ΕΘΝΙΚΟ ΚΑΠΟΔΙΣΤΡΙΑΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ

ΙΑΤΡΙΚΗ ΣΧΟΛΗ

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ΔΙΠΛΩΜΑΤΙΚΗ ΕΡΓΑΣΙΑ

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ΜΕΤΑΠΤΥΧΙΑΚΗ ΦΟΙΤΗΤΡΙΑ: ΕΥΓΕΝΙΑ ΠΑΠΑΧΡΗΣΤΟΠΟΥΛΟΥ

ΤΡΙΜΕΛΗΣ ΕΠΙΤΡΟΠΗ

α. ΝΙΚΟΛΑΟΣ ΣΜΥΡΝΗΣ, ΕΠΙΚΟΥΡΟΣ ΚΑΘΗΓΗΤΗΣ ΨΥΧΙΑΤΡΙΚΗΣ ΕΚΠΑ, **ΕΠΙΒΛΕΠΩΝ**

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γ. **ΙΩΑΝΝΗΣ ΖΑΛΩΝΗΣ**, ΕΠΙΚΟΥΡΟΣ ΚΑΘΗΓΗΤΗΣ ΨΥΧΟΛΟΓΙΑΣ ΕΚΠΑ

The effects of Impulsivity and Aggression personality traits on oculomotor function

Abstract

Personality traits are thought of as complex clusters of learned behaviours that vary greatly among healthy individuals. This variation has been considered to reflect variation in basic modes of brain function, reflecting genetic and epigenetic influences on the development of cognition. This study addresses the question whether inter-individual variability in aggression and impulsivity personality traits is related to variability in oculomotor function used here as a probe to measure a range of basic cognitive processes with a specific neural substrate. Our results showed that impulsivity and aggression were only weakly related to oculomotor function variation in this population. A weak effect of impulsivity but not aggression on ocular fixation were observed but these results were not sufficient to support the hypothesis that basic cognition as measured by oculomotor function is linked to personality variation as measured with aggression and impulsivity self-reporting questionnaires.

Introduction

Personality is a composite of characteristics that influence the process of thinking, expression of emotion, and the roots of human behaviour. (Pervin L.A., John O.P., 2001). Human behaviour is shaped by the continuous sensory and neurophysiological input received. The purpose of our study is to examine the relationship between basic cognitive processes as assessed by oculomotor performance tasks with aspects of personality as assessed by self-reported measures of aggression and impulsivity.

PERSONALITY TRAITS

Personality traits are thought of as foundational units of human character. They represent general predispositions, which shape an individual's ability of functioning in space and time. They are concrete units and are considered to have a a basic foundation in brain and cognitive processing.(Allport & Allport, 1921)

One of the most influential theoretical models of personality was put forward by Eysenck. Using factor analysis of psychometrically measured personality characteristics, Eysenck, derived two orthogonal dimensions, namely Extraversion and Neuroticism as the principal defining factors of a personality within the social norms. (Pervin L.A., John O.P.,2001). Extraversion and Neuroticism formulated an hierarchical model of personality. This model also defined a set of lower order traits with increasing specificity that were comprised of specific habits and behaviours. It was based on the premise that individual differences were linked to both cortical and automatic arousal (Congdon, A., Canli T.,2008).

Eysenck's model of personality placed the traits of impulsivity and aggression in a quadrant defined by the right angle formed by the two superfactors of Extraversion and Emotional Instability. (Pervin, L.A., John, O.P, 2001)

IMPULSIVITY

Impulsivity is defined as the tendency towards executing rapid unplanned reactions to both internal and external stimuli without considering the long term consequences that such reactions can have both on the individual himself or on others. (Moeller, F., Barrat, E., Dougherty, D., Schmitz, J., Swann, A.C., 2001). Impulsivity is generally accepted to be a normal characteristic of human personality. It has also been thought to offer a behavioural advantage in instances such as driving on the road, i.e. reacting to a cat running into your path, or in certain professions, i.e operating an aircraft amidst unexpected turns. It can also favourably affect one's social life, i.e everyone loves that witty person who can impulsively come up with a new plan of action, and it can also contribute to one's professional success. (Evenden,J., 1999). Nevertheless, impulsivity is often regarded as an obstacle to social integration. Impulsivity can threaten stability of social relations by or prioritizing the immediate goals as opposed to the more highly socially valued long-term goals . Individual differences of the degree of impulsivity, have also been linked to socially deviant behaviours, such as aggression and substance abuse. (Spinella, M., 2004). Impulsivity differences have also been measured in psychopathological disorders, including a number of classified personality disorders . (Stanford,M.S., 2009)

Both the definition and the properties of impulsivity, indicate that is an important multidimensional psychological construct (Whiteside, S.P., Lynam, D.R., 2000). It has also been linked to cognitive processes such as inhibitory processes of control. In fact the multidimensional nature of impulsivity, is organized into a taxonomy of inhibitory processes that it based on personality, behavioural, and neuroanatomical grounds. According to this classification system, inhibitory control includes executive inhibition processes such as: interference control, cognitive inhibition, behavioural inhibition and inhibition in oculomotor control. The ability to inhibit a motor response or an oculomotor response is though of as a core feature of impulsivity . (Congdon E., Canli T., 2008).

Barratt examined the role of cognitive processes in regulating impulsivity. He studied the relation of the construct with psychomotor activity and proposed that impulsivity can be deconstructed in three sub-traits : attentional impulsiveness (the inability to focus one's attention or concentrate) motor

impulsiveness(action without adequate thought and consideration) and non–planning impulsiveness (a lack of forethought) (Stanford,M.S., et al 2009, Paton,J.H., 1995,) .

There are several tools for the assessments used to examine impulsivity. (Stanford,M.S., Mathias, C.W., Dougherty, D.M., Lake, S.L., Anderson , N.E., Patton , J.H. 2009). These tools can be grouped in three categories : self reported surveys or questionnaires, behavioural laboratory measurements and psychophysiological measurements (Event-Related Potentials).

Self-reported assessments, such as Barratt Impulsiveness Scale and the Eysenck Impulsiveness Questionnaire measure longstanding behavioural tendencies of impulsivity, and are susceptible to report bias. They are not suitable for repeated assessment over short intervals and over experimental manipulations. Behavioural laboratory tests include three paradigms, namely punished and/or extinction paradigms, reward-choice paradigms and response disinhibition/attentional paradigms. These tools can be appropriately used in cases requiring repetition, but don't capture the social aspects of impulsivity, as well as, the chronic nature of the behaviour. Finally, psychophysiological measurements such as event –related potentials directly inform about brain function but lack the specificity of the other measurements for detecting purely impulsivity because they have been found to be associated with a variety of complex multifactorial processes.(Moeller,G.F., 2001, Keilp, J.G., 2005)

Data obtained from cases of various prefrontal cortex lesions , particularly lesions of the orbitofrontal region supports a link between specific brain functions and impulsivity. Therefore, neurobehavioral measures with proven sensitivity to the orbitofrontal cortical function, such as the go/no-go motor tasks, the antisaccade oculomotor task and the delayed alternation task could be used for measuring the link between impulsivity and brain function . (Spinella, M., 2004).

AGGRESSION

Aggression is a personality trait related to self control. It is commonly defined as, " Any behavior directed towards another individual that is carried out with the proximate intent to cause harm". It is important to stress that aggression implies intentional harm by the perpetrator to the target. Accidental harm is not aggressive because it lacks the intention that is a necessary condition of aggression (Bushman,B.J., Anderson, C.A., 2002). Research suggests that aggression is a product of complex interactions involving both internal and environmental factors, such as frustration, negative affect, learning, and biased information processing.

There have been many attempts towards grasping the multifaceted nature of aggression. One model derived from these attempts is the General Aggression Model that encompasses several aspects of aggressive behaviour. This model suggests that individual variables, such as idiosyncratic features, values and beliefs interact with situation variables (i.e pain ,frustration, attacks) through interrelated routes (negative affect, hostile cognition and arousal) and result in appraisal and decision processes. The resulting action was proposed to affect a given social encounter which in turn affects both the individual and the situation. It is important to emphasize that this model links aggression with impulsive action and this link is in agreement with a multitude of studies that support a strong association between aggression and impulsivity (Joireman J., Anderson J., Strathman A., 2003)

Coccaro used the term impulsive aggression to define an aggressive act characterized as deliberate and non-premeditated (Coccaro,E.F., 1998). There is disagreement in the literature whether impulsive aggression should be regarded as a unitary trait. It has been designated either as a single trait or as: a sub-trait of impulsive behaviour, as a su-btrait of aggressive behaviour, or as an integration of the both impulsive and aggressive behaviour. Therefore, the exact nature and limits of the two constructs remain unclear. (Garcia-Forero, C., Gallardo-Pujol, D., Maydeu-Olivares, A., Andres-Pueyo, A., 2008) .

Buss & Perry included a cognitive behavioural dimension in their model which divides aggression into four sub-traits. They proposed that physical and verbal aggression, which intentionally causes harm, represent the instrumental or

motor component of the construct. Anger, which involves physiological arousal and preparation of aggression, represents the emotional or affective component of the behaviour. Hostility, which consists of feelings of ill will and injustice, represents the cognitive component of the behaviour.(Buss A.H., Perry M., 1992, Bryant F.B, Smith B.D, 2001,Tsorbatzoudis H.,2006).
Indirect methods that capture any propensities towards aggressive action have been used to measure aggression . These methods can be divided into two categories : a. laboratory procedures that simulate real situations of aggression, b. self-reported real life events by the protagonists consisting of responses to hypothetical scenarios using provoking facts.

Self-reports can be further divided into accounts of specific events or acts and measures of an individual's tendency to act in an aggressive manner. Within the latter category belongs one of the most widely used questionnaires, namely "The Aggression Questionnaire" by Buss & Perry (1992). It is a 29-item self-report questionnaire which measures four dispositional subtraits of aggression: physical, verbal aggression, anger and hostility. (O'Connor D.B, 2001, Bryant F.B., 2001, Buss A.H., Perry M., 1992).

Animal studies have found that prefrontal cortex lesions positively correlate with aggressive behaviour. Patients with lesions limited to the frontal lobes tended to be more aggressive than patients with non frontal head injury and control participants. (Luria ,1980). Particularly, damage to orbitofrontal cortex has been associated with increased hostility, and aggression .(Peterson J., Shane M., 2004.)

EYE MOVEMENTS

Eye movements have been used as a behavioural assessment of sensorimotor processing and are characterized a higher-order cognitive function (Broerse A., Crawford T.J., Boer J.A, 2001). Specific oculomotor function tests work as a reliable means of assessing specific areas of cognition and brain function. Moreover, eye movement tasks have been generally used as phenotypic biomarkers for the deficits in neurological and psychiatric illnesses and more specifically deficits concerning frontal lobe dysfunction. (Smyrnis, N., et al., 2002) More specifically eye movement tasks have been used in neurobehavioral assessment specific for orbitofrontal

cortical function. (Spinella M., 2004).

Eye movements play an important role in a wide range of cognitive processes, including those involved in attention, working memory , learning , long term-memory and decision making. (Hutton S.B., 2008) Visually guided saccade tasks (prosaccades), smooth eye pursuit, antisaccade tasks, and ocular fixation tasks are the most commonly used oculomotor tests. (Smyrnis N., 2008, Smyrnis N. et al.,2004).

The visually–guided saccade task records automatic responses to peripheral stimuli (Broerse et al , 2000). This process requires the integration of spatial attention, visual encoding and a well-organized motor program , but relies far less on higher order executive functions .

The antisaccade task, requires that the test subject looks in the opposite direction of a visually presented target. This tasks requires the inhibition of the saccade generated in response to the visual targets, and the generation a volitional saccade towards the opposite location. Therefore, this paradigm includes volitional control and thus relies on higher order cognition. The smooth eye pursuit task is a procedure in which the participant is instructed to follow a slowly moving visual target. (Ettinger, U., et al., 2003, Smyrnis, N., et al., 2007) by foveating the target at all times and requires feedforward and feedback control of eye movements

In the ocular fixation task, the subject is asked to focus the gaze on visual targe. for a given time interval and measures sustnained visual attention. (Smyrnis N., 2004,Ettinger U. et al., 2003)

RATIONAL FOR THE PRESENT STUDY

The focus of the present study is on the relation of personality traits with oculomotor function as a measure of cognitive function.

Others have already studied the influence of personality traits on cognitive function. Keilp et al. (2005) studied the impact of trait impulsiveness on cognitive performance and linked impulsiveness and reaction time with attention, memory , verbal fluency and executive function.(Keilp J.G., Sackeim H.A., Mann J.J, 2005) . A recent research study investigated the influence of the complex personality traits of aggression and impulsivity to sustained attention and working memory in a large sample of healthy young conscripts

of the Greek Air force. They showed that specific characteristics of the two constructs were related to cognitive functioning: a. tendency for physical aggression and hostility was negatively associated with cognitive performance accuracy. b. increased verbal aggression was positively correlated to performance accuracy. c. increased tendency for physical aggression was associated with commission errors and finally, d. tendency for non planning impulsivity was related with decreased cognitive performance accuracy (d'). (Spilioti E.., 2011).

This study following the rational for the aforementioned study addressed the question whether inter-individual variability in oculomotor functions in the same population of apparently healthy young men can be explained by differences in aggression and impulsivity personality traits in these individuals. In a previous report Smyrnis et al. (2003) showed that schizotypal personality traits in this population were related to antisaccades performance and individuals with high schizotypy performed worse in this task. In a follow up study, Smyrnis et (2007)al investigated the effect of schizotypy, anxiety and depression on smooth eye pursuit performance in this population. Again individuals with with high schizotypy performed worse in this task .

In yet another study Smyrnis et al , 2004 found that individuals with high schizotypy characteristics had increased difficulty in maintaining ocular fixation on a visual target especially in the presence of increased inhibitory load.

One previous study (Spinella M., 2004) showed a correlation of impulsivity with performance in a go/no-go task an antisaccade task and delayed alternation task.

Another recent study by Cirilli L., 2011, showed a relation of impulsivity to anticipatory eye movements such as saccades and smooth pursuit eye movements. Finally there is up today no study investigating the effects of aggression on oculomotor function.

METHODS AND MATERIALS

Sample

The sample consisted of 2,130 male Hellenic Air Force (HAF) recruits aged 18-24. They were examined during their first two weeks of training. A screening for medical conditions and major psychiatric syndromes had been performed by a team of HAF medical personnel. And all recruits of the present sample had passed this screening. All participants gave written informed consent for participation to the study. A total of 2,075 individuals performed the following eye movement tasks: a. smooth eye-pursuit , b. antisaccade, c. visual fixation. The study protocol was approved by the Ethics Committee of the University Mental Health Research Institute. The subjects who had valid data in both the psychometric assessment and oculomotor performance were included in the present analysis.

Psychometric Assessment

Two self-reporting questionnaires were used to assess the aggression and impulsivity: the Aggression Questionnaire (Buss & Perry, 1992) assessing aggression and Baratt's Impulsiveness Scale-11 (BIS-11) for impulsivity; (Paton et al, 1995) were administered to 1657 subjects. Subjects that had a high rate of missing responses and subjects that appeared to be random responders were excluded from the analysis. The resulting sample for the AQ questionnaire consisted of 1228 subjects and 1224 subjects for BIS 11,. The AQ is a self-reporting measure consisting of 29 Likert type items (scored 1 to 5). Twelve of these items compile the shorter version of the AQ (hereafter AQ 12; Bryant and Smith, 2001) retaining however the four factor latent structure. The latter version was implemented in the present study, since Vitoratou et al., (2008) demonstrated that it had better psychometric properties. BIS-11 is a self-reporting measure of impulsivity as a stable trait consisting of 30 Likert type items (scored 1 to 4). It has three factors measuring cognitive instability (Attentional Impulsivity factor), acting on the spur of the moment (Motor Impulsivity factor) and lack of a sense of future (Non-planning Impulsivity factor). BIS 11 has been translated into Greek by Vitoratou et all (2011 under submission). Subscale and total scores reported in the present study are unit-weighted sums of the corresponding items, in accordance to the original.

Oculomotor Assessment

Apparatus

The apparatus has been described previously in more details (Smyrnis et al, 2003). IRIS SCALAR infrared devise has been used for recording eye movements from the right eye only. A 12 bit A/D converter was used for data acquisition (Advantech PC-Lab Card 818L; Advantech Co., Ltd., Taipei, Taiwan) Eye movement data were sampled at 600 Hz and were stored in the PC hard disc for off-line data processing.

Antisaccade Task

A fixation target appeared in the centre of the screen (white cross; 0,5X 0,5)

The central target was extinguished after a variable period of 1-2s , and an identical target appeared randomly at one of nine target amplitudes from the centre (2-10 at 1 interval) in left or right direction. The subjects were instructed to execute an eye movement as quickly as possible opposite in direction from that of the target coming from the left or right until the central fixation target reappeared 1.5 s later. Each participant completed a block of 90 experimental trials. In order to familiarize the participants with that task, an additional set of trials were provided for them.

Antisaccade Indices

Seven antisaccade performance indices were evaluated for each study participant:

AER: antisaccade error rate. Error was defined as a movement in the direction of the peripheral target following its presentation and then followed by a corrective movement (in the direction opposite of the target), which occurred in almost all of the trials (in over 99% of the error trials). The distribution of AER was normalised via an arcsine transformation for percentages, which was used for all subsequent analyses. (Snedecor & Cochran, 1980), In this analysis AER denotes transformed data.

ALAMD: median latency for correct antisaccades
ALACV : coefficient of variation of latency for correct antisaccades'
ALEMD: median latency for error prosaccades.
ALECV: coefficient of variation of latency for error prosaccades
ALCMD : median latency for correction antisaccades after an error prosaccade
ALCCV: coefficient of variation of latency for correction antisaccades'

Smooth Pursuit

Procedure

A target (white cross 0,5^{o} X 0,5^{o}) appeared at the centre of the screen and then moved successively 10o to the left and then back to the centre. This movement was repeated twice and reappeared at a distance of 5 for two more cycles. The participants were instructed to visually follow the moving target. Four saccades for each of the four positions (left/right , 5/10o) were recorded. Left/right differences in amplitude were corrected when necessary with a manual adjustment of the IRIS device gain control and the calibration procedure was repeated.

Subsequently the participant was asked to follow a target (white cross 0.5 X 0.5) that was moving horizontally on the computer screen at constant speed. The visual angle of the moving target was 10o from the centre of the screen. Five target speeds (10,20,30,40,50 deg/s) were used. Each individual completed five cycles for each target speed consisting of the target moving 20^{O} to the left and then 20^{o} to the right at constant speed. The movement of the target started at the speed of 10deg/s. When the five cycles had been completed, the speed of the target increased and the participant followed it at 20deg/s, then at 30deg/s, until the tracking would be completed at all five speeds consecutively. In this analysis, we use the first three of the speeds (10,20,30 deg/s). The reason for excluding the speed of 40 and 50deg/s was that at these target speeds a large proportion of subjects would change to a different strategy and would not pursue the target but would make large predictive saccades from one corner of the monitor to the other.

Smooth eye pursuit Indices

Three smooth eye pursuit performance indices were evaluated for each participant : 1) root-mean-square error between the eye position and the target position record at each target speed was calculated by a PC program. The root-mean-square error measures the pursuit accuracy and increases with increasing dissimilarity between the eye position and the target position. The root mean square erro was measured for each target speed:

PRMS10: root mean square error for speed of 10deg/sec

PRMS20: root mean square error for speed of 20deg/sec

PRMS30: root mean square error for speed of 30deg/sec

2 .median pursuit gain at each target speed which was the velocity of the eye divided by the target speed):

PG10: pursuit gain at 10deg/sec

PG20: pursuit gain at 20deg/sec

PG30: pursuit gain at 30deg/sec

3. saccade frequency at each target speed which was the total saccade number for all periods without artifacts divided by the sum of these time periods):

PSF10: pursuit saccade frequency at 10deg/sec

PSF20: pursuit saccade frequency at 20deg/sec

PSF30: pursuit saccade frequency at 30deg/sec

Active eye fixation task

Procedure

There were three different fixation conditions of 50 s duration which were presented in a random order to each participant. In the condition named “visual fixation undistracted”, participants were instructed to simply fixate a visual target on the centre of the visible screen (white cross 0.3^{o} X 0.3^{o}). In the conditioned called “visual fixation distracted”, individuals were instructed to again fixate on a central target, while ignoring any other moving target appearing to the left or the right. Four distracting targets were used (two small 0.3^{o} X 0.3^{o} white crosses and two large, 1^{o} X 1^{o} same color and form stimuli) each appearing for a duration of 500 ms at random intervals during the 50s

fixation period. The distracters were either presented at a random distance of 2-9 deg or at a random direction of left or right from the centre. The last condition called “no target fixation” included eye fixation in the primary condition (straight ahead) while avoiding any other eye movements by the participants. A calibration procedure consisting of saccadic movements at targets located 5^o and 10^o to the right and left of a central fixation target was performed before each active fixation task.

Fixation Indices

The eye movements records were analyzed by an interactive PC program (created using the Test-Point CEC Software). The program recorded saccadic eye movements as well as eye blinks and calculated the saccade frequency. The saccade frequency for each condition was derived by dividing the number of saccadic eye movements that were larger than 0.5^o by the total time in the task. Thus three indices of fixation performace were measured:

FUND: saccade frequency for the undistracted fixation condition

FDIS: saccade frequency for the distracted fixation condition

FNOT: saccade frequency for the no target fixation condtion.

<u>Statistical Analyses</u>

Structural equation models (SEMs) or Simultaneous equation models are multivariate regression models which gained popularity in social sciences because the models use causal interpretation of observational data. In a SEM model, the variable may appear as a predictor in another equation and variables in an SEM may influence one-another reciprocally, either directly or through other variables as intermediaries. These structural equations are meant to represent causal relationships among the variables in the model. (SEM; Fox, J., 2002) We used the Structural equation Modelling Approach with Maximum Likelihood methodology to evaluate the relationship between psychometric and the oculomotor indices variables. Specifically, SEM analysis was applied to estimate the potential effects of personality traits (psychometric variables) on the observed variables of oculomotor function, in a pair wise manner. In this model, observed variables are named “manifest” variables whereas conceptual constructs are called “latent” variables. In the

aforementioned model impulsivity and aggression were the latent exogenous variables whereas oculomotor function's variables were the latent endogenous variables.

SEM models are represented in the form of a graph called the path diagram. Variables on the left side are endogenous variables (i.e aggression,impulsivity), variables whose values are determined by the model. (Fox , J., 2002)

The variables on the right side are exogenous variables, whose values are held as conditionally fixed.

In our study, we kept the main variables or factors (exogenous or endogenous) enclosed in ellipses . (Fig. 2). Dimensions or subfactors of each variable are enclosed in rectangles. Directed (i.e single-headed) arrows represent structural parameters.

Bidirectional (double-headed) arrows represent non causal, potentially nonzero, covariances between exogenous variables.

There are two types of models that were used. Model A (Fig. 2) included the general effect of the factor (i.e aggression or impulsivity), which was the overall effect by the trait, while Model B included the specific effect of the subfactors, which encompassed the indicator effects.

The model's fit was evaluated using the un-dementional measures: the chi-square (x2), the relative chi-square (x2/df; Hoelter,1983), the Root Mean Square of Approximation (RMSEA; Browne & Cudeck, 1993) and a relative fit index, the Comparative Fit Index (CFI; Bentler, 1990) which assesses the fit of each model as compared to the null. Values close to 2 for relative chi square (x2), less than 0,05 for the RMSEA and higher than 0,9 for the CFI, indicate well fitted model. Data analysis was conducted in AMOS 5 (Arbuckle, 2003) and SPSS 17 (2008).

RESULTS

Descriptive statistics

The descriptive indices for psychometric assessment and its dimensions are presented in table 1.

The population distribution of the Total BIS-11 and AQ12 scores are presented in Fig. 1

Fig. 1 Graphs of distribution in the population of aggression and impulsivity

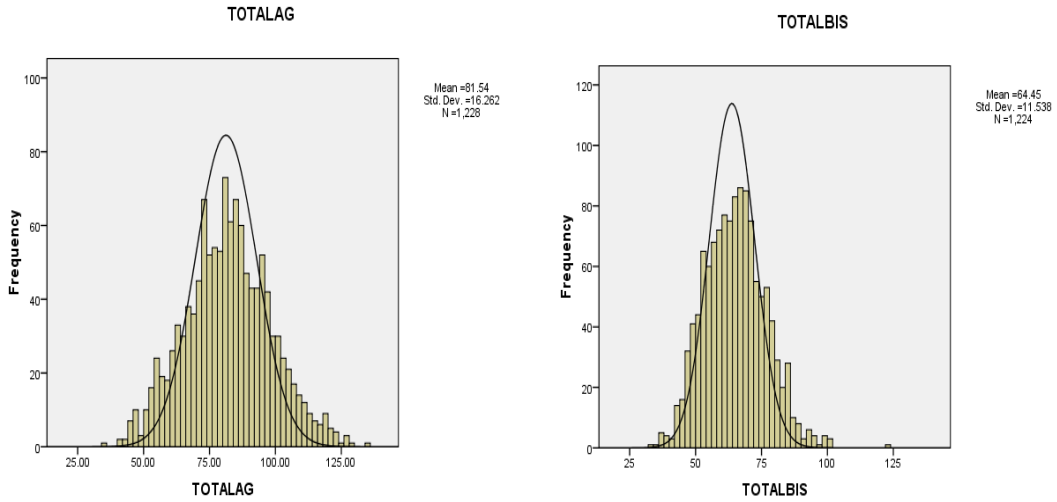


Table 1. Descriptive indices for measures of impulsivity and aggression

PERSONALITY TRAITS INDICES

IMPULSIVITY	Mean	MD	SD	Min	Max
TOTAL BIS	64.45	64.00	11.53	33	122
MOTOR IMP	22.11	22.00	5.13	11	55
ATTENTION IMP	17.88	18.00	3.65	8	40
NON PLANNING	24.45	25.00	4.93	11	40
AGGRESSION					
TOTAL AQ	81.53	81.00	16.26	35	135
PHYS. AGGRESSION	14.69	15.00	2.30	5	25
VERBAL AGGRESSION	19.70	20.00	5.57	7	35
ANGER	21.48	21.00	5.39	7	40
HOSTILITY	25.66	25.00	7.30	9	45

Note: The descriptive indices (Mean, Median (MD), Standard Deviation(SD), Minimum (Min) and Maximum (Max) score) for the trait of Impulsivity as a Total Score (Total BIS) and as its factors score (Motor Impulsiveness, Attention Impulsiviness, Non Planning) as well as , for Aggression as a Total Score (Total AQ) and its subscales (Physical Aggression, Verbal Aggression, Anger, Hostility).

Table 2. Descriptive indices for measures of oculomotor function from the eye movement tasks.

ANTISACCADES	Mean	MD	SD	Min	Max
AER	0,23	0.20	0.17	0.00	1.00
ALAMD	261.73	258.00	39.45	99.00	423.00
ALACV	0.24	0.23	0.08	0.09	1.59
ALEMD	200.98	194.00	38.38	91.00	525.00
ALECV	0.27	0.23	0.16	0.00	2.16
ALCMD	130.97	126.00	55.79	1.00	507.00
ALCCV	1.03	0.70	4.03	0.00	158.00
SMOOTH EYE PURSUIT					
PG 10	0.91	0.92	0.16	0.16	1.43
PG 20	0.86	0.88	0.19	0.11	1.36
PG 30	0.72	0.77	0.24	0.00	1.37
PRMS 10	149.40	124.35	94.00	22.18	537.81
PRMS 20	196.54	171.38	109.30	14.71	661.35
PRMS 30	241.46	216.90	125.40	19.41	773.61
PSF 10	1.72	1.50	1.29	0.00	7.52
PSF 20	2.39	2.25	1.42	0.00	8.59
PSF 30	3.26	3.00	1.77	0.00	9.77
FIXATION					
F UND	0.29	0.18	0.34	0.00	3.07
F DIS	0.38	0.29	0.35	0.00	2.18
FNOT	0.52	0.44	0.38	0.00	2.57

Note: Descriptive Indices (Mean, Median (MD), Standard Deviation (SD), Minimum and Maximum score) of Oculomotor Measurements.

A stands for Antisaccadic Eye Movements Measurements : AER: Antisaccadic Error Rate, ALAMD: Median Latency for correct antisaccades, ALEMD: Median Latency for error prosaccades. ALACV: coefficient of variation for correct antisaccades' .ALECV: coefficient of variation of latency for error prosaccades, ALCMD : median latency for correction antisaccades after an error prosaccade, ALCCV : coefficient of variation of latency for correction antisaccades'

P stands for Smooth Pursuit performance : PG 10, PG, 20, PG 30: pursuit gain at 10,20,30 deg/sec respectively. PRMS 10,20, 30: root mean square error for speed of 10,20,30 deg/sec respectively and PSF 10,20,30 :pursuit saccade frequency at 10,20,30 deg/sec respectively.

F stands for Fixation indices : FUND: saccade frequency for the undistracted fixation condition, FDIS: saccade frequency for the distracted fixation condition. FNOT: saccade frequency for the No Target fixation condition.

Pearson correlation coefficients for all individual pair of variables valued are presented in Table 3 and 4.

Table 3. Correlations among measurements of aggression and oculomotor function indices

	PHYSICAL AGGRESSION		VERBAL AGGRESSION		ANGER		HOSTILITY		TOTAL AQ	
	Pearson C	Sig 2	Pearson C	Sig 2	Pearson C	Sig 2	Pearson C	Sig 2	Pearson C	Sig 2
P_G10	0.01	0.796	0.03	0.282	0.02	0.589	0.01	0.638	0.01	0.639
P_G20	0.02	0.490	0.03	0.312	0.03	0.285	0.03	0.287	0.04	0.181
P_G30	0.04	0.200	0.01	0.821	0.02	0.570	0.03	0.313	0.01	0.651
P_RMS10	0.02	0.512	0.01	0.656	0.02	0.415	0.09	**0.004**	0.05	0.089
P_RMS20	0.01	0.701	0.01	0.705	0.01	0.860	0.04	0.172	0.02	0.419
P_RMS30	0.03	0.282	0.01	0.643	0.02	0.548	0.03	0.280	0.03	0.242
P_SF10	0.02	0.581	0.00	0.923	0.02	0.486	0.02	0.604	0.00	0.902
P_SF20	0.01	0.827	0.07	**0.013**	0.07	**0.018**	0.07	**0.030**	0.07	**0.024**
P_SF30	0.01	0.658	0.03	0.344	0.01	0.698	0.05	0.093	0.03	0.365
F_UND	0.01	0.728	0.02	0.580	0.06	0.059	0.07	**0.035**	0.05	0.147
F_DIS	0.00	0.902	0.03	0.276	0.04	0.240	0.06	**0.044**	0.05	0.129
F_NOT	0.02	0.563	0.01	0.793	0.01	0.752	0.01	**0.645**	0.00	0.904
A_ER	0.042	0.155	0.010	0.743	0.005	0.857	0.028	0.342	0.031	0.285
A_LAMD	-0.029	0.329	0.001	0.983	-0.009	0.771	0.015	0.601	-0.009	0.755
A_LACV	0.006	0.826	0.008	0.798	**0.061***	**0.036**	**0.066***	**0.025**	0.050	0.090
A_LEMD	-0.038	0.193	-0.014	0.637	0.015	0.599	0-.012	0.692	-0.018	0.535
A_LECV	-0.035	0.234	-0.012	0.675	-0.039	0.185	-0.026	0.371	-0.041	0.163
A_LCMD	0.009	0.753	-0.004	0.903	-0.013	0.663	0.047	0.113	0.014	0.630
A_LCCV	-0.010	0.744	-0.002	00.956	-0.019	0.518	-0.010	0.740	-0.015	0.620

As can be seen in table 3 the correlation coefficients for all among oculomotor indices and aggression scale scores were very small and none of the correlations exceeded the bonferoni corrected p value for a 0.05 significance level (0.05/95correlation coefficients = 0.0005).

Table 4. Correlations among measurements of impulsivity and oculomotor function indices

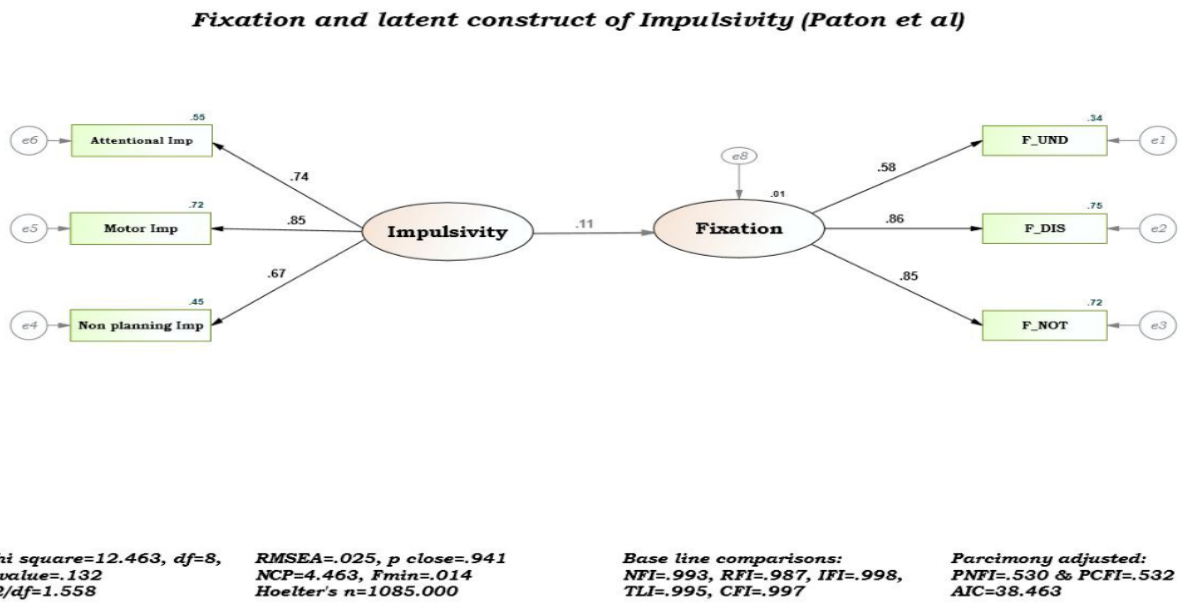
	ATTENTIONAL IMPULSIVENESS		MOTOR IMPULSIVENESS		NON-PLANNING		TOTAL BIS	
	Pearson C	Sig 2	Pearson C	Sig 2	Pearson C	Sig 2	Pearson C	Sig 2
P_G10	0.00	0.992	0.03	0.398	-0.02	0.464	0.00	0.950
P_G20	-0.02	0.568	0.02	0.451	-0.03	0.247	-0.01	0.738
P_G30	0.02	0.614	0.02	0.527	-0.02	0.502	0.00	0.876
P_RMS10	-0.04	0.157	-0.06	0.053	**0.06**	**0.030**	-0.01	0.699
P_RMS20	-0.04	0.207	**-0.07**	**0.015**	0.05	0.120	-0.02	0.413
P_RMS30	-0.04	0.138	-0.04	0.162	0.04	0.217	-0.02	0.572
P_SF10	**0.06**	**0.036**	0.00	0.998	0.02	0.519	0.03	0.350
P_SF20	**0.09**	**0.002**	**0.08**	**0.006**	0.06	0.060	**0.09**	**0.003**
P_SF30	-0.03	0.261	-0.03	0.388	0.05	0.101	0.00	0.965
F_UND	0.05	0.095	0.05	0.096	0.06	0.065	**0.07**	**0.040**
F_DIS	0.05	0.147	0.05	0.126	**0.07**	**0.028**	**0.06**	**0.037**
F_NOT	**0.10**	**0.002**	**0.07**	**0.035**	0.05	0.091	**0.08**	**0.008**
A_ER	0.03	0.337	0.04	0.226	0.03	0.362	0.04	0.230
A_LAMD	0.01	0.683	0.00	0.920	-0.03	0.238	-0.01	0.749
A_LACV	0.01	0.676	0.02	0.531	-0.01	0.631	0.00	0.871
A_LEMD	-0.01	0.670	-0.03	0.279	**-.073***	0.013	-0.05	0.101
A_LECV	0.01	0.829	0.01	0.839	0.02	0.436	0.01	0.614
A_LCMD	0.00	0.911	0.02	0.570	0.00	0.987	0.01	0.814
A_LCCV	-0.04	0.194	-0.04	0.164	-0.04	0.167	-0.05	0.107

As can be seen in table 4 the correlation coefficients for all among oculomotor indices and impulsivity scale scores were very small and none of the correlations exceeded the bonferoni corrected p value for a 0.05 significance level (0.05/76 correlation coefficients = 0.0006).

Structural Equation Modelling

All SEM models used provided excellent fit to the data. We first present the results of the SEM analysis for the relation of impulsivity and oculomotor function. The application of SEM showed no significant effect of impulsivity on antisaccades and smooth eye pursuit indices of oculomotor function. Fixation indices though had a weak but significant effect on impulsivity as shown in figure 2. This effect suggests that increased impulsivity leads to increased frequency of saccades in the fixation tasks thus a decreased capacity of maintaining active fixation.

Fig 2. **Model A Path diagram illustrating the general effect of impulsivity on the fixation of eye movements.**



As shown in figure 2 there is a weak (regression coefficient of 0.11) but still significant effect ($p < 0.05$)) of impulsivity as a global trait on the fixation performance again measured as a global index derived from the three fixation conditions .

Finally the application of SEM models showed no significant effect of aggression on any of the oculomotor function indices (antisaccades, smooth eye pursuit, fixation).

DISCUSSION

The goal of this study was to explore the effect of aggression and impulsivity personality traits on oculomotor function phenotypes. Our results showed that aggression was not related to oculomotor function while there was a weak effect of fixation indices on impulsivity shown with the use of multivariate analysis namely structural equation modelling. More specifically increased impulsivity (measured as a global index) resulted in an increase in saccade frequency in fixation tasks thus decreased capacity for maintaining active fixation. Thus increased impulsivity was in fact related to a decreased capacity for maintaining visual focused attention.

Previous studies had shown effects of both aggression and impulsivity on cognitive function measured with complex cognitive tasks (Keilp, 2005,Spilioti, 2011). Based on these previous studies our hypothesis was that either impulsivity or aggression, or both these personality traits would have an effect on oculomotor function and would explain a proportion of inter-individual variability of these functions in normal adults. Our results though did not favour such a hypothesis. All correlations among oculomotor function measures and dimensions of aggression and impulsivity were very small (none exceeding 0.1) suggesting that a negligible proportion of variance in oculomotor function could be attributed to differences in these personality traits.

The most relevant study to ours was that of Cirilli et al (2011). These authors report the effects of impulsivity as measured by UPPS Impulsive Behavior Scale which included four dimensions (Urgency, lack of Premeditation, lack of Perseverance and Sensation Seeking) on the performance of smooth eye pursuit task. They showed a negative correlation between total UPPS score and anticipatory eye velocity but a positive correlation between total UPSS score and visual pursuit latency. In addition the strongest correlations were found between the subtrait “Lack of Premeditation” and anticipatory saccades in smooth eye pursuit. The conclusion from that study was that impulsivity resulted in a release effect (more anticipatory saccades in pursuit) reflecting the function of anatomical

loops between the frontal cortex and basal ganglia, via the thalamus. Therefore, it is possible that these loops play an important role in motor or oculomotor functions, which influence impulsive behavior and psychiatric conditions. Our study showed a weak affect of Impulsivity as a global trait on fixation but not smooth eye pursuit. There are several differences between the two studies. The first was in the assessment of the trait of Impulsivity (using different questionnaires which included different subfactors). The second was the measurement of smooth eye pursuit parameters. We used classical measures of pursuit performance including root mean square error and pursuit gain and did not specifically measure anticipatory saccades. Our finding though of increased saccade frequency in ocular fixation for individuals with high impulsivity scores may reflect the same basic mechanism of a decreased ability to sustain focused performance in these individuals implicating a difference in frontal cortical - basal ganglia loops. In favour of this hypothesis is also the result of our previous study (Kattoulas et al, 2011) where we observed a weak but significant correlation between oculomotor function and sustained attention as measured by the continuous performance tests (CPT-IP version).

An important limitation of this study was the use of self-reporting questionnaires to assess personality traits. One important caveat to using self-reported questionnaires is that it is not clear whether a self report of a construct predicts construct-related behaviour. (Nicholls, J., Licht, B.G., Pearl , R.A., 1982). For example , do people who score high in the AQ-11 questionnaire behave aggressively in real life situations? The participant answering the questions is usually not aroused to anger, he does not direct his behaviour at another person, nor does he expect that his responses may have a harmful effect on another person. The self –report inventory measures only the individual's indications for certain types of aggressive or aggressively toned fantasies or behaviour in himself (Leibowitz, G., 1968). Thoughts and fantasies certainly do not translate into acts. Self –reports of one's subjective experience are however still useful and can be quantified in many ways, but these descriptions do not fully equate to the inner experience itself. (Siegel, D.J., 2012)There can also be the problematic case where scale items are

descriptive of non-test behaviour that extends beyond the test's range of evaluation. This challenges the accuracy of either the scale or the construct. (Nicholls , J., et all., 1982).Still self-reporting questionnaires have been used extensively in examining personality and developing personality theories (Nicholls, J., et all,1982).

Impulsivity is an important feature of human behaviour. It has been associated important stepping stones in human development such as childhood and adolescence. It has also be linked to psychopathic personality, in addition to symptoms of mania, substance abuse, ADHD, and disorders of disinhibition. Furthermore, "impulsivity" remains one of the most common diagnostic criteria for psychiatric illnesses in the fourth version of the Diagnostic and Statistical Manual of Mental Disorders (DSM IV) (Cirilli et al.,2011). Therefore, the finding of this study on the relation of impulsivity with decreased capacity for maintaining focused visual fixation raises potential for future research in other special populations. This research was conducted in healthy population at the early adulthood and the sample included only men. Since there are documented differences between the two genders in the rates of Impulsivity and Aggression (Ramirez, J.M., Andreu, M.J., Fujihara, T., 2001) it would be interesting to extend this investigation in men and women. It would also be interesting to study clinical populations with known deficiencies in sustained attention such as patients with schizophrenia and patients with attention deficit hyperactivity disorder to see whether the relation of impulsivity and fixation function would be different in those individuals.

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