INFORMATION ENTROPIES ARE UNABLE TO DESCRIBE MENTAL ACTIVITIES

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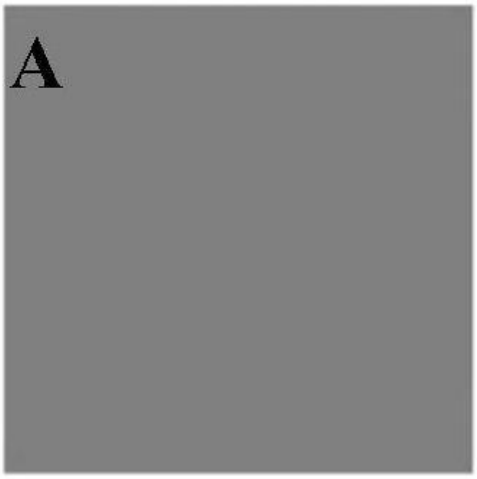
Information theory is a successful paradigm that permits the evaluation of the most general features of physical/biological systems (Bekenstein, 2003; Zenil, 2012). After Shannon's (1948) account and Kantor's (1977) claim, who first proposed that the world is made up of the fundamental, measurable physical quantity called information, countless information-related perspectives have been developed in different scientific fields. To provide a few examples, links among information theory, statistical thermodynamics, Renyi entropy, quantum mechanics and Bekenstein-Hawking entropy have been suggested (Jaynes 1957; Lloyd 2000; Marzuoli and Rasetti, 2005, Weizsäcker 2006; Bromiley et al., 2010). Even before the slogan "it from bit" was launched (Wheeler, 1990), neuroscientists started to ask to themselves: are we allowed to use physical information to assess neural and mental issues? By then, several efforts have been provided to describe brain activity -and its related mental functions and neural correlates- in terms of information. Many authors, including myself (e.g., Tozzi et al., 2016; Tozzi et al., 2018), provided explanations of mental functions in the fascinating framework of information entropy. Among the most successful attempts, free energy Bayesian approaches (Friston 2010) based on energy budgets (Attwell and Laughlin, 2001), and pairwise entropy extracted from fMRI neurodata (Watanabe et al., 2013 and 2014) are worth to be mentioned.

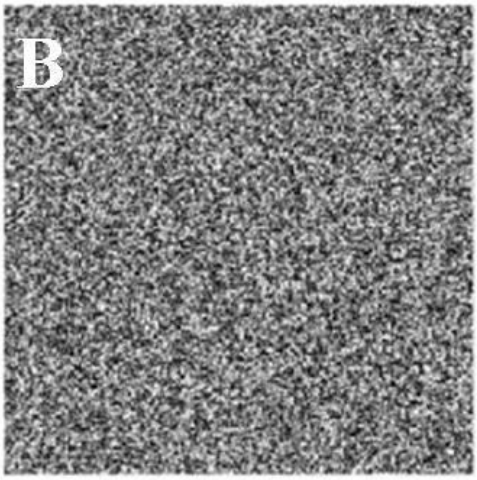
However, with time passing, It's starting to become quite clear that something got wrong with the duet information/brain. Recently, I was trying to correlate the informational content of an object located in the environment, say a cat in front of me, with the changes in brain informational content that are perhaps caused by my perception of the cat. In sum, I wanted to investigate how changes in environmental information modify the information in my brain. Going through the literature, I watched a simple picture, and it was enough to fully change my mind. I realized that information entropy is totally inadequate to assess, describe and quantify the activities of the brain that we term mental functions.

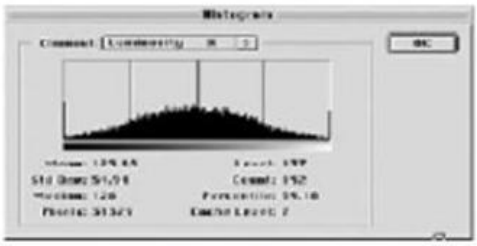
Here you are the very simple, almost trivial, proof. The **Figure** below illustrates four photographs (modified from Allen and Triantaphillidou, 2009) with different entropic content, the latter having been accurately quantified through the widely available techniques. When I look at the photographs, something weird occurs. It is easy to see that the two photographs A and B (the ones with the lower and the higher content of entropy) do not say anything: when I look at them, they are devoid of content. They are, by my standpoint of perceiver embedded in an environment, meaningless and senseless: that is, when I watch them, I cannot provide any proposition that can be judged true or false. By the psychological standpoint of the naïve observer, the two photographs are made just by useless spots that do not describe anything at all.

In turn, the two pictures C and D (the ones with intermediate values of entropy) display, by my psychological standpoint, a meaning and a sense. They give rise to vivid perceptions that cause inside my brain sensations, reasoning, thoughts, i.e., in short, all sorts of psychological activities.

What does it mean? This means that the perception of an observer is not correlated at all with the physical informational content of an object located in his environment. The link between the environmental object and my mental perception is unknown, but it cannot be a physical link based on information issues. Therefore, the efforts of neuroscientists to quantify the changes in information entropy inside the brain during different mental tasks is useless and devoid of content. In other words, the changes in brain entropy detected by the huge available mess of neurotechniques (such as, e.g., EEG, fMRI, tractography) are not able to describe my mental activities: psychological functions are not correlated with physical information. There must be mechanisms other that information that explain how I perceive an object. But that's another story…

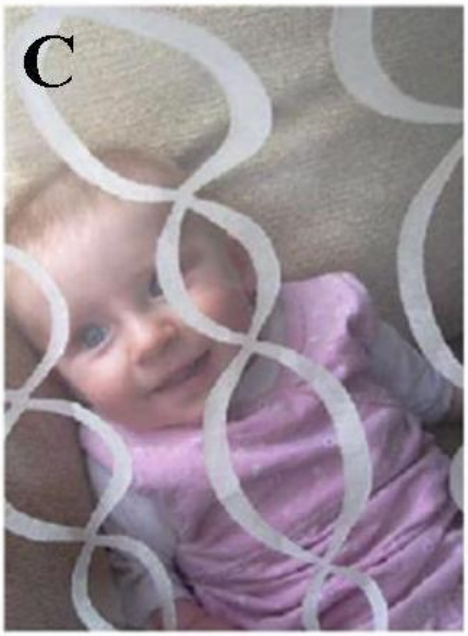






Entropy=0

Entropy=8.0



Entropy=7.22

Entropy=7.79

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