The stimulus-preceding negativity and its subcomponents

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the new commitment. Thus, the increase in approach motivation should activate the left frontal cortex. Results supporting this prediction will be presented. Specifically, two experiments have demonstrated that following commitment to a chosen course of action, left frontal cortical activity increases (as measured by EEG alpha power) relative to a control condition. Moreover, experimental evidence has demonstrated that biofeedback increases in left frontal cortical activity cause increases in attitudes toward the chosen course of action. Discussion will focus on the relationship between this research and other research suggesting that the left dorsolateral prefrontal cortex is involved in the implementation of control and reduced cognitive conflict.

THE ROLE OF CONFLICT-DETECTION IN THE REGULATION OF RACE-BIASED BEHAVIOR

Amodio, David M, University of California, Los Angeles

Despite egalitarian beliefs, many low-prejudice people often fail to regulate expressions of automatic race bias. This perplexing yet consistent finding has led researchers to examine the roles of conflict-detection and controlled processing in the regulation of unwanted race bias. I will review a set of studies in which participants completed a sequential priming task that induced race-biased responses on certain trials while EEG was recorded. Conflict-detection was indexed by the error-related negativity (ERN) ERP. Initial results revealed that larger ERN amplitudes associated with race-biased responses predicted greater behavioral control throughout the task. Next, we examined whether individual differences in the ability to regulate prejudiced behavior, as identified by past work, could be explained by differences in conflict-detection processes. Indeed, low-prejudice people identified as 'good regulators' exhibited higher levels of behavioral control than those identified as 'poor regulators,' and this effect was mediated by ERNs linked to race-biased responses. Finally, we examined how regulatory processes may differ between situations involving private vs. public responses on a task measuring automatic prejudice. Our findings suggest that when responding in public, error perception, as indexed by the error-positivity wave (Pe), becomes a predictor of behavioral control in addition to the ERN, particularly for participants reporting external (normative) motivations for responding without prejudice. These results suggest alternative processes underlying behavioral control that depend on an individual's motivation for regulating race bias and the situation in which responses are made.

THURSDAY AFTERNOON 1:00 – 2:30 PM

SYMPOSIUM 4

Affect, Attention, and the Stimulus-Preceding Negativity

Chair: Hackley, Steven A.

The SPN was first convincingly isolated from the Contingent Negative Variation (CNV) by Brunia and colleagues in the late 1980s. Since that time, numerous studies have shown that the SPN is best elicited when the participant is anticipating a motivationally significant stimulus such as performance feedback. Efforts to fractionate the CNV led to the identification of important subcomponents, including the Readiness Potential, O-wave, and SPN. Continuing this line of investigation, our symposium will describe research targeted at fractionating the SPN. Methods include functional neuroimaging, dipole modeling, neuropsychology, and various manipulations of the type of anticipated stimulus. The symposium will conclude with a discussion by Dr. Brunia, who will integrate the common and divergent findings across the papers.

THE STIMULUS-PRECEDING NEGATIVITY AND ITS SUBCOMPONENTS

Brunia, C.H.M., Tilburg University
van Boxtel, J.M., Tilburg University

Task performance nearly always involves some kind of motor response to a stimulus. A classic example is the warned reaction time (RT) task, in which a subject after a warning stimulus (WS) has to attend an impending stimulus and to prepare a (fast) response upon its arrival. The late wave of the Contingent Negative Variation (CNV) reflects at least three processes: timing, anticipatory attention to the imperative stimulus and motor preparation. The confounding of these functions is inherent to the experimental design. We have suggested in the past to separate anticipatory attention from motor preparation by using a time estimation task. A WS announces that a subject has to press a button, three or four seconds later. Two seconds after movement onset a feedback stimulus is presented, giving Knowledge of Results (KR), i.e. informs the subject about whether the movement was too early, correct or too late. With this paradigm, we can separate in time the motor preparation from the anticipatory attention to the KR stimulus. Motor preparation is accompanied by the Readiness Potential (RP), having larger amplitudes over the hemisphere contralateral to the movement. Anticipatory attention is accompanied by the Stimulus Preceding Negativity (SPN), having a right-hemisphere preponderance. The SPN can be recorded prior to KR stimuli, prior to instruction stimuli and prior to cues giving information about what can be expected a few seconds later. The different potential distribution in the three cases suggests a participation of different brain areas in the emergence of the SPN. We will present 1) modality specific effects in the SPN recorded in a time estimation task, and 2) a new form of SPN, recorded in a task resembling a slot machine, in which no movement at all is required.

STIMULUS-PRECEDING NEGATIVIES AS MANIFESTATIONS OF AFFECT AND ATTENTION

Böcker, Koen B.E., Utrecht University
Baas, Johanna M.P., Utrecht University
van Boxtel, Geert J.M., Tilburg University
Kenemans, J. Leon, Utrecht University

A review of the existing literature reveals that the Stimulus-Preceding Negativity (SPN), although originally considered a manifestation of anticipatory attention, has been observed most reliably preceding stimuli that either provide knowledge of results, or are affective. Preceding instruction and probe stimuli smaller negativities were observed than for feedback stimuli, with different scalp distributions. This led to the conclusion that the SPN should be regarded as a class of anticipatory slow potentials, with at least three components, i.e., basic, information and affect. In the present study we compared the SPN preceding faint to-be-detected vibrotactile stimuli and aversive electrical shocks, respectively. ERPs were recorded from 60 electrodes in twelve participants. They participated in two conditions in which one out of four equiprobable visual cues indicated that 1200 – 1400 ms later either a to-be-counted or an aversive stimulus could be presented. As expected an SPN with a frontocentral midline distribution was observed in the threat-of-shock condition. A comparable SPN, which extended slightly more posterior, was observed during the detection task. We will discuss the arguments for concluding to similar (small condition effects; conceptual similarities between conditions) or different underlying processes (correlations with subjective measures; conceptual differences; dipole source models), reflecting the proposed affective and information components, respectively. The results are probably affected by a third component that is either basic, related to time estimation or a residual O-wave.

THE EFFECT OF REWARD AND PUNISHMENT ON THE STIMULUS-PRECEDING NEGATIVITY (SPN): FMRI AND ERP STUDIES

Kotani, Yasunori, Tokyo Institute of Technology
Ohgami, Yoshimi, Tokyo Institute of Technology
Tsukamoto, Tetsuji, Tokyo Metropolitan University
Omura, Kazufumi, The University of Tokyo
Inoue, Yusuke, The University of Tokyo
Nakayama, Minoru, Tokyo Institute of Technology
Aihara, Yasutsugu, Tokyo Metropolitan University

Recent studies show that perceptual anticipation and emotional anticipation are crucial factors for the occurrence of the SPN. To investigate the emotional aspect of the SPN, we performed two separate functional magnetic resonance imaging

(fMRI) and event-related potential (ERP) studies using the same time estimation tasks with different subjects. In the time estimation task, subjects had to push a button 3 seconds after the offset of cue stimuli. Two seconds after the button press, a feedback (FB) stimulus was presented informing the subject whether the response was an undershoot, correct, or overshoot. Subjects were presented with five experimental conditions: (a) reward condition, (b) punishment condition, (c) reward/punishment condition, (d) no reward/punishment condition, and (e) control condition. Under the no reward/punishment and the control conditions, subjects did not receive any monetary reward or punishment. In the fMRI study, the whole-head fMRI was used to resolve the sources of the SPN. In the ERP study, the SPN was recorded from 55 electrode sites using the same task and the same conditions as the fMRI study. The fMRI results showed increased activations in the right frontal lobe, the supplementary motor area (SMA), the posterior lobe of cerebellum, and the thalamus in anticipation of reward, punishment, and reward/punishment. In the ERP study, the topography of the SPN showed negative peaks at the right frontal area and at the parietal area. The physiological model of the SPN will be discussed using dipole modeling based on the fMRI results.

ANTICIPATION OF REWARDS AND PENALTIES IS IMPAIRED IN PARKINSON'S DISEASE

Hackley, Steven A., University of Missouri, Columbia
Mattox, Sam, University of Missouri, Columbia
Valle-Inclán, Fernando, University of La Coruña

Extensive neurobiological research has shown that dopamine-secreting neurons play a central role in the anticipation and processing of rewards. Autopsy studies indicate that portions of the reward system (e.g., the ventral tegmentum-to-nucleus accumbens pathway) are atrophied in patients who die of Parkinson's Disease (PD). It seems likely, therefore, that reward anticipation and processing might be impaired in PD. To examine this possibility we studied the stimulus-preceding negativity (SPN), a potential believed to reflect anticipation of motivationally relevant stimuli, in 20 medication-withdrawn PD patients and 32 age-matched control subjects. These individuals performed a probabilistic classification task (Knowlton's Weather Task). On each trial, participants viewed a set of cards that were said to predict whether it would be rainy or sunny, and then typed their prediction. Two seconds later, a feedback display indicated whether the prediction was right or wrong and the amount of money won or lost. A robust SPN was observed prior to feedback in the neurologically normal group, with maximum amplitude over mesial-orbital cortex (FPz). In the patient group, by contrast, the SPN was absent or reduced in size at all electrode sites. The results suggest that cortical areas within or downstream from the dopaminergic reward system contribute to the SPN and that anticipation of rewards/penalties is impaired in PD.

Discussant: Brunia, C.H.M., Tilburg University

Symposium 5

CARDIOVASCULAR CORRELATES OF POSTTRAUMATIC STRESS DISORDER: MECHANISMS, TREATMENT, AND BEYOND

Chair: Aikins, Deane E., VA West Haven Healthcare System, National Center for PTSD

Posttraumatic Stress Disorder (PTSD) is an anxiety disorder characterized by an abnormal emotional hyper-reactivity to trauma-relevant cues, a persistent desire to avoid such cues, and increased arousal (including startle response). The majority of research to date has focused on characterizing a profile of PTSD-related cardio-acceleration in the presence of trauma-specific stimuli. In addition, there is mixed evidence of elevated laboratory basal heart rate in PTSD. Our desire for this symposium is to showcase studies which encompass diversity in their conceptualizations of cardiovascular contributions to PTSD. Woodward and Kaloupek will relate basal heart rate in chronic PTSD with impaired cognitive functioning and further elaborate on the nature of elevated heart rate in this population. Aikins, Borelli, and Baker will present PTSD-related diminished phasic heart period reactivity data in an effort to demonstrate the relationship between cardiophysiological models of attention with information-processing mechanisms. Griffin and Resick will articulate how cardio-reactivity (in this case, to auditory startle stimuli) may be used as a measure of clinical treatment gains, further establishing the role of autonomic contributions in PTSD. Lastly, Morgan et al. will describe a novel research opportunity examining the role of heart period variability (HPV) with active duty military personnel across several high stress training environments. Contrasting profiles of reduced HPV in non-PTSD individuals serves to clarify the role of cardiophysiology in PTSD.

BASELINE HEART RATE IN POSTTRAUMATIC STRESS DISORDER: WHAT IS IT TELLING US?

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Kaloupek, Danny G., VA Boston Healthcare System, National Center for PTSD

Many studies of autonomic responses to trauma-related stimuli in posttraumatic stress disorder (PTSD) have observed that "baseline" heart rate (HR), recorded just prior to presentation of trauma-related stimuli, distinguishes patients from controls nearly as well as the phasic HR accelerations the follow such cues (Buckley and Kaloupek 2001). From this perspective, baseline heart rate appears tonically elevated in PTSD. In this, PTSD appears quite distinct from panic disorder, to which it is related both phenomenologically and neurobiologically (Clark, Taylor et al. 1990; Roth, Margraf et al. 1992; Wilhelm, Trabert et al. 2001). Data from sleep studies and from some stress-reactivity paradigms not involving trauma cues paint a different picture, suggesting that baseline HR and respiratory sinus arrhythmia (RSA) are not tonically abnormal in PTSD. Further complicating this picture, we have observed in chronic PTSD patients, direct covariation between sleep HR and dysphoria, compatible with a model that elevated HR is pathognomonic (Woodward, Murburg et al. 2000). However, we will also present data suggesting that waking baseline HR is positively correlated with performance on the digit symbol subtest of the WAIS, a task that appears especially sensitive to PTSD-related cognitive impairment. These contradictory group differences and correlations suggest the significance of baseline HR in PTSD is context-dependent. A similar dependency has been advanced to explain contradictory observations of baseline cortisol in PTSD (Wang, Wilson et al. 1996).

PHASIC HEART PERIOD REACTIONS TO CUED AFFECTIVE STIMULI IN COMBAT-RELATED POSTTRAUMATIC STRESS DISORDER

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Borelli, Jessica L., Yale University Department of Psychology
Baker, Aaron, Fairfield University

Hallmark features of posttraumatic stress disorder (PTSD) include increased arousal, hypervigilance, and memory processing biases. A study was conducted to bridge the cognitive and physiological underpinnings of PTSD by examining phasic heart period (HP) responses to cued affective stimuli. Twenty Vietnam-era veterans with PTSD and 17 combat-exposed veterans without any current psychiatric diagnosis engaged in an S1-S2 procedure that employed cued positive, neutral, and negative picture stimuli taken from the International Affective Picture System, during which phasic HP reactions were recorded. As compared with the control group, the PTSD group demonstrated (1) impaired cardiac responses to emotionally arousing (both positive and negative valenced) pictures, (2) impaired conditioned anticipatory HP deceleration to the affective stimuli over repeated trials, and (3) impaired explicit higher-order conditioning. This profile of reduced affective cardio-responsivity was found in the absence of basal heart or respiration rate elevations. Indeed, the PTSD participants were only distinguished at base line by a reduction in high frequency heart period variability. The cardio-physiological mechanisms of PTSD appear to serve as a perceptual defense against highly arousing stimuli, which then impede associative conditioning. Such features may well provide insight to the emotional numbing often reported in chronic PTSD populations.