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Gaze and head contingency in visual prosthetic systems: A proposed artificial vision study

Despite being considered automatic, perceiving the visual world is a highly complex process that depends on intact visual and oculomotor function. Visual scanning is necessary to efficiently integrate individual glances into more coherent perceptions (Chen, Hallum, Suaning, & Lovell, 2007). To date, however, most prosthetic devices do not deliver stimulation based on full gaze position (head direction plus eye position within the head). They, therefore, provide suboptimal visual information to the user and require substantial training to hold the eyes fixed forward while scanning with the head (Gilchrist, Brown, & Findlay, 1997). Here, we report attempts of current visual prosthetic devices to overcome the hurdle of gaze contingency and address the effects of head versus eye movements on processing visual information in a simulated prosthetic vision paradigm (Chen et al., 2007). To date, studies of visual performance with normal, sighted subjects have employed a simulation of artificial vision and have updated the artificial percept based on the participants' head (Chen et al., 2007) and/or eye movements (Vurro et al., 2014; Rassia & Pezaris, in preparation). We now propose to perform a new study that includes a similar head-contingent mode so as to examine the potential improvements of adding full gaze contingency to existing visual prosthesis designs. Assessing the contribution of full gaze contingency to visual perception in a simulated reading task will provide a novel and rigorous examination of the three viewing modes (i.e., eye-only, head-only, and full-gaze contingent modes) and allow us to further optimize prosthetic utility for everyday activities. Finally, the proposed study also holds the premise of answering questions regarding the level of training in holding the eyes still that is required for optimal head-only use. Answering these questions could help overcome the limitations of current prosthetic devices and would contribute significantly to the post-implantation rehabilitation strategies that could assist patients make use of artificial visual signals that they provide.

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Thinking and feeling inside the cockpit. Approaching the construct of emotion and cognition interaction in civil aviation accidents

Descartian dualism had a detrimental effect in the study of the nature of emotion and cognition in philosophy and science, something that led to their treatment as largely separate entities. Today it is common ground that such a view is erroneous. With the advances in neuropsychology we have vast evidence for the common neurobiological background and clinical manifestations of emotion and cognition. Ultimately, in many cases the clear distinction between the two is blurry. Complex human behavior can only be perceived under this prism. Such a behavior is the human risk factor in aviation. Up until now human factor theories have not been informed adequately from the advances in neuroscience, treating cognitive and emotional variables as rather distinct entities. Moreover they are based on theoretical constructions with no obvious relation to data driven approaches. In the majority of cases human error is considered as a human factor synonym which has been thoroughly described but not adequately defined.

The 100 most fatal civil aviation accidents were subjected to data driven content analysis in order to extract the psychological/emotional and cognitive variables attributed to the cockpit crew at the time of the accident. Two clinical neuropsychologists reviewed official accident reports searching for commonly recurring psychological/emotional and cognitive themes. A third independent researcher calculated Cohen's interrater reliability for cognitive and psychological variables. Apart from accident reports as the official coding unit, researchers reviewed –where available– all possible sources of information for each accident (e.g., cockpit voice recordings, judicial reports, textbooks on aviation accidents, etc.).

25 emotional/psychological and 17 cognitive variables were recognized. A possible interaction between emotional and cognitive variables was found in the majority of accidents accounting for as much as 53% of total cases and 77% of human factor cases. The interaction construct was predefined as a spatiotemporal presence of at least one cognitive and one psychological variable attributed to the cockpit crew. Under this prism human error cannot be considered as the cause of an accident but as a symptom of a complex human behavior that can be studied and assessed. A discussion following the previous results is two-fold: 1) Neurobiological and clinical data of emotion and cognition interaction, and 2) civil aviation accident paradigms. A comprehensive approach for the assessment and study of the human risk factor in aviation is proposed based on clinical neuropsychology: Aerospace Neuropsychology is the integration of neuropsychological methodology, theory and practice in aerospace settings, in order to study and assess individuals in every aspect of the human machine interaction with an aim to fly.

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The effects of early life seizures in combination with peripubertal stress on cognition and brain structure during adulthood

Epilepsy is a common neurological disorder that affects a significant proportion of the population. Epileptic seizures are its main symptom and occur more often in young children due to the protracted maturation of the inhibitory circuitry. Meanwhile, puberty is a critical period due to the activation of the hypothalamus-pituitary-gonadal axis and the gonadal hormones. The puberty period is accompanied by changes, in both the structure and the function of the brain, as maturation of neuronal circuits continues.

The purpose of this study was to investigate the combined effects of early life seizures and peripubertal stress on behaviour and brain structure during adulthood, using the two-hit model, which hypothesizes that the exposure to a second hit during a critical period (here, the peripubertal stress), increases the organism's vulnerability to the effects of a first hit (here, the early life seizure, ELS). For this reason an epileptic seizure was induced with pentylenetetrazol (PTZ) in 16 male C57/bl6 mice on the 24th postnatal day (P24). Later, during puberty (P33-50) the animals underwent a chronic unpredictable stress protocol for 10 days (including elevated platform, tilted cage, forced swimming, social stress, food and water deprivation, wet bedding and restraint stress). When the animals reached adulthood, a battery of behavioral tests

(nesting, marble burying, openfield, elevated plus maze, sociability and social novelty, rotarod and novel object recognition task) was employed in order to evaluate aspects of their cognition and behavior.

To study the potential effects of ELS on brain structure, we used mouse brains that had undergone the same manipulation protocol except that they had experienced 4 epileptic seizures instead of one. These brains were processed for immunohistochemistry and the expression of parvalbumin (PV) and perineuronal networks (PNN) was quantified. Our results showed no combined effects of ELSs and peripubertal stress, either on cognitive abilities, or brain structure. Consequently, we can not confirm that stress, as a second hit, leads to an increase of the organism's vulnerability to the effects of the first hit. Nevertheless, individual main effects of both early life seizures and the stress were found, indicating that our protocols were effective. Future studies will be needed, using potentially a different epileptic substance or a more intense stress protocol, in order to further study the main effects and the two hit model under the same conditions.

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Η επίδραση της ημικρανίας-έντασης στη χωρική προσοχή σύμφωνα με την κοινωνική συναισθηματική προσαρμοστικότητα

Ο σκοπός της παρούσας μελέτης είναι να διερευνήσει την επίδραση του πόνου, σε ασθενείς που υποφέρουν μόνο από ημικρανίες. Περίπου το 45% του παγκόσμιου πληθυσμού υποφέρει από ημικρανίες (Lezak 2012). Η ημικρανία είναι μια χρόνια διαταραχή που χαρακτηρίζεται από επαναλαμβανόμενες, μέτριες έως έντονες κεφαλαλγίες (Adderson et al, 1994). Η ένταση του πόνου δημιουργεί διάσπαση προσοχής, διαταραχές στην μνήμη και στο αυτόνομο νευρικό σύστημα (ΑΝΣ) με αποτέλεσμα να υπάρχει διαταραχή στις υψηλής λειτουργικότητας γνωστικές διαδικασίες.

Για το σκοπό της παρούσας μελέτης χρησιμοποιήθηκαν το Clock Drawing Test (Kirby M et al, 2001) το Symbol Digit Modality test (Smith 1973) και η σκάλα κοινωνικό-συναισθηματικής αξιολόγησης (PCRS; Prigatono 1986) σε 60 ασθενείς (30 γυναίκες και 30 άντρες) με χρόνιες ημικρανίες. Τα αποτελέσματα στην παρούσα μελέτη έδειξαν αρνητικό στατιστικά σημαντικό συσχετισμό μεταξύ της έντασης του πόνου και τις οπτικοχωρικής προσοχής, και αντίληψης $r=-0.786$, $p<0.05$ καθώς και τις κοινωνικοσυναισθηματικής προσαρμογής ($r=-0.654$, $p<0.05$).

Επιπροσθέτως παρατηρήθηκε ότι το 85% της χαμηλής οπτικοχωρικής ικανότητας προβλέπεται από την ένταση του πόνου και την χαμηλή κοινωνικό-συναισθηματική προσαρμογή του ατόμου. Βάσει των παραπάνω, η εκπαίδευση ενός ατόμου με χρόνιες ημικρανίες σε προγράμματα, βασισμένο στην διαχείριση του πόνου (Gate Theory) μπορεί να βελτιώσει τις γνωστικές του δεξιότητες.

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The importance of a reliable and fast cognitive assessment in Multiple Sclerosis and the Montreal Cognitive Assessment as an effective tool.

Aim: Multiple Sclerosis (MS) is an autoimmune and neurodegeneration illness that, even in mild type (RRMS), 40% to 70% of patients deal with cognitive deficits. Up to nowadays, neuropsychological evaluation of MS patients remains a time-consuming procedure that, due to patients' fatigue, its outcome can be biased. Hence, the purpose of this study is to examine the effectiveness of the Montreal Cognitive Assessment (MoCA) as a reliable tool for assessing cognitive dysfunction of MS patients.

Methodology: Thirty RRMS patients were recruited by Evangelismos Hospital and 30 age-matched HCs by City Unity College. MoCA was used in order to measure cognitive impairments and it was compared to SDMT and VFT outcomes.

Results: MoCA is a valid neuropsychological battery which assesses MS patients ($\alpha = 0.72$) and provides proper outcomes to doctors and neuropsychologists. More to this, there were statistically significant differences in MoCA scores between HC and MS patients ($t(59) = 1.716$, $p < 0.05$). Finally, statistically significant strong positive correlations were observed between MoCA with SDMT ($r = 0.681$, $p < 0.05$) and VFT ($r = 0.673$, $p < 0.05$).

Conclusion: The findings of this study support previous studies on the efficacy of MoCA as a useful and reliable neurosurgical functionality test in MS patients, making neuroscience as a brief process whose effects are unaffected by the cognitive fatigue of the patient.