

## PREFRONTAL SYSTEM DYSFUNCTION AND CREDIT CARD DEBT

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*Credit card use often involves a disadvantageous allocation of finances because they allow for spending beyond means and buying on impulse. Accordingly they are associated with increased bankruptcy, anxiety, stress, and health problems. Mounting evidence from functional neuroimaging and clinical studies implicates prefrontal-subcortical systems in processing financial information. This study examined the relationship of credit card debt and executive functions using the Frontal System Behavior Scale (FRSBE). After removing the influences of demographic variables (age, sex, education, and income), credit card debt was associated with the Executive Dysfunction scale, but not the Apathy or Disinhibition scales. This suggests that processes of conceptualizing and organizing finances are most relevant to credit card debt, and implicates dorsolateral prefrontal dysfunction.*

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The use of credit cards for purchases often constitutes a disadvantageous allocation of finances. It is possible to use them responsibly, and even advantageously when payments are made on time and cash-back incentives are offered by the issuing company. However, credit card debt and delinquent payments have been increasing (Agarwal et al., 2003; Yoo, 1997), which are associated with an increase in bankruptcy in the United States (Schor, 1998). This is in contrast to the debt incurred by purchasing a home or automobile, which are generally associated with financial stability and responsibility (Drentea & Lavrakas, 2000). Finances are not the only consequence of credit card debt. The ratio of credit card debt to income is associated with increased anxiety and stress, and poorer health (Drentea & Lavrakas, 2000; Drentea, 2000). Credit card debt was associated with overall patterns of self-destructive behavior (Politano & Lester, 1997). The number of credit cards people possess is related to sex, affective attitude toward credit cards, and attitudes toward caution with money (Yang & Lester, 2001).

Credit card use is often a way of making purchases one could not otherwise afford (Schor, 1998). Credit card debt also tends to accumulate over time (Williams & Collins, 1995). The averse consequences for using credit cards is abstract (i.e., a printed bank statement) and delayed, and thus is likely to have less of an impact on behavior. High interest rates and penalties are present when payments are delinquent, often making it difficult to reduce the total amount of debt for individuals who do make payments. Thus, although not inevitable, credit cards allow for disadvantageous allocation of funds by allowing immediate impulsive purchasing at a high long-term cost.

There is mounting evidence that prefrontal-subcortical systems play a role in the processing of financial information and in guiding financial behavior. Different regions of prefrontal cortex, and associated regions of the striatum and thalamus, are known to play different roles in aspects of executive function (for review see Tekin & Cummings, 2002; Chow, 2000). Medial prefrontal regions (including the anterior cingulate) mediate motivational aspects of behavior, such as initiation and persistence (Cohen et al., 1999). Individuals with medial prefrontal dysfunction typically exhibit varying degrees of abulia, exhibiting a lack of initiative, drive, and spontaneous behaviors.

Severe dysfunction can result in akinetic mutism. Dorsolateral prefrontal cortex mediates conceptual reasoning (both verbal and non-verbal), mental flexibility, planning, and working memory (Masterman & Cummings, 1997). Individuals with dorsolateral lesions tend to be concrete, mentally inflexible, and disorganized. Orbitofrontal cortex mediates self-inhibition, social conduct, empathy, and decision-making (Malloy et al., 1993). Individuals with orbitofrontal damage exhibit disinhibition, impulsivity, inappropriate social conduct, a lack of empathy, and poor judgment. These could each play important roles in occupational and financial attainment.

Functional neuroimaging in healthy individuals has repeatedly shown prefrontal-subcortical systems to activate in response to monetary reward and punishment. Monetary rewards have been shown to activate orbitofrontal cortex (Thut et al., 1997; O'Doherty et al., 2001; Elliott et al., 2000). Knutson and colleagues (2001b) found activation of ventromedial prefrontal cortex when reward was contrasted against nonreward outcomes. O'Doherty and colleagues (2001) further showed that the magnitude of orbitofrontal activation correlates with the magnitude of rewards and punishments. Medial prefrontal cortex also responds to monetary rewards. Both increases in cerebral blood flow and electrophysiological activation is observed in medial prefrontal cortex during both monetary rewards and punishments (Knutson et al., 2000; Gehring & Willoughby, 2002). Further, choices made after losses tended to be riskier and created greater loss-related activity in medial prefrontal cortex. Subcallosal (or subgenual) regions of medial prefrontal cortex (Brodmann's area 25) also show activation during monetary reward (Elliott et al., 2000). Monetary decision making created predominantly right-sided activation across multiple prefrontal areas (dorsolateral, orbitofrontal, and anterior cingulate) (Ernst et al., 2002).

Functional neuroimaging shows striatal and brainstem monoamine structures also activate in response to financial reward (Elliott et al., 2003). For example, monetary rewards and punishments activate caudate and putamen (Knutson et al. 2000). The ventral striatum (nucleus accumbens) activates during the anticipation of monetary rewards, but not during the outcome phase nor in response to punishment (Knutson et al., 2001a, 2001b). Ventral striatum activation also corresponds to self-ratings of happiness during the task. Elliott

and colleagues (2000) similarly found activation of the ventral striatum during reward but not during punishment. However, Delgado and colleagues (2000) showed that rewards were associated with activation of the nucleus accumbens, whereas punishment caused a deactivation.

Given the logical role of prefrontal systems in management of finances, one would anticipate financial mismanagement in neurological illnesses affecting these areas of the brain. Accordingly, people with neurological insults have difficulty with finances. Bechara and colleagues (2000) have also shown individuals with ventromedial prefrontal damage to make disadvantageous choices on the Iowa Gambling Task. They tend to make short-sighted choices creating short-term gains, but long-term losses. Individuals with mild cognitive impairment show impairments in conceptual knowledge about finances, cash transactions, bank statement management, bill payment, and overall financial capacity (Griffith et al., 2003). People with frontal lobe lesions perform more poorly than controls on a financial planning task (Goel et al., 1997). Difficulties are seen in organizing and structuring their problems, in allocating adequate effort to each phase of problem solving, and generating their own feedback. In effect, they have trouble generalizing, mental set shifting, and exercising judgment about the adequacy and completeness of their plans. Individuals with traumatic brain injury often show reduced autonomy, have difficulty managing their finances, and require increased supervision (Mazaux et al., 1997). These difficulties largely result from impairments of executive function. There is also evidence of financial difficulties associated with neurodegenerative dementias. People with frontotemporal dementia develop deficits of executive functioning and behavioral control, typically necessitating a caretaker to assume their financial responsibilities (Mychack et al., 2001; Talerico & Evans, 2001). People with Huntington's disease (HD) show poor financial reasoning, making more disadvantageous responses on the Iowa Gambling Task when compared to those with Parkinson's disease (Stout et al., 2001). Further, their performance was related to measures of memory and conceptualization but not disinhibition, suggesting a deficit more related to cognitive dysfunction than impulsivity or risk taking. A case of

Creutzfeldt-Jakob disease was reported that manifested secondary mania, including pressured speech, thought racing, rapid thought shifting, insomnia, and spending sprees accumulating credit card debt (Lendvai et al., 1999).

Thus, both functional neuroimaging and clinical studies implicate prefrontal systems in cognition and behavior regarding finances. Prefrontal systems are a logical target of study in this context, given the disadvantageous nature of credit card use and abuse. This study examined executive functioning in community individuals in relation to credit card debt.

## **METHODS**

### **Participants**

Participants were 127 (69 female, 58 male) who ranged in age from 16 to 69 years (mean  $33 \pm 13.3$ ) and had completed between 8 and 21 years of education (mean  $14.5 \pm 2.1$ ). Males were coded as 1, whereas females were coded as -1. Individual net annual income was coded as follows: 1 = \$4,999 or less, 2 = \$5,000–\$9,999, 3 = \$10,000–\$49,999, 4 = \$50,000–\$99,999, and 5 = \$100,000 or more. Income ratings ranged from 1 to 5 ( $2.9 \pm 1.0$ ). Current total credit card debt was coded as: 1 = <\$100, 2 = \$100–\$499, 3 = \$500–\$999, 4 = \$1000–\$4999, 5 = >\$5000. Participants reported credit card debt ranging from 1 to 5 (mean  $2.6 \pm 1.4$ ).

Participants were recruited by research assistants, who were given no specific selection criteria other than to find community-dwelling adults. All participants read and agreed to an implied consent form approved by an institutional review board and in accordance with the ethical guidelines of the American Psychological Association and the Declaration of Helsinki. Participants did not receive any financial compensation for their participation and were free to decline from participation without any negative consequence. In order to preserve anonymity and confidentiality, participants sealed their responses in unmarked envelopes that were returned by the research assistants to the principal investigators.

## Measures

### *Frontal Systems Behavior Scale (FRSBe)*

The FRSBE is a 46-item rating scale, whose items are divided into three subscales, derived by factor analysis: Apathy (FRSBEa), Disinhibition (FRSBEb), and Executive dysfunction (FRSBEc), as well as a total score (FRSBEt). Representative items include: “I sit around doing nothing” (FRSBEa), “I do risky things just for the heck of it” (FRSBEb), and “I repeat certain actions or get stuck on certain ideas” FRSBEc (Grace et al., 1999; Grace & Malloy, 2001). Responses are made on a Likert scale, consistent with the original instrument. Items 1–32 represent deficits of prefrontal function, so that higher numbers indicate greater dysfunction (i.e., 1 = Almost Never, 2 = Seldom, 3 = Sometimes, 4 = Frequently, 5 = Almost Always). Items 33–46, on the other hand, reflect good executive functioning so the Likert descriptors are reversed. Thus, higher scores on all FRSBe items and scales uniformly indicate greater executive dysfunction.

The FRSBE has shown high intrascale reliability in normal and clinical samples. It has also been validated in neuropsychiatric populations involving prefrontal-subcortical dysfunction (Grace & Malloy, 2001). In frontal lesion samples, the FRSBE ratings shows differences between (1) pre-lesion and post-lesion scores, (2) frontal lesion patients and healthy controls, and (3) frontal system lesion patients from nonfrontal lesion patients (Grace et al., 1999). Additionally, both self and family rating forms correlate with objective tests of executive function, such as verbal fluency, working memory, processing speed, and mental flexibility (Chiaravalloti & DeLuca, 2003). Thus, although the FRSBE is a subjective rating scale, it has shown validity in both clinical samples and against objective neuropsychological tests.

## RESULTS

A hierarchical multiple regression was performed to assess the relationship between FRSBE scales after accounting for the influence of demographic influences (age, sex, education) and the level of

income, because debt relative to income is particularly relevant (Table 1). Age, sex, education, and income were entered into the equation as a first set and were significantly associated with credit card debt,  $F(4, 126) = 3.19, p = .016$ . The model accounted for 9.5% of the variance (Adjusted  $R^2 = .065$ ). In particular, sex and income added significant increments to multiple  $R$ . When FRSBE scales were entered into the equation, they were associated with a significant increment to multiple  $R$  for credit card debt,  $F(7, 126) = 3.03, p = .006, R^2 = .307$  (adjusted  $R^2 = 0.101$ ). FRSBEe was the scale that contributed significantly to multiple  $R$ .

## DISCUSSION

This study demonstrates independent effects of demographic variables on the amount of credit card debt, with females reporting higher amounts than males, and debt increasing along with income. This is consistent with the preponderance of females among those who present with compulsive buying (Black, 2001).

Among the FRSBE scales, FRSBEe was the one that significantly predicted credit card debt. FRSBEe items cover problems with organization, multitasking, sequencing, mental flexibility, benefiting from feedback, and using mental strategies. These are executive cognitive abilities associated most with dorsolateral prefrontal cortex. Thus, credit card debt seems to relate to an ability to track finances mentally and to spend and allocate them strategically. For

**TABLE 1.** Hierarchical regression for variables predicting credit card debt

<i>Variable</i>	<i>B</i>	<i>SE</i>	<i>Beta</i>	<i>Partial</i>	<i>Part</i>
Set 1					
Age	-0.02	0.01	-0.18	-0.15	-0.14
Sex	-0.27	0.12	-0.20*	-0.20	-0.20
Education	-0.02	0.06	-0.03	-0.03	-0.03
Income	0.41	0.14	0.31	2.98	0.26
Set 2					
FRSBEa	-0.03	0.03	-0.13	-0.09	-0.09
FRSBEd	-0.02	0.02	-0.11	-0.10	-0.09
FRSBEe	0.06	0.02	0.35**	0.24	0.22

\* $p < .05$ , \*\* $p < .01$ .

example, a person with dorsolateral prefrontal dysfunction may be less likely to take existing debt mounting interest into account when making another purchase with a credit card. This finding is consistent with other previous studies mentioned earlier. Ernst and colleagues (2002) demonstrated widespread prefrontal activation, including dorsolateral, during the Iowa Gambling task. People with Huntington's disease show that the Iowa Gambling Task that is related to dorsolateral-associated functions (concept formation, memory), and not Disinhibition (Stout et al., 2001). People with frontal lobe lesions have difficulty with financial planning due to dorsolateral-associated functions such as organization, conceptualizing, problem-solving, and benefiting from feedback (Goel et al., 1997). Thus, the differences between healthy and neurologically impaired individuals appears to be a matter of degree.

It is worthwhile to note that in this sample FRSBEa and FRSBED appeared to have little or no bearing on credit card debt. This could be due to the limited size of the sample, or they could in reality have no influence. Alternately, they may not be relevant to total current credit card debt, but they may relate to other aspects of credit card spending that was not measured in this study, for example, maximum lifetime debt or frequency of credit card use. Further research is needed to explore other aspects of credit card use.

The FRSBE is a subjective self-report instrument. Because self-evaluation is itself an executive function, it is possible that individuals with greater dysfunction are more likely to underestimate their degree of dysfunction, which would minimize the magnitude of relationships found. The FRSBE has been validated in clinical samples and against objective measures of executive function, so consistent with these results, it has at least some capacity to detect executive dysfunction. To address these methodological issues, further research should be done using objective measures of executive functioning as well as functional neuroimaging in relation to credit card debt.

The results suggest that different prefrontal regions may play differential roles in finance management. These roles would be anticipated to be logical extensions of existing studies of prefrontal system function. Dorsolateral prefrontal regions would likely play a role in organizing and conceptualizing finances and orbitofrontal

cortex would likely play a role in risk taking and impulse control. Medial prefrontal cortex would likely play a role in motivation and initiation of financial behavior. More diverse research designs and methods will, in time, clarify these relationships.

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