Poster 2-019

FITNESS MODULATES BEHAVIORAL NOT PUPILLOMETRIC INDICES OF ARITHMETIC PROCESSING IN COLLEGE-AGED ADULTS

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Descriptors: Pupillometry, Cognitive Effort

As a growing body of evidence supports a positive association between mathematics achievement and aerobic fitness, individuals higher in aerobic fitness may find assessments of mathematical reasoning to be less cognitively demanding. One means of indexing cognitive load is through the assessment of pupillary reactivity, such that lower cognitive load is associated with reduced pupillary reactivity. Accordingly, the present investigation examined pupillometric indices of cognitive load during arithmetic processing. A sample of 120 undergraduate students were separated into higher- and lower- aerobically fit groups determined by maximal oxygen consumption ($VO2_{max}$). Participants performed a complex arithmetic verification task presenting operands $a + b$ consecutively and were instructed to indicate whether the sums were greater than or less than 100. Problems were equally distributed across conditions that varied the numerical distance between operands: small-split (i.e., ± 2 or 5%; 67 + 38), large-split (i.e., ± 10 or 15%; 42 + 73), and massive-split (i.e., ± 50 or 55%; 17 + 28). Consistent with the cognitive load account of pupil size, behavioral and pupillometric indices modulated proportionally to problem difficulty. Novel to the present investigation, higher aerobic fitness improved response accuracy yet did not modulate pupil size—as an index of cognitive load—during arithmetic processing. These findings suggest that the cognitive mechanics underlying arithmetic may be optimized in college-aged adults, remaining robust to individual variations in processing demands.

Poster 2-020

THE EFFECT OF INTRANASAL INSULIN ON NEUROELECTRIC AND BEHAVIORAL INDICES OF INHIBITION: A DOSE-RESPONSE EXAMINATION

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Descriptors: Inhibition, Intranasal Insulin, Dose-Response

A growing body of evidence has supported the assertion that the atomization of insulin into the nasal passageway as a means of increasing cerebral glucose uptake is effective for enhancing cognition. The dosage of intranasal insulin necessary to induce such changes in cognition and the extent to which the effects of intranasal insulin manifest within ERPs is as of yet unknown. Utilizing a double-blind randomized control design, the aim of this investigation was to examine the extent to which attention and inhibition differentially modulated as a function of the dose of intranasal insulin. A sample of college-aged young adults underwent administration of 6 doses of 0.2 mL of solution atomized into the intranasal passageway providing an overall dose ranging from 0 to 120 IU of insulin aspart. Prior to and 20 minutes following administration, participants completed an inhibition task while neuroelectric measures were collected. Findings revealed that the effects of intranasal insulin were specific to behavioral indices of performance with no alterations in P3 amplitude observed in response to any dose of intranasal insulin. However, a dose-response relationship for intranasal insulin was observed for the speed of responding such that faster reaction time was only observed in response to the 20 to 80 IU dose of intranasal insulin, with no modulations observed in response to the placebo or doses exceeding 100 IU. Accordingly, these findings indicate a possible curvilinear relationship between increases in cerebral glucose uptake and enhancements in the speed of responding.

Poster 2-021

BRAIN SIGNATURE OF SUBJECTIVE PERFORMANCE DURING NUMERICAL STROOP TASKS

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Descriptors: numerical stroop, conflict resolution

In this study, we investigated the resolution of conflict by using the modified version of size-congruity comparison, a Stroop-like task in which numerical value and physical size were varied independently under task-relevant and -irrelevant conditions. In the physical size judgment task, congruent condition elicited a smaller anterior N2 than neutral (facilitation effect) and incongruent conditions; it also showed a greater parietal-distributed LPC than incongruent condition. In the numerical magnitude judgment task, the congruency effect was only significant on the parietal-distributed LPC. We further examined the within-subject relationship between intraindividual variability in behavioral and ERP responses of conflict monitoring. ERPs were back sorted into three bins according to the reaction time of each participant, the upper quantile, the median, and the lower quantile. Among all the trials, congruency effects were observed on parietal-distributed LPC. However, facilitation effects at anterior N2 were only evident for trials with fast RTs but not trials with median and slow RTs across two tasks. The results indicate that task irrelevant features have facilitation and interference effects during multiple processing stages in numerical stroop tasks. The intraindividual variability offers a window to understand the dynamic ranges of strategies that may be continuously employed during the conflict resolution.

Poster 2-022

MULTIVARIATE EEG ANALYSES REVEAL EVOLVING SPATIOTEMPORAL THETA NETWORKS DURING SELF-REGULATION

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Descriptors: cognitive control, EEG, multivariate analysis

Making good decisions requires us to exert cognitive control, which helps coordinate brain networks and redirect attention to relevant sensory inputs and task goals. Although frontal theta (4-7 Hz) oscillations have been implicated in cognitive control during inhibition tasks (e.g., Simon task), whether and how they implement control during value-based decisions (e.g., do you prefer apple or cake?) remains unclear. Here, we recorded EEG activity while subjects performed a self-regulatory dietary choice task. Subjects chose naturally or focused on health when indicating their preference for different foods. In the health (vs. natural) condition, the tastiness and healthiness attributes of foods influenced choices less and more respectively, suggesting subjects successfully regulated their attention. We applied multivariate pattern analysis (MVPA) to single-trial theta activity: The classifier decoded whether subjects were choosing naturally or focusing on health soon after (0.05s) stimulus onset (peaked at 0.8s). Multivariate spatial patterns revealed theta signals that propagated from occipital to parietal to frontal networks over time. When we applied the same analysis to broadband (0.1-30 Hz) data, decoding accuracies were also above chance, but the spatial patterns were dominated by parietal activity. Our results suggest theta oscillations coordinate brain networks and help redirect attention when regulating dietary decisions. Further, combining multivariate and time-frequency analyses can shed light on how the brain implements control during value-based decisions.