Tese de Mestrado

Córtex Pré-Frontal, Fatores Biopsicossociais e Personalidade: União ou Dissociação?

Dissertação para obtenção do grau de Mestre

Mestrado em Neuropsicologia Clínica

Luís Pedro Mesquita Araújo

Gandra, Julho de 2016

Instituto Universitário de Ciências da Saúde

Mestrado de Neuropsicologia Clínica

Dissertação de Mestrado

Luís Pedro Mesquita Araújo

Gandra, 2016

Mestrado de Neuropsicologia Clínica

Tese de Mestrado

Orientador: Professor Doutor Bruno Peixoto

Gandra, 2016

"Homo Sapiens é por vezes traduzido por "homem inteligente". Somos um macaco inteligente, um macaco muito inteligente, embora metido num pequeno sarilho. Uma tradução melhor, porém, seria "homem sábio". Ainda nos falta um bocado para isso."

Andrew Marr, 2012

Um enorme agradecimento do fundo do meu coração aos meus pais: José e Angelina

Pelo eterno apoio que me dão,

Pelo infinito amor que demonstram,

Pela perpétua paciência que têm,

Durante estes longos e árduos anos do meu percurso académico.

Onde cheguei hoje, e onde vou amanhã, é devido a vocês e para vocês.

Agradecimentos:

Um grande abraço aos meus irmãos e irmão, Sérgio, Daniela e Filipe e meus respetivos cunhados/as, Mónica, João e Carla, sem nunca esquecer os nossos pequenotes, Beatriz, Nuno e João, por encherem a minha vida de humor, prazer e conhecimento. Onde quer que vá no futuro, notar-se-á sempre um pouco de vocês em mim.

Um grande beijinho para a minha avó, Maria da Luz, por me ver crescer, e poder ver-me tornar naquilo que sou hoje. É, sem dúvida, devido às quantidades industriais de sopa que me davas.

Um enorme abraço e beijinho à minha tia, à qual carinhosamente trato por Madrinha do Porto, Conceição, por cuidar tantas vezes de mim e por ser para mim quase como uma segunda mãe e outro enorme abraço e beijinho à Sra. D. Maria, para mim também conhecida pelo o meu afetuoso nome já de infância, Sra. Das Bolinhas, sempre presente na minha vida com o seu sorriso e atitude positiva para a vida.

Um grande agradecimento é também fundamental ao meu ex-professor de Neuroanatomia, Introdução Histórico Epistemológica da Neuropsicologia, Neuropsicologia Cognitiva e Neuroanatomia Clínica e Funcional, ex-supervisor de estágio e atual orientador da tese, Professor Doutor Bruno Peixoto, por grandes ensinamentos, não só em aulas, mas também no âmbito profissional do meu estágio.

A todos os meus amigos do coração: Finalmente terminou! Obrigado a todos por existirem e por tanto apoio vosso de tantas formas.

Em especial, obrigado ao grande Brian Baron, por todos os momentos passados com ele, todos os desabafos, todas as discussões científicas e para-científicas, e em especial todas a risadas. Se 1500km de distância não nos separam, não é o tempo que o fará.

Breve Introdução

Esta dissertação tem como finalidade a aprovação ao Mestrado de Neuropsicologia Clínica e é composta por um artigo que será colocado para submissão da revista Acta Neuropsychologica.

O tema geral que esta dissertação debate é as funções executivas, tópico esse que tem sido abordado com bastante frequência nos últimos anos, e no entanto continua a ser um assunto que se mantem interessante, relevante e com muito para providenciar. Explicando, é sabido que o cérebro humano avalia e processa múltiplos estímulos simultaneamente e de variadas áreas coexistentes. Uma dessas áreas é o Córtex Pré-Frontal, o centro executivo do cérebro, que se divide em três áreas fundamentais – orbitofrontal, dorsolateral e ventromedial. Estas áreas cruciais para o nosso quotidiano regulam múltiplas atividades – planeamento, tomada de decisão e regulação emocional sendo algumas delas – mas são ainda reguladas por fatores internos, tal como a personalidade, ou até biológicos como, o género ou a idade. A questão que se impõe com estes dados é se estas áreas se encontram interligadas umas com as outras ou se são totalmente distintas na sua função. Investigaram-se estas relações entre género, idade, escolaridade, profissão, situação atual, agregado familiar e história clínica com a habilidade de planear, reconhecimento facial de emoções e tomada de decisão enquanto incluímos diferentes tipologias de personalidade, numa população de 100 indivíduos sem lesão cerebral, de ambos os géneros e com idade acima ou igual a 18, utilizando a Procura da Chave da BADS, o Gandra-Barta, o IOWA Gambling Task e o NEO-FFI.

Chegamos à conclusão que existem notáveis relações entre elas. De fato, um sujeito com um bom desempenho numa das áreas controladas pelo Córtex Pré-Frontal terá,

frequentemente, também um bom desempenho nas subsequentes áreas. Para além disso a idade e agregado familiar parecem agir de forma contraproducente no desempenho geral destas habilidades, enquanto a educação age a favor delas. O Neuroticismo também é adverso para a execução das habilidades, enquanto que a Abertura à Experiência e Conscienciosidade têm pontos positivos e negativos.

Como em qualquer estudo, encontram-se respostas, e mais perguntas surgem. De fato, o Agregado Familiar surgiu como a mais invulgar, correlacionando-se negativamente com múltiplas variáveis. O mesmo ocorreu com Agradabilidade, que surgiu como um fator que ia contra a literatura recolhida. Torna-se assim material fascinante para futuras linhas de estudo.

Prefrontal Cortex, Biopsychosocial Factors and Personality: Union or Dissociation?

Luís Araújo[1]; Muriela Silva[1]; Marcela Leite[1]; Bruno Peixoto[2 3]

[1] *Instituto de Investigação e Formação Avançada em Ciências da Saúde*. Gandra / Portugal

[2] *CESPU, Instituto Universitário de Ciências da Saúde.* Gandra / Portugal.

[3] NeuroGen – Center for Health Technology and Services Research (CINTESIS). Porto / Portugal.

Corresponding Author:

Luís Araújo
Instituto Universitário de Ciências da Saúde
Rua Central de Gandra, 1317.
4585-116 Gandra PRD
luisaraujo987@hotmail.com
luisaraujo987987@gmail.com
Tel: 00351 224157177
Fax: 00351 224157101

Abstract

Background: The human brain evaluates and processes a wide variety of stimuli simultaneously and from multiple coexisting areas. One of those areas is the Prefrontal Cortex, the brain's executive center, which divides itself in orbitofrontal, dorsolateral and ventromedial areas. These areas can be regulated by internal factors such as personality, or even biological, like sex or age. The researcher investigated the relationship between gender, age, education, profession, current situation, household and clinical history with the ability of planning, emotional recognition of faces and decision-making, while also including the different personality typologies, in a population without brain injury.

Material and Methods: For this study, 100 individuals from either gender and with age above or equal 18 were studied, using BADS Key Search, Gandra-BARTA, IOWA Gambling Task and NEO-FFI.

Results: We confirmed our hypothesis. A subject with a good performance in planning will most likely also be good at recognizing emotional faces and at making decisions. Furthermore, age and household act with a negative influence on performance, whilst years of education influence positively. Finally, a high Neuroticism level would be adverse for execution of our areas, whilst Openness to Experience and Conscientiousness have their pros and cons.

Conclusion: The results from our tests suggests that all these areas are somewhat related, having areas that affect positively and vice versa. Even so, many question remain to be addressed in future studies, especially in the Household variable.

Keywords: Neuropsychology; Decision; Planning; Emotion; NEO-FFI.

Introduction

The human ability to process a wide variety of stimuli from multiple brain areas (Tanji & Hoshi, 2001), such as the reception of stimuli from all sensory sources whose function shows connections to the occipital, temporal and parietal lobes (Miller & Cohen, 2001; Miller, Freedman & Wallis 2002; Carmichael & Price, 2004), the period before and during actions (Frith, Friston, Liddle & Frackowiak, 1991; Miller & Cohen, 2001; Miller, Freedman & Wallis, 2002; Killcross & Coutureau, 2003) the memory of past events, usually portrayed as episodic memory (Shallice, Fletcher, Frith, Grasby, Frackowiak & Dolan, 1994; Miller & Cohen, 2001; Miller, Freedman & Wallis, 2002), the anticipation of expected events and behavioral consequences (Bechara, Damásio, Damásio & Anderson, 1994; Bechara, Damásio, Tranel & Damásio, 1997; Bechara, Tranel & Damásio, 2000; Miller & Cohen, 2001; Miller, Freedman & Wallis, 2002), the planning of a list of sub-goals to fulfill the main goal (Capovilla, Assef & Cozza, 2007), the managing of information and the capability of exercising control over behavior, fundamentally derives from the Prefrontal Cortex (PFC), known for being the executive center of the brain, which may be still, to a certain level, modulated by internal factors such as attention and motivational states (Miller, Freedman & Wallis, 2002). In fact, lesions in this area create a range of cognitive deficits, such as attention problems, motor control, spatial orientation, working memory, temporary memory and source meta-memory, associative learning, creativity, perseverance and reasoning (Kane & Engle, 2002), and likewise, the application of neuropsychological tests stimulates the activation of the frontal areas to respond and work in each of these cognitive components (Rezai, Andreasen, Alliger, Cohen, Swayze II & O'Leary, 1993). Predominantly for this reason, this area has been considered by some to be one of, if not the most, pertinent one in our brain (García-Molina & Enseñat, 2015).

At a neuroanatomical level, you can divide the PFC in three functional areas: the orbitofrontal, ventromedial and dorsolateral area. The first one mostly controls behavior, more specifically social adjustment. This task can be explained by the Dynamic Filtering Theory (Shimamura, 2000), in which it states that the PFC would operate as a high level gating or filtering mechanism that enhances goal-directed activations and inhibits irrelevant activations. It would work as a 4 step executive control processing system – Selecting (focus attention on information processing), Maintaining (keep information active in short-term memory), Updating (modulation and reorganization of information), and Rerouting Activations (switch from one cognitive process or response set to another). This could also give some explanation towards emotional regulations – since damage to this area typically are met with emotional outbursts, social disinhibition, impulsivity, risk-taking, among others, which could happen due to a malfunction of the gating system.

The ventromedial area guides the subject in the processing of emotional signals in order to make a proper decision on the situation. It also affects human prosocial behavior, as Boes, Grafft, Joshi, Chuang, Nopoulos & Anderson (2011) reported, wherein they described a clinical case of a 14 year-old boy that, due to his lesion in ventromedial area, showed to be aggressive, manipulative, callous, egocentric, impulsive, hyperactive, incapable of planning ahead, and with an impaired moral judgment, lack of respect for authority and lack of empathy.

The last area participates in executive control, working memory, selective attention, planning, concept formation and cognitive flexibility (Oliveira, Birth & Fernandes, nd; Bechara, Damásio & Damásio, 2000). An evidence of this is the study of Owen (1997) that states that an altered cortico-striatral interaction may affect negatively a normal planning at a number of levels.

Despite the dorsolateral area being, in a cytoarquitectural and functional way, differentiated from other areas, holding much of the executive functions such as planning, time organization, and working memory (Palomo & Guinea, 2007), some authors (Zald & Andreotti, 2010; Kiehl & Sinnott-Armstrong, 2013) found that the ventromedial area overlaps the orbitofrontal space in the medial area, in the rectal and orbital gyrus, and as such, demonstrate some similar deficits when injured. This observation comes from some studies of patients with damage to the ventromedial area. In these studies, researchers had not only patients with the previously mentioned injuries, but also patients with damage to the medial orbitofrontal area. The opposite also occurred, which in studies of patients with damage to the orbitofrontal area, also had patients injured in the ventromedial area (Zald & Andreotti, 2010). It was then that arose the question of functional differentiation of both prefrontal areas. Bechara, Damásio and Damásio (2000), as well as Palomo and Guinea (2007) answer this question, noting that the Ventromedial area is more correlated with the integration of emotional information of the limbic system with sensory information and past experiences memories, which will allow a modulation of our actions, estimating the long-term consequences of decisions, while the behavioral adjustment depends on the orbitofrontal area, as well as the establishment of responses to social stimuli. This allows an adaptation response against each stimulus, and a rapid change of response when the situation changes.

About personality, Prinz, Gründer, Hilgers, Holtemöller & Vernaleken (2014) show that there are two traits that exert a greater influence, namely Openness to Experience and Agreeableness. The other traits do not seem to be statistically significant in direct correlational analysis. They also mention that individuals with lower receptivity traits exhibited lower risk aversion in their behavior regarding their financial situation, whilst

for the Agreeableness factor, this association is reversed.

Other factors assumed to be influenced by the personality is the attitude to risk and intolerance for ambiguity. As the authors Gosh & Ray (1997) stated, individuals who are less aversive to risk and that are more tolerant to ambiguity seem to demonstrate greater confidence in their decisions. Similarly, it is possible that patients with a low tolerance for ambiguity would interpret the lack of information as a risk, thereby taking a risk that does not result in a high cost with no benefit. Conversely, it is also possible that tolerant individuals, but that search for risk, may take no action when necessary (Ghosh & Ray, 1997).

Concerning other variables in our study, some authors (Naglieri & Rojahn, 2001; Hooper, Luciana, Conklin & Yarger, 2004; Keith Reynolds, Roberts, Winter & Austin, 2011; Best, Miller & Naglieri, 2012) argue that there is a biological component that can also influence these aspects, such as gender and age.

As a matter of fact, studies report having observed significant differences in gender, between the ages of 5 and 17 years, in Proofing tests, Letter-Word Identification, Passage Comprehension and Dictation. These tests are specific for the planning and attention areas, referring to a better ability to plan and to focus on the stimulus, such as finding errors in a sentence, the highlighting the relevant material and distinguishing it from the irrelevant one and planning to finish the race more effectively. In addition, females seem to have a higher processing speed, while the males presents a greater visuospatial ability (Naglieri & Rojahn, 2001; Keith, Reynolds, Roberts, Winter & Austin, 2011).

The authors explain that, since this study was based on teens, differences could be seen due to different PFC maturation speed (Naglieri & Rojahn, 2001).

Hooper et al. (2004) and Best, Miller & Naglieri (2012) are in agreement with data

found in recent authors, stating that the female tends to be better than males in terms of sustained attention and vigilance. However, it also reveals different performances throughout the ages, obtaining superior results in ages between 14 and 17. The fact that there is a clear distinction between ages and even the score between 14-17 years is below the standard of the normative value suggests that performance, and consequently the PFC, continues to be developed even after 17 years.

Furthermore, there seems to be a link between the socioeconomic status of children and their PFC thickness (Lawson, Duda, Avants, Wu & Farah, 2013). In the referred study it was only studied family income and parental education, but the results are impressive, nonetheless. Another very interesting study (Diamond, 2011) stated that executive functions could be influenced, and actually improved, on infants and preschoolers, simply by the activities performed out of school curricula, like arts, physical education, etc., which would by itself also improve academic outcomes.

All this information elicited above, translated into three questions, which are the goal of this study:

1) What are the relationships between the ability of planning, emotional face recognition and decision making in people without brain injury?
2) What is the relationship between gender, age, education, profession, current situation and household with the ability of planning, emotional face recognition and decision-making?
3) What is the relationship of different personality types in individuals without brain injury with the planning ability, emotional face recognition and decision-making?

Method

Participants

For this study, we recruited 100 individuals, divided equally for each gender, aged over 18 years. Participants with a history of neuropsychiatric, cardiac or renal disease, uncorrected sensory disorder and / or alcohol abuse (more than 50g for men and 20g for women) or other drugs were excluded. The sample was collected in the Instituto Universitário de Ciências da Saúde – Norte, in Gandra, other higher education institutions, primary health centers, and recreational and cultural centers in Braga and Porto districts (Table 1; Table 2).

Neuropsychological Assessment

Key Search from the Behavioral Assessment of the Dysexecutive Syndrome (BADS):

This test is a part of the Behavioral Assessment of the Dysexecutive Syndrome (Wilson et al., 1996). It is an action strategies conception test in which, similarly to any common problem, examinees are asked to demonstrate how to seek a lost object in a field, evaluating their planning capacity according to the functionality and probability of success. The score is assigned according to the standards of the manual, where higher scores reflect better performance (Barbosa, Peixoto & Silveira, 2011).

Gandra-BARTA (University of Bolton Affect Recognition Tri-Stimulus Approach):

Also known as Emotion Recognition Task, this task consists of 59 color photographs of human faces expressing universally recognized emotions (fear, disgust, rage, happiness, sadness and surprise) and neutral expressions, taken from the database Bolton Affect Recognition Tri-Stimulus Approach (BARTA). Each emotion is represented in 9 faces and neutral faces appear in 5 photos. The selection of 59 photos was based on a pilot study with a normative sample. The stimulus was presented in a Power-Point presentation on a 17-inch screen. For each photo, the participants were asked to identify the expressed emotion. They were told to answer verbally or to point to an A4 sheet placed in front of the subject, to the worded description or drawing below every description. There was no time limit, and the examiner recorded the answers and the time participants took to complete the task. Before the exercise, a pre-test was performed to evaluate the understanding of the task by the subject, asking, "If I show you a happy face what will be your answer?". This question was asked for each emotion. If any participant would verbalize or indicate an incorrect emotion, the participant would be excluded. The score is assigned according to the standards of the manual, where higher scores reflect better performance (Carvalho, Paris, Lemos & Peixoto, 2014).

Iowa Gambling Task:

The Iowa Gambling Task (IGT) is a test designed to simulate a real life situation of decision-making, in order to evaluate this component of the executive PFC. There is no time limit to the test. It is based on a game where the "player" sits on a table in front of four decks of cards, named A, B, C and D. It loans € 2,000 in play money to the player (which resembles real money) and tells him that the aim of the game is to lose as little as possible of the loan money and to earn as much as possible of extra money. The game consists of flipping cards, one at a time, of any deck, for 100 turns, until the experimenter signals the ending. However, whenever a card is turned, it results in a gain of money, up to € 100 from the deck A or B, € 50 C or D deck, or loss of money, in exaggerated amounts up to € 1,250 from the deck A or B, or very small and controllable amounts up to 100 € on deck C or D. The patients with ventromedial lesions, as opposed to "players" with no psychopathology, systematically choose cards from decks A and B, despite the great punishment received by those decks. In the end, a higher amount of money above the initial loan reflect a better performance overall in the test (Damásio, 1994).

NEO-FFI (New Five Factor Inventory):

The NEO-FFI is the reduced version of the NEO Personality Inventory Revised (NEO-PI-R), which aims to assess the same construct. It consists of 60 items, 12 corresponding to each dimension, Neuroticism, Extraversion, Openness to Experience, Agreeableness and Conscientiousness, and uses a Likert scale of 5 points (Correia, 2009). It implies a rapid assessment (10 to 15 minutes), the reliable and valid way of the

five areas of adult personality and is especially useful when time is limited and global information on the personality is considered sufficient (Bertoquini & Ribeiro, 2002).

Procedure

The research project was submitted to the ethics committee of the Instituto Universitário de Ciências da Saúde – Norte. After acceptation of the project, it was asked to the participants to go to a closed room, where the evaluation took place. All participants gave their informed consent before being included in the study and told the data would be anonymous. They were also given a short questionnaire for sociodemographic, medical and psychological data collection. If everything was in order, the psychological assessment instruments listed above were then administered.

Statistical Analysis

Statistical analysis was carried out using the program IBM *Statistics* version 23 for Windows.

We resorted to measures of central tendency and standard deviation (SD) to the general characterization of the sample and data. We then advanced to the study of the relationship between evaluation measures of planning (Key Search), decision making (IGT) and emotional faces recognition (Gandra-BARTA) using Pearson correlations. The same test was used to study the relationship between age and those capabilities. The Mann-Whitney U Test was also used to compare the performance in the psychological tests in accordance with genre.

We also made a comparative analysis of different types of personality in relation to

planning skills, decision making and emotional face recognition through the Kruskal-Wallis test. We considered results with $p \leq .05$ as significant.

Results

We will refer to the correlations of our tests and the age of the sample. In terms of personality, and even if only with a weak correlation, only Neuroticism seems to increase with age. In Gandra-BARTA, it is also seen that the time that it takes to finish the test also increases with age, whilst the total successes decrease, both with a strong correlation. The most significant emotions to be marked as different within age differences are Disgust, Surprise, Fear, and Neutral. This tells us that the older the sample would get, the longer and harder would be for them to recognize facial emotions, especially Disgust, Surprise, Fear and Neutral faces. Also, in IGT it was shown that the older the sample would get, they would choose more Deck 2 and less in Deck 4. This translates to lower results in IOWA Blocks 2 and 3 (Table 4).

When joining the Education variable with our tests, we noticed that the higher this variable was, the less Neuroticism our sample would have, even if in a weak correlation. They would also have higher Key Search score. Gandra-BARTA showed us that a higher education can strongly correlate with less time in performing the test, and a higher score overall, with special mention to the emotions Disgust, Rage, Fear and Neutral, the first two with weak correlations, and the others with moderate and strong correlations, respectively. In IGT, a higher education symbolizes negative correlation with deck 2 and a positive correlation with deck 3, both weak.

In terms of Household, a higher number of members of a family are related to a high Neuroticism and a reduced Conscientiousness. It also reveals a higher time on Gandra-

BARTA and a lower number of total successes, with special mention to the emotions Disgust, Fear and Neutral. Finally, it was also associated with a negative correlation on IOWA Block 1, showing worst results on the first 25 turns of the test (Table 6).

Considering the variable Neuroticism, we can see that a higher scoring of this could also increase the Gandra-BARTA Time and reduce its score, particularly on the emotion Disgust, Sadness and Neutral. We also expected the Rage variable to light up in our analysis, yet it did not. Finally, a higher score of Neuroticism also reduces the "safer" choices, as seen in a negative correlation in Deck 3 and 4, and a positive one in Deck 2, which translates into a negative correlation in Block 5 (Table 7).

Advancing to Openness to Experience, this variable only correlates positively with Conscientiousness, and negatively with IGT Block 1. There does not seem to be other significant correlations (Table 8).

In the Conscientiousness factor, a higher scoring would reveal a higher Key Search scoring as well, but not on IOWA's Gambling Task, which had a positive correlation on Deck 1 and a negative one on Block 5 (Table 9).

It seems that the Extraversion and Agreeableness factors do not correlate with any of the shown variables.

In the Key Search test variable, if our sample had a higher scoring, they would also have a faster, or lower, time in Gandra-BARTA. The only emotion that was revealed as significant for this test was Neutral. Furthermore, they would also choose Deck 2 less, and obtain a higher scoring in Block 1 of IGT (Table 10).

On our analysis of Gandra-BARTA Time, a higher time strongly correlates negatively to its own successes, with special mention to the emotions Disgust, Fear and Neutral. Oddly, correlating it to IGT, it shows a weak positive correlation to Deck 2 and a weak

negative correlation to deck 4. This probably affects the next outcomes of Block 1, 2 and 5, where they show a negative correlation with Gandra-BARTA Time (Table 11).

Progressing to Gandra-BARTA Total Successes, it obviously has a positive correlation with each emotion of the test, but it also shows that a higher score here mean a lower score in Deck 2 (number of choices of the deck) and higher in deck 4, which reveals a positive correlation in Block 1, 2 and 3 (Table 12).

Moving up to the analysis of each emotion of Gandra-BARTA, Disgust has a positive correlation with Happiness, Surprise and Neutral, and also, a high scoring on this emotion signifies a higher performance in IGT, as shown in its correlation to the Deck 4 (Table 13). Happiness, also correlates positively to a greater performance in IGT (Table 14). Rage, only positively to Neutral (Table 15). A higher score of Surprise relates to a lower score of Fear (Table 16), whereas Fear relates to a higher scoring of Neutral (Table 17), and Neutral, to a better performance in IGT, as shown in its positive correlation with Deck 4, Block 1, 2 and 3, and negative correlation with Deck 2 (Table 18). Sadness does not correlate to any variable in this study.

Reaching the final test, IGT, a higher scoring in Deck 1 or Deck 2 both symbolized a lower scoring in Deck 3 and 4, and a consequential lower performance over Block 3, 4 and 5 for Deck 1 (Table 19) and over Block 2, 3, 4 and 5 for Deck 2 (Table 20). In Deck 3, a higher scoring meant a lower scoring for Deck 4, which contrasted with our expectations. In any case, Block 2, 3 4 and 5 were positively correlated to this deck, as expected (Table 21), just as in Deck 4, all Blocks were positively correlated (Table 22).

As it is obvious, all Blocks in IGT somewhat relate to other Blocks. In IOWA Block 1, higher scorings relates positively to Block 2 (Table 23), whilst Block 2 relates also

positively to Block 5 (Table 24), Block 3 relates positively to Block 4 and 5 (Table 25) and Block 4 relates positively to Block 5 (Table 26),

Discussion

After a verification of all data, and a comparison to their original studies, it was noticed that our sample had varying results, mostly from studying an elder population with a younger one, which could explain most of the disparities with other studies that will be reported. We alert to this fact several times throughout the discussion, while we try to answer the questions from our study.

The first question we proposed was if there was any relationship between the planning, the emotional facial recognition and the decision making in people who do not have brain injury. Reviewing the data so far, we performed a descriptive analysis about the tests applied to the sample, as shown in Table 3. In the Key Search test (Table 3), it was found that the sample of this study was one SD above the values found by the authors of the original article (Monteiro & Peixoto, 2014). Given that the younger population typically has a better score in the Key Search test, this can be a reasonable explanation for the discrepancy, since there is a clear difference of ages between our study and the referenced one (M=79.55; SD= 6.19) (Table 1). Not only that, but if our sample had a better performance in this test, possibly meaning that they had a better planning ability, they would also be faster in identifying emotions correctly – even though it did only correlate with the emotion Neutral. Furthermore, and although no correlation was made with Deck 3 or 4, our sample would also prove to have better decision making skills, by not choosing Deck 2 so often.

For the Gandra-BARTA, the time variable once again is influenced by the crossing of young and elderly population, but it seems to be according to the original papers, as are the total successes (Carvalho, Páris, Lemos & Peixoto, 2014), with all the specific emotions (Table 3). Moreover, a higher/slower time is regularly associated with a lower success rate in identifying emotions - special mention to the emotions Disgust, Fear and Neutral. This reverberates to IGT, showing a weak positive correlation to Deck 2 and a weak negative correlation to deck 4. This spells out that the more time you take identifying emotions, the harder it will be to make and to maintain good decisions on IGT, which affected Block 1, 2 and 5 for the worse (Table 11). The same is true for Gandra-BARTA Total Successes, where it shows that a lower score in this task correlates to a higher score in Deck 2 and lower in Deck 4 (Table 12). Through the analysis of each emotion, Disgust, Happiness and Neutral all signify a higher performance in decision making (Table 13; Table 14; Table 18). However, Rage, Fear, and Surprise only correlate significantly with other emotions (Table 15; Table 16; Table 17) whereas Sadness does not correlate to any variable in this study.

Finally, in IGT, we can see that in its five Blocks, our sample usually started by losing money in the first 25 turns, then went slowly improving and regaining their lost money over the remaining turns, which was expected, as we were working with a population with no brain injuries. Another argument for this affirmation is that all decks were chosen almost equally, and yet Deck 3 and 4, which are the "safer" choices in terms of less money loss and higher income over time, were chosen more frequently, showing a learning curve over the 100 turns (Table 3) (Bechara, Damásio, Damásio & Anderson, 1994; Bechara, Damásio, Tranel & Damásio, 1997; Bechara, Tranel & Damásio, 2000). As we saw, a higher scoring in Deck 1 or Deck 2 both symbolized a lower scoring in Deck 3 and 4, and a consequential lower performance over the Blocks (Table 19; Table

20). Unusually, in Deck 3, a higher scoring meant a lower scoring for Deck 4, even though, all but Block 1 were positively correlated to this deck, as expected (Table 21), just as in Deck 4 (Table 22).

The results from these three tests, Key Search, that studied the planning, Gandra-BARTA, which focused on the emotional face recognition, and IGT, which leaned on the decision making factor, and their due correlations, all aligned themselves together to provide the answer to the question, which we had prospected – all these areas are related. If someone has a good ability of planning, they will most likely also be good at recognizing emotional faces fairly quickly and correctly, and also be good at making decisions.

The second interrogation was based on the possibility of having a relation between several biosocial factors, such as age, gender, education, profession, current situation, household, clinical situation and the three cognitive functions, planning, emotional face recognition and decision making.

Regarding age, it seems that the older the sample would get, the lower would be the performance on the different tasks – facial recognitions of emotions, processing speed and success of a performed task – but not planning. Furthermore, as it was shown in IGT, the older the sample would get, the more "risky" choices they would take, in this case being Deck 2 – more wins, yet bigger losses – and opting less on the "safer" route of Deck 4, which translated to lower results in IOWA Blocks (Table 4). These data were expected, since the decline of cognitive functions is well known in older age, but the fact that planning was not affected mean that only a certain level of functions can be affected, denying the conclusion of a global decline of the brain (MacPherson, Phillips & Sala, 2002; Lamar & Resnick, 2004). Regarding emotional face recognition, our

study found close results to the study of Isaacowitz et al. (2007) whereas we similarly found Disgust and Fear with lower recognitions.

Continuing, we also noticed that a higher number of years of education is associated to an increase in overall performance of tests, which can be related to a higher levels of planning, facial recognition and processing speed. Likewise, in IGT, a higher education symbolizes a negative correlation with deck 2 and a positive correlation with deck 3, which could mean that they learnt what the "risky" choices are, and avoid them, to gain more money in the long term, as we can see this immediately in Block 1 and 2 of the test (Table 5). This result was anticipated as well, according to the literature (McCrea, Mueller & Parrila, 1999; Burrage et al., 2008), whose authors mention that the continuous undertaking of education will generate ramifications in the executive functions.

In the Household variable, a higher value is unexpectedly associated with a lower performance throughout all the tests (Table 6). This might be related to the already acknowledged fact of correlating positively with Neuroticism, which does then explain the low results.

Unfortunately, the remaining studied biosocial factors did not correlate significantly with any of our variables, which tells us the answer to our second interrogation – There is a relationship, even if only of some of our studied variables influence the planning, the emotional face recognition and the decision making - age and household with a negative influence on performance, whilst years of education proved itself by being a positive influence on those abilities.

Finally, our concluding doubt was if there was a connection with different personality types in individuals without brain injury with the planning ability, emotional face recognition and decision-making.

Exploring this area through the view of the Big Five in NEOFFI, it was shown that Neuroticism, the Extraversion, Openness to Experience and Conscientiousness are according to the data obtained by the Portuguese version of NEOFFI (Correia, 2009; Pedroso-Lima et al., 2014), however the Agreeableness factor is one SD below the original data of the authors (M = 32.49, SD = 5.61). Considering the fact that Pedroso-Lima et al. (2014) mention in their article that the Agreeableness dimension tends to have the highest mean in all of the Big Five in the younger population, it is not known why this factor was so low in our study.

Particularizing, we discovered that Neuroticism is higher with a less numerable years of education, with older ages and / or a larger number of household members. This also reduces performance all across tests, which translates into slower processing speeds, difficulties in recognizing emotional faces and decision making (Table 7). Even though our sample was younger, we found the same results that Steunenberg, Twisk, Beekman, Deeg & Kerkhof (2004) did, in relation to the aging factor. It's true that theirs did not include any young subjects (aged 55-85 years; M=70), but the aging factor seems to be goes according the information we gathered, as is the education factor (Jaconelli, Stephan, Canada & Chapman, 2012). The Household members factor remains a mystery to be addressed in future studies.

The Conscientiousness factor showed itself as relevant for performance on planning, but not decision making, whereas in emotional face recognition it did not correlate at all. We can see this in the study of Mirnics et al. (2013), whereas he states that planning and Conscientiousness are related. It is relevant to mention however, distinctively because it

was unforeseen, that a high Conscientiousness is associated to a low Household number (Table 9).

Openness to Experience appears to only correlate to Conscientiousness, and negatively with IGT Block 1. This could signify that this factor affects negatively performance on decision making, which is unanticipated (Table 8). However, Mohan & Mulla (2013) reveal a most interesting discovery – Openness to Experience was positively correlated to a high complexity job performance, and negatively with a low complexity job performance. As we saw in Table 2, we had more "Blue Collar" participants overall, which is related to a more physical and low complexity job. This relation could be used to explain our results.

It seems that the Extraversion and Agreeableness factors do not correlate with any of the shown variables.

Responding to our final question – some of the different personality types do affect differently our performance on our three studied variables. Our results lead us to think that a subject with a high Neuroticism level would presumably be worse on all three areas, whilst Openness to Experience and Conscientiousness have their pros and cons, and the remaining two do not correlate.

Conclusion

As we have seen throughout this paper, all of our hypothesis have been confirmed, by our study and by the literature of many other authors. Indeed, we witnessed proof of existence of relations among the ability to plan, to make decisions and to recognize facial emotions – meaning that usually a subject that performs well on one of them, will likely perform well on the other two. The same is true for the existing relation in

psychosocial factors and the studied abilities, even if apparently minimal – gender, profession, current situation and clinical history were not highlighted in our study – it was present in age and household as a negative influence, and years of education as positive, and it is also true for the personality connection, even though seemingly minimal, as Extroversion and Agreeableness did not draw attention, Openness to Experience and Conscientiousness did, with a special focus on Neuroticism as a definitive negative effect.

Even though we had these results, what did really provoke some staggering results was the Household variable. It was quite eye-opening, as we did not find any literature to back-up our own results. This means that this variable should be explored in the future, to compare data and verify if larger number of family members are indeed related to higher Neuroticism, reduced Conscientiousness and reduced performance all over the studied abilities.

Finally, a special reiteration is necessary for the Agreeableness item. It was especially low in our study wherein our literature it was quite high. This too might prove a challenging research for the future.

References

Barbosa, F.B., Peixoto, B. & Silveira, C. (2011). Behavioral Assessment of the Dysexecutive Syndrome (BADS): dados normativos portugueses e indicadores psicométricos. *Saúde Mental*. 13 (6): 21-7.

Bechara, A., Damásio, A., Damásio, H. & Anderson, S. (1994). *Insensitivity to future consequences following damage to human prefrontal cortex*. Cognition. 50 (1-3): 7-15.

Bechara, A., Damásio, H., Tranel, D. & Damásio, A. (1997). *Deciding Advantageously Before Knowing the Advantageous Strategy*. Science. 275 (5304): 1293-1295.

Bechara, A., Damásio, A. & Damásio, H. (2000). *Emotion, decision making and the orbitofrontal cortex.* Cereb Cortex. 10 (3): 295-307.

Bechara, A., Tranel, D. & Damásio, H. (2000). *Characterization of the decision-making deficit of patients with ventromedial prefrontal cortex lesions*. Brain. 123 (11): 2189-2202

Bertoquini, V. & Ribeiro, J. (2002). *NEO-FII: Estudo Psicométrico*. 5º Congresso Nacional de Psicologia da Saúde.

Best, J., Miller, P. & Naglieri, J. (2012). *Relations between Executive Function and Academic Achievement from Ages 5 to 17 in a Large, Representative National Sample*. Learn Individ Differ. 21 (4): 327-336.

Boes, A., Grafft, A., Joshi, C., Chuang, N., Nopoulos, P. & Anderson, S. (2011). *Behavioral effects of congenital ventromedial prefrontal cortex malformation*. BMC Neurology. 11:151

Burrage, M., Ponitz, C., McCready, E., Shah, P., Sims, B., Jewkes, A. & Morrison, F. (2008). *Age- and Schooling-Related Effects on Executive Functions in Young Children: A Natural Experiment*. Child Neuropsychology. 14 (6): 510-524.

Capovilla, A., Assef, E. & Cozza, H. (2007). *Avaliação Neuropsicológica das Funções Executivas e Relação com Desatenção e Hiperatividade*. Avaliação Psicológica, 6 (1): 51-60.

Carmichael, S. & Price, J. (2004). *Limbic connection of the orbital and medial prefrontal cortex in macaque monkeys*. Journal of Comparative Neurology. 363 (4): 615-641.

Carvalho, C., Páris, M., Lemos, M. & Peixoto, B. (2014). *Assessment of facial emotions recognition in aging and dementia. The development of a new tool.* Biomedicine & Aging Pathology. 4: 91-94.

Correia, A. (2009). *Factores Psiquiátricos e Psicossociais na Evolução Clínica do Doente Submetido a Transplante Hepático. Estudo Longitudinal, Prospectivo, Observacional, Analítico (Doctoral Dissertation). Retrieved 11 December 2014 from* *http://repositorio.ul.pt/bitstream/10451/6385/5/ulsd05802_td_tese.pdf*

Damásio, A. (1994). *Descartes' Error*. NY: Avon Books.

Diamond, A. (2011). *Biological and social influences on cognitive control processes dependent on prefrontal cortex*. Proq Brain Res. 189: 319-339.

Frith, C., Friston, K., Liddle, P. & Frackowiak, R. (1991). *Willed Action and the Prefrontal Cortex in Man: A Study with Pet*. Proc Biol Sci. 244 (1311): 241-246.

García-Molina, A. & Enseñat, A. (2015). *Es la corteza prefrontal el centro del universo?*. REV NEUROL. 16: 372-376.

Ghosh, D. & Ray, M. (1997). *Risk, Ambiguity, and Decision Choice: Some Additional Evidence*. Decision Sciences. 28 (1): 81-104.

Hooper, C., Luciana, M., Conklin, H. & Yarger, R. (2004). *Adolescents' Performance on the Iowa Gambling Task: Implications for the Development of Decision Making and Ventromedial Prefrontal Cortex*. Developmental Psychology. 40 (6): 1148-1158.

Isaacowitz, D., Löckenhoff, C., Lane, R., Wright, R., Sechrest, L., Riedel R. & Costa P. (2007). *Age differences in Recognition of Emotion in Lexical Stimuli and Facial Expressions*. Psychology and Aging. 22 (1): 147-159.

Jaconelli, A., Stephan, Y., Canada, B. & Chapman, B. (2013). *Personality and physical functioning among older adults: the moderating role of education*. J Gerontol B Psychol Sci Soc Sci. 68 (4): 553-557.

Kane, M. & Engle, R. (2002). *The role of prefrontal cortex in working-memory capacity, executive attention, and general fluid intelligence: An individual-differences perspective.* Psychonomic Bulletin & Review. 9 (4): 637-671.

Kiehl, K. & Sinnott-Armstrong, W. (2013). *Handbook on Psychopathy and Law*. NY: Oxford University Press.

Keith, T., Reynolds, M., Roberts, L., Winter, A. & Austin, C. (2011). *Sex differences in latent cognitive abilities ages 5 to 17: Evidence from the Differential Ability Scales – Second Edition*. Elsevier. 39 (5): 389-404.

Killcross, S. & Coutureau, E. (2003). *Coordination of Actions and Habits in the Medial Prefrontal Cortex of Rats*. Cereb Cortex. 13 (4): 400-408.

Lamar, M. & Resnick, S. (2004). *Aging and prefrontal functions: dissociating orbitofrontal and dorsolateral abilities*. Neurobiology of Aging. 25 (4): 553-558.

Lawson, G., Duda, J., Avants, B., Wu, J. & Farah, M. (2013). *Associations between children's socioeconomic status and prefrontal cortical thickness*. Dev Sci. 16 (5): 641-652.

MacPherson, S., Phillips, L. & Sala, S. (2002). *Age, Executive Function, and Social Decision Making: A Dorsolateral Prefrontal Theory of Cognitive Aging*. Psychology and Aging. 17 (4): 598-609.

McCrea, S., Mueller, J. & Parrila, R. (1999). *Quantitative Analyses of Schooling Effects on Executive Function in Young Children*. Child Neuropsychology. 5 (4): 242-250.

Miller, E. & Cohen, J. (2001). *An Integrative Theory of Prefrontal Cortex Function*. Annu Ver Neurosci. 24: 167-202.

Miller, E., Freedman, D. & Wallis, J. (2002). *The prefrontal cortex: categories, concepts and cognition*. Philos Trans R Soc Lond B Sci. 357 (1424): 1123-1136.

Mirnics, Z., Heincz, O., Bagdy, G., Surányi, Z., Gonda, X., Benko, A., Molnar, E., Jakšić, N., Lazary, J. & Juhasz, G. (2013). *The relationship between the big five personality dimensions and acute psychopathology: mediating and moderating effects of coping strategies*. Psychiatria Danubina. 25 (4): 379-388.

Mohan, G. & Mulla, Z. (2013). *Openness to Experience and Work Outcomes: Exploring the Moderating Effects of Conscientiousness and Job Complexity*. Great Lakes Herald. 7 (2): 18-36

Naglieri, J. & Rojahn, J. (2001). *Gender differences in Planning, Attention, Simultaneous, and Successive (PASS) Cognitive Processes and Achievement*. Journal of Educational Psychology. 93 (2): 430-437.

Oliveira, A., Nascimento, E. & Fernandes, J. (n.d.). *Avaliação Neuropsicológica do Planejamento Cognitivo*. Retrieved January 7th 2015, from http://www.ibapnet.org.br/congresso2011/trabalhos/588.pdf

Owen, A. (1997). *Cognitive planning in humans: neuropsychological, neuroanatomical and neuropharmalogical perspectives.* Proq Neurobiol. 53 (4): 431-450.

Palomo, N. & Guinea, S. (2007). *Repercusiones Forenses del Daño en el Cortex Prefrontal Ventromedial: Relevancia de la Toma de Decisiones*. Psicopatologia Clinica, Legal y Forense. 7: 127-145.

Prinz, S., Gründer, G., Hilgers, G., Holtemöller, O. & Vernaleken, I. (2014). *Impact of personal economic environment and personality factors on individual financial decision making.* Front Psychol. 5: 158

Rezai, K., Andreasen, N., Alliger, R., Cohen, G., Swayze II, V. & O'Leary, D. (1993). *The Neuropsychology of the Prefrontal Cortex*. Arch Neurol. 50 (6): 636-642.

Shallice, T., Fletcher, P., Frith, C., Grasby, P., Frackowiak, R. & Dolan, R. (1994). *Brain regions associated with acquisition and retrieval of verbal episodic memory*. Nature. 368: 633-635.

Shimamura, A. (2000). *The role of the prefrontal cortex in dynamic filtering*. Psychobiology. 28 (2): 207-218.

Steunenberg, B., Twisk, J., Beekman, A., Deeg, D. & Kerkhof, A. (2004). *Stability and Change of Neuroticism in Aging*. Gerontol B Psychol Sci Soc Sci. 60 (1): 27-33.

Tanji, J. & Hoshi, E. (2001). *Behavioral planning in the prefrontal cortex*. Current Opinion in Neurobiology. 11: 164-170.

Wilson, B.A., Alderman, N., Burgess, P.W., Esmlie, H. & Evans, J.J. (1996). *Behavioral Assessment of the Dysexecutive Syndrome*. Sufolk: Thames Valley Test Company

Zald, D. & Andreotti, C. (2010). *Neuropsychological assessment of the orbital and ventromedial prefrontal cortex*. Neuropsychologia. 48(12): 3377-3391.

Annex

Table 1. Socio-demographic Characteristics of the Sample.

	Gender	Age	Education	Profession	Current Situation	Household	Clinical History
N	100	100	100	100	100	100	100
Mean	1,50	36,67	11,57	2,08	1,29	4,15	0,77
Mean SE	0,05	2,100	0,385	0,086	0,046	0,102	0,146
Median	1,5	25	12	2	1	4	0
Range	1	53	15	2	1	5	6
Min.	1	18	3	1	1	2	0
Max.	2	71	18	3	2	7	6

Table 2. Socio-demographic Characteristics of the Sample.

	n	%
Gender		
Male	50	50
Female	50	50
Profession		
Student	33	33
White Collar	26	26
Blue Collar	41	41
Current Situation		
Active	71	71
Retired	29	29
District		
Braga	52	52
Porto	48	48

Table 3. Descriptive Statistics of the applied tests.

	Minimum	Maximum	Mean	SD
Neuroticism	17	33	25,22	0,318
Extraversion	26	39	32,56	0,304
Openness to Experience	24	30	26,78	0,208
Agreeableness	17	32	25,79	0,367
Conscientiousness	24	38	31,70	0,342
Key Search	0	4	2,70	0,111
Gandra-BARTA Time	120	1056	471,24	23,078
Gandra-BARTA Total Successes	34	54	47,06	0,457
Disgust	4	9	8,05	0,097
Sadness	4	9	6,41	0,142
Happiness	6	9	8,38	0,098
Rage	5	9	7,66	0,111
Surprise	6	9	7,99	0,093
Fear	1	8	4,60	0,205
Neutral	0	5	3,91	0,166
IOWA Deck 1	4	32	21,51	0,511
IOWA Deck 2	14	37	23,69	0,454
IOWA Deck 3	18	43	28,39	0,502
IOWA Deck 4	14	39	26,34	0,504
IOWA Block 1	-12	8	-0,68	0,323
IOWA Block 2	-8	14	1,50	0,354
IOWA Block 3	-6	10	2,24	0,352
IOWA Block 4	-8	20	2,38	0,452
IOWA Block 5	-6	20	4,15	0,526

Table 4. Significant Correlations between Age and Tests.

	Correlation Coefficient	Bilateral Significance
Neuroticism	0,318	0,000
Gandra-BARTA Time	0,642	0,000
Gandra-BARTA Total Successes	-0,587	0,000
Disgust	-0,509	0,000
Surprise	-0,244	0,015
Fear	-0,302	0,002
Neutral	-0,695	0,000
IOWA Deck 2	0,288	0,004
IOWA Deck 4	-0,323	0,001
IOWA Block 1	-0,201	0,045
IOWA Block 2	-0,292	0,003
IOWA Block 3	-0,225	0,024

Table 5. Significant Correlations between Education and Tests.

	Correlation Coefficient	Bilateral Significance
Neuroticism	-0,367	0,000
Key Search	0,263	0,008
Gandra-BARTA Time	-0,503	0,000
Gandra-BARTA Total Successes	0,570	0,000
Disgust	0,333	0,001
Rage	0,206	0,040
Fear	0,495	0,000
Neutral	0,598	0,000
IOWA Deck 2	-0,340	0,001
IOWA Deck 3	0,254	0,011
IOWA Block 1	0,238	0,017
IOWA Block 2	0,273	0,006

Table 6. Significant Correlations between Household and Tests.

	Correlation Coefficient	Bilateral Significance
Neuroticism	0,222	0,026
Conscientiousness	-0,197	0,049
Gandra-BARTA Time	0,473	0,000
Gandra-BARTA Total Successes	-0,494	0,000
Disgust	-0,264	0,008
Fear	-0,312	0,002
Neutral	-0,604	0,000
IOWA Block 1	-0,221	0,027

Table 7. Significant Correlations between Neuroticism and Tests

	Correlation Coefficient	Bilateral Significance
Gandra-BARTA Time	0,408	0,000
Gandra-BARTA Total Successes	-0,414	0,000
Disgust	-0,286	0,004
Sadness	-0,202	0,044
Neutral	-0,454	0,000
IOWA Deck 2	0,263	0,008
IOWA Deck 3	-0,212	0,034
IOWA Deck 4	-0,213	0,033
IOWA Block 5	-0,263	0,008

Table 8. Significant Correlations between Openness to Experience and Tests.

	Correlation Coefficient	Bilateral Significance
Conscientiousness	0,218	0,029
IOWA Block 1	-0,248	0,013

Table 9. Significant Correlations between Conscientiousness and Tests.

	Correlation Coefficient	Bilateral Significance
Key Search	0,206	0,040
IOWA Deck 1	0,249	0,012
IOWA Block 5	-0,233	0,020

Table 10. Significant Correlations between Key Search and Tests.

	Correlation Coefficient	Bilateral Significance
Gandra-BARTA Time	-0,237	0,018
Neutral	0,297	0,003
IOWA Deck 2	-0,227	0,023
IOWA Block 1	0,250	0,012

Table 11. Significant Correlations between Gandra-BARTA Time and Tests.

	Correlation Coefficient	Bilateral Significance
Gandra-BARTA Total Successes	-0,582	0,000
Disgust	-0,501	0,000
Fear	-0,431	0,000
Neutral	-0,718	0,000
IOWA Deck 2	0,249	0,012
IOWA Deck 4	-0,290	0,003
IOWA Block 1	-0,206	0,040
IOWA Block 2	-0,337	0,001
IOWA Block 5	-0,247	0,013

Table 12. Significant Correlations between Gandra-BARTA Total Successes and Tests.

	Correlation Coefficient	Bilateral Significance
Disgust	0,693	0,000
Sadness	0,304	0,002
Happiness	0,316	0,001
Rage	0,324	0,001
Surprise	0,265	0,008
Fear	0,560	0,000
Neutral	0,764	0,000
IOWA Deck 2	-0,212	0,035
IOWA Deck 4	0,206	0,040

IOWA Block 1	0,289	0,004
IOWA Block 2	0,260	0,009
IOWA Block 3	0,217	0,030

Table 13. Significant Correlations between Disgust and Tests

	Correlation Coefficient	Bilateral Significance
Happiness	0,364	0,000
Surprise	0,399	0,000
Neutral	0,594	0,000
IOWA Deck 4	0,272	0,006
IOWA Block 2	0,349	0,000
IOWA Block 3	0,221	0,027

Table 14. Significant Correlations between Happiness and Tests.

	Correlation Coefficient	Bilateral Significance
Surprise	0,356	0,000
IOWA Deck 4	0,209	0,037

Table 15. Significant Correlations between Rage and Tests.

	Correlation Coefficient	Bilateral Significance
Neutral	0,235	0,018

Table 16. Significant Correlations between Surprise and Tests.

	Correlation Coefficient	Bilateral Significance
Fear	-0,291	0,003

Table 17. Significant Correlations between Fear and Tests.

	Correlation Coefficient	Bilateral Significance
Neutral	0,423	0,000

Table 18. Significant Correlations between Neutral and Tests.

	Correlation Coefficient	Bilateral Significance
IOWA Deck 2	-0,348	0,000
IOWA Deck 4	0,312	0,002
IOWA Block 1	0,328	0,001
IOWA Block 2	0,316	0,001
IOWA Block 3	0,257	0,010

Table 19. Significant Correlations between IOWA Deck 1 and Tests.

	Correlation Coefficient	Bilateral Significance
IOWA Deck 3	-0,362	0,000
IOWA Deck 4	-0,316	0,001
IOWA Block 2	-0,393	0,000
IOWA Block 3	-0,320	0,001
IOWA Block 4	-0,350	0,000
IOWA Block 5	-0,491	0,000

Table 20. Significant Correlations between IOWA Deck 2 and Tests.

	Correlation Coefficient	Bilateral Significance
IOWA Deck 3	-0,284	0,004
IOWA Deck 4	-0,368	0,000
IOWA Block 2	-0,301	0,002
IOWA Block 3	-0,313	0,002
IOWA Block 4	-0,360	0,000
IOWA Block 5	-0,364	0,000

Table 21. Significant Correlations between IOWA Deck 3 and Tests.

	Correlation Coefficient	Bilateral Significance
IOWA Deck 4	-0,314	0,001
IOWA Block 2	0,258	0,010
IOWA Block 3	0,308	0,002
IOWA Block 4	0,250	0,012
IOWA Block 5	0,488	0,000

Table 22. Significant Correlations between IOWA Deck 4 and Tests.

	Correlation Coefficient	Bilateral Significance
IOWA Block 1	0,245	0,014
IOWA Block 2	0,390	0,000
IOWA Block 3	0,280	0,005
IOWA Block 4	0,378	0,000
IOWA Block 5	0,314	0,001

Table 23. Significant Correlations between IOWA Block 1 and Tests.

	Correlation Coefficient	Bilateral Significance
IOWA Block 2	0,239	0,017

Table 24. Significant Correlations between IOWA Block 2 and Tests.

	Correlation Coefficient	Bilateral Significance
IOWA Block 5	0,229	0,022

Table 25. Significant Correlations between IOWA Block 3 and Tests.

	Correlation Coefficient	Bilateral Significance
IOWA Block 4	0,269	0,007
IOWA Block 5	0,258	0,009

Table 26. Significant Correlations between IOWA Block 4 and Tests.

	Correlation Coefficient	Bilateral Significance
IOWA Block 5	0,262	0,009

http://www.actaneuropsychologica.com//page.php?IDpage=135&p=4

Instructions for Authors

Acta Neuropsychologica seeks to publish innovative papers concerned with all aspects of the brain-behavior relationship, including (but by no means limited to):

– Neurobehavioral disturbances, including diagnosis and treatment, social and legal consequences, ethical and moral problems, etc.

– The brain/mind problem;

– General or specific theories of brain function and development, cognitive and emotional processes, speech and language functions, etc.

Authors are encouraged to submit manuscripts on theoretical and clinical topics in neuropsychology, broadly understood; interdisciplinary studies that explore issues not previously regarded as strictly neuropsychological are particularly welcome.

Acta Neuropsychologica publishes articles of several types:

– Experimental and clinical research papers (group studies, case studies, metanalyses);

– Theoretical essays;

– Reviews (normally by invitation of the Editors, but unsolicited submissions of particular value can be considered);

– Letters to the editor (at the Editors' discretion, these can be published as commentary articles);

– Book reviews.

From time to time the Editors may also organize a Clinical Forum, which will feature an invited lead paper accompanied by 3-5 commentaries by independent researchers active

in the same field, and the original author's response to the commentaries. Readers are cordially invited to submit requests, proposals, suggestions, and nominations for review and clinical forum articles.

Structured abstracts

Authors submitting papers are required to provide a 200-300 word abstract, preferably structured. This is especially important for the proper indexing and citation of papers. The structure of the abstract should generally reflect the structure of the article as a whole. Below the abstract the authors should give 3-6 key words, which as a general rule should not be terms that occur in the title of the paper. The purpose of key words is to direct the attention of search engines to an article, and these programs scan titles first for the search string, so the reappearance of words from the title among the key words is pointless and deprives the author of a valuable opportunity to attract reader interest.

The essential features of a structured abstract for a clinical or empirical research study are given below.

Background: Describe the background to the study, including the central problems or issues and their importance, the aims and objectives of the study, research questions or hypotheses advanced, etc.

Material and methods: Outline the research subjects/participants with relevant demographics and clinical information, the basic tests and parameters, and the experimental design, including statistical methods if different from routine tests and measures.

Results: Outline the important and relevant results generated by the experiment in general terms, without undue specificity of data.

Conclusions: The most important conclusions and implications of the study, with particular emphasis on any implications for clinical practice.

The foregoing should be treated as a model and not a prescription. Essays of a more discursive nature need not have a structured abstract. If the Editors upon review of the manuscript feel that the abstract should be structured, they will ask the author(s) to do so prior to publication.

Manuscript preparation

For detailed regulations, see the Editorial Policy. All manuscripts should be sent to the Editor-in-Chief. Submissions should be sent in the form of an electronic mail message with attachments, sent to the Editor's address as indicated in the Editorial Policy, or on a 3.5", 2HD, IBM-formatted diskette (with printout) sent by post. No submitted materials will be returned to the authors; please do not send original illustrations until the article has been reviewed and accepted for publication. Hard-copy submissions not accompanied by a diskette or e-mail attachment cannot be accepted, since the manuscripts are sent to the referees only in electronic form. Please send text files in Rich Text Format (*.rtf), with scanned illustrations in JPEG (*.jpg) or bitmap (*.bmp) format; other formats should be explicitly cleared with the Editor before submission.

Manuscripts are accepted for publication subject to the following conditions:

– Copyright must be transferred by the author(s) to Agencja Wydawnicza MEDSPORTPRESS prior to publication; a form for this purpose will be sent at the same time as the galley proofs.

– The work as submitted must be the original work of the author(s), containing no plagiarism, and not previously published or submitted for consideration in another journal or publication.

– All the co-author(s), if any, are assumed to have read and accepted the manuscript prior to its submission and agreed to its publication in *Acta Neuropsychologica* , and to the order in which they are listed. Unless otherwise expressly provided, the first author is responsible for making all editorial decisions on behalf of all the authors and obtaining their consent to emendations and final publication. Galley proofs will be sent only to the first author. The first author alone will be held responsible for meeting these conditions; neither the Editors nor the Publisher will be responsible for misunderstandings among the co-authors of a given article.

– The necessary permissions must be obtained in writing from the person(s) holding authorial rights to any text, illustration, or other material which is reproduced or derived from a copyrighted source beyond the scope of the "fair use" principle. No material should be reproduced from a published source without explicit citation.

– The work may not include content that is abusive, defamatory, libelous, obscene, fraudulent, or in violation of applicable laws, including international and national laws against the unauthorized disclosure of private and personal information.

If the manuscript is accepted for publication, the authors may use the substance of their work in future publications, provided that its prior publication in *Acta Neuropsychologica* is properly and explicitly acknowledged.

Ten complimentary offprints of the article and a complimentary copy of the issue in which the article appears will be sent to the first or sole author of articles. Larger quantities of offprints may be ordered at a special discount price by contacting the publisher directly:

neuropsychologia23@o2.pl

sekretariat@medsport.pl

Review process

The editors will accept only those works which are acknowledged by the reviewers and the editors to be thematically appropriate works making an original contribution to progress in science and/or clinical practice.

The signature of all authors on the letter of submission signifies that:

• The submitted manuscript is the authors' own work;

• The research results have not been published or submitted for publication elsewhere;

• All the authors named on the title page have consented to the submission of this work for publication in Acta Neuropsychologica.

Received manuscripts are first examined by the Acta Neuropsychologica editors. Manuscripts considered unsuitable for publication in Acta Neuropsychologica are immediately returned to the author without further review.

Once the manuscript has been registered at the Editorial Office, the first author is notified only by e-mail giving the reference number for future correspondence. The registered manuscripts are sent to two reviewers for scientific evaluation. The

evaluation process should not take longer than 3 months, but the editors cannot guarantee an editorial decision within any established deadline.

Manuscripts are accepted unconditionally if both reviewers agree that the work can be published in its present form. If the reviewers disagree or feel that the manuscript should be accepted subject to specific corrections, the editors may decide to send the work to another reviewer or return it to the author for correction.

The ultimate decision to accept for publication, accept subject to correction, or reject a work is the prerogative of the editors and cannot be appealed. The editors are not obliged to justify their decision.

Conflict of interests

The editors of Acta Neuropsychologica expect that the authors of research articles are not financially involved in a company whose product is presented in the text, or in a competing company.

The authors of a research article should disclose at the time of submission any financial arrangement they may have with a company whose product figures prominently in the submitted manuscript. Such information will be held in confidence while the manuscript is under review and will not influence the scientific evaluation of the work, but if the article is accepted for publication, the editors will either agree with the authors how such information is to be communicated to the reader, or decide to forego such notification.

Acta Neuropsychologica policy requires that reviewers, associate editors, editors, and senior editors reveal in a letter to the Editor-in-Chief any relationships they may have

that could be construed as causing a conflict of interest with regard to the author of a manuscript under review. The letter should include a statement of any financial relationships with commercial companies involved with a medical product under study.

Manuscripts submitted for publication will not be sent to a reviewer from the same home institution as the author(s).

Ghostwriting and guest authorship

Ghostwriting and guest authorship are examples of scientific misconduct. Any identified cases will be disclosed, including notification of appropriate bodies or institutions (authors' home institutions, scientific societies, associations of academic editors, etc.).

Permissions

Materials taken from other sources must be accompanied by a written statement from the first author and the publisher of the original publication giving permission for reproduction in Acta Neuropsychologica.

Permission should be obtained in writing from the first author of papers still in press, and from the source of any unpublished data or personal communications used in the article.

Patient confidentiality

Changing the biographical details of a patient in order to protect his/her identity is a form of data alteration and should be avoided. However, the authors of clinical papers

are obliged to protect the patient's privacy rights. Only clinically or scientifically important information should be published. Therefore, if it is possible to identify a patient from the information given in the article, the authors must obtain the written consent of the patient or his/her guardian to publish his/her data, including photographs, radiological images, etc., prior to submission. Details regarding the race, ethnicity, cultural background or religion of any person involved in the study should be disclosed only when in the author's considered opinion such details have a bearing on the course of the disease and/or treatment under discussion in the text.

Copyright transfer

Upon acceptance of a manuscript for publication, the authors transfer copyright to the MEDSPORTPRESS Publishing House. Once an article is accepted for publication in Acta Neuropsychologica , the information it contains cannot be revealed in the public media until the publication date of the issue in which the article appears.

Upon acceptance all published manuscripts become the permanent property of MEDSPORTPRESS, the Publisher of Acta Neuropsychologica and may not be published elsewhere without written permission from MEDSPORTPRESS.

Disclaimer

Every effort is made by the Publisher and Editorial Board to see that no inaccurate or misleading data, opinions or statements appear in Acta Neuropsychologica . Nevertheless, the substantive contents of articles and advertisements remain the sole responsibility of the author, sponsor, or advertiser concerned. Accordingly, neither the

Publisher nor the Editorial Board accept any liability whatsoever for the consequences of any such inaccurate or misleading data, opinion, or statement.

Every effort is made to ensure that drug doses and other quantities are presented accurately. Nevertheless, the editors advise all readers to apply methods and techniques involving drug usage and other treatment procedures described in Acta Neuropsychologica in compliance with the recommendations and instructions of the drug or equipment manufacturer as published in the reader's own country.