the time delay in the communication of information at the time of initiation of communication is maintained even if the distance between the source and observer changes subsequently. Obviously, even sound waves do not communicate information.

The zoom microphones can reduce and even eliminate the time delay in the communication of information. The number of mics and the direction of mics cannot reduce the time delay in communication of information. The trick is done by the condenser placed in the microphone. The condenser acts like a magnifying glass. Similarly, zoom lens reduces the time delay in the communication of information and wide-angle lens increases the time delay in the communication of information.

In the above cases, the time delay may increase or decrease even after the communication is initiated.

The fact that the camera registers the photons in a span of 5 nanoseconds shows that the light is manifestation of information. The camera acts as an observer because it manifests the information about the light source and fruit.

Any entity that manifests information acts as an observer for the entity being manifested.

The white light is not a combination of light of seven colors. The energy of the photon determines the color of the light. If the energy of a photon absorbed by eyes crosses a threshold limit then, it is projected in white color. If the energy goes below a threshold limit then, we see the black color. Light and darkness are not mutually exclusive phenomena. Darkness indicates relative, not the absolute absence of light. For example, the area covered by shadow indicates relative absence of light, not the absolute absence of light.

The illusion of motion of light is created because every subsequent particle absorbs and emits energy emitted by a light source. If the medium generates strong enough activity to be sensed by our sense organs then the information is forwarded to the brain. If the information generates enough brain activity then, the information is projected as light but only in the state of mental alertness.

Light does not move, but for the sake of convenience in the analysis of the communication mechanism of nature, we can assume that light actually moves.

In the double-slit experiment, the particles do not pass through the slits in any physical form whatsoever. The particles manifest only as a consequence of an act of observation. If we place a

detector in the slits then detectors act as an observer and manifest the information or else screen acts as an observer. Placement of the detector changes the experimental setup causing a change in the result of the experiment.

In the double-slit experiment, the pattern formed on the screen manifests information about the source of the photons/electrons, the nature of the path between the source and observer, and nature of the observer (screen). If multiple paths are available then, the nature of the projection of information cannot be the same as it will be if only one path is available for the exchange of information between the source and observer.

All the outcomes of the double-slit experiment make sense only if we realize that nothing travels physically from the source to the observer (a detector placed in slits or the screen).

An important feature of the double-slit experiment is that the behavior of individual particles is unpredictable, but the overall interference pattern is predictable.

This feature manifests even in the radioactive elements. It is not possible to predict the time at which a radioactive nuclei may decay, but radioactive elements have a predictable half-life.

In both these cases, the behavior of the whole is predictable, but the behavior of the parts is unpredictable. However, the unpredictability does not indicate arbitrariness in the behavior of the particles because the behavior of the whole cannot be predictable if the parts behave arbitrarily.

The particles do enjoy some degree of freedom within the whole therefore the behavior of individual particles is unpredictable but this freedom is not absolute. At the same time, it does not mean that the particles make any conscious decisions or that particles have free will because if

particles had free will then it would not be possible for us to predict the behavior of the whole.

It may not be possible to discover the rule or mechanism that controls the behavior of the particles because of our observational limitations; however, we cannot deny that some rule or mechanism controls the behavior of individual particles, which in turn ensures that the behavior of the whole is predictable.

The uncertainty in the behavior of parts is indeed an inherent feature of nature. In the absence of this feature, the structure of the universe would be the same everywhere. However, as we have mentioned, the freedom is restricted; therefore, we are not living in a chaotic universe.

The superposition is of apparent form of entities. The apparent form of entities is observer dependent. If we show all seven colors of the rainbow to a color blind person then, the person will not see some colors, but nothing collapses in this case because the inability of the observer to manifest any specific information does not affect the properties of the entity being manifested.

An entity may have 'n' number of properties that it can manifest in physical form, but observer also must have the potentiality to manifest these properties in physical form. One observer may manifest one set of properties and other observer may manifest another set of properties of the same entity simultaneously. In some cases, these properties may even be mutually exclusive. For example, the light is neither a particle nor a wave. It only has the potential to manifest both as a wave as well as a particle. The properties of the observer determine the apparent form of light.

The wavefunction of an entity is the sum of all the properties that the entity has the potential to manifest in the physical world. The wavefunction of the entity exists even in the absence of an act

of observation.

Now, let us enter the brain and see what happens within the brain after it receives a signal from the sense organs.

One of the most counterintuitive assumptions of neuroscience is that the light is projected inside the brain, but the brain remains in absolute darkness even while projecting the light.

If light is projected inside the brain then, even heat also must be projected inside the brain. Light may not cause any damage to the brain tissues, but brain tissues would definitely be damaged if heat were to be projected inside the brain.

Our sense organs sense the information; therefore, the light or any other information is not projected inside the brain. The information is projected at the place it is generated.

Dr. Susan Greenfield uses the analogy of raindrops falling in a pond to explain this phenomenon. Dr. Greenfield suggests that the bigger rain drops create bigger waves and smaller drops create smaller and weak waves. A few drops may be so small that they may not produce any significant disturbance. Similarly, weak brain activities go unnoticed. *[3]*

Dr. Susan Greenfield is right as far signals generating brain activity in the brain, but the analogy of raindrops does not explain the process of perception because the strength of signals does not depend only on the strength of the incoming signals.

Experiments show that if we perform an activity over and over again then, the mind does not need the information to flow to it through the brain. It can perform these activities intuitively. These

actions generate negligible brain activity. In other words, the mind can control the body without involving the brain. [4]

Most sports will be played at much slower pace if the brain were to be the decision- making authority. The mind can anticipate the events based on its experience of being in a situation over and over again. It prepares the body for an appropriate response much before the information can flow to it through the brain. In fact, the normal mechanism of perception stands suspended in these situations. Therefore, the brain activity is minimal. In these cases, conscious decision-making can be a hindrance in the performance. However, even in these cases, the brainactivity reduces gradually.

Surprisingly, maximum brainactivity is observed when the body is least active.

The neuroscientists expected that the brain activity would be minimal in the state of deep sleep, but they were surprised to find that the brain activity is maximum in the state of deep sleep.[] The brain appears to receive maximum information in the state of deep sleep. The sense organs do not have any activity, which means the brain receives the information through some other channel. Obviously, the person in the deep sleep is not aware of the information the brain receives from across the world.

We are fully conscious in the state of deep sleep and our brain also functions but we are still isolated from the rest of the world because our mind sleeps peacefully.

We become aware of any information only if the mind is active. The activity of the brain in itself is not enough to project the information.

In the *'monkey illusion business'* experiment, Dr. Daniel Simmons shows a video to the participants. In this video, two teams, one dressed in white and the other dressed in black, are passing the balls to their team members. The participants are asked to count the passes made by the group in white dress while ignoring the passes made by the group dressed in black. Several other activities are going on in the background; for example, a gorilla enters the scene stops in the middle, thumps his chest several times and walks out. *[5]*

Dr. Simmons points out that only about half the participants noticed the gorilla. Therefore, Dr. Simmons concludes that our ability to pay attention is limited. Dr. Simmons suggests that we may look at something without seeing it. We can eliminate a good deal of information by focusing our attention on a particular set of information.

Dr. Simmons suggests that this experiment is an example of 'inattentional blindness', the failure to see something obvious when focusing attention on something else.

A human being may not want to receive all the information that his sense organs may provide at any given point of time. For example, a doctor may not want to receive all the information his eyes can provide him while he is performing a surgery. Therefore, nature has granted us the ability to focus our attention on the information we want to receive and eliminate the unwanted information.

On the other hand, we may not notice an event or an entity because of the absentmindedness. Our mind and body do not always stay together therefore we cannot see something even if it is placed right in front of our eyes until someone points it out to us.

In the experiment conducted by Dr. Simmons, the subjects may fail to count the passes and may

even fail to notice other events on the stage either due to absentmindedness or because their mind is focused on counting passes or is busy somewhere else.

Absentmindedness is a case inattentional blindness. Inability to notice certain objects/events because our mind is focused on something else indicates intentional partial blindness because we consciously decide to embrace partial blindness by focusing our attention on specific information.

In this experiment, the eyes of the participants were observed to see if the eyes notice the gorilla. It was discovered that several participants whose eyes noticed the gorilla said that they did not see the gorilla. Therefore, transmission of the signals to the brain by the sense organs is not sufficient to project the information.

This experiment shows that we can project the information only in the state of mental alertness. The brain registers the information even if we look at the gorilla, but the information is not projected because the mind is focused on something else.

Let us examine another example of intentional blindness.

Jim Rose and his partners in the Jim Rose Circus perform some very painful routines in their shows. Jim Rose explains that they focus their attention on some imaginary situation while going through their routines; therefore, they do not feel the pain; for example, Jim Rose thinks he is standing in neck deep waters. Their technique does the job of an anesthetic. *[6]*

The performers in the Jim Rose Circus do not feel pain because their mind is somewhere else. Mr. Jim Rose clarifies that they feel the pain like any other normal human being unless they consciously divert their attention to some other activity. Obviously, even pain is not projected if we

divert our attention to something else.

Not surprisingly, watching someone else in pain activates the same neuromachinery as does the actual experience of the pain. However, we do not experience the pain because the signals are not strong enough to be projected by the mind in the form of pain. Obviously, the brain activity can be generated even without the brain receiving any signals in any physical form because the mind feels the pain.

This experiment shows that even the pain is also projected only in the state of mental alertness. This experiment also shows that consciousness does not play any role in the projection of information. Mental alertness should not be confused with the consciousness.

Medical science assumes that the expression of even the feelings is a function of the hypothalamus. It suggests that the happiness is one set of chemicals, and the sadness is another set of chemicals.

Freud does not agree. Freud says, *"We would readily express our gratitude to any philosophical or psychological theory which was able to inform us of the meaning of the feelings of pleasure and unpleasure which act so imperatively upon us."* Freud goes on to say. *Most of the unpleasure we experience is perceptual unpleasure."* [7]

According to medical science either the hypothalamus or some other part of the brain decides whether we are happy or sad causing the release of certain hormones.

Experiments have shown that a person's reaction to the mood stimulators given to him depends on whether he has been told beforehand that he has been given only a placebo or he has been

informed that he has been administered a mood stimulator. [8]

The placebo effect shows that the mind plays a key role in determining the effect of medicines or any other object we consume. The mind only needs to be convinced that it has received the medicine to produce the necessary effects.

This shows that the response of the brain depends on the person's beliefs. The brain simply responds to the mental state of the person.

Obviously, the mind plays a role even in the biochemistry.

Feeling of happiness or sadness and the expression of these feelings are two different phenomena. A disorder in the brain may prevent a person from expressing his feelings, but does not prevent him from feeling happy or sad.

The hypothalamus cannot decide whether we are happy or sad; it simply reacts to the state of the mind. The release of the chemicals by the hypothalamus is an effect, not the cause of the state of the mind.

Now, let us examine an experiment, which suggests that the mind, not the brain, is the decision-making authority.

In one of the experiments, a subject was asked to randomly press one of the two buttons. The subject thinks for some time before pressing one of the buttons. [9]

It was discovered that if the subject decided to press the left button then this decision manifested in brain activity in one part of the brain and if he decided to press the right button then the decision

manifested in brain activity in a different part of the brain.

It was discovered in this experiment that the decision of the subject manifests in the brain activity at least 6 seconds before the subject himself realizes that he has already made a decision.

The only explanation is that two different entities are involved in the decision-making process. One entity makes the decision, but this decision may remain in our sub-conscious mind until it is projected in the conscious mind. The person himself becomes aware of the decision only after the conscious mind knows about it. It shows that the brain activity is not sufficient to make a person realize that he has made a decision.

We observe the physical world and draw numerous conclusions about it without being consciously aware that we have formed strong opinions about people and events. Obviously, it requires the existence of at least two entities.

Our ability to focus also shows that the brain is not the decision-making authority. The brain can decide which information to focus on and which information to ignore only after it receives the information. Therefore, in the experiment conducted by Dr. Simmons, all the participants must see not only the gorilla and everything else that happens on the stage because then only they can decide if they want to focus their attention on any specific event. However, participants in the experiment do not even know that gorilla made an appearance on the stage.

We can focus on any particular information and ignore the rest of the information because mind can intuitively predict the events. In fact, the filters are applied at the level of the sense organs. Obviously, the brain is not involved in this process of decision-making.

We have already explained that brain activity is not required in all the cases for the projection of information. However, in most cases, brain activity is required for projection of information, but the analogy of rain drop does not explain the process of perception because the strength of brain signals does not depend only on the strength of the incoming signals.

The energy of the surface of the brain may also affect the projection of information and even memory.

For most people remembering the things is a problem but some people just cannot forget anything.[10]

The surface of the brains of these people may be hyperenergetic. This hardens the surface of the brain; therefore, even weak signals are enough to project the information. A hyperenergetic brain requires little strengthening of the connections therefore recalling any information is also not a problem. On the other hand, anesthetics may soften the surface of the brain. Therefore, the information is not projected in physical form.

Discussion

Reality of the quantum states, wave-particle duality, measurement problem, and entanglement are all major problems of the quantum world.

We have provided vital clues to the solution of these problems.

We must realize that we perceive the information generated by an entity, not the entity itself therefore an act of observation cannot create an entity.

The apparent form of entities is observer dependent therefore the outcome of an experiment is valid only for one particular setup. Any change in the setup or the measuring device is bound to change the outcome of the experiment. For example, a detector placed in the slits in the double-experiment signifies a change in the setup. Therefore, the outcome of the experiment also changes.

The superposition is not about the existence of an entity in more than one state or at more than one place simultaneously. No physical entity can exist at more than one place or in more than one state simultaneously because it is practically impossible.

Superposition is of the apparent form of the physical entity. The properties of the apparent form and the place of its appearance are observer dependent. For example, the Sun appears in numerous apparent forms and sizes simultaneously to different observers without any change in its own properties. We cannot say that the Sun exists in more than one state at more than one place simultaneously (Refraction and time delay in communication of information may manifest the Sun at different places to different observers) or that properties of the Sun are observer dependent. A coin placed in a cup filled with water appears in different sizes and at different places to different observers depending on the position of the observer. It does not mean that the coin exists in different sizes and at different places simultaneously.

Einstein's main argument against the quantum theory was that the theory was incomplete because it did not explain the state of the physical entity prior to an act of observation.

We have shown that an entity exists even before it is observed. However, it is not possible to discuss the actual state of the entities in this paper even in the supplementary file. Therefore, this paper only explains the reality of superposition; it does not offer a complete solution to the

measurement problem.

The theory of relativity assumes that the information is exchanged physically; therefore, it concludes that the information cannot be exchanged faster than the velocity of light in vacuum. Our finding that the communication of information does not require physical, local particles shows that the faster than light communication is possible without invalidating the theory of relativity. Our findings do not invalidate theory of relativity's observation that no physical entity can move faster than light.

Our finding that the communication of information does not involve real, local particles is not enough to resolve the problem of entanglement, but it offers vital clues to the solution of the problem.

We have shown that the mind not only projects the information but is also the decision-making authority. Neuroscience may think of new experiments to confirm this observation. Neuroscience may also work on discovering new ways of treating behavioral disorders.

This analysis marks massive advancement in the field of medicine in general and neuroscience in particular. This analysis can be of great help in the treatment of behavioral disorders and also in the treatment of patients suffering from brain injuries.

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