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Functional magnetic resonance imaging and marketing research, a new way to understand consumer

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Abstract: In the first decade of the 21st century, advanced imaging techniques for neuroscience research began to be applied. The fMRI or Functional Magnetic Resonance Imaging is one of the most important and most used technique for emotions researchbecause it makes easy to observe the oxygenated areas of the brain when performing different tasks. The fMRI consists in obtaining detailed images of the internal organs and tissues, using radiofrequency waves and a very powerful magnet. It measures the metabolic changes that occur in a part of the brain tissue in activity, being useful not only for the study of the cerebral anatomy but also can help to determine exactly which area of the brain is performing each function.

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I. Functional magnetic resonance and marketing research

The term Functional Magnetic Resonance (MRI) with "F" means another set of techniques within MRI that are sensitive to physiological changes such as water movement. Functional Magnetic Resonance "with lowercase f" refers generally to the study of brain activity with its mapping.

Conventional MR equipment consists of a cylindrical magnet in which the patient is introduced and in which the patient must remain still for the duration of the examination. It may occur that the patient feels trapped or has a feeling of claustrophobia.

MRI uses radiofrequency waves and a very powerful magnetic field instead of using x-rays to obtain great detail images of internal organs and tissues. FMRI uses this technology to identify regions or areas of the brain where an increase in the amount of oxygen is occurring, a process that occurs when a brain area has to be activated to send instructions to the body.

In fMRI studies the subject performs a certain activity while the equipment is obtaining images. The metabolism of the brain area responsible for this activity will increase and the signal in the MRI study will vary. Performing different specific tasks that correspond to different anatomical areas we can locate the region of the brain responsible for a certain function, which is being activated at each moment.

The subject under study is accommodated on the movable table with the head inside a helmet designed to avoid movement during the test. During the exploration the subject receives various instructions for performing cognitive activities and purchasing various products. You can also communicate with the radiologist or technician throughout the entire exploration.

The study lasts approximately 30 minutes per subject, it´s important not to move, because the images are being obtained.

Risks and advantages of fMRI

The fMRI can identify the location of the different normal functional areas of the brain. In addition, functional images of the brain and other brain structures obtained with fMRI are more detailed than those obtained with other imaging methods. We must consider that this technique avoids exposure to radiation.

But there are also risks, we will consider that the metallic fragments can be attracted by the magnet if the patient has a metallic object and he does not know it. When introduced into the magnetic field it can move, and also that fMRI should be avoided within the first 12 weeks of pregnancy.

About the limitations of fMRI, we must consider that it is in evolution and progressively progressing. It is as accurate as other imaging methods to locate brain activity, but there is less experience in fMRI than in other areas of MRI.

Through fMRI we will observe if the cerebral zones that are activated in each of the phases of the experiment correspond to areas responsible for regulation or emotional or cognitive activity.

II. fMRI studies and marketing

We will then review the main research carried out on the influence of emotions in the decision making process using fMRI.

Authors	MainContributions
Knutson (2001, 2005, 2007)	There are three key brain areas in the purchase decision, the bilateral nucleus accumbens (NaCC); the bilateral insula and the mesial prefrontal cortex (mPFC). Accumbens Nucleus (NAcc) is oxygenated when a correct gain prediction is produced, while activation occurs in the mesial prefrontal cortex in the presence of a gain prediction error.
Erk et al. (2002)	Sport cars are rated significantly better than the rest, and in this category a greater activation is observed in the ventral striatum, the orbitofrontal cortex, the anterior cingulate and the occipital regions. In this way it is observed that an artificial cultural object associated with wealth causes the activation of the areas of the brain related to the reward.
Dolcos et al. (2004)	The enhancer effect of emotion on memory formation is due in part to an increase in memory operations at semantic and strategic level in the prefrontal cortex.
McClure et al. (2004)	The ventromedial prefrontal cortex is related to the preferred behavior. In branded consumption, knowledge of them has a major influence on behavioral preferences and measures of brain response.
Knutson et al. (2007).	Before the purchase process occurs in the brain, there is a process of activation of different areas related to affection (anticipatory to the purchase of a product): Excessive prices cause the insula to activate and deactivate the mesial prefrontal cortex. NAcc is related to positive profit.
Cohen (2007)	The subjects of an experiment must choose between rewards with high risk and with reduced, observing the errors of prediction and the values obtained by each individual in each attempt. The results show a great activity in each task in different limbic regions and the prefrontal cortex, as well as a great importance in the individual differences of each subject according to their difference with the rest in the learning process.
Rangel et al. (2008)	Decision-making based on evaluation can be divided into five basic processes: first, the construction of a representation of the decision problem, which involves the internal and external identification of the different states, as well as possible types of action; second, the assessment of the different actions under consideration; third, the selection of one of the actions based on their assessments, fourth, after the decision, the brain needs to measure the appropriateness of the results and, lastly , the results evaluation is used to update other processes to improve the quality of future decisions.
Pessiglione et al. (2008)	During the conditioning process and prediction errors, generated from a calculation model, the tasks are related to activity in the ventral striatum. Even without conscious processing of contextual cues, our brain can learn the value of reward and use it to provide guidance in decision making.
Stoll et al. (2008)	The contrast of attractive and unattractive packagins revealed significant changes in the cortical activity of the visual areas of the occipital lobe and precuneus, regions associated with processing of visual stimuli and attention. The brain processes negative visual stimuli in a different way than positive ones.
De Martino, et al. (2009)	The activity in the orbitofrontal cortex and the dorsal striatum is activated in relation to the expected value of lottery tickets, which indicates the value-independent reference calculation process.
Chib et al. (2009)	There is activity in an area of the prefrontal cortex ventromedia in the process of coding options. This shows that the brain uses a "common currency" that allows a shared assessment, even for different categories of products.
Kirk et al. (2009)	The results show that the aesthetic judgments made by the people, performed by the prefrontal and orbitofrontal cortex are significantly influenced by the expectations of the subjects of their probable hedonic value. The qualifications given by the participants on the aesthetic quality of the images are considerably higher on the works they believed were in an art gallery than on those they believed were generated by the computer. This modulation is related to the medial orbitofrontal cortex and the prefrontal cortex, while the context, regardless of aesthetic value, is related to the bilateral entorhinal cortex.
Ariely y Berns. (2010)	The amount of money that participants in a snack purchase experiment were willing to pay is related to activity levels in the medial orbitofrontal cortex (OFC) and the prefrontal cortex (PFC).
Sescousse et al. (2010)	Monetary gains activate the anterior regions of the orbitofrontal cortex (OFC) and erotic images, posterior regions.
Tusche et al. (2010)	There is no difference in the decisions of buying products with much attention and those of little. This suggests that the evaluation processes of the different products do not depend on the attention given to them, highlighting the importance in this task of the implicit and automatic brain processes.
Hare et al. (2010)	Blood oxygenation in the ventromedial prefrontal cortex (VMPFC) is related to the subjective value of voluntary donations, suggesting that it could be a system of assessment during the decision-making process. The value could also integrate processes in the anterior insula and the posterior superior temporal cortex, which are believed to be involved in social cognition.
Salimpoor et al. (2011)	An intense pleasure in response to music can lead to the release of dopamine in the striatal system. The anticipation of an abstract reward may result in the release of dopamine into an anatomical pathway other than that associated with the pleasure peak itself.
Levy et al. (2011)	Activation of the striatum and the middle prefrontal cortex in processes where no choice is required predict the possible choice of each subject, suggesting that these areas of the brain represent value, either in an elective process or not.
Plassmann et al. (2011)	The evaluation of the different results is defined by the expected value and the weight of the decision of each option during the period of decision making. The outcome evaluation system is influenced by cognitive processes that determine expectations and beliefs, a phenomenon also called the "placebo

	marketing effect" or "expectation bias."

III. Discussion

In fMRI the paradigm is called the set of activities that the patient has to perform in a certain time sequence during the acquisition of the images. Basically there are two major types of paradigm design: block design and event-related design. In the block design the paradigm is formed by a sequence of blocks, so that the patient alternates blocks in which he performs an activity and blocks in which the patient is at rest or performs a task that is taken as a control situation; in each block the hemodynamic responses overlap and accumulate, reaching a plateau. In event-related design activities and control tasks alternate individually, in a rapid sequence, usually in a random or pseudorandom order. Although event-related designs allow assessment of the characteristics of hemodynamic response in a specific region of the brain during a given activity, block designs have a greater power of detection of activation from a statistical point of view and their analysis is simpler.

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