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Strategic Decision-Making Performance On The Iowa Gambling Task Based On Universal Basic Emotions, Gender, And Daytime

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Abstract
Every day we make decisions that can be ordinary and known through experience and others that can be complex, such as what to eat, hygiene, work, investment, family and education, shopping, marriage. In addition, sometimes decisions are deliberate, other times they are contingent or automatic, unconscious. The act of deciding involves various cortical processes, both consciously and unconsciously, with or without processes for evaluating consequences and the risks involved in each one. This study aims to evaluate the financial performance resulting from strategic decision-making in the risky environment of the Iowa Gambling Task (IGT) game between two groups of voluntary participants. Through an experiment, we compare their performance at different times of the day (morning and afternoon), measuring differences in gains based on primary emotional responses and gender. A web-based data collection platform was developed. The platform hosts the IGT game in the foreground and, in the background, collects data on the individual's performance and captures images of their face throughout the game. The data collected allowed us to carry out analyses that were divided into (i) analyses of performance in the IGT game in the two periods of the day; and (ii) analyses of basic emotional behavior and emotional valence in the two periods of the day; (iii) analyses of basic emotional behavior and emotional valence about performance in the game. Performance was also analyzed based on the variables: gender, hours of sleep, playing time, and age. The results showed statistical differences in basic emotional responses (i) in the groups separated by gender, where it was possible to see the presence of expressions of fear and surprise in the overall performance that was more detectable in women. (ii) In the groups separated by performance, it was possible to see the presence of expressions of surprise that were more detectable in the disadvantageous result group. These results suggest a behavioral response resulting from a physiological manifestation related to the undesired outcome.

Keywords: *strategic decision-making; basic emotions; facial emotion expression; neuroscience; Iowa Gambling Task; Facereader.*

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I. Introduction

In our daily lives, success in our tasks is related to the efficient interdependent use of specific skills. The subject must identify their objective, develop a good goal plan, and hierarchically organize the execution sequence. After this planning, it is necessary to carry out the steps, constantly evaluating the results of each of them, correcting those that were not successful, and flexing with new strategies when necessary. In parallel, the individual must be able to maintain the focus of their attention on the task they are performing, monitor their attention, and temporally connect the steps that have already been performed, such as the one being executed and the following steps. Lastly, and not least, it is necessary to temporarily store in your memory the information necessary to carry out the task, in addition to ensuring the "protection" of this information (Fuentes, Malloy-Diniz, de Camargo & Cosenza 2014).

To use the various skills mentioned, we count on the support of executive functions, thus encompassing a set of processes that enable the individual to direct behaviors towards goals, measure the efficiency and adequacy of these behaviors, eliminate ineffective strategies in favor of more efficient ones and, thus, solving short, medium and long-term problems (Robbins, 1996). They therefore consist of a group of fundamental

processes for the subject's adaptation to everyday life and also serve as a basis for the development of various skills such as social interaction and occupational performance. Among these processes, we have decision-making, which consists of choosing one among several alternatives in situations involving levels of uncertainty (risk). We make countless decisions every day, which include perceptual decisions, such as how to walk down the street, decisions involving primary rewards, such as what to have for breakfast, and social decisions that require balancing our benefits and those of others. However, the guiding principles behind choices in various domains are still not well understood (Krajbich, Hare, Bartling, Morishima & Fehr, 2015).

Experiments that evaluate decision-making can use different tools, tests, and scales (Fuentes et al., 2014). One of the classic tests for evaluating the decision-making process is the Iowa Gambling Task (IGT) (Bechara, Damasio, Damasio & Anderson, 1994). In this test, patterns of disadvantageous choices are those that lead to immediate gains and significant long-term losses. These patterns have been associated with a pattern of impulsivity, referred to by Bechara as "cognitive impulsivity" or non-planning, which represents the inability to assertively plan actions concerning their short, medium, and long-term results (Rutz, Hamdam & Lamar, 2013).

Initially, research related to decision-making behavior was mainly based on economic decision-making. However, in recent decades, research on decision-making behavior has gone beyond the economic field, expanding to areas such as psychology, neurosciences, sociology, and administration. Several well-established studies even show us that emotional factors have a direct influence on our daily behavior about decision-making (Jiao, Wu & Wang, 2018).

The literature points to a consistent relationship between emotion, decision-making, and cognition. Our sensory channels interact with the environment, we analyze the previous information available, arouse emotions, evaluate risks and opportunities, and make decisions. The IGT operates in the last two processes: risk assessment and decision- making. In this work, we inserted the first item: analysis of emotional markers through facial microexpressions. How does emotion moderate the decision-making process? In practice, we analyzed the performance of two groups of independent volunteers during the Iowa Gambling Game Task (IGT) and the possible existence of performance differences between groups and different basic emotions during decision-making in the game.

According to the literature consulted by Rosenberg mainly, AND. L., & Ekman, P. (Eds.) (2020); Andrade, E.B., & Ariely, D. (2009); Den Uyl, M.J., & Van Kuilenburg, H. (2005); Ekman, P. (2016); Laureiro-Martinez, D. (2014), this study aims to evaluate the financial performance resulting from strategic decision-making in the risky environment of the Iowa Gambling Task (IGT) game between two groups of voluntary participants. Through an experiment, we compare their performance at different times of the day (morning and afternoon), measuring differences in gains based on primary emotional responses and gender.

II. Hypotheses And Methods

Thus, to achieve the outlined objectives, the Hypotheses proposed in the project are based on several works contained in the references and notably in the works of Dias, CMM (2020); Rosenberg, AND. L., & Ekman, P. (Eds.) (2020); Andrade, E.B., & Ariely, D. (2009); Den Uyl, M.J., & Van Kuilenburg, H. (2005); Ekman, P. (2016); Laureiro- Martinez, D. (2014).

To achieve the objectives previously proposed, the following hypotheses are proposed.
Ho,1: There is a significant difference in performance in the quality of decision- making in the morning and afternoon in experiments adopting IGT.
Ho,2: The performance optimization speed is statistically equal in the morning compared to the afternoon in IGT.
Ho,3: Performance in the IGT game is statistically equal for groups separated by: gender, and playing time, both in the morning and afternoon groups.
Ho,4: Decision-making in the IGT at different times of the day does not show significant variation in basic emotions and emotional valence, measured through facial expressions of emotion.

The experiment to verify the hypotheses was carried out via a web platform, with the participation of 40 healthy Brazilian individuals, 20 women and 20 men, aged between 23 and 46 years. The criteria for inclusion in the sample included being a computer user, having a webcam, having access to the internet, and being in the job market. The participants had Brazilian Portuguese as their main language and were of Brazilian nationality. Participants also agreed to the free and informed consent form, made available before the start of the experiment, and were duly informed about the project's approval by the ethics committee.

The experiment consisted of volunteers participating in a card game called Iowa Gambling. Task (IGT). IGT consists of a card game containing 4 different decks identified as A, B, C, and D, where the objective is to accumulate as much money as possible throughout the game and each deck has a previously defined sequence of rewards and punishments (Bechara et al., 1994). The mission requires individuals to choose

one card at a time from the decks, over 100 consecutive plays, where the cards in the deck vary in probabilities and magnitude about rewards and punishments.

Decks A and B have higher rewards, but on the other hand, higher punishments. The frequency of punishments in deck B is lower compared to deck A, but the punishment values are higher, so that in the sum of punishments throughout the plays, they are equivalent. According to Bechara, Damásio, Damásio, and Anderson (1994), decks A and B are classified as "disadvantageous" because, in the long term, the monetary penalties are greater than the rewards. Decks C and D have lower rewards and produce significantly lighter losses as well. Regarding the frequency of punishments, deck D has a lower punishment frequency compared to deck C, but with higher values, meaning that the sum of punishments throughout the plays, they are equivalent. These decks are classified by Bechara et al. (1994) as "advantageous" because, in the long term, the rewards exceed the penalties. As the objective of the game is to win as much money as possible, the most efficient strategy is to select more cards from decks C and D than from decks A and B (Areias, Paixão & Figueira 2013).

The individuals were randomly divided into 2 groups to carry out the task, with group 1 performing the test in the morning (9:00 am to 10:00 am) and group 2 performing the test in the afternoon (4:30 pm to 18:40h). Throughout the game, information was extracted from the player to analyze decision-making performance during the test. In parallel, the participant's face was recorded via webcam during the test, where these recordings were saved by the web system developed in this project. Subsequently, data relating to basic emotions during the task were analyzed with the aid of the FaceReader measuring instrument, which is a program that enables the detection and analysis of facial expressions, basic emotions, emotional valence, and skin arousal (manufacturer Noldus Information Technology) (as illustrated in Figure 1).

The complete development of the project has 5 stages, being: (i) development of a web system for data collection; (ii) carrying out the IGT task; (iii) behavioral collection and analysis during the task; (iii) collection and analysis of facial expressions of emotions;
(iv) Statistical processing of data.

In step (i), the IGT game was prepared to be reproduced in the form of a web system, where this system was subdivided into three parts, being front-end, back-end, and hosting. On the front end (client side), the visual part, interaction logic, and organization of data specified by the user are developed. In this part, some technologies were used, including Angular technology (framework for building reusable components), JavaScript programming language (logic development through code), HTML, and CCS (Information marking and styling). The back-end involves the server, database, and application. In this part, some technologies were used, including NodeJs (creation of a service capable of receiving and sending data), MYSQL database (place for storing data), JavaScript programming language, and TypeScript (development of logic through code).

In step (ii), the individual went through the following sequential steps: reading an initial lineup under standardized conditions for all participants, filling out a form with basic information, accepting the consent terms, reading the game instructions, carrying out the task and completion of the experiment after the system stores the data.

For step (iii) of behavioral analysis during the task and based on the global performance results, the "performance" variable was created as categorical, being: disadvantageous performance (score equal to or less than-18), advantageous performance (score equal to or greater than 18) and results between these limits called borderline (Bakos, Denburg, Fonseca, & Parente, 2010). The overall performance was measured by the formula (C + D)-(A + B), which corresponds to the calculation of the difference between the total sum of choices from the advantageous decks minus the total sum of choices from the disadvantageous decks (Bechara et al., 1994).

Another type of analysis carried out was about facial expressions of emotions. At this stage, the web system stored 5 videos for each participant, with the videos for the moves being: video from 1 to 20, video from 21 to 40, video from 41 to 60, video from 61 to 80, video from 81 to 100. These videos were exported to the " facereader " software that is responsible for analyzing the videos. The technique used to measure basic emotions in this software is the Facial Action Coding System (FACS), developed by Ekman and Friesen (1976) and revised by Ekman and collaborators (2002). FACS consists of a decipherable facial movement measurement system that allows the systematic categorization of physical facial expressions in different contexts and has also become a measuring instrument to identify the basic emotions present in an event. According to Ekman and Oster (2013), FACS has as a reference the anatomical aspects of the face, that is, based on the movement of the facial muscles which act to modify the appearance of the face in interaction with the environment. This coding system demonstrates perceptible face activity based on (i) single action units (AU's), which consists of the contraction or relaxation of one or more facial muscles, (ii) eye movements and position, (iii) movement and head position (Rosenberg & Ekman, 2020).

FaceReader has been trained to detect and classify the 6 basic universal emotions: joy, anger, surprise, sadness, fear, disgust, and neutral. These emotional categories were described as basic or universal emotions by Ekman (2011). It is important to highlight that there are interpersonal variations between emotions and facial expressions vary in intensity and are often a mixture of emotions. The result of FaceReader is a

classification of the test participant's facial expressions with an accuracy of around 90%. Each expression has a value in the entire range between 0 and 1, indicating its intensity. Where '0' means the expression is absent (minimum value), '1' means it is fully present (maximum value). Facial expressions are often caused by a set of emotions, so it is very common for two (or more) expressions to occur simultaneously with high intensity. Therefore, the sum of the intensity values for the expressions at a given time normally does not equal 1.

Finally, the statistical analysis of the data was supported by SPSS version 25 software. The significance level for all analyses was the value (alpha value) of 5%.

III. Results

The 40 participants were divided into two groups: the morning group (10 men and 10 women) and the afternoon group (10 men and 10 women). Participants' results are classified as disadvantageous performance (final score less than or equal to-18), borderline (if results between-17 and 17), and advantageous performance (final score greater than or equal to 18). Through Table 1, it is possible to see that no group performs better than the other, that is, there is no association between the time of day and performance ($p > 0.05$), Tab 1.

Table 1 shows the performance of groups in the morning and afternoon.

Table 1-Association of performance with group. P_value = 0.231

Performance	Morning group (n = 20)	afternoon group (n = 20)	Total
Disadvantageous (n = 10)	7 (35%)	3 (15%)	10 925%)
Borderline (n = 23)	11 (55%)	12 (60%)	23 (57.5%)
Advantageous (n = 7)	2 (10%)	5 (25%)	7 (17.5%)
Total	20 (100%)	20 (100%)	40 (100%)

Chi-Square (2.92; 2); p_value = 0.231

Prepared by the authors

Therefore, hypothesis Ho,1 presents a significant difference in performance in the quality of decision-making in the morning and afternoon in experiments adopting the IGT is not true, refuted by the Chi-Square test. The same was observed for Ho,2 for which the speed of performance optimization is statistically equal in the morning compared to the afternoon in IGT, therefore the hypothesis was verified true.

Regarding the intensity of emotions by gender of participants, it is possible to observe from the values in Table 2 that the presence of expressions of "fear" and "surprise" are more detectable in women ($p > 0.05$).

These results are independent of the IGT result by sex, where men and women had no statistical differences in performance. Therefore, Ho,3: Performance in the IGT game is statistically equal for groups separated by sex, both in the morning and in the afternoon group, which is partially not refuted in the Mann-Whitney test.

Table 2 shows the intensity of emotions by participant gender for FACS analysis

Table 2-Comparison of expression results for all cards by group. FACS analysis according I'm the individual's sex.

Median (Q1-Q3)

	Woman (n = 19)	Man (n = 17)	P *
Neutral	0.8 (0.61-0.92)	0.79 (0.59-0.85)	0.925
Happy	0.03 (0-0.11)	0 (0-0.03)	0.186
Sad	0.03 (0.01-0.04)	0.05 (0.01-0.22)	0.531
Angry	0.02 (0.01-0.1)	0.01 (0-0.09)	0.452
Surprised	0.02 (0-0.05)	0 (0-0.02)	**0.025**
Scared	0 (0-0.02)	0 (0-0)	**0.013**
Disgusted	0 (0-0.02)	0.01 (0-0.02)	0.232
Intensity	-0.02 (-0.12; 0.01)	-0.07 (-0.24;-0.02)	0.093
* Mann Whitney test – p_value.			

Prepared by the authors

Table 3 presents results in which the presence of "surprise" expression is more detectable in the disadvantageous result group. The result was statistically the same for the borderline, advantageous performance group, and the other emotions. Thus, the hypothesis that Ho,4: Decision-making in the IGT at different times of the day does not present significant variation in basic emotions and emotional valence, measured through facial expressions of emotion, is therefore not Rejected according to the Mann-Whitney test.
Table 3 shows results for the FACS analysis according to IGT performance.

Table 3-Comparison of expression results for all cards by performance				
		Median (Q1-Q3)		
	Disadvantageous (n = 9)	Borderline (n = 21)	Advantageous (n = 6)	P *
Neutral	0.67 (0.60-0.88)	0.80 (0.61-0.89)	0.81 (0.47-0.92)	0.904
Happy	0.02 (0-0.07)	0.01 (0-0.09)	0 (0-0.01)	0.444
Sad	0.04 (0.02-0.26)	0.02 (0.01-0.06)	0.04 (0.02-0.16)	0.117
Angry	0.02 (0-0.07)	0.01 (0-0.1)	0.04 (0.01-0.08)	0.534
Surprised	0.04 (0.01-0.12)b	0 (0-0.03)a	0.01 (0-0.04)a	**0.033**
Scared	0 0-0.03)	0 (0-0.01)	0 (0-0.01)	0.760
Disgusted	0 (0-0.01)	0 (0-0.02)	0.01 (0-0.04)	0.298
Intensity	-0.05 (-0.23;-0.01)	-0.04 (-0.16; 0.04)	-0.07 (-0.21;-0.04)	0.500
* Mann Witney test: p_value Prepared by the authors				

IV. Complementary Discussions

The development of this work has as its main objective to evaluate the performance of two groups of independent volunteers during the Iowa Gambling game. Task (IGT) is the possible existence of performance differences between groups and basic emotions during game decision-making.

In the first part of the experiment, the general performance of individuals separated into groups was investigated, with (i) Disadvantageous performance with a score <=-18, (ii) borderline performance with a score between-17 and 17, and (iii) advantageous performance a score >= 18 (Bakos, Denburg, Fonseca, & Parente, 2010). The results show that the quality of decision-making in the morning is statistically similar to the afternoon in experiments adopting the IGT, with no possible correlation between the time of day and the quality of decision-making in the morning. In parallel, the speed of developing learning heuristics in the morning compared to the afternoon also does not have a significant difference.

Still, in the first part of the analysis, the participants were separated by sex and age, where in all cases the results indicate that there is no type of relationship between the score and the volunteer's sex, score, and age, both in the morning group as in the afternoon group. When we analyzed the time spent in the game about performance, a significant difference in the results was also not observed, corroborating some studies, which provide evidence that more time to respond does not mean a better decision quality (Oud, Krajbich, Miller, Cheong, Botvinick & Fehr, 2016).

These results found in the first part of the experiment suggest that for group behaviors, the quality of decision-making in the IGT game is independent of factors such as task time, individual gender, age, and response time.

In the second part of the experiment, basic emotions and emotional valence during the task were analyzed in both groups. It was possible to observe that there is no significant difference between the morning group and the afternoon group for the intensity of basic emotions and emotional valence.

When the groups were separated by sex, it was possible to notice in the general performance the presence of expressions of "fear" and "surprise" that were more detectable in women. According to Nelson (2012), although some literature in economics and finance suggests that women are more averse to risk than men, it was possible to see that this conclusion deserves reconsideration, as we demonstrated in this work. In a survey that aimed to measure the gender difference in risk aversion with professors from universities in the United States, researchers showed that when individuals have the same level of education, regardless of their knowledge of finance, women are no longer risk averse than men (Hibbert, Lawrence & Prakash, 2008). One hypothesis (to be further explored) for these results of greater intensity of expressions of "fear" and "surprise" found in women is the possible influence of historical cultural factors, which can trigger emotions of fear, surprise (among other emotions) with greater emotional intensity in women compared to men.

In the third and final stage of analysis, the groups were separated by performance and the behavior of facial expressions was then analyzed. At this stage, the presence of the expression "surprise" was statistically more detectable in the group with a disadvantageous result. These results suggest a behavioral response, resulting from a physiological manifestation related to the undesirable result in the game. Therefore, it is suggested that the quality of decision-making is negatively moderated by the presence of the emotion of surprise. This finding has considerable relevance to the results, because even if the volunteer does not consciously realize it, their body reacts through facial expressions, in the face of a disadvantageous result.

As a limitation of this work, collection outside the laboratory environment can be analyzed as a limitation and at the same time as a positive differentiator of the work. Web collection allows you to considerably increase the number of participants in the research, optimizes logistics and data collection time, and can

therefore be considered as a high potential for innovation in some types of research. In contrast, collecting data via the web makes it impossible to control some variables, such as environmental conditions, possible interruptions during the experiment, technological conditions of each individual, and internet quality. Likewise, the web environment does not allow for closer preparation, alignment, and monitoring of the individual, which makes it difficult to perceive (at least subjectively) the individual's engagement in the task. After all, studies consistently observe that decision-makers allocate their resources inefficiently time for choices to which they feel indifferent (Krajbich, Oud & Fehr, 2014). To minimize these interferences, prior alignment meetings were held, a pre-experiment manual was developed and before the game, a new request was made for the individual to focus solely on the experiment.

It was possible to notice that in general group behavior, the time of day does not interfere with game performance. As suggestions for further research, we can ask what it would be like if we analyzed the same individual at different times of the day. How does the amount of sleep and sleepiness scale affect performance and basic emotions? How much does the context and environment in which the individual is inserted affect the emotional response during the game?

All these suggestions for new research and challenges encountered are placed in a multidisciplinary sphere, which opens up space for research at various levels of complexity, in different areas such as psychology, neurosciences, philosophy, biology, and administration, among others. All this interdisciplinarity is relevant and necessary, so that, instead of separating, we can combine the areas involved and thus open up space to make better decisions.

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Authors contributions

Prof. Daniel Hosken carried out data collection in the field. Selecting participants for the research sample Based on inclusion and exclusion criteria. Prof. Daniel and Prof Carlos Gonçalves defined the research problem and objectives, writing topics 1-introduction.

Prof. Carlos Gonçalves with Prof Daniel contributed to the methods adopted on topic 3 Methods. The application of statistical methods was done by Prof Daniel and all authors participating in the analysis on Topic 4-Results and Discussions. Prof. Carlos and Prof. Carlos Magno provided support for the adoption of the FaceReader software for interpreting universal basic emotions. He also assisted in writing the final findings. All authors read and approved the final manuscript.

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Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

Informed consent

Obtained.

Ethics approval

The Publication Ethics Committee of the Canadian Center of Science and Education. The journal and publisher adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

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Data availability statement

The data that supports the findings of this study are available on request from the corresponding author. The data is not publicly available due to privacy or ethical restrictions.

Data sharing statement
No additional data are available.

V. REFERENCES

Andrade, E.B., & Ariely, D. (2009). The enduring impact of transient emotions on decision-making. Organizational Behavior and Human Decision Processes, 109(1), 1-8.

Areias, G., Paixão, R., & Figueira, APC (2013). The Iowa Gambling Task: a critical review. Psychology: Theory and Research, 29(2), 201-210.

Ayduk, O., Mendoza-Denton, R., Mischel, W., Downey, G., Peake, P.K., & Rodriguez, M. (2000). Regulation the interpersonal self: strategic self-regulation for coping with rejection sensitivity. Journal of Personality and Social Psychology, 79(5), 776-792.

Baddeley, A. (2000). The episodic buffer: a new component of working memory? Trends in Cognitive Sciences, 4(11), 417-423.

Bakos, DS, Denburg, N., Fonseca, RP, & Parente, MA d. MP (2010). A cultural study on decision-making: performance differences on the Iowa Gambling Task between selected groups of Brazilians and Americans. Psychology & Neuroscience, 3(1), 101-107. It hurts 10.3922/j.psns.2010.1.013

Barkley, A. A. (2001). The executive functions and self-regulation: an evolutionary neuropsychological perspective. Neuropsychology review, 11(1), 1-29.

Bechara, A. (2004). The role of emotion in decision-making: Evidence from neurological patients with orbitofrontal damage. Brain and Cognition, 55(1), 30-40. Doi: 10.1016/j. band.2003.04.001

Bechara, A., & Van Der Linden, M. (2005). Decision-making and impulse control after front wolf injuries. Current Opinion in Neurology, 18(6), 734-739.

Bechara, A., Damasio, A. R., Damasio, H., & Anderson, S. (1994). Insensitivity to future consequences following damage I'm human prefrontal cortex. Cognition, 50(1-3), 7-15

Bechara, A., Damasio, H., Tranel, D., & Anderson, S. W. (1998). Dissociation of working memory from decision-making within the human prefrontal cortex. The Journal of Neuroscience, 18(1), 428-437. Retrieved from http://www.jneurosci.org/

Bechara, A., Dolan, S., Denburg, N., Hindes, A., Anderson, S. W., & Nathan, P. E. (2001). Decision-making deficits, linked to a dysfunctional ventromedial prefrontal cortex, revealed in alcohol and stimulant abusers. Neuropsychologia, 39(4), 376-389. doi: 10.1016/S0028-3932(00)00136-6

Bechara, A., Tranel, D., & Damasio, H. (2000). Characterization of the decision-making deficit of patients with ventromedial prefrontal cortex injuries. Brain, 123(11), 2189-2202, doi: 10.1093/brain/123.11.2189

Belzung, C. (2007). Biology of emotions. Lisbon: Piaget Institute.

Benţa, KI, & Vaida, MF (2015). Towards real-life facial expression recognition systems.

Advances in Electrical and Computer Engineering [AECE], 15 (2), 93-102.

Bishop, C. M. (1995). Neural networks for pattern recognition. Oxford University Press.

Bradshaw, J. L. (2001). Developmental disorders of the frontostriatal system: Neuropsychological, neuropsychiatric, and evolutionary perspectives. East Sussex: Psychology Press.

Brand, M., Labudda, K., & Markowitsch, H. J. (2006). Neuropsychological correlates of decision-making in ambiguous and risky situations. Neural networks, 19(8), 1266-1276. It hurts 10.1016/j.neunet.2006.03.001

Bull, P. N., Tippett, L. J., & Addis, D. R. (2015). Decision making in healthy participants on the Iowa Gambling Task: new insights from an operational approach. Frontiers in Psychology, 6, 389-391. Doi: https://doi.org/10.3389/fpsyg.2015.00391

Casey, B., Somerville, L.H., Gotlibb, I.H., Ayduck, O., Franklin, N.T., Askren, M. Shoda, Y. (2011). Behavioral and neural correlates of delay of gratification 40 years later. Proceedings of the National Academy of Sciences of the United States of America, 108(36), 14998-15003.

Cootes, T. F., & Taylor, C. J. (2000). Statistical models of appearance for computer vision. Wolfson image analysis unit, imaging science, and biomedical engineering, University of Manchester. Technical report, online technical report.

Damasio, H., Grabowski, T., Frank, R., Galaburda, A. M., & Damasio, A. A. (1994). The return of Phineas Gage: clues about the brain from the skull of The famous patient. Science, 264 (5162), 1102-1105.

Den Uyl, M. J., & Van Kuilenburg, H. (2005, August). The FaceReader: Online facial expression recognition. In Proceedings of measuring behavior (Vol. 30, No. 2, pp. 589-590). Wageningen.

Denburg, N. L., Tranel, D., & Bechara, A. (2005). The ability to decide advantageously declines prematurely in some normal older persons. Neuropsychologia, 43(7), 1099-1106. It hurts 10.1016/j.neuropsychologia.2004.09.012

Diamond, A. (2013). Executive functions. Annual Review of Psychology, 64, 135-168.

Dias, CMM (2020). Visual elements in political advertising: a study of the response emotions of voters in different scenarios in election campaign videos. (Thesis PhD, ICB-Institute of Biological Sciences, Federal University of Minas General). Recovered from https://repositorio.ufmg.br/handle/1843/33630

Dunn, B. D., Dalgleish, T., & Lawrence, A. D. (2006). The somatic marker hypothesis: A critical evaluation. Neuroscience and Behavioral Reviews, 30, 239-271.

Ekman, P. (2011). A language of emotions. They are Paul: Moon in Paper, 77-108.

Ekman, P. (2016). What scientists who study emotion agree about? Perspectives on psychological science, 11 (1), 31-34.

Ekman, P., & Friesen, W. v. (1976). Measuring facial movement. Environmental psychology and nonverbal behavior, 1(1), 56-75.

Ekman, P., & Friesen, W. v. (2013). Measuring facial movement with the facial Action Coding System. In: P. Ekman (Ed.); Emotion in the human face. 2nd ed., p.440, 2013. Los Highs: Malor Books

Ekman, P., & Friesen, W. V. (1978). facial action coding system. Environmental Psychology & Nonverbal Behavior.

Fuentes, D., Malloy-Diniz, L. F., de Camargo, CHP, & Cosenza, R. M. (2014). Neuropsychology-: Theory and Practice.Artmed Publishing Company.

Fuster, J. M. (2008). The prefrontal cortex. Amsterdam: academic press. Fuster, J. (2015). The prefrontal cortex. Academic press.

Gehring, W. J., & Willoughby, A. A. (2002). The medial front cortex and the quick processing of monetary gains and losses. Science, 295 (5563), 2279-2282.

Goldberg, AND. (2002). O brain executive: Wolves front It is The civilized mind. River in January: Imago.

Happaney, K., Zelazo, P. D., & Stuss, D. T. (2004). Development of orbitofrontal function: Current themes and future directions. Brain and Cognition, 55(1), 1-10.

Hibbert, A. M., Lawrence, E., & Prakash, A. (2008). Are women more risk-averse than men?. file:///D:/Users/Carlos/Downloads/ARE_WOMEN_MORE_RISK-AVERSE_THAN_MEN.pdf

Hosken, D. (2020). Per what is difficult to change? Provocations about your challenge human that journey from the change. Publishing company Gulliver.

Jiao, W., Wu, A., & Wang, L. (2018). Correlation between Emotion and Job Burnout Decision-making Quality Based on Cognitive Neuroscience. NeuroQuantology, 16(5). It hurts 10.14704/nq.2018.16.5.1396

Johnston, E., & Olson, L. (2015).The feeling brain: The biology and psychology of emotions. W. W. Norton & Company.

Kahn, I., Yeshurun, Y., Rothstein, P., Fried, I., Ben-Bashat, D., & Hendler, T. (2002). The role of the amygdala in signaling prospective outcome of choice. Neuron, 33 (6), 983-994.

Kluwe-Schiavon, B., Viola, T. W., & Grassi-Oliveira, R. (2012). Theoretical models about single construct or multiple processes of executive functions. Neuropsychology Magazine Latin American, 4(2), 29-34.

Krajbich, I., Hare, T., Bartling, B., Morishima, Y., & Fehr, E. (2015). A common mechanism underlying food choice and Social decisions.decisions PLoS computational biology, 11(10), e1004371.

Krajbich, I., Oud, B., & Fehr, E. (2014). Benefits of neuroeconomics modeling: New policy interventions and predictors of preference. American Economic Review, 104(5), 501-06.

Kukla, E., & Nowak, P. (2015). Facial emotion recognition based on cascade of neural networks. In New Research in Multimedia and Internet Systems (pp. 67-78). Springer, Call.

Laureiro-Martinez, D. (2014). Cognitive control capabilities, routinization propensity, and decision-making performance. Organization Science, 25(4), 1111-1133.

Mischel, W., Shoda, Y., & Rodriguez, M. L. (1989). Delay of gratification in children science, 244(4907), 933-938.

Nelson, J. A. (2012). Are women more risk-averse than men? Institute for New Thinking in Economics (INET) and is available as INET Research Note #12.

Noldus Information Technology. (2015). Emotion analysis: Facereader. Wageningen. Retrieved from www.noldus.com/ facereader /resources.

O'Doherty, J., Kringelbach, M. L., Rolls, E. T., Hornak, J., & Andrews, C. (2001). Abstract reward and punishment representations in the human orbitofrontal cortex. Nature neuroscience, 4 (1), 95-102.

Oud, B., Krajbich, I., Miller, K., Cheong, J. H., Botvinick, M., & Fehr, E. (2016). Irrational time allocation in decision-making. Proceedings of the Royal Society B: Biological Sciences, 283(1822), 20151439.

Pfister, H.R., & Böhm, G. (2008). The multiplicity of emotions: A framework of emotions

functions in decision-making. Judgment and decision-making, 3(1), 5.

Riva, D., Cazzaniga, F., Esposito, S., & Bulgheroni, S. (2013). Executive functions and cerebellar development in children. Applied Neuropsychology: Child, 2(2), 97-103.

Robins, T. W. (1996). Dissociating executive functions of the prefrontal cortex. Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences, 351(1346), 1463-1471.

Rocha, AFD, & Rocha, FT (2011). Neuroeconomics and decision-making process. Rio de Janeiro: LTC.

Rogers, R.D., Tunbridge, E.M., Bhagwagar, Z., Drevets, W.C., Sahakian, B.J., & Carter, C.S. (2003). Tryptophan depletion alters the decision-making of healthy volunteers through altered reward processing cues. Neuropsychopharmacology, 28(1), 153-162.

Romine, C. B., & Reynolds, C. R. (2005). A model of the development of frontal lobe functioning: Findings from The meta-analysis. Applied Neuropsychology, 12(4), 190-201.

Rosenberg, AND. L., & Ekman, P. (Eds.). (2020). What the face reveals: Basic and applied studies of spontaneous expression using the Facial Action Coding System (FACS). Oxford University Press.

Ruff, C. C., & Fehr, E. (2014). The neurobiology of rewards and values in social decision-decision-making. Nature Reviews Neuroscience, 15(8), 549-562.

Rutz, A., Hamdan, A. C., & Lamar, M. (2013). The Iowa Gambling Task (IGT) in Brazil: A systematic review. Trends in Psychiatry Psychotherapy, 35(3), 160-170.

Samara, A., Galway, L., Bond, R., & Wang, H. (2016). Sensing affective states using facial expression analysis. In International Conference on Ubiquitous Computing and Environment Intelligence pp. 341-352). Springer, Cham.

Sporns, O. (2011). Networks of the brain Cambridge.

Stuss, D. T. (2011). Functions of the frontal lobes: Relationship I'm executive functions. Journal of the International Neuropsychological Society, 17(5), 759-765.

Tasli, HE, & Ivan, P. (2014). Turkish presidential elections publicity speech facial expression analysis. ArXiv preprint arXiv:1408.3573. http://arxiv.org/abs/1408.3573.

Tieppo, W. (2019). One trip for the brain: A via quick to understand neuroscience. Publishing company Connectomus.

Ulus, E. (2015). Workplace emotions in postcolonial spaces: Enduring legacies, ambivalence, and subversion. Organisation, 22 (6), 890-908.

Zelazo, P. D., & Müller, U. (2002). The balance beam in the balance: Reflections on rules, relational complexity, and developmental processes. Journal of Experimental Child Psychology, 81(4), 458-465.