Project Details	
Project Code	MRC23NMHBr Fischer
Title	Understanding how stress affects food-related action choices at the behavioural and neural level to develop cognitive training and neurostimulation treatments for binge eating disorder
Research Theme	Neuroscience and Mental Health
Summary	Binge eating disorder (BED) causes out-of-control eating episodes that are commonly preceded by stress. This project sets out to understand how neural activity involved in controlling food-related action choices is dysregulated in BED, and how this may be further affected by stress. We will use a novel task to train people with BED to flexibly switch between three distinct food-triggered actions and test whether neurostimulation can facilitate their learning.
Description	Individuals affected by binge eating disorder (BED) regularly experience out-of-control eating episodes that feel unstoppable. The diagnostic criteria for BED include 1) eating an unusually large amount of food despite feeling full, 2) eating rapidly, and 3) marked distress regarding binge eating. BED is distinct from bulimia nervosa in that individuals do not perform compensatory purging behaviours, and over two thirds of those with BED are overweight. A recent study estimated the economic burden of untreated BED in the UK to be more than £3.5 billion annually, due to work impairments and healthcare needs. Binge eating is commonly preceded by stress and anxiety, and despite the rising numbers, with an estimated global lifetime prevalence of 2.8%/1.0% (f/m), current treatment strategies are limited. Only 1 in 4 people who live with BED in the UK ever receive treatment in the NHS, and only half of those seeking help are fully remitted after cognitive behavioural therapy. The first key objective of this PhD project is to characterize how neural activity involved in controlling food-related action choices is altered in people with BED, and how the control mechanisms further deteriorate under stress. Central to the project is a novel IGNORE-REACT-STOP task that was recently developed and tested by the primary supervisor PF. The task relies on a custom-built rotational device to obtain a continuous behavioural readout, which will allow detailed analyses of electroencephalography (EEG) data to investigate how neural activity when facing food-related action choices. In the first year, the PhD student will organize a focus group with individuals affected by BED to find out which methods of experimentally induced stress are most relevant to the study population and refine the design based on the feedback. One of the co-supervisors, NL, has previously developed a Go/NoGo training protocol that results in significant weight loss in people with overweight, and reductions in eating disorder symptoms in those with binge eating/bulimia. However, despite robust evidence from meta-analyses that such training reduces high-calorie food intake and liking, effects are not seen in everyone and it is still unclear what mechanisms mediate the effects. Our novel task will allow us to distinguish between inhibitory and attentional mechanisms and is more demanding, and thus might be more effective in helping participants regain agency over food-related action choices. Our second objective thus is to train participants to flexibly switch between food-triggered action choices (ignoring food stimuli, quickly shifting reactions to them,

	or rapidly stopping) to track how neural synchronization patterns develop as the performance improves. Previous recordings in healthy participants performing this task have shown rapid and brief neural synchronization in the 60-90 Hz 'gamma' range in frontal cortical areas that are linked to inhibitory control. The primary supervisor will train the PhD student to perform detailed EEG analyses to test the hypotheses that gamma synchronization is reduced in participants with BED and can be improved with training. Finally, recent studies have shown that non-invasive transcranial alternating current (tACS) stimulation can enhance motor learning and improve inhibitory control. Our third objective is to test the utility of gamma tACS in facilitating the training process. In summary, our series of projects will answer the key research questions: 1) How are the cortical control mechanisms that culminate in food-related action choices altered in people with BED? Which properties are further exacerbated by stress? 2) Can our novel executive control task be used as a training tool to improve compulsive eating behaviour? Is this form of training more or less effective than conventional Go/NoGo tasks? 3) What is the potential for personalized non-invasive neurostimulation to facilitate executive control training?
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