

Putting the Trigger in One Man's Definition of Vision

Presented by Paul Harris at 1990 Skeffington Symposium

For many years I have struggled with my own definition of vision. For the past few years my definition has varied amongst the following three definitions.

1. Vision is the deriving of meaning and direction of action.
2. Vision is the deriving of meaning and direction of action from light.
3. Vision is the deriving of meaning and direction of action through the use of light.

The first parts are the same in all three instances and I am very comfortable at the present time with the first 10 words. However, I have been increasingly uncomfortable with the ending of this one line definition of vision.

Dr. Robert Kraskin and others have used an ending phrase similar to the following: "as triggered by a selective band of radiant energy." I was uncomfortable with the word "triggered" and with the meaning of the phrase "a selective band of radiant energy."

For the moment I will side step the second question with the following answer, recognizing that this should be taken up a later time. I feel that we may react or be triggered by more than a small selected band of radiant energy although we may not be consciously aware of such stimulation and or triggering. Therefore, I will substitute "by light" for "by a selective band of radiant energy."

The operative word I wish to discuss is "triggered." According to the Oxford unabridged dictionary, a "trigger" is "anything as an act or event, that serves as a stimulus and initiates or precipitates a reaction or series of reactions." A second stem of the definition is "to initiate or precipitate a chain of events, scientific reaction, psychological processes, etc. "

Just a few months ago, following the Rosslyn meeting I received in the mail as I often do from various colleagues a short hand written note suggesting for my reading pleasure a book entitled, "Godel, Escher, Bach" by Douglas Hofstadter. (aside who are you?) I believe the book was suggested not so much for how it might affect my optometry but as pleasure reading about music, art and mathematics subjects which have a common denominator and which I find interesting. I came very close to becoming a professional classical musician. I find Escher's paintings highly intellectually stimulating. My mind rushes along at a furious pace attempting to resolve the paradoxes presented in his works attempting to resolve the perspective and dimensionality conflict in the drawings. In optometry school I was the person who enjoyed the geometric optics proofs and as a child enjoyed mathematical games and the world of solving problems as formulated by Martin Gardner. My background in computers and artificial intelligence is an outgrowth of these early interests. All these areas are hit in the book.

I approached this book not like reading a journal or an article about some aspect of vision but as sheer pleasure reading. As I read I found myself more and more caught up in it. After reading "Cannon by Intervallic Augmentation" and Chapter VI entitled "The Location of Meaning" I stopped dead in my tracks. I realized that my definition of vision had just changed. Also, my entire outlook on the role of DNA in heredity, the role of light energy entering the eye and its relation to vision, the role of the written or spoken word to the message communicated has all been changed in one fell swoop. In Hofstadter's words I had been shot by a trigger into understanding how the outer messages, the energy or symbols transmitted, act as triggers in the receiver of the message and the fact that the message has little intrinsic in itself. The inner message is only received and understood if the receiver of the message has the ability to decode the message and to have the appropriate concepts, ideas and memories triggered off. Throughout Hofstadter's book when one is discussing a subject at a level higher than the subject itself he adds the prefix meta- to the word. This book was a trigger to me about triggers and could be called a metatrigger. Since the impact was so strong I would like to share some of the text directly from the book with you in hope that this message might also act as a trigger for you. I realize that what was a trigger for me may not act as a trigger for you in quite the same way.

The first passage is a conversation between Achilles and the Tortoise. Hofstadter alternates his text with dialogues between several characters. These dialogues are a vehicle to demonstrate at one level that which he discusses in full at another level in the subsequent chapter.

I will now excerpt from Chapter VI his more in depth explanation interspersed with my own commentary. An important question being asked is "When is one thing not always the same?" By this he is asking whether meaning can be said to be inherent in a message, or whether meaning is always manufactured by the interaction of a mind or a mechanism with a message.

"I'll begin with my favorite example: the relationship between records, music and record players. We feel quite comfortable with the idea that a record contains the same information as a piece of music, because of the existence of record players, which can 'read' records and convert the groove-patterns into sounds. In other words, there is an isomorphism between groove-patterns and sounds, and the record player is a mechanism which physically realizes that isomorphism. It is natural, then, to think of the record as an information-bearer, and the record player as an information-revealer. "

"One gets the impression that isomorphisms and decoding mechanisms simply reveal information which is intrinsically inside structures, waiting to be "pulled out. " This leads to the idea that for each structure, there are certain pieces of information which can be pulled out of it, while there are other pieces of information which cannot be pulled out of it. But what does this phrase "pulled out" really mean? How hard are we allowed to pull? There are cases where by investing sufficient effort, you can pull very recondite pieces of information out of certain structures. IN fact, the pulling-out may involve such complicated operations that it makes you feel you are putting in more information that you are pulling out. "

"Take the case of genetic information commonly said to reside in the double helix of DNA. A molecule of DNA - a genotype - is converted into a physical organism - a phenotype - by a very complex process, involving the manufacture of proteins, the replication of the DNA, the replication of cells, the gradual differentiation of cell types, and so on. Epigenesis is guided by a set of enormously complex cycles of chemical reactions and feedback loops. By the time the full organism has been constructed, there is not even the remotest similarity between its physical characteristics and its genotype. And yet, it is standard practice to attribute the physical structure of the organism to the structure of its DNA, and to that alone. "

"Therefore one seems forced into accepting the idea that the DNA's structure contains the information of the phenotype's structure, which is to say, the two are isomorphic. However, the isomorphism is an exotic one, by which I mean that it is highly nontrivial to divide the phenotype and genotype into "parts" which can be mapped onto each other. Prosaic isomorphisms, by contrast, would be ones in which the parts of one structure are easily mapable onto the parts of the other. An example is the isomorphism between a record and a piece of music, where one knows that to any sound in the pieces there exists an exact 'image' in the patterns etched into the grooves, and one could pinpoint it arbitrarily accurately, if the need arose."

"The isomorphism between DNA structure and phenotype structure is anything but prosaic, and the mechanism which carries it our physically is awesomely complicated. For instance, if you wanted to find some piece of you DNA which accounts for the shape of your nose or the shape of your finger- print, you would have a very hard time. It would be a little like trying to pin down "the" note in a piece of music which is the carrier of the emotional meaning of the piece. Of course there is no such note, because the emotional meaning is carried on a very high level." By this he means that the emotional meaning stems from an organization of the notes at a higher level which he calls "chunking." The specific notes which trigger an emotional response may be spread throughout the piece and may not necessarily be contiguous. The same is true in the DNA coding. A phenotype may only be present by looking at a large number of genes over many non-contiguous areas of the DNA.

Hofstadter continues by using an analogy to a jukebox where a pair of buttons act as a trigger which begins a very complex series of events. Converting the genotype to a phenotype is done by "button- pushing" some small parts of the DNA which begins the process of the cells playing rather long songs or sequences of songs by activating rather small portions of the DNA. "Portions of the DNA t trigger the manufacture of proteins; those proteins trigger hundreds of new reactions; they in turn trigger the replicating-operation which, in several steps, copies the DNA and on and on... The final result of these

many-triggered triggerings is the phenotype-the individual. "

He then asks, "Is information pulled out of the DNA? Is that where all of the information about the organism's structure resides?" The answer seems to be no, "because so much of the pulling-out process depends on extraordinarily complicated cellular chemical processes, which are not coded for in the

DNA itself. The DNA relies on the fact that they will happen, but does not seem to contain any code which brings them about. " Therefore, the DNA can be looked at as nothing more than a series of triggers, like a sequence of buttons to be pushed on a jukebox. Thus, the DNA is nearly meaningless without its context of all the inner working of a cell.

According to Hofstadter we can separate three levels of information:

1 . The frame message: "The frame message is the message 'I am a message; decode me if you can!' and it is implicitly conveyed by the gross structural aspects of any information-bearer. To understand the frame message is to recognize the need for a decoding mechanism. " (Discuss the record in space)

2. The outer message: Once the frame message is recognized the attention is switched to the outer message. "This is the information implicitly carried by symbol-patterns and structures in the message, which tells how to decode the inner message. To understand the outer message is to build, or know

how to build, the correct decoding mechanism for the inner message. This out level is an implicit message, in the sense that the sender cannot ensure that it will be understood. " It would be impossible to send a message about how to decode a message because the message about how to do the decoding would first have to be decoded. "For this reason, the outer message is necessarily a set of triggers, rather than a message which can be revealed by a known decoder. " (Discuss Rosetta Stone)

3. The inner message: this is the message which is supposed to be transmitted: the emotional experiences in music, the phenotype in genetics, etc. "To understand the inner message is to have extracted the meaning intended by the sender."

"It is always the listener's burden to understand the outer message. Success lets him break through into the inside, at which point the ratio of triggers to explicit meanings shifts drastically towards the latter. By comparison with the previous stages, understanding the inner message seems effortless. It is as if it just gets pumped in. " At this point I wrote in the margin, "The AH-HA occurs! ", meaning that the message is being received, the decoding system exists and is complete and the message is triggering inner understanding directly. What must be understood is that no message contains inherent meaning. Before it can be understood it must be fed into some "jukebox." Thus, the information already in the jukebox is added to and necessary for the understanding of the message.

Although he did not discuss vision in this section it is apparent that the light impinging on our retinas is only a series of triggers with nothing inherent in the light energy itself. To derive meaning requires a very sophisticated and complicated hardware-software system that in my opinion approaches the DNA genotype to phenotype system in complexity. The vision system is particularly remarkable in its speed of processing, deriving meaning, or "pulling-out" the information from the light triggers.

I hope that in some way this paper has acted as a trigger for each of you and that my message and Hofstadter's message has gotten across. Vision is the deriving of meaning and the direction of action as "triggered" by light. This book has put the trigger in my definition for good!

"Godel, Escher, Bach: An Eternal Golden Braid", Hofstadter, Douglas, R., Vintage Books Edition, May 1979, Basic Books, Inc. A Division of Random House.