university of groningen

# Symposium

## Studying the neural and cognitive mechanisms of the processing of information as modulated by reward and attention

Monday, November 19, 2018
Time: 15:00 - 18:00 hrs
Location: M.0074, Grote Kruisstraat 2/1, Groningen

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| dr. Marty Woldorff | Duke University |
| dr. Leon Kenemans | Utrecht University |
| dr. Heleen Slagter | University of Amsterdam |
| Berry van den Berg | University of Groningen |

## BCN Lecture:

The Dynamic Interplay between
Reward and Attention in the Human Brain

dr. Marty Woldorff

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The symposium is followed by the
dissertation defense of Berry van den Berg:

The Neural and Cognitive Mechanisms
Underlying Adaptation

Tuesday 20 November 2018 at 11:00 hours
Academiegebouw, Broerstraat 5, Groningen

contact:
berry.van.den.berg@rug.nl

## The Dynamic Interplay between Reward and Attention in the Human Brain

Marty G. Woldorff, Center for Cognitive Neuroscience, Duke University
Abstract: The cognitive functions of attention and reward processing both play fundamental roles in our successful functioning in our complex world. Although these two cognitive functions have often been studied separately, there has been a growing recognition that they interact extensively in everyday life. In this talk, I'll present some of our recent findings of the dynamic interactive relationship between attention and reward processing in the human brain.

## Reward, dopamine, and inhibitory control

Leon Kenemans, Helmholtz Institute, Utrecht University
Anticipating the value and probability of a possible future reward may recruit cortical mechanisms, which in turn may depend on dopamine (DA) and norepinephrine (NE) systems. In a first study we examined these cortical aspects using EEG during a cued Go/NoGo experiment. We identified a value-related frontal-central positivity (VRP), a value-related P300-like ERP, and a frontocentral probability-related positivity (PRP) during reward anticipation, with no apparent interaction between value and probability. In a follow-up study we implemented a haloperidol (2 mg) vs clonidine (0.150 mg) vs placebo cross-over design to address the effects of DA and NE antagonism on these ERPs. Haloperidol specifically attenuated the value-related P300 but only with high baseline dopamine level, as assessed by eye blink rate. Clonidine specifically affected the probability ERP, so a double dissociation between DA/ NE and value/ probability was observed. Within a second line of studies we addressed "the other side of dopamine": Its role in adequate inhibitory control. Using a stop-signal task with healthy volunteers, we found that haloperidol 2 mg resulted in a performance pattern characteristic of ADHD patients.

## No evidence that predictions and attention modulate the first feedforward sweep of cortical information processing

Heleen Slagter, University of Amsterdam
Predictive coding models propose that predictions (stimulus likelihood) reduce sensory signals as early as primary visual cortex (V1), and that attention (stimulus relevance) can modulate these effects. Indeed, both prediction and attention have been shown to modulate V1 activity, albeit with fMRI, which has low temporal resolution. This leaves it unclear whether these effects reflect a modulation of the first feedforward sweep of visual information processing and/or later, feedback-related activity. In two experiments, we used EEG and orthogonally manipulated spatial predictions and attention to address this issue. Although clear top-down biases were found, as reflected in pre-stimulus alpha-band activity, we found no evidence for top-down effects on the earliest visual cortical processing stage (<80ms post-stimulus), as indexed by the amplitude of the C1 ERP component and multivariate pattern analyses. These findings indicate that initial visual afferent activity may be impenetrable to top-down influences by spatial prediction and attention.

## Caffeine boosts preparatory attention for reward-related information

Berry van den berg, University of Groningen
Both the intake of caffeine-containing substances and the prospect of rewards have been associated with improved behavioral performance. These improvements might be related to an effect on attentional preparatory mechanisms, potentially through the influence of both caffeine and the prospect of rewards on the dopaminergic system. To examine the common influence of caffeine and reward-prospect on preparatory attention, we tested twenty-four participants during a 2-session experiment in which they performed a cued-reward Stroop task in which a cue informed the participants about potential performance based rewards. During each session, participants received either coffee with caffeine (3 mg/kg bodyweight) or with placebo (3 mg/kg bodyweight lactose). In addition to behavioral measures, electroencephalography (EEG) was recorded. Results showed that both the intake of caffeine, as well as the prospect of reward improved speed and accuracy. The effects of caffeine and reward-prospect were additive on the performance level. Neurally, the prospect of reward and caffeine resulted in an enlarged contingent negative variation (CNV), and reductions in oscillatory Alpha power (8 to 14Hz) which have been related to enhanced preparatory attention. Interestingly, the reward-related CNV enhancement was more pronounced in the caffeine condition as compared with the placebo condition. These results revealed that caffeine intake boosts preparatory attention for task-relevant information that can lead to rewards.