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Cognitive processes associated with compulsive buying behaviours and related EEG coherence

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ABSTRACT

The behavioural and cognitive phenomena associated with Compulsive Buying (CB) have been investigated previously but the underlying neurophysiological cognitive process has received less attention. This study specifically investigated the electrophysiology of CB associated with executive processing and cue-reactivity in order to reveal differences in neural connectivity (EEG Coherence) and distinguish it from characteristics of addiction or mood disorder. Participants ($N=24$, $M=25.38$ yrs, S.D. $=7.02$ yrs) completed the Sensitivity to Punishment Sensitivity to Reward Questionnaire and a visual memory task associated with shopping items. Sensitivities to reward and punishment were examined with EEG coherence measures for preferred and non-preferred items and compared to CB psychometrics. Widespread EEG coherence differences were found in numerous regions, with an apparent left shifted lateralisation for preferred and right shifted lateralisation for non-preferred items. Different neurophysiological networks presented with CB phenomena, reflecting cue reactivity and episodic memory, from increased arousal and attachment to items.

1. Introduction

Compulsive Buying (CB) is associated with episodes of uncontrolled buying of items that the individual cannot afford or does not need, because of maladaptive, irresistible, intrusive and senseless pre-occupations. Individuals invest longer than anticipated time into buying episodes that subsequently cause distress and significant impairment in social or occupational life. However, buying episodes are independent of mania and hypomania (Dell'Osso et al., 2006). The onset of CB is primarily in late adolescence and early 20's (Dell'Osso et al., 2006) with the likelihood of disorder onset diminishing overtime (Dittmar, 2005). The chronic condition exists in at least 2% to 8% of the population (Koran et al., 2006); although prevalence has been reported at 12% to 16% (Black, 2007).

Dittmar and Drury (2000) compared compulsive buyers with ordinary consumers, and found that higher CB severities were associated with much richer, sophisticated, elaborative, and reflexive shopping experiences. However, this effect was lower for males. This gender difference may relate with shopping being used as an emotional compensation strategy in females. Whereby, particularly in Western societies, females are encouraged to buy to reduce negative affect – males are encouraged to use alternative methods (Dittmar and Drury, 2000). Although 80% to 95% of individuals with CB presenting for therapy and research are female (Dell'Osso et al., 2006; Black, 2007), findings from large samples suggest an approximate equal gender distribution (Koran et al., 2006). This emotional compensation strategy gives rise to a concern that CB may become more prevalent as emotional concerns increase across the community (Neuner et al., 2005).

Buying to reduce negative affect affixes an emotional value to purchased items, and this contributes to attachments to items (Kyrios et al., 2004). The greater the emotional value, the greater the attachment (Grisham et al., 2009). Those with CB relieve distress through purchasing items creating positive short-term emotional outcomes. However, these positive short-term effects turn negative (Rodríguez-Villarino et al., 2006; Clark and Calleja, 2008), and this leads to continued buying (Rodríguez-Villarino et al., 2006). Such positive outcomes are associated with emotional or tension relief (Kellett and Bolton, 2009) and the belief that purchasing will increase self-esteem (Clark and Calleja, 2008), reduce negative affect, or provide emotional security (Kyrios et al., 2004) and present as euphoria (Rodríguez-Villarino et al., 2006). However, negative affect quickly follows purchases, and includes withdrawal, rumination, and self-critical thinking from guilt, shame, regret and despair (Kellett and Bolton, 2009), presenting as dysphoria (Rodríguez-Villarino et al., 2006).

CB has been related to Obsessive Compulsive Disorder (OCD), mood disorders and addiction (Black, 2007). However, Clark and Calleja (2008), suggest that CB is more reflective of addiction

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rather than a mood or OCD. Although buying beliefs may appear to be related in both OCD and CB (Frost et al., 1998; Frost et al. 2002), the addiction of hoarding behaviour may play a more important role in the development of CB (Frost et al., 2002). The euphoria experienced in CB is not associated with depression, nor OCD, but is associated with substance dependence and a behavioural addiction known as Pathological Gambling (PG) (APA., 2000). Links to addiction have further been implicated based on dopamine reward circuitry (Hartston, 2012). However, few studies have investigated the neurophysiology of CB (Elger et al. 2011). The similarity of CB to addiction, substance and behavioural addictions (PG) may provide insights in explaining or modelling the neurophysiology of CB (Sansone et al., 2012). For example, sensitivities to reward are reported to be higher in substance dependence relative to controls (Franken, 2002; Franken et al., 2006), and this is reflected in the increased response to addiction-related cues (Zisserson and Palfai, 2007). High sensitivities to reward are also evident in PG, but also sensitivity to punishment (Goudriaan et al., 2006; Loxton et al., 2008). Insightfully, high sensitivities to reward have been reported in CB (Claes et al., 2010), but seemingly not yet for sensitivities to punishment.

Previously, addiction cueing methodologies revealed a greater frontal positivity for Event Related Potential (ERP) waveforms between 200 and 500 ms to smoking word cues for smokers (Fehr et al., 2006). Similarly, an increased P300 amplitude in frontal and central regions was related to respective cues in other substance dependences (Herrmann et al., 2001; Franken et al., 2003; Wölfling et al., 2008), and chronic game playing (Thalemann et al., 2007). Although similar results could be expected for CB because compulsive buyers purchase according to their emotional attachment (i.e., preferred and non-preferred items) it is more problematic to devise experimental tasks for CB (Kyrios et al., 2004). A ranking system of *urges to buy* can help resolve this (see Kyrios et al., 2006; McQueen, 2008) though this leaves an unpredictable and potentially unreliable number of epochs for EEG analysis. For this reason, it would be more realistic to utilise EEG coherence that does not rely on large amount of epochs to that of ERP counterparts (Viemose et al., 2013).

EEG coherence is a technique that allows statistical quantification of the functional connectivity between scalp sites and hence the potential strength of neural networks and pathways. EEG coherence correlates independent frequency components in a spectrum of sampled EEG oscillations recorded at two selected spatially separated sites (Andreassi, 2007; Nunez and Srinivasan, 2006). EEG coherence has been consistently used to investigate brain development (Hanlon et al., 1999; Thatcher et al., 1987; Hanlon et al., 1999), changes associated with substance dependence (Verdejo-García et al., 2006) and PG (Van Holst et al., 2010). For these reasons, this EEG technique would be useful in investigating CB specifically with Alpha EEG coherence, as this measure has been shown to reflect attention and awareness processes, various states of arousal, and anxiety (Budzynski et al., 2009). Within which, decreased levels of alpha frequency relate to greater processing (Andreassi, 2007). Based on the visual and attentional neurophysiological pathways reported by Verdejo-García et al., (2006) and the empirically recognised ventral and dorsal processing streams associated with object identification within an environment (Merigan and Maunsell, 1993), specific EEG coherences (networks) for CB cue-reactivity can be postulated. Specifically, increased coherences between occipital and temporal lobes are expected when comparing high and low CB severity in accordance to the ventral vision processing stream (Merigan and Maunsell, 1993). This may reflect the greater attention and processing of pictorial cues also seen in substance dependence (McBride et al., 2006; Franklin et al., 2007). This is further supported by the reported activation in the fusiform cortex and nearby areas seen in substance dependence (Childress et al., 1999; Bonson et al., 2002; Yang et al., 2009).

Similarly, increased coherence can be expected between the occipital to the posterior parietal region because of a greater attention to the location of cues that is related to the dorsal processing stream (Merigan and Maunsell, 1993). As posterior parietal activation has been found whilst gambling (Potenza et al., 2003b; Crockford et al., 2005) and during cues for substance dependence (Due et al., 2002; Yang et al., 2009), it is expected that a similar pattern will emerge in CB with image cues. Furthermore, an increase in coherence between the temporal area and the dorsolateral prefrontal cortex (DLPFC) and the posterior parietal area to the DLPFC is expected to be associated with CB. This will reflect a greater attention to relevant images (McBride et al., 2006; Franklin et al., 2007).

The DLPFC reports to communicate with the ventromedial prefrontal cortex (vmPFC) aiding decision making and executive functioning (Verdejo-García et al., 2006). It has been suggested that a decoupling between these areas explains many of the deficits in substance dependence (Verdejo-García et al., 2006) and with PG (Potenza et al., 2003a; Potenza et al., 2003b; Reuter et al., 2005). Therefore, if this decoupling occurs, a decrease in EEG coherence could be expected between frontal areas associated with vmPFC activity and frontal areas associated with the DLPFC. In addition, greater arousal and emotional processing from the cues, perhaps originating from the amygdala (Gasbarri et al., 2007) should be reflected in those higher in CB severity (Verdejo-García et al., 2006).

The present study aimed to identify the neurophysiology of compulsive buying severity and provide support for an addictive component in a non-clinical population of females. Those with greater compulsive buying severity are expected to report greater levels of sensitivity to reward and punishment, relative to those who report low CB phenomena. During a memory task, relative to a low CB cohort, those high in CB severity would have a significant high connectivity (reflected in alpha EEG coherence) in occipital, temporal, parietal and DLPFC-related frontal areas with preferred and non-preferred items.

2. Materials and methods

2.1. Participants

Participants were recruited from the general population (N=24, M=25.38 yrs, S.D.=7.02 yrs). The final analysed sample comprised of 22 females (M=25.27 yrs, S.D.=7.21). Two participants were dropped from the study due to a low number of responses during the memory task sufficient for EEG averaging analysis. Participants were also recruited using a Research Experience Programme for 1st year psychology students. Participants completed, or were completing postgraduate studies (9.1%), a Bachelor degree (72.7%), or year 12 (18.2%). All participants were over 18 years of age. The study was approved by a human research ethics committee and involved informed consent procedures.

2.2. Materials

The Compulsive Buying Scale (CBS) was used to assess CB symptom severity amongst the participants. The 7-item self-report questionnaire assesses both the financial and emotional consequences of shopping. Two items pertain to emotional consequences, and five items pertain to those of financial. “If I have any money left at the end of the pay period I just have to spend it” is an example of an item. Using five point Likert responses, where 1 indicates “strongly agree” and 5 indicating “strongly disagree”; lower levels reflect greater CB symptoms. With a Cronbach's alpha being 0.95 it demonstrates internal reliability (Faber and O'Guinn, 1992).This CBS has been used primarily as a clinical screener for CB, although studies have also used it as a measure of buying severity (Kyrios et al., 2004).

The Compulsive Acquisition Scale (CAS) assesses acquisition behaviours and their consequences. This 18 item self-report Likert response format measures how much individuals acquire, and feel compelled to acquire possessions. Two subscales have been identified, assessing levels of compulsive acquisition of items with