

Of Codes and Consciousness

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Abstract

In this note, the author suggests an analogy between codebook design and the wiring of the brain and how that influences the life of an individual.

In coding theory [1] a linear code is a set of words such that any linear combination is a bonafide word as well. Now suppose that the different brain regions are like codewords. If we stimulate the auditory (A) codeword alone, it conveys auditory information. If we stimulate the visual (V) codeword alone, it conveys visual information. If we stimulate a generic linear combination of A and V, some specific linear combination may be a bonafide codeword itself, for example, a DF codeword, for double-flash. Thus joint stimulation of A and V in specific proportions would be the same as stimulating the DF codeword. In other proportions it would be gibberish or a non-codeword. So depending on what brain regions correspond to what codewords, we may occasionally access an ‘illusion’ (DF) codeword [2, 3, 4].

The brain would then simply be a mechanism by which a codebook is hard-wired. The suggestion would be that an individual is like a code or a codebook. The stimuli from the environment throughout their life activate different codewords at different times, yielding him or her different experiences. Thus for each individual, life plays out a different symphony of messages. Within noise bounds, there may be some malleability in the exact physical substrate and representation of each codeword.

The codebook of the brain is the prototype (blueprint) of the individual. Just as one can occasionally access an illusion (DF codeword), one might also occasionally access inspiration, or a so-called ‘new’ insight of understanding, arousal of the brain, knack, or creativity or deep meditation. Self-knowledge [5] is then equivalent to understanding one’s codebook in all its details. Objectively, when brain activity is examined, one can gain knowledge of the identity of these regions and their mathematical linkages (in the sense of linear resolution) with other brain regions.

Whereas Tononi’s integrated information theory [6] gives us an observation based characterization of the ‘degree’ of consciousness in terms of overall ϕ or network information exchange, the codebook approach of this note tells us why certain complexes have high ϕ . They do so because they are the mathematically allowed connected-regions in the coding theory sense. So after noting

high phi we can then note down the complex and thereby get an idea into the underlying codebook structure.

In summary, this note presents a suggestion to the experimental community, to figure out the codebook structure of the brain and therefrom predict behavioral responses of the individual as they go through various situations or experiences. It is an extension of the usual concept of pathways and decussations in the fine structure of the brain [7, 8]. An analysis such as the one presented here, offers clues in determining the ‘location’ or ‘locus’ of the individual or ‘self’ in the brain [9], which is an important question in neuroscience and philosophy.

References

- [1] G. David Forney. *Principles of Digital Communication II*. Massachusetts Institute of Technology.
- [2] Ladan Shams, Sunao Iwaki, Aman Chawla, and Joydeep Bhattacharya. Early modulation of visual cortex by sound: An MEG study. *Neuroscience Letters*, 378(2):76–81, 2005.
- [3] Ladan Shams and Robyn Kim. Crossmodal influences on visual perception. *Physics of life reviews*, 7(3):269–284, 2010.
- [4] Aman Chawla and Salvatore Domenic Morgera. On an analogy between ephaptic coupling in large tracts and cross-modal integration during illusory percept. *bioRxiv*, 2022.
- [5] Timothy D Wilson and Elizabeth W Dunn. Self-knowledge: Its limits, value, and potential for improvement. *Annu. Rev. Psychol.*, 55:493–518, 2004.
- [6] Giulio Tononi, Melanie Boly, Marcello Massimini, and Christof Koch. Integrated information theory: from consciousness to its physical substrate. *Nature Reviews Neuroscience*, 17(7):450–461, 2016.
- [7] Dale Purves, George J Augustine, David Fitzpatrick, William Hall, Anthony-Samuel LaMantia, and Leonard White. *Neurosciences*. De Boeck Supérieur, 2019.
- [8] Dale Purves, Elizabeth M Brannon, Roberto Cabeza, Scott A Huettel, Kevin S LaBar, Michael L Platt, and Marty G Woldorff. *Principles of cognitive neuroscience*, volume 83. Sinauer Associates Sunderland, 2013.
- [9] Antonio Damasio. *Self comes to mind: Constructing the conscious brain*. Vintage, 2012.