International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Neuroeconomics : The Art of Relating Neuro Science and Economics - A Systematic Literature Review

B.V.D.S Sai Pavan Kumar

Amity Global Business School, India

ABSTRACT

Till date, economic theory has not systematically integrated the effects of emotions on decision-making. Interdisciplinary research emerged under the label "neuroeconomics", as neuroscience evidence suggests that decision-making in economic theory is based on prior emotional processing. The main idea of this approach is to use recent neuroscience techniques to analyze economically related brain processes. The purpose of this paper is to provide a brief overview of the concept of neuroeconomics, to provide an overview of current neuroeconomic research by describing commonly used methods and current studies in this new area of research. Finally, some possibilities and limitations in the future are discussed.

Keywords: Neuro Science, Economics, Neuroeconomics

Introduction

Neuroeconomics seeks to combine economics, psychology and neuroscience. The fundamentals of economic theory were formed based on the assumption that we would never discover the intricacies of the human mind However, with the advancement of technology, neuroscience has developed methods for the analysis of brain activity The study of neuroeconomics needs to fill in some gaps in basic traditional economic theories. Making a financial decision based on rational choice theory implies that investors will assess the loss objectively and respond in a very rational manner, but consider the internal functioning of the decision maker as a black box that examines the financial scope Behavioural economics overcomes this barrier by applying insights from psychology to situations where people do not follow the theory of psychological rational selection or optimize utility. Neuroeconomics seeks to take the next step by studying the relationship between financial decisions and observable events in the animal or human brain. Insights into the mechanisms that drive people can help predict the future of economics.

Neuroeconomics can be divided into three central areas of study: intertemporal selection, social decision making, and decision making under risk and uncertainty.

Intertemporal selection

Intertemporal selection is the process by which people decide what and how much to do at different times. People value financial goods differently at different times and the choices made at one time affect the choices available to others. Neuroeconomic studies in this area attempt to understand how brain activity and chemistry affect time priority and motivation.

Social decision making

Social decision-making studies are concerned with the consequences of game theory-based choices, including multiple, interactive aspects for the observation of brain and neural activity. Game theory applies mathematical models of conflict and collaboration between rational, intelligent decision makers. Neuroeconomic studies on social choice have focused on how belief, flexibility, and interaction in social decision-making are related to brain function.

Decision making under risk and uncertainty

The decision-making study under risk and uncertainty describes the process of choosing from the options that determine the results, but may not be known to decision makers or vary according to unknown probability distributions. These studies focus on how risk preference, risk and loss aversion and incomplete information on decisions in the brain and nervous system are reflected.

Why is neuroeconomics useful for business?

Neuroeconomics is useful for business because it explores the brain processes underlying decision making. For example, understanding why consumers prefer one product over another is very relevant to the business. In addition, neuroscience helps business leaders explain why they make decisions on certain actions. Helps to answer many important questions related to the neuroscience business context, including "How can we make the best decision?" "How to identify the most productive parts of the brain?" And "How can we encourage the brain to be creative?"

Overview of first neuroeconomic studies

Author	Theoretical background	Problem	Method	Results
Breiter et al.	Behavioral decision theory, prospect theory	Neural responses to expectancy and experience of monetary gains and losses	fMRI	Activation changes in the sub lenticular extended amygdala SLEA) and orbital gyrus were triggered by expected values of the prospects. Responses to experience of rewards increased monotonically with monetary value in the nucleus accumbens, SLEA, and thalamus Responses to prospects and outcomes were generally, but not always, seen in the same regions. Overlaps with activation changes seen previously in response to tactile stimuli, gustatory stimuli, and euphoria-inducing drugs were found
McCabe et al.	Behavioral decision theory, game theory, particularly trust and willingness to cooperate	Neural correlates of cooperative behavior	fMRI	Within the group of cooperative subjects the PFC showed activation changes when subjects are playing a human than when they are playing a computer. Within the group of non-cooperators, no significant activation changes in the PFC between computer and human conditions were found.
Erk et al.	Behavioral decision theory, social interactions	Neural correlates of social rewards	fMRI	Products symbolizing wealth and status lead to increased activity in reward-related brain areas.
Smith et al.	Behavioral decision theory, game theory, in particular ambiguity, risk, gains and losses	Neural correlates of attitudes about monetary gains or losses and risk or ambiguity	PET	Participants turned out to be risk averse in gains and risk-seeking in losses; and ambiguity-seeking in neither gains nor losses. Interactions between attitudes and beliefs trigged neural activation changes in dorsomedial and ventromedial brain areas.
Sanfey et al.	Behavioral decision theory, game theory, in particular ultimatum game	Neural correlates of decision-making processes during the Ultimatum Game	fMRI	Unfair offers lead to activity changes in brain areas related to both emotion and cognition. Increased activity in anterior insula for rejected unfair offers suggests an important role for emotions in decision-making.
Ambler et al.	Behavioral decision theory	Neural correlates of product choices	MEG	Brain activations in product choice differed from those for height discrimination and a positive relationship between brand familiarity and choice time was found. Neural activation during choice task involved brain areas responsible for silent vocalization. Decision processes took approximately 1 s and can be seen two halves. The first period seems to involve gender-specific problem recognition processes. The second half concerned the choice itself (no gender differences).
Knutson and Peterson	Behavioral decision theory, expected utility	Neural correlates of monetary rewards, review of several studies	fMRI	Increasing monetary gains activates a subcortical region of the ventral striatum in a magnitude-proportional manner. This ventral striatal activation is not evident during anticipation of losses. Actual gain outcomes instead activate a region of the medial prefrontal cortex. During anticipation of gain, ventral striatal activation is accompanied by feelings characterized by increasing arousal and positive valence.

Author	Theoretical background	Problem	Method	Results
de Quervain et al.	Behavioral decision theory, altruism, cooperation	Neural bases of "altruistic punishment"	PET	Sanctions against defectors activate reward processing brain regions.
McClure et al.	Behavioral decision theory, preferences	Neural correlates of preference for culturally familiar drinks	fMRI	For the anonymous task, a consistent neural response in the ventromedial prefrontal cortex is reported that correlates with subjects' behavioral preferences for these beverages. In the brand-cued experiment, brand knowledge for one of the drinks had a dramatic influence on expressed behavioral preferences and on the measured brain responses
McClure et al.	Behavioral decision theory, temporal preferences	Neural correlates of immediate and delayed monetary rewards	fMRI	Two separate systems were found to be involved. Parts of the limbic system are activated by decisions involving immediate rewards. Activity changes in the lateral prefrontal cortex and posterior parietal cortex were triggered by inter-temporal choices. The relative engagement of the two systems is directly associated with subjects' choices, with greater relative fronto-parietal activity when subjects choose longer term options.
Deppe et al.	Behavioral decision theory, preference decisions of consumers	Influence of implicit brand information on individual economic decisions	fMRI	Only the presence of a subject's favorite brand leads to a distinctive mode of decision-making, activating regions responsible for integrating emotions.
King-Casas et al.	Behavioral decision theory, game theory, trust game	Neural correlates of trust reciprocity and reputation in a multi-round trust game	Hyper scan-fMRI	The authors suggest that the head of the caudate nucleus processes information about the fairness of a social partner's decision and the intention to repay with trust.
Abler et al.	Behavioral decision theory	Neural correlates of omission relative to receipt of reward (frustration)	fMRI	The authors found a neural correlates of frustration in form of decreased activation in the ventral striatum and increased activation in the anterior insula and the right medial prefrontal cortex.
Deppe et al.	Behavioral decision theory, credibility judgments of news headlines in the context of different magazine frames	Neural correlates of framing effects and pre-judgements	fMRI	The credibility of ambiguous news headlines is biased by the magazine brand, in which the news headline is published. These framing effects correlate with activation changes in the medial prefrontal cortex.

References

[1] B. Abler, H. Walter, S. Erk, Neural correlates of frustration, Neu-roreport 16 (2005) 669–672.

[2] T. Ambler, S. Braeutigam, J. Stins, S.P. Rose, S.J. Swithenby,Salience and choice: neural correlates of shopping decisions, Psy-chol. Market. 21 (2004) 247–266.

[3] R. Axelrod, W.D. Hamilton, The evolution of cooperation, Science211 (1981) 1390–1396.

[4] F. Babiloni, F. Cincotti, C. Babiloni, F. Carducci, D. Mattia, L.Astolfi, A. Basilisco, P.M. Rossini, L. Ding, Y. Ni, J. Cheng, K.Christine, J. Sweeney, B. He, Estimation of the cortical functionalconnectivity with the multimodal integration of high-resolution EEGand fMRI data by directed transfer function, NeuroImage 24 (2005)118–131.

[5] A. Bechara, A.R. Damasio, The somatic marker hypothesis: a neuraltheory of economic decision making, Games Econ. Behav. 25 (2005)336–372.

[6] G. E. Bolton, E. Katok, A. Ockenfels, Trust Among Internet Traders:A Behavioral Economics Approach, No. 5, Working Paper Series inEconomics from University of Cologne, Department of Economics,2004.

[7] G.E. Bolton, A. Ockenfels, ERC: a theory of equity, reciprocity, andcompetition, Am. Econ. Rev. 90 (2000) 166–193.

[8] S. Braeutigam, S.P. Rose, S.J. Swithenby, T. Ambler, The dis-tributed neuronal systems supporting choice-making in real-life situa-tions: differences between men and women when choosing groceriesdetected using magnetoencephalography, Eur. J. Neurosci. 20 (2004)293–302.

[9] S. Braeutigam, J.F. Stins, S.P. Rose, S.J. Swithenby, T. Ambler,Magnetoencephalographic signals identify stages in real-life

decisionprocesses, Neural Plast. 8 (2001) 241–254.

[10] H. Brandst¨atter, W. G¨uth, Personality in dictator and ultimatumgames, Cent. Eur. J. Operat. Res. 10 (2002) 191–216.

[11] H.C. Breiter, I. Aharon, D. Kahneman, A. Dale, P. Shizgal, Func-tional Imaging of Neural Responses to Expectancy and Experienceof Monetary Gains and Losses, 2001.

[12] M. Brett, I.S. Johnsrude, A.M. Owen, The problem of functionallocalization in the human brain, Nat. Rev. Neurosci. 3 (2002)243–249.

[13] K. Brodmann, Vergleichende Lokalisationslehre der Großhirnrindein ihren Prinzipien dargestellt auf Grund des Zellenbaues, Barth,Leipzig, 1909.

[14] A.J. Calder, A.D. Lawrence, A. Young, Neuropsychology of fear andloathing, Nat. Rev. Neurosci. 2 (2001) 352–363.

[15] C.F. Camerer, Behavioral Game Theory Experiments in StrategicInteraction, Princeton University Press, 2003.

[16] C.F. Camerer, G. Loewenstein, D. Prelec, Neuroeconomics: HowNeuroscience can Inform Economics, Working Paper, UCLA Depart-ment of Economics, Levine's Bibliography, 2003.

[17] C.F. Camerer, R.H. Thaler, Anomalies: ultimatums, dictators andmanners, J. Econ. Perspect. 9 (1995) 209–219.

[18] J.S. Coleman, Foundations of Social Theory, Cambridge, MA, 1990.

[19] H.D. Critchley, R. Elliot, C.J. Mathias, R.J. Dolan, Neural activityrelating to generation and representation of galvanic skin conduc-tance responses: a functional magnetic resonance imaging study, J.Neurosci. 20 (2000) 3033–3040.

[20] R. Croson, N. Buchan, Gender and culture: international experimen-tal evidence from trust games, Am. Econ. Rev. 89 (1999) 386–392.

[21] A.R. Damasio, The somatic marker hypothesis and the possible func-tions of the prefrontal cortex, Philos. Trans. R. Soc. B Biol. 351(1996) 1413–1420.

[22] D.J.-F. de Quervain, U. Fischbacher, V. Treyer, M. Schellhammer,U. Schnyder, A. Buck, E. Fehr, The neural basis of altruistic pun-ishment, Science 305 (2004) 1254–1258.

[23] M. Deppe, W. Schwindt, J. Kr¨amer, H. Kugel, H. Plassmann, P. Ken-ning, E.B. Ringelstein, Evidence for a neural correlate of a framingeffect: Bias-specific activity in the ventromedial prefrontal cortexduring credibility judgments, Brain Res. Bull. (2005).

[24] M. Deppe, W. Schwindt, H. Kugel, H. Plassmann, P. Kenning, Non-linear responses within the medial prefrontal cortex reveal whenspecific implicit information influences economic decision making,J. Neuroimaging 15 (2005) 171–182.

[25] S.W.G. Derbyshire, A.K.P. Jones, F. Gyulai, S. Clark, D. Townsend,L.L. Firestone, Pain processing during three levels of noxious stimu-lation produces differential patterns of central activity, Pain 73 (1997)431–445.

[26] M. Doebeli, C. Hauert, T. Killingback, The evolutionary origin ofcooperators and defectors, Science 306 (2004) 859–862.

[27] S.A. Drakopoulos, Two levels of hedonistic influence on microeco-nomic theory, Scott. J. Polit. Econ. 37 (1990) 360–379.

[28] J. Elster, Emotions in economic theory, J. Econ. Lit. XXXVI (1998)47–74.

[29] S. Erk, M. Spitzer, A.P. Wunderlich, L. Galley, H. Walter, Culturalobjects modulate reward circuitry, Neuroreport 13 (2002) 2499–2503.

[30] H. Evanschitzky, P. Kenning, V. Vogel, Consumer price knowledge inthe German retail market, J. Prod. Brand Manag. 13 (2004) 390–406.