Australasian Society for Psychophysiology

Abstracts of peer-reviewed papers at the 22nd meeting of the Australasian Society for Psychophysiology, *ASP2012*, University of New South Wales, Sydney, Australia, 28-30 November, 2012.

Members from Australia, Fiji, Korea and Poland participated in a range of scientific sessions and post-conference workshops, as well as the Society's Annual General Meeting.

Conference abstracts are presented below within category (Keynote/Oral/Poster) ordered alphabetically by first author surname.

Keynotes

Identification of sites of sympathetic outflow at rest and during emotional arousal: Concurrent recordings of skin sympathetic nerve activity and fMRI

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The sympathetic innervation of the skin primarily subserves thermoregulation, but the system has also been commandeered as a means of expressing emotions. In order to understand the central neural processes involved in emotional processing and the generation of autonomic markers of emotion we recorded skin sympathetic nerve activity (SSNA) concurrently with functional magnetic resonance imaging (fMRI) of the brain at rest in thermoneutral conditions, or while showing subjects neutral or emotionally-charged images from the International Affective Picture System (IAPS). SSNA was recorded via tungsten microelectrodes inserted into the peroneal nerve in 21 subjects. Gradient echo, echo-planar fMRI was performed using a 3T scanner (Philips Achieva). Two hundred volumes (46 axial slices, TR=8 s, TE=40 ms, flip angle=90 deg, raw voxel size =1.5x1.5x1.5 mm) were collected in a 4s-ON, 4s-OFF protocol. Total sympathetic burst amplitudes were measured during the period between scans. Blood Oxygen Level Dependent (BOLD) changes in signal intensity (SPM5, uncorrected $p<0.001$) were measured during the subsequent period to account for neurovascular delays. Resting SSNA was positively correlated to signal intensity in the orbitofrontal, frontal and insular cortices on the right side, mid-cingulate and precuneus, and negatively correlated to signal intensity in the left orbitofrontal and left insula. Positive and negative emotionally-charged images evoked significant increases in total SSNA and signal intensity in the orbital, dorsolateral and ventromedial prefrontal cortices, amygdala, nucleus accumbens and anterior insula. Increases in signal intensity during increases in SSNA occurred in a number of brain regions, including the central and lateral amygdala, dorsolateral pons, thalamus, nucleus accumbens, and cerebellar cortex. Signal intensity decreases during emotionally evoked increases in SSNA occurred in the left orbitofrontal, frontal and right precuneus cortices. We have identified structures in the brain differentially engaged in the generation of sympathetic markers of introspection and emotional arousal.

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How can psychophysiology contribute to neuropsychological research?

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Traditional neuropsychological assessment is primarily based upon pen and paper tests. The ecological validity of this approach for predicting real world function in people with brain damage has always been a major limitation. The utility of these approaches to provide insights into the underlying mechanisms of neuropsychological impairment is also constrained. Such approaches do provide important insights into the cognitive mechanisms of perception, language, new learning etc. However, they are a poor indicator of physiological responsivity. Increasingly, it is being recognised that arousal and affect interweave with cognitive processing to produce complex neuropsychological skills. A good example of this is emotion perception. Emotion perception is impaired following traumatic brain injury (TBI: and many other forms of brain damage, psychiatric and developmental disorders). A neuropsychological model of emotion perception disorders suggests impairment in a specific threat appraisal network in the ventral frontal regions of the brain that informs more detailed cognitive processing via dorsolateral frontal cortex and visa versa. Using electromyography (EMG) and skin conductance levels (SCL) we have found new evidence to support this model. We have found dissociations between cognitive and affective appraisal of emotional significant material. We have also found that facial mimicry is specifically impaired to negative facial expressions following TBI. In addition, directed attention to images (theoretically mobilising dorsolateral frontal cortex) to some extent normalises responses. This suggests a potentially useful strategy in remediation. Further, psychophysiological measures have been found to predict self-reported loss of empathy. These findings provide a unique contribution to neuropsychological theory.

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Oral Presentations

Linking components of event-related potentials and autonomic measures of the orienting reflex

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This study examined event-related potentials (ERPs) associated with elicitation and habituation of the basic Orienting Reflex (OR). We aimed to assess the effects of stimulus novelty and intensity in the absence of task demands. Subjects received 16 innocuous tones with intensity alternating between 60 and 80 dB, at long

inter-stimulus intervals; there was no stimulus-related task. Single-trial ERPs were obtained, and components extracted by Principal Components Analysis (PCA) were examined for potential response fractionation in the central indices of stimulus processing. The predicted fractionation of autonomic measures was obtained: electrodermal responses showed substantial main effects of trials and intensity, cardiac deceleration showed no systematic change with intensity or trials, respiratory pause showed a substantial main effect of trials but no intensity effects, and peripheral vasoconstriction showed intensity but no trials effects. A range of intensity and novelty effects were obtained in components identified as the N1, P3a, P3b, Novelty P3, and the classic Slow Wave. The different stimulus-response profiles of the ERP components are discussed in relation to the autonomic response profiles within the context of a sequential processing model of the OR.

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Effect of mnemonic load on cortical activity during visual working memory: A comparison of event-related potentials and power changes

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Visual working memory is a key cognitive process that involves the active encoding, retention and retrieval of information in distributed cortical networks. Whilst there is a plethora of information on electrophysiological components related to these memory processes, fewer studies have sought to relate the varied expression of these components under conditions of increasing task demands. In this study, we investigated correlated changes in event-related potentials and event-related power using a multivariate technique, partial least squares (PLS). 64-channel EEG data were acquired from eight healthy human subjects who completed a visuo-spatial associative working memory task as task load was parametrically increased from easy to medium to hard. We assessed traditional channel-space event-related potentials (ERP) and event-related synchronization (ERS) in the theta and alpha band during encoding, retention and at different levels of mnemonic load. We then utilized these experimental effects to correlate the changes in event-related potentials with event-related power changes across channels using PLS. Evoked activity showed a complex of event-related potentials over occipital regions followed by a negative slow wave that was strongly modulated by task and load. Spectral analysis showed an event-related increase in theta activity and a decrease in alpha activity, which were again modulated by task parameters. PLS analysis showed that earlier evoked components are negatively correlated with power changes in the alpha band whereas the negative slow wave was positively correlated with the theta band. The correlated changes in ERPs and ERS show that these measures are related and may reflect the same underlying process. These results are interpreted in terms of attentional processes and asymmetric amplitude modulations of ongoing brain oscillations.

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Sensory gating in current and abstinent cannabis users

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Chronic cannabis use has been associated with neurocognitive deficits and alterations in brain structure and function. This study investigates the effects of chronic cannabis use on P50 sensory-gating ratios in current and ex-cannabis users, including the potential for sensory-gating impairment to recover following prolonged abstinence. Twenty controls (age: 29.9(12.1) years, 12 female), 21 regular cannabis users (age: 29.5(10.8) years, 7 female), and 16 ex-cannabis users (age: 38.4(10.0) years, 6 female) completed a P50 paired-click paradigm with 3 and 9 second inter-pair interval (IPI) conditions. A subset of 16 age-matched controls participants were compared with the ex-cannabis users. P50 ratios were larger in the IPI3 condition ($p = .044$) and tended to be larger in the IPI9 condition ($p = .072$) in current cannabis users relative to controls, and were significantly larger in ex-cannabis users compared to controls in the IPI9 condition only (IPI 3: $p > 0.10$; IPI 9: $p = .007$), indicating less effective sensory-gating. In both cannabis use groups, IPI9 P50 ratios were positively correlated with duration of regular use indicating worse sensory-gating with greater exposure (current users: $r(21) = .47$, $p = .032$; ex-users: $r(16) = .58$, $p = .019$). After controlling for duration of use and age, IPI9 P50 ratios were negatively correlated with length of abstinence in ex-users ($r(12) = -.66$, $p = .01$) suggesting increased inhibition of irrelevant sensory input with longer periods of abstinence. These results suggest prolonged exposure to cannabis resulted in impaired P50 sensory-gating in both current regular and abstinent cannabis users. While it is possible that these deficits may have pre-existed cannabis use and reflect a vulnerability to cannabis use, their association with increasing years of cannabis use and suggested gradual recovery with increasing abstinence suggests that this is unlikely. Impaired P50 sensory-gating ratios have also been reported in patients with schizophrenia, and may indicate a similar underlying pathology.

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Cross modal auditory and vibrotactile stimulation reveals an inverse relationship between psychophysical thresholds and steady state EEG responses to amplitude modulation

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Multisensory perception is fundamental aspect of perception and is dependent on our ability to merge complementary information between different sensory modalities. While the cortical mechanisms involved in the cross modal integration of sensory information are not well understood, a popular hypothesis predicts that the binding of sensory information reflects the synchronisation of cortical responses to sensory stimulation with similar temporal properties. Prior EEG studies have shown increases in steady state EEG activity for temporally congruent cross-modal stimulation although few studies have examined the relationship between EEG and perceptual measures of cross-modal integration. The aim of the present study was to determine whether changes in steady state EEG activity associated with the cross-modal correspondence of temporal information is reflected in perceptual sensitivity to temporally congruent cross-modal stimulation. To achieve this, steady state EEG responses and amplitude modulation (AM) detection thresholds for simultaneously presented auditory and vibrotactile stimuli were obtained in 33 participants as a function of the cross-modal correspondence of AM rate. In this within-subject design, 21 and 40Hz auditory and vibrotactile stimuli were presented where the modulation rate was either the same for modalities (SAME), different (DIFF) or where only one modality was amplitude modulated (NONE). As expected based on prior research, the results showed significant increases in EEG power for EEG frequencies corresponding to stimulus AM rate, for the SAME

relative to the NONE or DIFF conditions. This relationship was observed for both 21 and 40Hz AM stimulation rates. In contrast, psychophysical thresholds showed decreased sensitivity for the SAME and DIFF, relative to the NONE conditions. This relationship was consistent for both auditory and vibrotactile thresholds and for both AM rates. Taken together these results suggest that increases in steady-state EEG activity associated with temporally congruent cross modal stimulation has an inverse relationship with perceptual measures of multisensory integration.
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Excess beta activity in the EEG of children with Attention-Deficit/Hyperactivity Disorder: A disorder of arousal?

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Past research has reported that a small proportion of children with Attention-Deficit/Hyperactivity Disorder (AD/HD) have excess beta activity in their EEG, rather than the excess theta typical of the syndrome. This atypical group has been tentatively labeled as hyperaroused. The aim of this study was to determine whether these children have a hyperaroused central nervous system. Participants included 104 boys with AD/HD and 67 age-matched male controls. EEG and skin conductance (SCL) were simultaneously recorded during an eyes-closed resting condition. The EEG was Fourier transformed and estimates of total power, and relative power in the delta, theta, alpha, and beta bands, and the theta/beta ratio, were calculated. AD/HD patients were divided into an excess beta group and a typical excess theta group. Relative to controls, the typical excess theta group had significantly increased frontal total power, theta and theta/beta ratio, with reduced alpha and beta across the scalp. The excess beta group had significantly reduced posterior total power, increased centro-posterior delta, globally reduced alpha, globally increased beta activity, and globally reduced theta/beta ratio. Both AD/HD groups had significantly reduced SCL compared to the control group, but the two groups did not differ from each other on SCL. These results indicate that AD/HD children with excess beta activity are not hyperaroused, and confirm that the theta/beta ratio is not associated with arousal. This is the first study of arousal measures in AD/HD children with excess beta activity, and has implications for existing models of AD/HD.
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Clarifying the Functional Significance of P50 Paired-Click Measures

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P50 suppression is often described as a pre-attentive electrophysiological index of sensory gating subserved by active inhibitory inputs (as opposed to passive refractory periods); assumptions which have not been adequately demonstrated. Resolving these issues is necessary in order to understand the functional significance of P50 suppression, and thus the nature of the deficit in populations with reduced P50 suppression (e.g., in schizophrenia, where impaired P50 suppression is thought to be an endophenotype). P50 ERP amplitudes were measured in response to paired clicks in 14 healthy undergraduates. Paired clicks (S1 and S2) were presented at one of three inter-stimulus intervals (ISI; 200, 500 and 800 ms), two inter-pair intervals (IPI; 2 and 8 s) and two attention conditions (directed attention and passive). P50 measures were the S2/S1 ratio, S1–S2 difference, S1 and S2 P50 amplitudes. We failed to find an effect of attention on any P50 measures. Reducing IPI from 8 to 2 s increased S2/S1 ($p < .05$) and decreased S1–S2 ($p < .05$), indicating reduced P50 suppression. Reduced P50 suppression was due to a smaller S1 P50 amplitude ($p = .052$) and a larger S2 P50 amplitude ($p < .05$) in the short (2s), compared to the long (8s) IPI condition. The failure to find an effect of attention on P50 measures is consistent with the view that they measure pre-attentive cognitive processes, and suggests that impairments in P50 measures are not confounded by attentional deficits. However, the degree to which the attention manipulation was achieved is being further analysed. The pattern of effects of IPI on P50 amplitudes is consistent with the view that P50 suppression is subserved by inhibitory inputs and inconsistent with the suggestion that refractory periods are sufficient to explain the reduction of P50 amplitude from S1 to S2.
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The Development of Rapid Facial Mimicry in Infancy

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It has been demonstrated that observation of emotional facial expressions elicits rapid automatic facial reactions in the observer. This phenomenon is often referred to as rapid facial mimicry, and has been associated with empathic function, and other socio-cognitive abilities such as facial recognition. Using facial electromyography (EMG), the rapid facial mimicry response has been demonstrated across the lifespan in child, adolescent, adult and older adult samples. However, no study has investigated this response in children younger than 6 years of age. Nevertheless, it has been proposed that this response may be present from birth, and may be a basic building block for emotional development. The aim of the present study was to investigate the presence of rapid facial mimicry in an infant sample of 7 month olds. Corrugator supercillii (brow) and zygomaticus major (cheek) muscle activity was recorded (1000 ms post-stimulus onset) using facial EMG whilst infants viewed happy and angry facial expressions which varied in orientation. Preliminary results reveal that 7-month-olds exhibit typical facial mimicry responses when viewing happy but not angry faces. This mimicry response to happy faces was not affected by inversion. Implications for emotional and facial processing development will be discussed.
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Prestimulus EEG – ERP amplitude relationships in a habituation paradigm: I. Low-frequency effects

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We aim to delineate the relationship(s) between the prestimulus electroencephalographic (EEG) activity and subsequent event-related potential (ERP) amplitudes in a habituation paradigm, after having previously explored these relationships in an equiprobable Go/NoGo task. Here we investigate the delta and theta band contributions separately, and assess the correlation between the immediately prestimulus activity in these low-frequency bands and the single-trial ERP amplitudes at three midline sites. In a counterbalanced order, 20 participants completed two 10 trial auditory habituation conditions, count and no-task, each with random 5-7 s stimulus onset asynchrony (SOA). Single trial ERPs were derived from the electro-oculogram

corrected data. For each of the midline sites (Fz, Cz, Pz), the mean prestimulus EEG amplitudes were computed using time-frequency analyses applied individually for each trial, condition, and EEG band. The ERP component amplitudes at the midline sites were obtained via Principal Components Analysis (PCA) conducted on 19 scalp sites. Seven PCA factors were identified as ERP components: P1, N1, PN, P2, P3a, P3b, and the SW. Prestimulus delta was directly correlated with the SW amplitude for the no-task condition only. Prestimulus theta was directly related to the positivity of the P1 and PN for count, and the N1 for the no-task condition. Theta was inversely related to the count and no-task P3a, but was directly related to the SW for the no-task condition only. P2 and P3b amplitudes were unrelated to the prestimulus activity in either band for each condition. The low-frequency EEG activity present immediately prestimulus is significantly implicated in the determination of several subsequent ERP outcomes. The patterns of relationships found here differ from those found previously in the fixed SOA equiprobable auditory Go/NoGo task, and provide insight into the stimulus specific processing contributions of the delta and theta bands in this different paradigm.
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Prestimulus EEG – ERP amplitude relationships in a habituation paradigm: II. Higher-frequency effects

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We recently explored the prestimulus electroencephalographic (EEG) - event-related potential (ERP) relationships in an equiprobable auditory Go/NoGo task, and now we investigate these in a habituation paradigm. Here we explore single-trial ERPs and use Principal Components Analysis (PCA) to assess the prestimulus EEG contributions separately for the alpha and beta bands. Twenty participants completed two 10 trial auditory habituation conditions, count and no-task, in a counterbalanced order. The stimulus onset asynchrony (SOA) was randomised between 5-7 s. The data underwent electro-oculogram correction to provide the single-trial ERPs. For each EEG band, time-frequency analyses were used to derive the mean prestimulus EEG amplitudes for each trial and condition at three midline sites (Fz, Cz, Pz). A PCA was conducted on 19 scalp sites to obtain the ERP component amplitudes at these midline sites. Seven PCA factors were identified as ERP components. Prestimulus alpha was inversely correlated with both the P3a and P3b amplitudes, and was directly correlated with the SW in the count condition. Alpha was inversely related only to the P3a amplitude in the no-task condition. In the count condition prestimulus beta activity was inversely related to the N1 and P3a amplitudes, and in the no-task condition was directly related to the SW. P1 and PN amplitudes were unrelated to the prestimulus activity in either band, and prestimulus EEG-P2 correlations failed to reach significance across the midline sites. The stimulus specific effects in alpha and beta found in this long and random SOA habituation paradigm differ from those found in our investigations utilising a short fixed SOA equiprobable Go/NoGo task. The patterns of findings provide support for the robust nature of the immediately prestimulus EEG – ERP relationships, and the results indicate the alpha and beta band contributions in regard to the stimulus specific ERP processing outcomes.
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Sex Differences between the Combined and Inattentive types of Attention-Deficit/Hyperactivity Disorder: An EEG perspective

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This study investigated EEG differences between the Combined and Inattentive types of AD/HD within boys and girls aged 8-12 years. Groups included 80 controls (40 boys & 40 girls), 80 AD/HD Combined type (40 boys & 40 girls), and 80 AD/HD Inattentive type (40 boys & 40 girls). All participants had an eyes-closed resting EEG recorded and Fourier transformed to provide estimates for total power, absolute and relative power in the delta, theta, alpha and beta frequency bands. The boy AD/HD groups had greater absolute and relative theta, greater theta/beta ratio, and reduced absolute and relative alpha and absolute and relative beta, than boy controls. The girl AD/HD groups had greater absolute delta, absolute and relative theta, total power and theta/beta ratio, and reduced relative delta and relative beta, than girl controls. Between AD/HD types, boys Combined type had globally greater absolute and relative theta, greater theta/beta ratio and reduced relative alpha than boys Inattentive type. While topographical differences emerged, there were no significant global differences between AD/HD types in girls. Boys and girls have differing EEG profiles between the AD/HD types and this should be recognised in future research.
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A neurophysiological investigation into Tourette Syndrome and Comprehensive Behavioural Intervention for Tics (CBIT)

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Tourette syndrome (TS) is a childhood onset neuropsychiatric disorder characterised by motor and phonic tics. Neurophysiological investigations have suggested that motor cortical inhibitory control mechanisms are reduced in efficacy in TS resulting in reduced movement suppression. This study investigated the efficacy of Comprehensive Behavioural Intervention for Tics (CBIT) in TS and explored the underlying meurophysiological mechanisms such as reafferent suppression and motor cortical inhibition. Transcranial magnetic stimulation (TMS) paradigms were used to measure cortical silent period (CSP), short latency intracortical inhibition (SICI) and short and long latency afferent inhibition (SAI & LAI) and intracortical inhibition (ICI) before and after CBIT intervention in 9 participants (7 boys and 2 girls) with a mean age of 11 years (SD: 1.9, Range 9-14 years). Neurophysiological inhibitory mechanisms were tested using TMS/ Electromyography protocols including active motor threshold (AMT), resting motor threshold (RMT) and motor evoked potential (MEP). Neurophysiological measures of CSP/MEP ratio showed the largest significance (z=-1.836, p=0.066) in cortical inhibitory improvement. No conclusive significant results were gathered from LAI and SAI measurements. Participant scores of Parent Tic Questionnaire (PTQ) total tic severity was significantly lower after treatment (z=-2.31, p=0.021, effect size=0.97) with the average frequency (z=-2.196, p=0.028, effect size=0.79) and average intensity (z=-2.073, p=0.038, effect size=1.41) also showing a significant reduction. The Yale Global Tic Severity (YGTS) Total Tic Score similarly displayed a significant tic severity improvement (z=-2.366, p=0.018, effect size=1.38) after undertaking CBIT. Pre-post reduction in YGTSS showed a

large effect size (Cohen's d=1.38). Alongside significant clinical improvements, the lengthening of the CSP duration in ratio to MEP represents an improvement in motor cortical inhibitory mechanisms. The results suggest a role of CSP circuitry in the neurophysiologial changes underlying behavioural treatments but in light of inconclusive afferent inhibitory findings, further research using a larger sample is indicated.
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Autonomic and neural correlates of dysregulated arousal in severe traumatic brain injury

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A consequence of severe traumatic brain injury (TBI) in adults is abnormalities in arousal and emotional responsivity, which manifest themselves physiologically, behaviourally and via self-report measures (de Sousa et al., 2011; 2010, McDonald et al., 2011). While an accurate measure of physi ological arousal is widely debated, Barry et al. (2005, 2007, 2008) have consistently shown an inverse relationship between skin conductance level (SCL), and mean alpha power during an eyes-closed resting condition (EC), accompanied by a concomitant significant increase in SCL and decrease in alpha power in an eyes-open (EO) resting condition. Thus, EEG alpha power may provide a novel index of autonomic arousal. The current study aimed to elucidate the neural and autonomic correlates of arousal disturbances following a TBI. Participants were 15 adults (11 males; mean age 47 years; mean education 13 years) with a severe traumatic brain injury (TBI) and 19 education- and age-matched controls (12 males; mean age 40 years; mean education = 15 years) ($p < 0.05$). Participants completed a session of EEG, whereby mean alpha power and SCLs were recorded across two 2 minute conditions (EC and EO). In line with previous research (e.g., Barry et al., 2007), a significant decrease in EEG alpha power was found from EC to EO conditions for the overall sample, but this was significantly reduced in the TBI patients ($p < 0.01$). Lower SCLs across EC-EO were also found in TBI patients compared to controls. Mean alpha power was greater in posterior compared to frontal regions ($p < 0.01$) for both groups across conditions. In TBI patients greater mean alpha power was evident in the mean of the hemispheres compared to the midline. Controls showed the opposite pattern of differences with midline dominance. On both sagittal and lateral dimensions, there was greater regional differentiation (Frontal vs Posterior; Central vs Frontal/Posterior; and Midline vs Left/Right) on mean alpha power during EC compared to EO. This differentiation also appeared to differ for groups. Our findings suggest that EEG alpha power provides a sensitive measure of TBI-related arousal disturbances, namely hypoarousal, and dysregulated arousal changes during EC and EO resting states, and changes to regional differentiation with lowered arousal in the left and right hemispheres. This is consistent with the global and focalised damage that characterises TBI.
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Changes of beta-band power reveal attentional deficits in visual performance of elderly subjects

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As beta-band (13-30 Hz) EEG activity has previously been linked to attentional modulation in the visual system (Wrobel, 2000; Kaminski et al., 2012), we searched for deficits in beta power in the elderly subjects performing a delayed attentional task with spatial differentiation between target visual stimuli (Gola et al., 2012). We have confirmed that attentional deficits in the elderly subjects might result either from a disturbed activation of the attentional mechanism (alertness) or from a decrease in sustained attention (vigilance). Deficits in both mechanisms were shown to be related to changes in decreased activation of beta band in the parieto-occipital cluster of independent components (ICA) of EEG signal during the anticipatory period.
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The effect of target-to-target interval on P300 varies with age

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There is consistent evidence that the target-to-target interval (TTI) influences P300 in a linear fashion, with increases in TTI producing larger P300s. Further, manipulations of the TTI may underlie P300 increases previously attributed to lower target probability, longer inter-stimulus interval and preceding sequence manipulations. Template update theory (Gonsalvez et al., 2002, 2008) suggests that P300 amplitude changes may reflect updating in working memory following temporal decay of target memory traces as TTI increases. If this were the case, age manipulations should affect the TTI-P300 function, given the known deterioration of short-term memory among older persons. The aim of the current study was to test the prediction that the linear relationship between P300 and TTI would vary as a function of age. Eighteen young (18-35) and eighteen older (60-75) participants completed a visual odd-ball task that manipulated TTIs at four levels (1.5, 3.0, 6.0, and 9.0s). Event-related potentials were recorded using an electrode cap (19 electrodes) under standard recording conditions. The linear relationship between TTI and P300 was confirmed — longer TTIs increased P300s in a linear fashion. As predicted, the linear function (P300 as a function of TTI) was flatter for the older compared to the younger group. Further, we found smaller amplitudes at frontal sites and larger amplitudes at parietal sites for the younger group. The results of the current study are consistent with the interpretation that the P300 component captures updating processes following degradation of target templates in working memory. Paradigms using longer TTIs are more sensitive at capturing age-differences and would be more suitable as potential predictors of ageing and dementia. Further research examining the relationship between cognitive measures and the various subcomponents of the P300 are warranted.
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Mismatch negativity in abstinent cannabis users

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Cannabis users show a range of information processing deficits, with evidence of reduced auditory Mismatch Negativity (MMN) in chronic users. The long-term effects on early auditory processing after prolonged abstinence are not well understood. This study aimed to determine whether deficits in MMN persist following prolonged abstinence from regular cannabis use. Sixteen regular long-term ex-cannabis users with minimum one month abstinence from cannabis (median, 2.75 years; range, 1 month-16 years) and 32 controls were administered a multi-feature MMN paradigm (deviants 6%; standards 82%, 50ms, 1000Hz, 80dB) with duration (100ms), frequency (1200Hz) and intensity (90dB) deviants. Associations with cannabis use measures and symptomatic rating scales were examined. The ex-users showed significantly reduced duration ($F(1,44.9)=4.34$; $p=.04$) and frequency ($F(1,45)=4.33$; $p=.04$) MMN relative to controls, while no group differences were observed for intensity MMN ($z=-.49$; $p=.62$). Duration since abstinence of regular cannabis use was positively correlated with duration MMN ($r=.68$; $p=.004$), which remained significant after controlling for age, indicating reduced MMN with longer periods of abstinence. Higher scores on the Schizotypy Personality Questionnaire were associated with reduced frequency MMN amplitude in the abstinent user group ($r=.603$; $p=.037$), which was not observed in the control group ($p>0.4$). The current findings of reduced duration and frequency MMN in ex-cannabis users with several years of abstinence suggests that chronic use may lead to early sensory information processing deficits that persist after cessation of use. Alternatively, these deficits may have pre-existed the onset of cannabis use and may indicate a shared vulnerability to psychosis and cannabis use. However, the association between reduced MMN and longer periods of abstinence may indicate an accelerated aging effect as a result of regular prior cannabis exposure, which persists beyond cessation of use.

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Anger and the Emotion-Modulated Startle Eyeblink Reflex

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The studies were designed to investigate the effect of angering pictures on the startle eyeblink response, based on anger's unique identity as an approach-oriented negative affect. In each study, pictures that evoked anger, disgust/fear, positive, and neutral emotions were presented, and startling noises were presented during the midst of picture viewing. Startle eyeblinks were measured using EMG. In Study 1, eyeblinks to probes during angering and neutral pictures did not differ, despite angering pictures being rated higher on arousal and anger and more negative in valence. Study 2 replicated Study 1; also, dysphoric participants exhibited potentiated eyeblinks to probes during angering pictures much like those to probes during fear/disgust stimuli. A follow-up study revealed that dysphoric participants rated angering pictures higher in fear. Study 3 again found that eyeblinks to probes during angering and neutral pictures did not differ. These results suggest that probes during angering stimuli elicit eyeblinks much like those during neutral stimuli, perhaps due to the competing influences of arousal, valence, and motivation on the startle eyeblink reflex.

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"I just called to say I heart you": Smartphone-enabled pulse rate variability (PRV) as a substitute for heart rate variability

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Heart rate variability, a measure of autonomic nervous system activity, has traditionally been collected in a laboratory on dedicated equipment. However, advances in hardware miniaturization and access to flexible software platforms mean this may no longer be necessary. Smartphones are ubiquitous and powerful microprocessors, are owned by the majority of university students, and are increasingly being used for telehealth and data-gathering applications. This raises two questions: 1) Can we take heart rate data from a smartphone with sufficient accuracy for research? 2) Given 1), can we use this platform to successfully replicate links between well-established respiratory, attentional and personality effects and heart rate variability? We constructed a pulse-rate sensor which works from an iPhone, controllable from an iPhone application (app). This records heart period as defined by photoplethysmography, and then exports the heart periods through the phone's mail client. After which we compared time, frequency and non-linear domain measurements between a laboratory ECG. Finally, data (baseline HRV, paced breathing, attention mediated HR response, and personality and arousal scales) was obtained from 115 students over 10 hours of tutorial time, spread over a working week. Accuracy of a smartphone-enabled pulse monitor compares moderately well to an ECG, but is substantially improved when revised signal analytic techniques are used. We also directly replicated two well established results from the extant literature concerning paced vs. unpaced breathing, and the comparison between self-reported and cardiac arousal. With the correct signal analytic techniques, smartphone-enabled pulse rate monitoring has the potential to augment traditional HRV data collection, as it display sufficient accuracy and has advantages in speed, portability, scale, and ease of use.

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The effect of high-intensity intermittent exercise on cardiovascular and autonomic reactivity

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The aim of the study was to examine the effect of a 12-week exercise intervention on the cardiovascular and autonomic response of males to psychological challenge. Thirty four young overweight males were randomly assigned to either an exercise or control group. The exercise group completed a high-intensity intermittent exercise (HIIE) program three times per week for 12 weeks. Cardiovascular and autonomic response to the Stroop task was determined before and after the intervention by assessing heart rate (HR), stroke volume (SV), arterial stiffness, baroreflex sensitivity (BRS), and skeletal muscle blood flow. The exercise group improved their aerobic fitness levels by 17% and reduced their body weight by 1.6 kg. Exercisers compared to controls experienced a significant reduction in HR ($p < 0.001$) and a significant increase in SV ($p < 0.001$) at rest and during Stroop. For exercisers, arterial stiffness significantly decreased at rest and during Stroop ($p < 0.01$), whereas BRS was increased at rest and during Stroop ($p < 0.01$). Forearm blood flow was significantly increased during the first two minutes of Stroop ($p < 0.05$). HIIE induced significant cardiovascular and autonomic physiological adaptations at rest and during mental stress after 12 weeks of training.

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Emotion in voice matters: Neural correlates of emotional prosody perception

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The ability to perceive emotions is imperative for successful interpersonal function. The present study aimed to examine the

neural characteristics of emotional prosody perception. An exploratory event-related potential (ERP) analysis was conducted on 59 healthy individuals using a discrimination task. 120 semantically neutral word pairs from five prosody conditions (happy/happy, angry/angry, neutral/neutral, angry/happy, happy/angry) were presented to participants who determined whether the words in the pair were spoken in same or different emotional prosody, whilst electroencephalogram and accuracy was recorded. Reflective of the first processing stage, word 1 N1 was found to have greatest activation in parietal regions of the hemispheres, and was largest for emotional compared to neutral stimuli, indicating detection of emotion features. The second processing stage, represented by word 1 P2, showed similar topographic effects, however, amplitude was largest for happy in the left hemisphere while angry was largest in the right, illustrating differentiation of emotions. At the third processing stage, word 1 N3 amplitude was largest in frontal regions, indicating later cognitive processing occurs in the frontal cortex. N3 was largest for happy, which had lowest accuracy compared to angry and neutral. The results of the present study are congruent with Wildgruber, Ethofer, Grandjean, and Kreifelts' (2009) Cerebral Network Model of speech prosody, as it elucidated the locality and function of three primary stages of emotional prosody perception, controlling for semantic influence.

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The Psychological and Physiological Effects of Ostracism Following Brain Injury

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Traumatic Brain Injury (TBI) results in a heterogeneous collection of cognitive and psychosocial sequelae. Deficits in these realms often lead to significant changes in occupational and social functioning, and over time these individuals become socially isolated. While past studies have highlighted these issues, little research has focused directly on the emotional impact of social exclusion in individuals with a TBI. This study examined the psychological and physiological effects of ostracism (being socially excluded by one or more other people) in 14 adults with TBI and 16 matched control participants. The Cyberball (Williams et al., 2000) ball tossing paradigm was used to induce an immediate experience of ostracism. Against predictions, preliminary data suggest little difference between groups on the self-reported effects of ostracism, however, while not significant, the observed trend suggests that participants with a TBI display a different physiological response (skin conductance levels) to ostracism than control participants [F (1, 29) = 3.54, p = 0.07, ç2 = 0.11]. Specifically, adults with a TBI displayed higher levels of arousal during the inclusion condition, when contrasted with the ostracism condition. This finding is discussed in terms of the consequences of impoverished physiological responses in motivating people to employ strategies that will lead to social re-engagement.

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The relationship between mental and physical health: Insights from the study of heart rate variability

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Clinical depression with or without cardiovascular disease (CVD) is associated with a significant two- to four-fold increased risk of cardiac mortality. Reductions in heart rate variability (HRV) - an index of the beat-to-beat changes in heart rate - are a robust marker for cardiovascular risk. We aim to present recent outcomes from our laboratory on the impact of psychiatric illness and its treatment on HRV. Findings from meta-analysis, as well as observational, and experimental studies will be presented. HRV reductions were observed for patients with major depressive disorder (Hedges g = 0.293, p < 0.001), generalised anxiety disorder (Hedges g = 0.688, p = 0.00 6) and alcohol dependence (Hedges g = 0.6, p < 0.001). While no overall effect of the SSRI class on HRV was observed, escitalopram – a highly selective SSRI – increased HRV (Cohen's d = 0.754, p = 0.032). Tricyclic medication is associated with large decreases in HRV (Hedges g = 1.236, p < 0.008). Results highlight the need for comprehensive cardiovascular risk reduction strategies in patients being treated for depression and anxiety without cardiovascular disease.

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Neural correlates of emotional enhancement of memory in frontotemporal dementia and Alzheimer's disease

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Emotional stimuli are typically remembered more vividly than non-emotional stimuli. This emotional enhancement of memory is reported to depend on integrity of the medial temporal lobe. These regions are affected in common neurodegenerative brain disorders, such as frontotemporal dementia (FTD) and Alzheimer's disease (AD), yet the extent that emotional enhancement of memory is compromised in these syndromes remains unclear. This study aimed to: (a) investigate recognition memory for emotional and neutral stimuli in FTD (behavioural-variant FTD (bvFTD), semantic dementia (SD), progressive nonfluent aphasia (PNFA)) and Alzheimer's disease, and (b) establish their neural correlates. Thirty-four FTD patients (11 bvFTD, 13 SD and 10 PNFA) were compared with 10 AD and 15 controls. Participants studied 40 negative and 40 neutral images, and completed a forced-choice recognition test after a 1-hour delay. Correlations between behavioural performance and grey matter integrity were investigated using voxel-based morphometry. For true recognition, a significant interaction between emotion and memory was present. Controls and AD recognised more emotional than neutral items, whereas in bvFTD, SD and PNFA, recognition was comparable regardless of emotional content. Recognition, collapsed across emotional and neutral items, was correlated with the left hippocampus and parahippocampal gyrus, together with the lateral occipital cortex bilaterally, the precuneus and posterior cingulate, and the right middle and superior temporal gyri. Importantly, recognition of emotional stimuli was associated with separate neural regions, including the right orbitofrontal and subcallosal cortex, and right middle and inferior frontal gyri. Emotional enhancement of memory is compromised in FTD, but remains intact in AD. Although the medial temporal lobe is involved, frontal structures including the orbitofrontal cortex are also critical for emotional enhancement of memory. The orbitofrontal cortex is implicated in emotional decision-making and directing attention to emotional stimuli, and these features may also contribute to emotional enhancement of memory.

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Autonomic and emotion dysregulation in postconflict East Timor: associations with trauma exposure and psychopathology

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Reduced heart rate variability is associated with depression-anxiety disorders, possibly reflecting a core mechanism that underpins emotion dysregulation. Given the majority of research has been conducted in Western clinical settings, it is not known whether autonomic disturbances are universal or how they are influenced by exposure to excessive conflict-related trauma. We examined whether heart rate variability and emotion regulation mediated or moderated the dose-response relationship of trauma exposure with symptom severity in postconflict Timor-Leste. We conducted in-depth interviews with 97 Timorese community members encompassing: 1) self-report instruments, including the K10 (psychological distress), Harvard Trauma Questionnaire (PTSD symptoms), a culturally sensitive measure of explosive anger, emotion regulation style; 2) SCID interviews for major depressive episode, PTSD and intermittent explosive disorder. Resting state heart rate data was collected from consenting participants via the RS800CX Polar Watch system for 10 minutes. A total of 74 participants (n=45 cases; n=29 non-cases) had valid heart rate and clinical data for analysis. Moderated mediation analyses were performed, examining the associations between trauma exposure, symptom severity, heart rate variability and emotion regulation style, controlling for age and sex. All clinical groups demonstrated significant ($p<.05$) reductions in heart rate variability relative to non-cases. Heart rate variability (RMSSD) partially mediated the association between trauma exposure and level of distress and traumatic stress symptoms (not anger) in the full sample. Further, low reappraisal utility moderated the trauma-PTSD symptom relationship; low suppression utility moderated the trauma-aggressive behaviour relationship. The findings demonstrate heart rate variability reductions in clinical groups from a non-Western setting, adding weight to the argument that such reductions may be universal. The mediating influence of heart rate variability on the association between trauma exposure and symptom severity was restricted to symptoms of internalizing disorders. The utility of alternative emotion regulation strategies may moderate the impact of trauma on the development of specific symptom and pathological behaviour profiles. The implications of these findings for the Timorese context will be discussed.

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Problem gamblers are hyposensitive to wins: An analysis of skin conductance responses during live gambling

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Physiological arousal is purportedly a key determinant in the development and maintenance of gambling behaviours, with problem gambling being conceptualised in terms of an autonomic response deficit. Specifically, it has been suggested that problem gamblers may be hyposensitive to losses and/or hypersensitive to wins however, previous research examining phasic electrodermal responses of these individuals has been limited to laboratory settings. To test the nature of deficit in this disorder, reactions to real gaming situations, where gamblers wager their own money, need to be examined. Skin conductance data to losses, wins and fake wins (outcomes where the amount returned is less than that wagered) were recorded in real-time from ten problem and ten non-problem gamblers while they played an electronic gaming machine (EGM). Participants wagered their own money on a gaming machine of their choice within a real gambling venue. While win outcomes elicited substantial skin conductance responses (SCRs) in the non-problem gambler group, problem gamblers demonstrated significantly reduced SCRs. Losses and fake win outcomes did not differ appreciably between problem and non-problem gambler groups. The current study allowed an examination of autonomic arousal in problem and non-problem gamblers in an ecologically valid setting. The results suggest that, rather than being hypersensitive to reward as previous theory predicted, problem gamblers are less reactive to win outcomes on an electronic gaming machine than are non-problem gamblers. This hypo-sensitivity to positive outcomes implies that a malfunction in incentive value processing is implicated in problematic gambling behaviours, and presents as a potential marker for addiction.

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Can event-related potentials serve as neural markers for both win and loss events in a gambling task? A principal components analysis

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The feedback–related negativity (FRN) event-related potential (ERP) component is a robust neural correlate of negative outcome processing, with losses producing larger FRN amplitudes than wins. This component is particularly valuable in advancing our understanding of the development and maintenance of both normal and problem gambling behaviours. The current study investigated whether independent ERP components, including the FRN, can be isolated for wins and losses, with the aim of elucidating the nature of the latent neural responses associated with incentive-value processing. Eighteen non-problem gamblers played a computer gambling task that presented feedback regarding the success of each trial, and the elicited brain activity was recorded. The distribution of reward/non-reward outcomes closely matched that of a real electronic gaming machine (EGM), with frequently presented losses and infrequently presented wins, as well as 'losses-disguised-as-wins' (near-wins). A spatial-temporal principal components analysis (PCA), using Varimax rotations for both dimensions, was employed. The PCA revealed the FRN to be characterised by a frontally maximal negative deflection to losses, and a positive deflection to wins. As expected, the latent components of the late positive complex also differed according to outcome valence. Interestingly, FRN and error positivity amplitudes following near-win outcomes were significantly different from losses. The results provide evidence that the FRN is a robust neural correlate of negative outcomes, and that the neural generators of the FRN are differentially activated following reward and non-reward/punishment feedback. The finding that near-wins were perceived as less aversive than losses suggests that they constitute a design feature of EGMs that maintains the attention of gamblers. We integrate the results of the current study in an account of the spatial and temporal characteristics associated with incentive-value processing during an ecologically-valid gambling task, which may aid the future development of a response profile of pathological gamblers.

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Trials effects in single-trial ERP and autonomic measures in a dishabituation paradigm with very long ISIs

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To compare the stimulus-response patterns of single-trial ERP components and autonomic measures at long ISIs from the perspective of a sequential processing theory of the Orienting

Reflex (OR). Twelve indifferent 80 dB tones (1000/1500 Hz, 50 ms with 15 ms rise/fall times) with random ISIs (45 to 70 s) were presented to subjects (10 females and 6 males). The first 10 trials were of one frequency, followed by a change trial at the other frequency (recovery), and a subsequent dishabituation trial at the initial frequency. The evoked cardiac responses (ECR), Respiratory Pause (RP), SCR, and single-trial ERPs from 19 sites, were collected. EOG-corrected ERP data were submitted to principal components analysis (PCA). SCR displayed the stimulus-response pattern expected of the OR: decrement, recovery, dishabituation. ECR showed no trial effects. RP decreased linearly over trials and showed recovery at the change trial. Eight identifiable ERP components were extracted: P1, N1, Processing Negativity (PN), P2, P3a, P3b, Novelty P3 and the early Slow Wave (SW). The SW alone displayed a trials main effect, without recovery. P1, N1, PN, and P3b showed topographical reductions over trials without recovery, while Novelty P3 showed topographical decrement over trials and recovery; P2 and P3a showed no trial effects. The autonomic measures showed the three patterns expected: cardiac deceleration was insensitive to novelty, respiratory pause showed evidence of decrement and recovery, and SCR exhibited the stimulus-response pattern of the OR. The ERP components showed a different range of patterns: no trial effects, topographical decrement with and without recovery, and substantial decrement over trials without recovery. There was no evidence of dishabituation. The implications of these differences in autonomic/central patterns for our understanding of the OR are discussed.

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It's not only in the eyes: nonlinear relationship between face orientation and N170 amplitude irrespective of eye presence

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We have investigated the interplay between face orientation, eye presence, and N170 amplitude by recording Event Related Potentials. To clarify previous reports of nonlinearity in N170 amplitude changes along rotation angle changes, we adopted Itier's et al. model (Itier et al., 2007) which links N170 face inversion effects with presence of eyes. Comparison of N170 amplitude and latency for five stimulus categories (Faces-with-eyes, Faces-without-eyes, Eyes, Cars-with-lights, Cars-without-lights) in five different rotations (0, 45, 90, 135, 180) resulted in mixed conclusions. The main findings of this study are: (1) a strong nonlinear relationship between N170 and angle of rotation that is specific to faces, distinguishing face from car category even when no significant differences were observed between these categories for upright and inverted orientations; (2) the nonlinear relationship between N170 and angle of rotation does not depend on eye presence. We also proposed a hybrid model according to which N170 amplitude consists of two related aspects of face processing: (A) incompatibility (relative distance of the stimulus pattern from experience-based hypothetical prototype) and (B) integration (degree to which stimulus is integrated into holistic representation), with the former affecting the latter. Moreover, we suggest two possible neural events underlying these two aspects of face processing: neural population size activated by the stimulus, and synchronization within this population.

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Arousal and empathy in adults with high-functioning autism spectrum disorder

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Individuals with autism spectrum disorders (ASDs) are characterised by severe impairments in social-emotional reciprocity. It has been proposed that these deficits may be due to disruptions in empathy and/or the amygdala. Given that autonomic functioning is mediated by the amygdala, we sought to explore the relationships between baseline skin conductance level (SCL) and empathy in high-functioning adults with ASDs. In light of recent theoretical considerations, cognitive and affective empathy were examined separately. Finally, relationships between empathy and facial mimicry (electromyography; EMG) were explored. Thirty adults (24 males; mean age 38.4 years) with ASDs were matched to 32 controls (25 males; mean age 41.5 years). SCL was measured as the average skin conductance during a 2-minute, eyes-closed, resting baseline task. EMG was measured as the peak response in zygomaticus and corrugator muscles post-stimulus onset to happy and angry faces. As expected, the ASD group had significantly lower levels of both cognitive and affective empathy. While the ASD group as a whole did not differ significantly in SCL from the control group, there was a subgroup that had significantly lower resting baseline SCL. Interestingly, this subgroup had no significant associations between SCL and empathy. In contrast, both the control group and the ASD subgroup with "typical" resting baseline SCL showed negative correlations between SCL and empathy. Finally, the ASD group demonstrated atypical EMG. Interestingly though, there was a subgroup of ASDs with low levels of affective empathy that demonstrated the typical pattern of corrugator responses. These findings will be discussed in relation to the orienting response and neural networks known to underlie social cognition.

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Heart rate variability predicts impulse control in alcohol dependent outpatients

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Past research has highlighted the important role of the autonomic nervous system in impulse control. Heart rate variability (HRV) may provide a physiological index of impulse control processes. The aim of the present study was to determine whether HRV predicts impulse control related to drinking in individuals with alcohol dependence. Resting-state HRV and impulse control, as indexed by the compulsive subscale of the Obsessive Compulsive Drinking Scale (OCDS), was assessed in 26 alcohol dependent outpatients. Exclusion criteria included comorbid mood disorders or any serious medical conditions. A multiple regression was performed to evaluate if HRV could predict scores on the compulsive OCDS subscale. As potential covariates, measures of anxiety and age were entered in the first step with HRV entered in the next step. Results supported the hypotheses suggesting that HRV predicts levels of impulse control associated with drinking. Importantly, this result was found after controlling for the potential covariates of age and anxiety. Our study provides further evidence for the important role of the autonomic nervous system in the development and maintenance of dependence disorders. Our study also suggests that impulse control may play an important role in preventing relapse during the treatment of alcohol dependence.

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Repetitive viewing of affective movie clips normalizes physiological arousal in TBI

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Deficits in empathy, manifested in egocentricity and insensitivity, are among widely documented social problems in individuals who have sustained a severe traumatic brain injury (TBI). The current study was designed to examine the relationship between deficits in empathy and emotional responsivity in adults with severe traumatic brain injury (TBI) to determine if impairments in responsivity can be ameliorated through repeated presentations of emotional stimuli. Nineteen participants with TBI (13 males; 41 years) and 23 control participants (14 males; 31 years) viewed five repetitions of six two-minute film clip segments containing pleasant (When Harry Met Sally and Mr Bean's Christmas), unpleasant (My Bodyguard and Cry Freedom), and neutral content (Birds and Stream taken from the documentary, Danali). Facial muscle responses (zygomaticus and corrugator) and skin conductance level (SCL) were recorded. A pre-experiment 2-minute resting baseline period was recorded, and mean physiological responses were derived as the difference for each viewing period relative to this baseline. Emotional empathy was also assessed. In line with previous research, TBI participants showed impaired corrugator responses to negative films ($p < 0.01$), but normal zygomaticus responses to positive films. Both groups showed response decrement to repetitions of positive clips (linear trend: $p < 0.001$) but only control participants showed decrement to negative clips; TBI responses were consistent to repetitions. Compared to control participants, TBI participants reported less ability to empathise emotionally, and this was related to lower arousal levels (SCL) at rest, however, arousal normalised over repetitions, irrespective of valance ($p < 0.001$), supporting a role for emotion contagion in empathy. Results were consistent with the view that TBI impacts upon one's ability to respond and empathise emotionally, but some normalisation of physiological arousal may be apparent to repeated stimulus presentations. The implication of these effects upon rehabilitation will be discussed.

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Autonomic and brain volume changes contribute to arousal disturbance in TBI

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Loss of emotional responsivity, i.e., reduced facial mimicry and autonomic arousal to facial expressions, have been reported to be associated with emotional empathy following TBI. To date, however no comparisons have been made between changes in brain morphometry and loss of empathy. The current study aimed to determine whether a relationship is evident between brain regions implicated in emotion processing and changes to arousa l regulation and empathic ability. Sixteen adults (12 males; 38 years) with severe TBI (Mean PTA = 81 days; = 5 years post injury) and 16 matched controls (12 males; 46 years) participated. We compared grey matter volume in whole brain, bilateral amygdala and thalamus, with resting arousal (measured by mean skin conductance level (SCL)) and cognitive and emotional empathy scores derived from the Interpersonal Reactivity Index (IRI; Davis, 1980, 1983). Reduced grey matter volume was found in several structures in TBI, with the largest found in the right amygdala ($p < 0.01$). TBI participants had lower resting arousal ($p < 0.01$) and cognitive empathy ($p < 0.01$), but higher emotional empathy ($p < 0.001$). Amygdala volume was correlated with SCL (right, $p < 0.001$) lower cognitive empathy. It was also associated with greater self-reported emotional empathy (right, $p < 0.01$). Correlations were also found between thalamus volume and cognitive empathy (left, $p < 0.05$; right, $p < 0.01$). Overall, the present study shows that amygdala reduction after TBI leads to deficits in the regulation of physiological arousal and empathy. The impact upon emotional responsiveness observed after TBI will be discussed.

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Habituation to Emotional Facial Expressions from an OR Perspective

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The Orienting Reflex (OR) serves to facilitate basic interactions of an organism with its environment via the involuntary projection of attention towards novel stimuli (Sokolov, 1960). Over repetition or prolonged exposure, novelty of a stimulus declines and the OR diminishes as a product of habituation. One method of investigating OR habituation is the EEG dishabituation paradigm, which enables the observation of electrical potentials in the brain over stimulus repetition and change. Thus far, this research has only been conducted using stimuli of soft and loud auditory tones (Rushby, Barry, & Doherty, 2005; Rushby & Barry, 2007). The current study tests this paradigm in a new context using happy and angry facial expressions. Dependant variables of the P3 and CNV components (derived from event-related potentials) are used as the measures of phasic and tonic arousal towards stimuli. The results demonstrate a successful translation of the dishabituation paradigm and also show evidence of differential activation towards happy and angry stimuli. These findings support the hypotheses and provide novel insight into the basic mechanisms that drive everyday responses to facial expression. Prospective avenues of investigation are discussed, which focus on further expansion of ERP theory and elucidation of factors responsible for a number of social impairments affecting clinical populations.

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Alcohol effects on young adults' inhibitory function in the stop-signal task

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New models of the development and maintenance of substance abuse give increasing importance to the role of deficits in inhibitory function. Much of this knowledge comes from studies of older, more established/dependent users, but increasing evidence suggests deficits are apparent in younger drinkers, who have less exposure to alcohol, but drink in more risky patterns and with more risk of damage to their still-developing brains. We examine behavioural and psychophysiological measures of inhibitory function in young adults who do and do not binge drink. Thirty-five young adults (aged 18-21) who binge drink at varying frequencies, and do not use any other drugs regularly, underwent interviews assessing prior use of alcohol, before completing a stop-signal task while EEG was recorded. The time required to stop an inappropriate response (the stop-signal reaction time) increased with binge frequency and with scores on the Alcohol Use Disorders Identification Test. Preliminary ERP results suggest increased alcohol use is also associated with impaired performance monitoring following these errors of inhibition. These results suggest that atypicalities in inhibitory processing and performance monitoring are apparent in a younger group, with less alcohol exposure, than considered in most other studies. However, it may be the case that these deficits pre-date and contribute to later alcohol abuse problems.

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CNV resolution in the Go/NoGo task: A failure to replicate Simson et al.

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For 35 years, some researchers have argued that CNV resolution may affect or even produce the increased P3 for NoGo compared to Go trials, and thus that no 'inhibitory' NoGo P3 exists. This is based largely on the work of Simson et al. (1977), which compared Go and NoGo topography after CNV was subtracted from NoGo trials only. Specifically, the NoGo P3 topography showed the distinctive frontocentral maximum when referenced to a pre-target baseline. This NoGo topography changed to a more parietal maximum, similar to that on Go trials, when referenced to a pre-cue baseline. Many other researchers have cited this study, while failing to use the delayed response design on which Simson et al. based their argument. We attempted to replicate Simson et al.'s experiment with delayed responses and also with immediate responses, as are more often used. As expected, the amplitudes of CNV and P3 to both Go and NoGo trials were increased when immediate compared to delayed responses were required, but we failed to replicate the topographic shift of NoGo P3 with different baselines for both delayed responses and immediate responses. That is, subtraction of the CNV from NoGo P3 did not change the distinctive frontocentral topography of this component, which is often linked to a motor inhibitory source. The results suggest that CNV may affect the amplitude and measurement of post-target P3, but that P3 is not caused by CNV resolution.

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Can working memory ability predict different temporal effects on the P300?

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The P3 ERP component is often considered as an electrophysiological index of memory-updating processes associated with target stimuli. Component magnitude varies with stimulus presentation characteristics, such as the time separating target stimuli (target-to-target interval: TTI), with longer TTIs eliciting larger P3 amplitudes. According to template-update theory, TTI effects on the P3 reflect the updating of stimulus-templates in working memory. The current study explored whether young adults' memory-task ability could predict TTI effects on the P3. EEG activity was recorded from 50 university students (aged 18-25 years) while they completed an equiprobable auditory Go/NoGo task; button press to targets. Stimulus presentation order was semi-random, with manipulations of TTIs and a variable SOA. Participants also completed a CogState battery that included attention and memory tasks. Composite scores were derived for participants from working memory subtests as an index of *working memory ability*; participants were sorted according to this. Performers in the top and bottom thirds were selected (high vs. low groups) for further analysis. ERPs were analysed using a temporo-spatial PCA. P3 subcomponents were identified as P3a, P3b, SW, and these were followed by a very late negativity. P3b amplitudes increased linearly to longer TTIs and the slope of this relationship differed between groups, with smaller amplitudes at longer TTIs for the low ability group. Both negative and positive aspects of the SW became more negative as TTI increased; this did not differ between groups. There were no interactions or main effects of group or TTI for P3a or the very late negativity. These results suggest that the TTI/P3 relationship is dominated by P3b and is also sensitive to working memory ability. Specifically, small P3b amplitudes at longer TTIs, as seen for the low ability group, could suggest that poor working memory results from inadequate memory-update processes.

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Matter Over Mind: A Randomised-Controlled Trial of Single-Session Biofeedback Training on Performance Anxiety and Heart Rate Variability in Musicians

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Musical performance is a skilled activity performed under intense pressure, thus is often a profound source of anxiety. In other contexts, anxiety and its concomitant symptoms of sympathetic nervous system arousal have been successfully ameliorated with Heart Rate Variability biofeedback (HRV BF), a technique involving slow breathing which augments autonomic and emotional regulatory capacity. This randomised-controlled study explored the impact of a single 30-minute session of HRV BF on anxiety in response to a highly stressful music performance. A total of 46 trained musicians participated in this study and were randomly allocated to a slow breathing with or without biofeedback or no-treatment control group. A 3 Group × 2 Time mixed experimental design was employed to compare the effect of group before and after intervention on performance anxiety (STAI-S) and frequency domain measures of HRV. Slow breathing groups (n=30) showed significantly greater improvements in high frequency (HF) and LF/HF ratio measures of HRV relative to control (n=15) during 5 minute recordings of performance anticipation following the intervention (effect size: ç2=0.122 and ç2=0.116, respectively).The addition of biofeedback to a slow breathing protocol did not produce differential results. While intervention groups did not exhibit an overall reduction in self-reported anxiety, participants with high baseline anxiety who received the intervention (n=15) displayed greater reductions in self-reported state anxiety relative to those in the control condition (n=7) (r = 0.379). These findings indicate that a single session of slow breathing, regardless of biofeedback, is sufficient for controlling physiological arousal in anticipation of psychosocial stress associated with music performance and that slow breathing is particularly helpful for musicians with high levels of anxiety. Future research is needed to further examine the effects of HRV BF as a low-cost, non-pharmacological treatment for music performance anxiety.

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Poster Presentations

The role of cognitive processes in generalisation of conditioned fear

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Generalisation of conditioned fear has been implicated in the maintenance and proliferation of fear in anxiety disorders. It is still unclear to what extent generalisation of fear learning is an automatic as opposed to a cognitively controlled process. The present study aimed to explore the role of cognitively controlled processes in fear generalisation by manipulating the instructions given to participants. Specifically, the study aimed to test whether explicitly instructed information would affect the pattern of generalisation observed following fear conditioning. In the acquisitions phase, participants were presented with repeated presentations of simple geometric figures, each consisting of a particular shape and colour. One of these figures (the conditioned

stimulus, CS) was always followed by an electric shock (the unconditioned stimulus, US). Before the test phase, participants were instructed that one of the stimulus features (either colour or shape) was useful for predicting the occurrence of the shock. In the generalisation test phase, participants were presented with new stimuli that contained either the same colour or shape as the CS. On all trials, self-reported shock expectancy and skin conductance were recorded. Based on self-reported expectancy of shock, participants showed significantly greater generalisation to the test stimuli that included the instructed stimulus feature. Participants instructed that colour/shape was predictive of shock were seen to generalise more strongly to stimuli that were the same colour/shape as the CS. Skin conductance data also reflected this overall pattern (not statistically significant). Generalisation of conditioning was stronger in a direction consistent with the instruction manipulation, suggesting that explicitly instructed information was used to guide generalisation. While such a result does not rule out the existence of an automatic process in the generalisation of conditioning, it does suggest that higher-order cognitive processes play an important role that requires continued investigation.

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Does watching movies make us ill?

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The effect of watching horror movies on the immune system, in particular salivary immunoglobulin A (sIgA) was studied. 26 undergraduate female students in the Faculty of Psychology and Education at the University of Tehran were allocated randomly to experimental and control groups (N=13). Before the experiment, all participants were checked up by physician to confirm that they were in good physical health. A horror movie (Gothika) was shown to the experimental group and a romantic movie (Maid in Manhattan) was shown to the control group. Before and after watching movies, their saliva samples were collected using the same method. ANOVA revealed a significant enhancement in sIgA concentration after watching the horror movie; there was no change in sIgA concentration after watching the romantic movie. It was concluded that watching horror movie can promote the level of sIgA in saliva. A similar reaction is seen with other acute stressors (making a speech, doing an exam). Theoretical and practical implications for health are discussed.

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Mismatch negativity (MMN) and sensory auditory processing in children aged 9-12 years presenting with putative antecedents of schizophrenia

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Identification of markers of abnormal brain function in children at-risk of schizophrenia may inform early intervention and prevention programs. Individuals with schizophrenia are characterised by attenuation of MMN amplitude, which indexes automatic auditory sensory processing. The current aim was to examine whether children who may be at increased risk of schizophrenia due to their presenting multiple putative antecedents of schizophrenia (ASz) are similarly characterised by MMN abnormalities, relative to typically developing (TD) children. EEG was recorded from 22 ASz and 24 TD children aged 9 to 12 years (matched on age, sex, and IQ) during a passive auditory oddball task (15% duration deviant). ASz children were those presenting: (1) speech and/or motor development lags/problems; (2) internalising, externalising, and/or peer-relationship problems in the clinical range; and (3) psychotic-like experiences. TD children presented no antecedents. MMN amplitude, but not latency, was significantly greater frontally in the ASz group than in the TD group. While MMN abnormalities were present in children at risk of schizophrenia, the nature of this abnormality differed from that observed in adults with schizophrenia. This may reflect developmental and disease effects in a pre-prodromal phase of psychosis onset. Longitudinal follow-up is necessary to establish the developmental trajectory of MMN in at-risk children.

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Training students to drink less: The effects of inhibitory control training on alcohol consumption, alcohol-related cognitions and brain electrical activity

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Hazardous alcohol consumption within undergraduate university students is increasing. This study aimed to replicate findings that alcohol consumption can be reduced using inhibitory control training, with the addition of the Brief Alcohol Intervention (BAI) as an active training control, and by implementing objective psychophysiological measures. Since frontal EEG asymmetry can be used to index approach motivation, it was used as a dependent measure to examine the outcomes of the training. Participants were randomly assigned to Beer-Go, Beer-Nogo or BAI training conditions. The Go-Nogo tasks consistently paired a stimulus that required a response with either a water image (Beer no-go) or a beer image (Beer-go). Alcohol consumption was measured post-experiment and at a one week follow-up. Pre- and post-experiment frontal EEG asymmetry was recorded during a passive image viewing task in which beer, non-alcoholic beverage, and neutral stimuli were presented. Participants in the Beer-Nogo and BAI conditions consumed less alcohol than those in the Beer-Go condition directly after the training. This was in line with the frontal EEG asymmetry data, which indicated that left hemisphere activity decreased in the Beer-Nogo and BAI conditions and increased in the Beer-Go, indicating that approach tendencies towards beer stimuli were altered in the expected direction directly after the experimental conditions. Inhibitory control training can be used to reduce alcohol consumption in university students. The trend in both the consumption measures and EEG data are promising and should be explored further using variations to the Go-Nogo tasks.

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Effect of yogic exercise (Pranayam) on reaction time in chronic alcoholic patients

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Chronic alcoholic patients (n=35) having poor reaction time were chosen as subjects and were recruited for different yoga training for one year. Exclusion criteria were inability to either perform pranayam or to understand procedure for testing RT. Visual (VRT) and auditory reaction time (ART)was measured using RT apparatus before and after pranayama (yogic exercise) and a control period of ten minutes of normal activities to rule out any test-retest practice effect. Analysis of non-intervention period

values showed that the reliability in terms of reproducibility of the observation for both VRT (r=0.87) and ART (r=0.95) was excellent. Yogic exercise produced a significant decrease in both VRT and ART. There was a statistically significant decrease in VRT (P<0.0001). Decrease in RT signifies improved central neuronal processing ability. This may be due to greater arousal and faster rate of information processing, improved concentration and/or ability to ignore or inhibit extraneous stimuli. Yogic exercises may be altering afferent inputs from abdominal and thoracic regions, in turn modulating activity at ascending reticular activating system and thalamo-cortical levels. It is suggested that yogic techniques like pranayam be used as an effective means of improving reaction time in peripheral neuropathy patients.

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Effect of stress on the quality of life among working and non-working women: A comparative study

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Life events give us stress. Change (at home, work, or in relationships), loss (financial, property, personal) and demands (overwhelming or unreasonable) are stressful experiences we all must deal with throughout our lives. Commuting, confrontations and busy schedules also contribute to our daily stress levels. Our attitude towards stressful situations determines how effectively we will cope. Quality of life is defined as an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns. It is a broad ranging concept affected in a complex way by the person's physical health, psychological state, level of independence, social relationships, personal beliefs and their relationship to salient features of their environment. The current study aimed at comparing the stress and quality of life of working married women and working unmarried women and non working married and non working unmarried women and investigating the correlation between stress and quality of life. Sample of the study consisted of 80 women, 40 working and 40 non-working women which are subdivided into 20 married and 20 unmarried women. Their age ranged between 22 to 32 years. They belong to different background and households, working in different government and private sectors of Noida, India. PSLE stress scale is used to assess the stress level and WHOQOL brief is used to assess the quality of life. It was hypothesized that there will be significant difference in the effect of stress level on the quality of life of working and non working woman, married and unmarried women and there will be interaction effect of stress, quality of life, occupational status of the woman and the marital status of the woman. The study reported significant negative correlation between stress and quality of life among working and non working women. The results further show that working group of women can perform well in their married life and they are more capable to handle their daily life events and have better quality of life during their life time as compared to non-working married and unmarried women. Though the stress level is high in working married women compared to non working married women, yet the quality of life is seen better in working married women compared to non working married women. The study provides an opportunity for further research across age and gender to uncover the possible differences or similarities that may be present. Also it adds to the already existing data pool with equivocal studies.

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An attempt to influence alcohol consumption through training on a Go/NoGo task

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Deficits in inhibitory control are associated with alcohol abuse and dependence. The development of techniques that improve inhibitory control may lead to better outcomes for the treatment or prevention of these disorders. A recent study (Jones et al., 2011) reported that training on a Stop-signal task using instructions designed to promote or diminish response inhibition influenced subsequent alcohol consumption measured directly after the task. This study aimed to determine whether training on a Go/NoGo task could also influence alcohol consumption and to determine if the effects last for up to one week. Participants aged 18-35 were recruited from the University of NSW campus. Participants completed the Go/NoGo task under instructions designed to: i) promote response inhibition by emphasising accurate inhibition of responses (Restraint); ii) discourage response inhibition by emphasising rapid responding (Disinhibition); or iii) have no effect on response inhibition (Control). Alcohol consumption was assessed in a taste test directly following the task. Alcohol intake during the weeks before and after the task was also compared. Implicit and explicit attitudes to alcohol were assessed throughout the course of the study. Participants in the Restraint and Disinhibition group exhibited significantly different response times to Go trials in the Go/NoGo task. There was, however, no effect of experimental group on alcohol consumption or attitudes to alcohol. This study indicates that the Go/NoGo task may not be appropriate for training inhibitory control.

Reference:: Jones et al., (2011). Drug and Alcohol Dependence113:55–61.

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Resting state EEG activity in Internet addiction

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Internet addiction is the inability of an individual to control his or her use of the Internet, resulting in psychological, social, and/or work difficulties. To date, there is little information on spontaneous EEG activity in the resting-state. The aim of this study was to investigate the nature of resting-state EEG differences in the beta and gamma bands between Internet addiction and healthy controls. Twenty-one patients with Internet addiction (age: 23.33 ± 3.50 years), and 20 age-, sex- and IQ-matched healthy controls (age: 22.67 ± 2.28 years) were enrolled in this study. All patients were drug naïve and treatment-seeking, that is, they visited clinics due to their suffering from excessive Internet use. The severity of Internet addiction was assessed by using the Young's Internet Addiction Test (IAT). Resting-state EEG during eyes closed was recorded, and absolute powers on both beta and gamma bands of the frontal area were analyzed. We found significant main effects of frontal electrode locations and frontal electrode locations X group on the absolute beta powers. A significant main effect of group was also found for absolute beta powers. Patients with Internet addiction showed lower beta absolute power in contrast to healthy controls at all frontal electrode locations. With respect to gamma bands, a significant main effect of group was found for absolute gamma powers. Patients with Internet addiction showed higher gamma absolute power in contrast to healthy controls at all frontal electrode locations, except the F7 site. We found no significant correlations between clinical variables and

EEG activity in patients with Internet addiction. The present study suggests that decreased beta with increased gamma power in the Internet addiction is suggestive of imbalance of inhibition-excitation in maintaining cortical homeostasis. These differences may be neurobiological markers for the pathophysiology of Internet addiction.

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Is the change in arousal from resting baseline to a task situation a better predictor of performance than within-task activation?

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Previous studies have investigated two conceptually-different aspects of an individual's energetic state, arousal and activation, using the electrodermal measure of ski n conductance level (SCL). Arousal, the energetic state at a point in time, amplifies physiological responses, such as the Orienting Reflex (OR), as measured by the skin conductance response (SCR). Additionally, behavioural performance is dependent on task-related activation, the change in state from resting baseline to the task situation. This study examined whether changes in arousal levels from resting baseline to a task situation would differentially predict performance c.f. within-task activation. Electrodermal activity was measured from 20 participants during two pre-task baseline conditions (eyes open: EO; and eyes closed: EC) and during an auditory dishabituation task. The task involved fixating on a cross as tones were presented with a random SOA of 13-15 seconds. There were two counterbalanced conditions: indifferent, where there was no task requirement; and significant, where participants were required to press a button as quickly as possible whenever they heard a tone. As expected, the OR correlated positively with immediately-prestimulus arousal levels for both conditions. Unexpectedly, ORs were also dependent on both EO- and EC-based activation levels, with larger correlations for the significant than the indifferent condition. The relative change in OR magnitude between the task conditions was correlated positively with the between-condition change in arousal within the task. For the significant condition, as expected, reaction time (RT) did not significantly correlate with arousal. RTs weakly correlated positively with activation (both EO- and EC-based), however, RTs did not correlate with between-condition activation. These findings indicate that task performance could not be predicted from within-task activation. Together, our results suggest that tasks with long and variable ISIs are suboptimal for separating these energetic constructs.

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Improved Heart Rate Variability Following Intensive 10-Days Vipassana Meditation is Dependent on Change in Mindfulness

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Meditation has a variety of beneficial physiological effects including decreases in heart rate and increases in heart rate variability (HRV), yet it is unclear to what extent individual differences such as change in mindfulness impact on these physiological effects. This study aims to clarify these issues. It was hypothesised that heart rate would decrease and HRV increase following intensive meditation training, that these effects would be greatest during meditation practice (versus rest) and that change in mindfulness – as measured by Mindful Attention Awareness Scale (MAAS) – would moderate these effects. A total of 26 participants completed a 10-day intensive meditation course at the Vipassana Meditation Centre in Blackheath. Data were collected on the day before the course, and as soon as possible after the course (where possible within a week of course completion). R-R data were collected using a Polar watch RS800CX with chest strap, recorded during a 5-minute baseline, and a 5-minute Anapana (mindfulness of breathing) meditation exercise after which they completed a number of questionnaires. While all participants showed significant improvement on several self-report measures including positive and negative affect and satisfaction with life, physiological effects depended on change in mindfulness. Heart rate was observed to decrease, and HRV to increase, only in those participants who displayed the greatest change in mindfulness (the high mindfulness improvement group). These participants also displayed greater improvement in satisfaction with life. The high mindfulness improvement group improved significantly more on mindfulness ($M=1.05$, $N=12$) than the low mindfulness group ($M = 0.01$, $N=10$), ($F1,20=26.17$, $p<.001$). This difference represented a large effect size (Cohen's $d = 2.21$). Findings suggest that the physiological benefits of meditation are dependent on the moderating effects of mindfulness.

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Bimodal functionality in newborn brain

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This study aims to investigate spatial relationships between cortical areas of the newborn by analysing correlations between power time series of the EEG signals. Due to the inherent nature of neonatal EEG signals, we develop novel measures and also compare the findings with comparable characteristics of fMRI time series obtained from other cohort of newborns. The Band-Amplitude Fluctuations (BAFs) of each subject were extracted for all EEG channels using Hilbert transform after band-pass filtering to a desired frequency band. A non-uniform segmentation was performed based on amplitude percentiles, and the pair-wise linear relationships between channels were computed. It led to a symmetric connectivity map for each subject representing the amplitude correlations ("connectivity matrix") between EEG signals. The procedure was repeated for all subjects in two EEG datasets (preterm, N1=10 and fullterm, N2=11) as well as a fullterm fMRI database (N=18).Statistical significances at individual and at group levels were calculated using surrogate data. Finally we compared the connectivity matrices using graph theory-based measures. Two functionality modes can be observed in the spatial correlations in the preterm EEG datasets, and this dichotomic behaviour fades towards fullterm age. Specifically, the preterm brain exhibits periods of "low mode" (low amplitude) without meaningful spatial correlations, and "high modes" (high amplitudes) with robust brain wide correlations No bimodal functionality is detected in the fullterm fMRI time series. Our study provides evidence of a dichotomic behavior of an early developing brain network, which as a concept is fully in line with the recently established ideas about early neuronal functions. Our study also shows that such behavior is not observed in the fMRI signal, which calls for a need to revisit the idea of a direct relationship between fMRI signal and neuronal activity.

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Motor and non-motor conflict and inhibition in a cued Go/NoGo task

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Two current debates exist in interpreting ERPs in the Go/NoGo task. One concerns the N2 component and its interpretation as a reflection of response inhibition versus conflict processes. The second concerns the confounding influence of movement-related potentials on the Go/NoGo P3 effect. We examined both aspects in two versions of a cued-Go/NoGo task, requiring count and button presses responses in different groups. Participants were required to inhibit a planned response, change a planned response to a different one, and execute an unplanned response on rare conflict trials. The N2 component was increased whenever the demanded response differed from the expected one, with these effects being generally stronger in the press condition. The P3 was larger whenever the planned response was inhibited, again with this effect being generally stronger for motor than non-motor responses. The results support the interpretation of N2 as an index of conflict, while P3 represents inhibition, with an additional positivity in the P3 range relating to the inhibition of a motor response in particular.

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Variations in EEG entrainment reflect the temporal cross modal correspondence of auditory and vibrotactile stimulation

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Multisensory integration is the process whereby sensory information from different modalities (i.e. sound and touch) is integrated within the central nervous system. Prior behavioural studies have shown that the temporal correspondence between modalities can facilitate multisensory integration although the nature of the cortical mechanisms involved remains poorly understood. One predominate view, the temporal correlation hypothesis (Singer and Gray, 1995), proposes that the synchronous oscillations of large neural populations provide the basis for the selection and binding of otherwise disparate sensory information. The aim of the present study was to determine whether oscillatory EEG activity which becomes entrained to the rate of auditory and vibrotactile stimulation shows evidence of multisensory integration. To achieve this simultaneously presented auditory and vibrotactile stimuli were varied as a function of the cross modal correspondence (NONE; SAME or DIFF) of stimulus amplitude modulation rate (21 and/or 40 Hz). The results showed significant entrainment of EEG frequencies at both the 21 and 40 Hz amplitude modulation rates, where the scalp topography of auditory and vibrotactile stimulation differed in a manner consistent with the underlying anatomy of the auditory and somatosensory systems. Consistent with prior unisensory studies, EEG entrainment showed clear modality specificity as a function of amplitude modulation rate, where significantly greater EEG power was obtained at 21Hz for vibrotactile stimulation and at 40Hz for auditory stimulation. A significant effect of cross modal correspondence was also obtained where significantly greater EEG power was found at the EEG frequencies corresponding to the stimulation rates in the SAME, relative to either the NONE of DIFF conditions. This indicates that multisensory integration has an additive rather than multiplicative effect on oscillatory EEG activity and is discussed in terms of the putative cortical mechanisms underlying multisensory integration.

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Listen to Your Heart: A Preliminary Investigation of the Influence of Sound Therapy on the Heart Rate Variability

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The chronic experience of negative mood states such as stress and depression, predispose individuals to risk of somatic dysfunction (i.e., heart disease and obesity). Sound Therapy claims to target and reduce stress, providing a potential cost-effective, non-pharmacological, stress-reducing treatment to prevent and reduce risk of cardiovascular disease. However, evidence for the efficacy of Sound Therapy in healthy adults is minimal and the mechanism for the potential benefits of such treatment is unclear. This study aimed to investigate the acute and longitudinal effects of Sound Therapy on heart rate variability (HRV): a sensitive physiological marker of psychological wellbeing; and, selected behavioural measures of psychological wellbeing. Two experiments were conducted using a double-blind, randomised controlled, mixed experimental design investigating acute and long-term effects of Sound Therapy, relative to a Control condition (classical music). HRV variables (LogRMSSD, LogHF) were calculated from electrocardiography (ECG). Experiment One (N = 24) found that Sound Therapy increased HRV relative to resting-state baseline, and Control. Experiment Two (N = 15) found some evidence suggesting that Sound Therapy may also increase resting-state HRV following daily exposure for three-months. However, no effects were observed across behavioural assessments of psychological wellbeing. Although the results support a positive impact of Sound Therapy on HRV acutely, evidence is yet to substantiate claims of positive long-term effects of Sound Therapy on wellbeing. Likewise, the underlying mechanism for Sound Therapy in healthy adults reporting normal levels of daily stress remains unsubstantiated and therefore presents an avenue for future investigation.

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Cardiovascular Activity in Children During a Challenging Outdoor Activity: State Anxiety Effects

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This study investigated the use of systolic blood pressure, diastolic blood pressure, mean arterial pressure and heart rate as indices of state anxiety. State anxiety and cardiovascular measures were taken from child participants (N = 24) on a challenging Ropes Course activity at a state government Sport and Recreation Centre. The Ropes Course activity provides a natural challenging environment that may stimulate a variety of emotional changes, including anxiety. Subjects were divided into two equal groups according to directional changes in state anxiety during the Ropes Course attempt. It was found that systolic blood pressure and mean arterial pressure significantly reflected the group changes in state anxiety. Diastolic blood pressure showed little variation over the Ropes Course attempt, while heart rate increased for both groups. These findings point to the use of systolic blood pressure as a sensitive index of state anxiety, particularly when subjects are actively involved in the emotional experience.

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Multi-level cognitive workload classification using multi-resolution analysis during an arithmetic task

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Researchers in cognitive science, psychology, Brain-Computer Interfaces (BCI), and Human-Computer Interaction (HCI), have an ongoing interest in cognitive monitoring. This is to gain information on the cognitive user's state; such as their mental/ cognitive activities, memory workload and task engagement. In this study, we tackle cognitive monitoring to investigate the precise

measurement of cognitive workload to avoid cognitive overload and maintain efficiency. This is of high significance, especially in critical/high mental load workplaces such as; air traffic control, military operations and emergency/interventional medicine. We therefore designed a cognitive task (an arithmetic task) inducing seven different levels of load on the working memory to find suitable features for fine workload measurement and discrimination using electroencephalography (EEG) signals. We extracted the entropy and energy of the wavelet coefficients for each non-overlapped artefact-free EEG segment to classify the imposed cognitive workload. We then calculated p-values using a Kruskal-Wallis test across all channels for each extracted feature, across all participants to measure the effectiveness of the features in separating different task loads imposed. To narrow down the number of EEG channels under study, we selected the channels located in the frontal lobe of the brain (shown to have a close association with attention and working memory) that revealed low p-values (at the level of 0.01). We then classified the imposed mental loads using multilayer perceptron (MLP) structure of artificial neural networks (ANN) from the selected EEG channels. It is demonstrated that the entropy and energy of the wavelet coefficients extracted from the segmented EEGs are statistically good discriminators of cognitive load levels and change consistently in accordance with the induced load. We show that subject-independent multi-channel classification accuracy of up to 93% (91%) using an ANN for seven load levels can be achieved by the entropy-based (energy-based) features for a subset of EEG channels from the brain's frontal lobe, across the twelve participants studied. Our spatiography results demonstrate that as the induced load level increases, the frontal lobe is affected more deeply and widely compared with lower load levels. We present results suggesting that the delta frequency sub-band shows significant differences among task levels, carrying sufficient information associated with cognitive workload in our experiment. We compare these results with measures such as performance, subjective rating, and reaction time of the participants, and compare their reliability with the EEG-based method introduced. Statistical analysis and classification results showed that the features achieved a high discrimination between the fine task loads imposed in particular in the frontal lobe, for which a high classification accuracy was achieved in the delta frequency band. The influence of the higher load was deeper and wider in the frontal lobe of the brain indicating higher and deeper activation of the underlying neurons. Our findings suggest EEG as the preferred measure of cognitive workload.

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