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Prefrontal cortex dysfunction and attitudes toward money: A study in neuroeconomics

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Abstract

In a sample of 139 community residents, attitudes toward money and credit cards were found to be associated with a measure of prefrontal cortex dysfunction (FrSBe), even after controls for age, sex, education and income. The results provide support for a neuroeconomic approach to the study of economic behavior.
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1. Introduction

Neuroeconomics is a relatively new field in economics (Glimcher, 2002; Montague and Berns, 2002) which seeks to apply findings from neuroscience to the study of economic behavior. Neoclassical economists deliberately have chosen to ignore applications of psychology to decision-making, focusing instead on models which assumed that people maximzed utility or on models which were based on revealed preferences. Economists have argued that psychological forces were not observable and predictable (Loewenstein, 2000) and so of little use. Various attacks have been made on the view of people as rational decision makers and, recently, Camerer et al. (2003) have suggested that brain damage, and in particular damage to the frontal cortex, can impair economic decision-making.

Camerer et al. (2003, p. 8) provided a framework by categorizing neural functioning into controlled and automatic processes (Schneider and Shiffrin, 1977) and by distinguishing between cognition and affect. Controlled processes involve effort, are deliberately evoked and are open to introspection—they are conscious and logical/analytical; automatic processes are reflex responses and are not open to introspection.[1] An example of a controlled process is the decision (and brain command) to pick up an object, say a pencil, whereas an example of an automatic process is a command from the brain for the secretion of gastric juices into the stomach.

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[1] See Camerer et al. (2003) for a more detailed explanation.

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Cognitions are thoughts, while affects are emotions. Thoughts can be descriptive, such as, "The weather is cold and windy," or analytical such as, "The weather is cold and so I should dress warmly." Emotions can be positive such as happiness, elation, love or pride, or negative such as sadness, fear, hatred or embarrassment.

Camerer et al. noted that this two-dimensional characterization of neural functioning yields, therefore, four types of processes: (i) controlled cognitive processes, (ii) controlled affective processes, (iii) automatic cognitive processes, and (iv) automatic affective processes. The two types of controlled processes are both associated with the prefrontal cortex. Since the framework of orthodox rational-choice models, which involve utility optimization after conscious deliberation, is based on controlled cognitive processes, the role of the prefrontal cortex is critical.

When people incur damage to the cortex, especially to the prefrontal cortex, their short and long-term decision-making is jeopardized. This may be reflected in their economic decisions and their capacity to make a living. Some people who become disabled as a result of brain damage from such incidents as car accidents are eligible for supplemental security income (SSI) in the United States if they qualify financially. However, those people who are minimally neurologically dysfunctional are not qualified for welfare assistance from the government, but they might not be able to integrate properly all of the inputs from the different regions of the brain to form and plan economic actions optimally.

There are very few seriously brain-damaged individuals in the United States, and so their economic decisions would not be expected to have much of an impact on economic behavior in general. However, the personality traits of those with brain damage and their behavioral habits may be shared to some small degree by a large proportion of the population which has no gross, measurable brain damage. The economic decisions of these individuals may impact on the economy as a whole. Based on this hypothesis, the present study collected information from a sample of individuals about their attitudes toward money and credit cards and a measure of their possible diminished neural functioning.

The next section describes the specific scale used in this study—the Frontal System Behavior Scale (FrSBe), a self-rating scale which measure the behavioral and personality traits associated with the functioning of the prefrontal cortex. The description of the subjects and the statistical results are presented in the third section. The fourth section discusses the results and presents ideas for future research.

2. The FrSBe

The present study was designed to explore the association between a measure of prefrontal cortical functioning and credit card and money attitudes. The Frontal Systems Behavior Scale (FrSBe)[2] is a 46-item rating scale developed to assess behavioral and personality traits associated with the function of the prefrontal cortex (Grace et al., 1999). The FrSBe has three subscales derived by factor analysis: apathy (A), disinhibition (D) and executive dysfunction (E), as well as a total score (T). The subscales were designed to measure neurobehavioral syndromes associated with medial prefrontal, orbitofrontal and dorsolateral prefrontal cortex, respectively (Malloy et al., 1993; Masterman and Cummings, 1997). The Apathy subscale has items regarding the neglect of personal hygiene and loss of interest in former activities; the disinhibition subscale has items regarding laughing or crying too easily and getting into legal troubles; the executive dysfunction subscale has items regarding inflexibility and being disorganized (Grace et al., 1999).

The validity of the FrSBe has been established by studies of brain-damaged patients with prefrontal lesions: (1) post-lesion scores are worse than pre-lesion scores, (2) prefrontal lesion patients score worse than healthy controls, and (3) prefrontal lesion patients perform worse than non-prefrontal lesion patients (Grace et al., 1999). Validity has also been established in psychiatric patients and patients with neurodegenerative dementia.

3. The study

3.1. Subjects

The subjects were 139 community residents, 71 women and 66 men (two subjects had missing data). Their mean age was 33.6 years (standard deviation 14.7; range 17–84). Their mean education was 14.4 years of schooling (S.D.

[2] This scale was originally called the Frontal Lobe Personality Scale (FLOPS).

2.3; range 1–18). They were asked to complete (1) the FrSBe; (2) a 12-item scale to measure affective, cognitive and behavioral attitudes toward credit cards (Hayhoe et al., 1999); (3) a scale to measure four attitudes toward money (Yamauchi and Templer, 1982): (a) power-prestige which relates to the use of money to impress and influence others and as a symbol of success, (b) retention-time which relates to actions designed to bring financial security in the future, (c) distrust which involves hesitancy, doubt and suspicion regarding money transactions and (d) viewing money as a source of worry and anxiety; and (4) how many credit cards they owned, their current credit card debt, the most credit card debt they had ever carried, and their annual income, which was rounded up to the nearest $10,000.

4. Results

Simple Pearson correlation coefficients were calculated between the variables (see Table 1). The total FrSBe score was significantly associated with the affective attitude toward credit cards, the number of credit cards owned (negatively), the maximum credit card debt ever carried, the power-prestige, distrust and anxiety money attitude scores and the retention-time money attitude score (negatively). Using partial correlation coefficients to control for age, sex, education and income, the total FrSBe score was still significantly associated with the money attitude scores (see Table 1).

Examination of the subscale scores from the FrSBe indicated that all three subscale scores (apathy, disinhibition, and executive dysfunction) correlated significantly with the money attitudes scores, both in the simple Pearson correlation coefficients and in the partial correlation coefficients controlling for age, sex, education and income.

Table 1
Correlations between FrSBE scores and the economic variables

	Apathy	Disinhibition	Executive dysfunction	Total score
Pearson correlations				
Credit card attitudes				
Affective	0.11	0.23**	0.23**	0.21*
Cognitive	0.11	0.03	−0.06	0.02
Behavioral	−0.14	−0.04	−0.15	−0.13
Money attitudes				
Power-prestige	0.36***	0.33***	0.28***	0.37***
Retention-time	−0.20*	−0.28***	−0.37***	−0.32***
Distrust	0.25**	0.19*	0.27***	0.27***
Anxiety	0.19*	0.26**	0.27***	0.28***
Number of credit cards	−0.11	−0.23**	−0.17*	−0.19*
Current debt	−0.07	−0.14	−0.06	−0.10
Maximum debt	0.28***	0.20*	0.22**	0.26**
Income	−0.18*	−0.34***	−0.29***	−0.31***
Partial correlations (controlling for age, sex, education and income)				
Credit card attitudes				
Affective	0.07	0.16	0.18*	0.16
Cognitive	0.09	−0.03	−0.11	−0.03
Behavioral	−0.11	0.02	−0.08	−0.07
Money attitudes				
Power-prestige	0.25**	0.12	0.16	0.21*
Retention-time	−0.19*	−0.21*	−0.30***	−0.28**
Distrust	0.17	0.11	0.21*	0.20*
Anxiety	0.15	0.27**	0.25**	0.26**
Number of credit cards	−0.01	−0.03	−0.04	−0.03
Current debt	−0.03	−0.06	−0.01	−0.04
Maximum debt	0.06	−0.06	0.05	0.02

*** Two-tailed $p < .001$.
** Two-tailed $p < .01$.
* Two-tailed $p < .05$.

5. Discussion

The present study has shown that traits and habits associated with psychological impairment due to prefrontal cortical dysfunction are significantly associated with credit card and money attitudes and behavior. Those subjects with higher scores on the measure of prefrontal cortical dysfunction saw money as a means to impress and influence others and as a symbol of success (power-prestige), had hesitancy, doubt and suspicion regarding money transactions (distrust), saw money as a source of worry and anxiety and were less concerned with producing financial security for the future.

It is clear that, as adults incur serious brain damage and the resulting dementia, their financial decision-making may be impaired. Indeed, under such circumstances, there are legal provisions for putting the financial affairs of such individuals under the control of others. However, there may be many individuals (of all ages) who have minimal signs of brain damage and who also make less-than-ideal financial decisions. For example, there are millions of children and adolescents in the United States (and other nations) who are diagnosed as having minimal brain dysfunction (or given one of the many other diagnostic labels such as attention deficit and hyperactivity disorder) and who are prescribed amphetamine-derived medications (such as Ritalin). These youths are assumed to have brain dysfunctions that are undetectable physiologically, but which manifest themselves in the behavior of the youths. These youths may grow into adults with continued "minimal brain dysfunction" who then make less-than-ideal financial decisions.

The point is that there may be a good proportion of adults in the society with slight (or minimal) damage to the prefrontal cortex system whose financial decision-making may be less than rational. This neuroscientific perspective may provide the basis for a major challenge to the notion that humans fit the model of a completely rational "economic man." This study confirmed the usefulness of such a neuroeconomic perspective in understanding economic behavior by indicating that the behavioral and personality traits associated with prefrontal cortex dysfunction do predict income.

This preliminary study has raised several issues for future research. Not every financial variable was significantly associated with the measures of prefrontal cortex dysfunction. Attitudes toward money were the most consistent correlates of prefrontal cortex dysfunction, while the associations between attitudes toward credit cards and credit card behavior and FrSBE scores did not survive controls for age, sex and education. It is important in future research to identify which financial attitudes and decisions are associated with prefrontal cortex dysfunction and which are not.

Interestingly, all three subscales of the FrSBE scale were significantly associated with attitudes toward money. The possibility exists that future research may identify differences in the predictive power of the three subscales and different financial correlates of the three subscales.

It would also be of interest in future research to examine the association between neuropsychological measures of brain dysfunction and decision-making using the standard tests that economist have employed to investigate decision-making, especially decision-making under conditions of risk and uncertainty. The present results suggest also that it would be fruitful to explore the association between direct *neurophysiological* measures of brain dysfunction (such as abnormal electrcoencephalograms [EEGs]) and income (and other economic variables) to see whether the associations identified in the present study are validated.

Of course, the sample in this study was small, and the results may not be generalizable to other populations. A larger sample would permit other controls to be introduced and for the impact of other confounding variables to be explored. A larger sample would also permit the results to be explored for subgroups of the population such as men and women separately, those of different ages and ethnicity, and those with different levels of education. Nonetheless, the present results do provide a stimulus for further research into the neuroeconomic perspective.

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