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Analysis of Response Times When Purchasing Rational And Emotional Products, Compared to A Cognitive Task. A Study Using FMRI.

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Abstract: *Several authors investigates the relationship between the rational and the emotional product purchasing. They normally associates the emotional purchasing with a lower time response, and the rational with a faster one, because of the time needed to think. We use the FMRI technique to find out if this is really happening, and we compare this two buying tasks with pure rational or cognitive task, to investigate if this one is similar to the rational buying process. As we can see in the discussion, the times that people need to buy both rational and emotional types of products are very similar, and different to the time needed to perform a cognitive task.*

I. Literature Review

In the first decade of this century, it began to be implemented advanced imaging techniques for neuroscience research. In this sense, the FMRI or functional Magnetic Resonance byimaging is one of the most important and most used techniques when it comes to the research of emotions,due to its ease to observe brain areas that are oxygenatedwhen performing various tasks.

One of the least frequently analyzed parameters in experiments in Marketing is time. As noted in several previous publications (Lopez et al 2016, Lopez 2016), the use of emotions in decision making processes represent significant savings in time, since purely cognitive tasks have an implied cost-benefit detailed analysis process, whichis altered, when emotions come into play, since certain options see their weight increased or reduced, thanks to the somatic marker (Lopez 2016).

In this paper we propose a purchase experiment of rational and emotional products through the FMRI technique, for a comparative analysis of time spent on them. Likewise, a purely cognitive task will be done, and it willbe observed and analyzed whether the results regarding the temporary estimate of a task that requires only rational processing is higher as expected, when compared to a decision-making process, of either rational or emotional products, in which there is already evidence of emotional processes involved (Lopez 2016).

In the table below we present a summary of the main research contributions made by studies that used FMRI:

AUTHORS	MAIN CONTRIBUTIONS
Knutson (2001, 2005, 2007)	There are three fundamental brain areas in the purchasing decision, the bilateral nucleus accumbens (NaCC); the bilateral insula and the mesial prefrontal cortex (mPFC). Oxygenation of the nucleus accumbens (NAcc) occurs when a correct gaining prediction occurs, while there is an activation of the mesial prefrontal cortex before a gain prediction error.
Erk et al. (2002)	Sports cars are rated significantly better than the rest, and it is also observed in this category an increased activation in the ventral striatum, in the orbitofrontal cortex, in the anterior cingulate and the occipital regions. Thus it is observed that an artificial cultural object associated with wealth causes activation of brain areas related to reward.
Dolcos et al. (2004)	The potentiating effect of emotion on memory formation is due in part to an increase in working operations of memory in semantic and strategic levels in the prefrontal cortex.
McClure et al. (2004)	The ventromedial prefrontal cortex is related to preference behavior. In consumer brands, their knowledge of them has an important influence on the behaviorpreferences and response measures of the brain.
Knutson et al. (2007).	Before making the purchase,occurs a process of activation in the brain of different areas related to affection (anticipatory to a product purchase): Excessive prices activate the insula and the mesial prefrontal cortex is deactivated. The NAcc is related to the positive gain.
Cohen(2007)	Subjects of an experiment must choose between rewards with high risk and reduced risk, observing prediction errors and the values obtained for each individual in each attempt. In the results, high activity was observed in each task in the different limbic and prefrontal cortex regions, as well as great importance put on the individual differences of each subject, according to their difference with the rest in the learning process.
Rangel et al. (2008)	Decision making processes based on evaluation can be divided into five basic processes: first, the construction of a representation of the decision problem, which involves internal and external identification of the different states, as well as possible types of action, Secondly, the valuation of the different actions into consideration. Thirdly, the selection of one of the actions, based on its ratings. Fourthly, after the decision, the brain needs to measure the convenience of the results, and finally, the evaluation of results is used to update other processes to improve the quality of future decisions.

Pessiglione et al. (2008)	During the conditioning process and the prediction errors, which are generated from a calculation model, tasks are related to the activity in the ventral striatum. Even without conscious processing of contextual cues, our brain can learn the value of the reward and uses it to provide guidance in decision-making.
Stoll et al. (2008)	The contrast of attractive and unattractive packaging revealed significant changes in the cortical activity, in visual areas of the occipital lobe and the precuneus, regions associated with processing visual stimuli and attention. The brain processes visual stimuli negative differently than the positive.
De Martino, et al. (2009)	Activity in the orbitofrontal cortex and the dorsal striatum is activated in relation to the expected value of lottery tickets, which indicate the reference calculation process, regardless of value.
Chib et al. (2009)	There is activity in an area of the ventromedia prefrontal cortex in the coding options process. This is evidence that the brain uses a "common currency" that allows a shared assessment, even for different product categories.
Kirk et al. (2009)	The results show that that the aesthetic judgments made by individuals, carried out by the prefrontal and orbitofrontal cortex, are significantly influencedby the expectations of the subjects of their likely hedonic value. The scores given by the participants on the aesthetic quality of the images are considerably higher on the works they thought were in an art gallery than those who believed they were generated by the computer. This modulation is related to the orbitofrontal cortex and medial prefrontal cortex, while context, regardless of the aesthetic value, is related to the bilateral entorhinal cortex.
Ariely y Berns. (2010)	The amount of money that participants were willing to pay in an snacks purchase experiment 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, the posterior regions.
Tusche et al. (2010)	There is no difference in product purchasing decisions madeby paying lots of attention and those made barely paying any. This suggests that the evaluation process of different products don't depend on the attention paid to them, stressing the importance of implicit and automatic brain processes in this task.
Hare et al. (2010)	Blood oxygenation in the ventromedial prefrontal cortex (VMPFC) is related to the subjective value of voluntary donations, suggesting that it might be a rating system during the decision-making process. The value could also integrate processes in the anterior insula and the posterior superior temporal cortex, which are thought to participate in social cognition.
Salimpoor et al. (2011)	Intense pleasure in response to music can lead to a dopamine release in the striatal system. Anticipating an abstract reward can result in the release of dopamine in a different anatomical pathway associated with the peak of pleasure itself.
Levy et al. (2011)	Activation of the striatum and of the medial prefrontal cortex in processes in which no choice is required predict the possible choice that each subject would make, suggesting that these brain areas represent the value, either in an elective process or not.
Plassmann et al. (2011)	The evaluation of the different results is defined by the expected valence and the weight of the decision of each option during the decision-making process. The result evaluation system is influenced by cognitive processes that determine expectations and beliefs, a phenomenon also known as "placebo effect in marketing" or "selection bias".

Table 1: main contributions of research that used FMRI
Source: author

II. The FMRI Technique

The FMRI technique consists in obtaining detailed images of internal organs and tissues, through the use of radiofrequency waves and a powerful magnet. It measures the metabolic changes that occur in a part of active brain tissue, being useful not only for the study of brain anatomy, but it also can help to determine exactly which area of the brain is the one that is performing each function.

The term Functional Magnetic Resonance (FMR, with capital F) includes a series of techniques in MRI which are sensitive to physiological changes, such as water movement. Whereas functional Magnetic Resonance (with lowercase f) generally refers to the study of brain activity througharea maps.Conventional MRI scanners are formed by a cylindrical magnet capsule to which the patient is introduced and in which it must remain still for the duration of the scan, and it can happen that the patient feelslocked up or feels claustrophobia.MRI uses radio waves and a very powerful magnetic field instead of using x-rays to produce images of great detail of internal organs and tissues. FMRI uses this technology to identify regions or areas of the brain where there is an increase in the amount of oxygen, a process that occurs when a brain area must be activated to send instructions to the body.

In FMRI studies, the subject is doing an specific activity while the computer is obtaining images. The metabolism of the brain area responsible for this activity will increase and the signal in the MRI study will vary. By doing different specific tasks that correspond to different anatomical areas we can locate the brain region responsible for a particular function being activated at all times.The subject under study is accommodated in a mobile table with its head in a helmet designed to prevent movement during the test. During the examination, the patient receives various instructions to do cognitive activities and purchasing various products. The patient can also communicate with the radiologist or technician throughout the entire examination.

Limitations and benefits of FMRI

Regarding benefits, FMRI can identify the location of the different normal functional areas of the brain. Besides, the functional brain images and other brain structures that are obtained with FMRI are more detailed than those obtained with other imaging methods. Finally, we must consider that radiation exposure is avoided with this technique.As for the limitations of FMRI, this technique is currently evolving and progresses gradually. It is as accurate as other imaging methods to track brain activity, but there is less experience with FMRI than in other areas of MRI.

III. Experiment Description

The FMRI experiment that we will implement will consist of three tests. On the first we will define the pattern of cognitive reference. What we want to know is the time that subjects spend making decisions that may lead to establish a brain pattern, which occurs when performing a task that is purely cognitive, without any emotional decision-making process. For this we will define an exercise in which participants have to say which product corresponds to a certain price.Then we will implement the second test, in which subjects have to perform a task of purchasing products previously labeled as rational. The observation time spent on this task will give us a sample of the existing differences with the first test, in which no decisions are madeFinally, we will have a third test in which participants have to go through a purchase process of products previously labeled as emotional.We want to determine if in this test the time invested is less than or greater than the other two.

I. CONTROL TEST: cognitive reference pattern.

Subjects are exposed to a set of images of four products, in which they have to say, in their opinion, what product corresponds to a certain price that is shown. This is done during a period of time necessary to record their brain response and thus obtain a pattern of cognitive dominance. In this test, there is no purchase process. They are presented with sets of four products of correlative slides separated by seven rest slides until the five minutes of test time are met, in which it instantly finishes (see images 1 and 2).

Image 1: Control test example slide: cognitive reference pattern
Source: autor

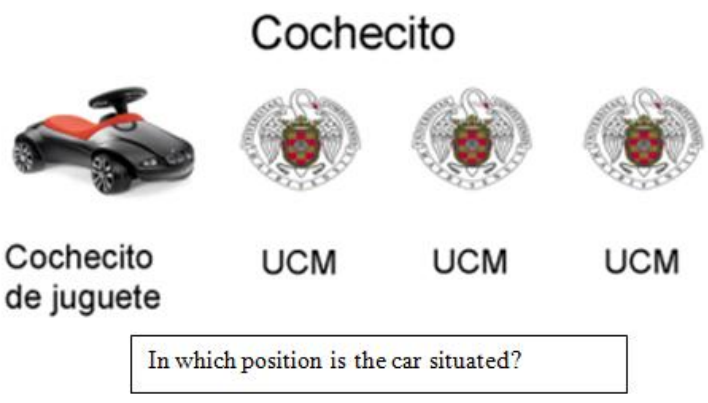

Image 2: Example slide of rest transparency between images
Source: author

II. EXPERIMENTAL TEST I: rational purchase decision

Subjects are exposed to a series of slides, each of which pose a making purchase decision of a series of considered products, rational in character, for example, such as bread, napkins, rulers, shelves, visors, alkaline batteries, knives, umbrellas, juicers, pens, toothpaste, hangers, oral elixirs, etc.Subjects must buy in a simulated situation, being showed images of products, a small definition of them, and the price of each.

There is a possibility that a product is in areduced price offer, as in real purchasing situations, because you want to simulate a shopping environment as realistic as possible, within the natural limitations of this type of experiment.As in the case of the control test, they were presented with sets of four products of correlated slides separated by seven rest slides until the five minutes of test time are met, instant in which it ends (see images 3 and 4). These are intended to determine the time spent on it, comparing it to the first task.

Image 3: Example slide of experimental test I: rational purchase decision
Source: author

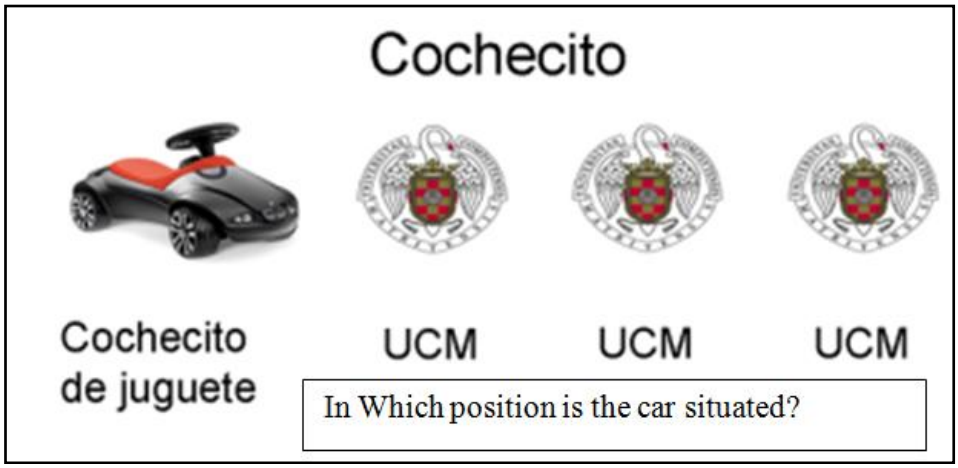

Image 4: Example slide of rest transparency between images
Source: author

III. EXPERIMENTAL TEST II: emotional purchase decision.

Subjects are exposed to a series of slides, each of which will pose a decision making purchase process of products considered emotional in character. For example, canvas prints, lingerie, digital picture frames, men's shirts, men's shoes, women's shirts, digital cameras, car radios, men's colognes, men's jewelry, brandy, mobile phones, computer speakers, women's perfumes, coolers, etc.Subjects must buy in a simulated situation, being showed images of products, a small definition of them, and the price of each.

There is a possibility that a product is in areduced price offer, as in a situation of actual purchase, because you want to simulate a shopping environment as realistic as possible within the natural limitations of this type of experiment.As in the case of the control test, they are presented with sets of four products of correlated slides, separated by seven rest slides untilfive minutes test time are met, instant in which it ends (see images 5 and 6).The time spent on the task is observed.

Image 5: Example slide of experimental test II: emotional purchase decision
Source: author

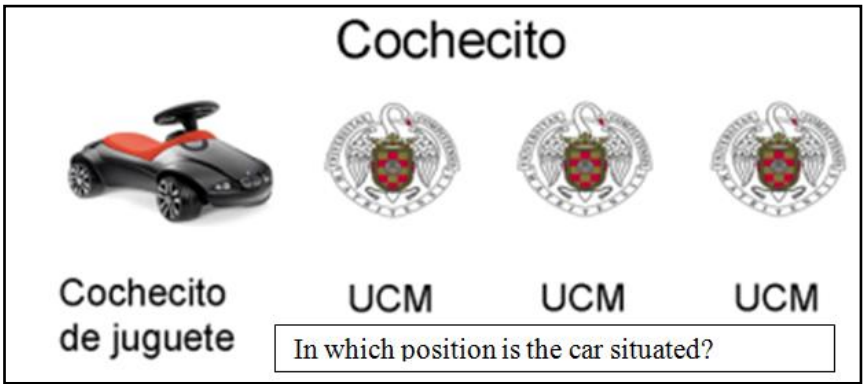

Image 6: Example slide of rest transparency between images
Source: author

IV. Discussion

In the experiment we obtained the following data:

Cognitive Task Response Times

	TRANSPARENCIES		CONTROL	
	MEAN	TYP. DEV.	MEAN	TYP. DEV.
SUBJECT 1	11,15	2,44	2,37	0,7
SUBJECT 2	8,13	2,94	0,84	0,96
SUBJECT 3	10,67	2,63	1,16	0,53
SUBJECT 4	11,73	3,69	2,24	0,97
SUBJECT 5	8,65	3,38	0,9	0,4
SUBJECT 6	7,04	1,79	0,81	0,29
SUBJECT 7	6,22	1,97	0,76	0,27
SUBJECT 8	8,73	2,91	1,25	0,75
SUBJECT 9	4,48	1,72	0,88	0,44
SUBJECT 10	9,17	2,82	1,04	0,31
SUBJECT 11	7,59	2,41	0,83	0,41
SUBJECT 12	11,05	1,82	0,87	0,4
SUBJECT 13	9,94	2,48	1,1	0,54
SUBJECT 14	10,17	2,39	1,12	0,49
SUBJECT 16	7,64	2,28	1,31	0,66
SUBJECT 17	8,62	2,3	0,8	0,27
SUBJECT 18	11,99	3,32	1,47	1
SUBJECT 19	4,77	1,65	0,82	0,28
SUBJECT 20	11,94	3,6	1,31	0,76
SUBJECT 21	8,07	2,35	0,92	0,41
SUBJECT 22	7,27	2,81	1,26	0,55
SUBJECT 24	8,95	1,81	0,96	0,34
SUBJECT 25	7,86	1,61	1,19	0,45
MEAN	8,7752	2,483	1,13957	0,53

Table 1: Cognitive task response times.
Source: author.

Purchase Cognitive Task Response Times

	TRANSPARENCIES		CONTROL	
	MEAN	TYP. DEV.	MEAN	TYP. DEV.
SUBJECT 1	8,88	2,03	1,48	0,36
SUBJECT 2	4,93	2,21	0,54	0,26
SUBJECT 3	5,64	1,5	0,62	0,2
SUBJECT 4	8,62	2,76	1,2	0,38
SUBJECT 5	7,6	2,99	0,63	0,18
SUBJECT 6	8,99	3,3	0,71	0,25
SUBJECT 7	6,37	1,58	0,66	0,2
SUBJECT 8	7,41	2,75	0,87	0,46
SUBJECT 9	3,17	1,35	0,67	0,25
SUBJECT 10	7,59	2,11	1	0,5
SUBJECT 11	7,87	2,38	0,73	0,36
SUBJECT 12	8,24	2,88	0,68	0,36
SUBJECT 13	7,95	2,46	0,94	0,48
SUBJECT 14	10,87	3,67	0,75	0,23
SUBJECT 16	7,73	2,19	0,97	0,58
SUBJECT 17	6,41	2,06	0,64	0,2
SUBJECT 18	13,45	2,57	1,22	0,58
SUBJECT 19	7,09	2,64	0,82	0,36
SUBJECT 20	11,33	2,96	0,96	0,49
SUBJECT 21	9,43	2,21	0,76	0,26
SUBJECT 22	6,68	2,73	0,83	0,32
SUBJECT 24	6,63	1,76	0,82	0,23
SUBJECT 25	6,62	2,01	0,96	0,5
MEAN	7,80435	2,396	0,846087	0,347

Table 2: Rational purchase response times.
Source: author.

Emotional Purchase Task Response Times

	TRANSPARENCIES		CONTROL	
	MEAN	TYP. DEV.	MEAN	TYP. DEV.
SUBJECT 1	7,61	1,83	1,38	0,43
SUBJECT 2	5,64	2,04	0,54	0,17
SUBJECT 3	8,02	1,88	0,63	0,35
SUBJECT 4	7,74	2,52	0,9	0,56
SUBJECT 5	6,07	2,08	0,59	0,16
SUBJECT 6	11,57	3,35	0,67	0,24
SUBJECT 7	7,45	2,14	0,66	0,26
SUBJECT 8	5,67	2,2	0,75	0,32
SUBJECT 9	4,61	2,13	0,75	0,75
SUBJECT 10	8,05	2,67	0,74	0,23
SUBJECT 11	6,92	1,9	0,63	0,26
SUBJECT 12	9,09	2,04	0,69	0,28
SUBJECT 13	8,36	2,72	0,81	0,4
SUBJECT 14	9,51	3,2	0,56	0,19
SUBJECT 16	8,29	3,22	0,97	0,49
SUBJECT 17	6,05	2,35	0,65	0,22
SUBJECT 18	13,53	3,87	0,91	0,31
SUBJECT 19	6,6	2,5	0,71	0,23
SUBJECT 20	12,32	3,78	0,85	0,59
SUBJECT 21	8,68	2,77	0,68	0,18
SUBJECT 22	7,16	2,29	0,87	0,42
SUBJECT 24	7,52	2,3	0,74	0,25
SUBJECT 25	6,55	1,94	0,87	0,4
MEAN	7,956957	2,51	0,76304	0,3343

Table 3: Emotional purchase response times.
Source: author.

As you can see, when making a comparison between the time spent on the task of establishing cognitive pattern time and the time spent on the task of cognitive purchase, the first is much higher than the second, which can lead us to consider that while we are carrying out a task which does not involve emotions, the period of time spent in it is higher, which is consistent with the considerations noted in various studies (Stoll et al 2008, Kirk et al. 2009). Emotions, in that sense, would be shortcuts, advances that are made in the decision making processto select options with a different value and that save time and effort devoted to the task (Bechara et al. 1996).

Noting the differences between time spent on the task of cognitive pattern andtime spent in the task of purchasing emotional products, we can conclude that in this case a similar situation occurs, since the former is significantly higher than the latter. It´s perfectly logical that when it comes to emotional products, there are elements that accelerate the decision-making process, making some attributes to be recognized and considered in a quick manner by the subject (Knutson 2005, Knutson 2007), and the purchase decision making process is thus more fleeting than the establishment of a cognitive pattern through a purely rational task.

As for the comparison of the two time measurements used in the cognitive and emotional purchase processes, it is observed that there are virtually no significant differences between them, which is a breakthrough in the line of various conducted researches (Zajonc 1980, Wikielman et al. 2007, Lopez 2016), showing evidence that emotions directly influence decision-making processes in people, either consciously or unconsciously, forming part of the decision-making mechanisms on a physiological level.

As for the comparison of the standard deviations times, they are very similar in all three cases, which is why we consider that there are no significant differences and an analysis of the situation is not pertinent.Observing the time spent on rest transparencies, it is also concluded that there are no differences that can be considered mentionable and remarkable among those invested in the three different tasks, and neither between the standard deviations of them, therefore an analysis will not be made about them.Therefore,it can ultimately be considered, depending on the outcome of this investigation, that the decision-making process of products, whether rational or emotional, is a task in which, under the influence of emotions, gets less timeinvested than in other tasks that have a marked cognitive nature, with rational processes in which purchasing decisions are not presented.

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