Genoeconomics - Building bridges between economics and molecular biology

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Background

- What is Genoeconomics?
- Intersection of economics and molecular genetics
- Why should economist be interested in genetics?
- Why should evolutionary biologists be interested in economics?

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Molecular Genetics and Economics[†]

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The question of how traits and behaviors pass from one generation to the next has been the subject of intense interest throughout the history of science. Simple parent–child correlations are open to multiple interpretations, as parents transmit both environment and genome to their children. Until recently, genotyping—or the direct measurement of variation in an individual's DNA sequence through biological assays—was exorbitantly expensive; distinguishing the roles of genetics and environment was the realm of behavioral genetics, in which

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[†] To access the Appendix, visit http://www.aeaweb.org/articles.php?doi=10.1257/jep.25.4.57.

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Some history

- (New) Behavioural economics
- Experimental economics + Behavioural psychology/Psychological decision theory = (New) Behavioural economics
- Behavioural economics has challenged traditional economic model of rationality (rationality probably doesn't mean what you think it means)
- Neuroimaging technology has allowed scientists to explore the links between behaviour and the brain (Neuropsychology, Cognitive and Behavioural Psychology, and Economics have all been enriched by this development.
- New Fields: Neuroeconomics, Neuromarketing, Neurofinance and then came Genoeconomics.

Genoeconomics

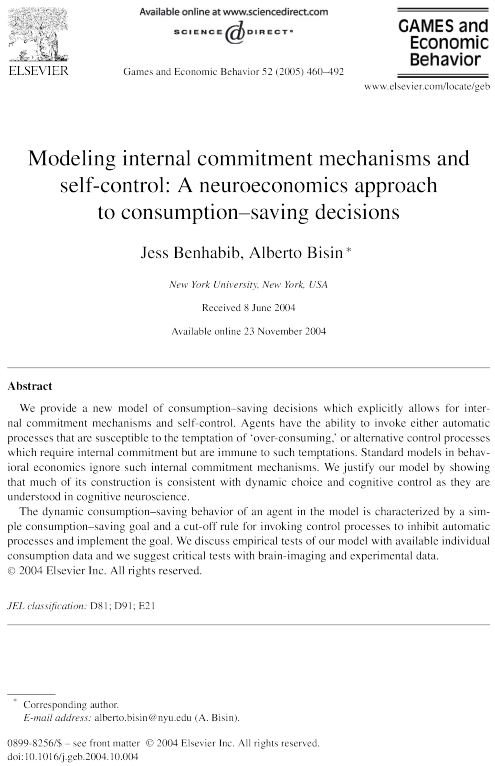
- Two broad approaches within Genoeconomics
- One approach has grown in part out of the literature on programme evaluation (this is largely the literature out of which many of the innovations on causal inference have come, e.g. use of SNP's as instrumental variables to show causal effects)
- The other approach has grown out of the literature on behavioural game theory on the one hand and neurofinance on the other.
- Will concentrate on the latter

Neuroeconomics, Neurofinance and Genetics

- Neuroeconomics employs brain imaging studies and attempts to link brain activity to particular behavioural outcomes in economic experiments under controlled conditions
- some methods employed include PET (positron emissions tomography) scans, fMRI (functional Magnetic Resonance Imaging), galvanic skin response measurement.
- Treatments may be both socio-economic in nature and/or biological
- based on economic "scenarios"
- hormone treatment, e.g. Trust experiments using oxytocin nasal sprays.

Overview paper: Zak, P. J. (2004). Neuroeconomics. Philosophical Transactions of the Royal Society B: Biological Sciences, 359(1451), 1737–1748. doi:10.1098/rstb.2004.1544

Benhabib, J., & Bisin, A. (2005). Modeling internal commitment mechanisms and self-control: A neuroeconomics approach to consumption–saving decisions. Games and Economic Behavior, 52(2), 460-492.



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Modeling internal commitment mechanisms and self-control: A neuroeconomics approach to consumption–saving decisions

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Abstract

We provide a new model of consumption–saving decisions which explicitly allows for internal commitment mechanisms and self-control. Agents have the ability to invoke either automatic processes that are susceptible to the temptation of 'over-consuming,' or alternative control processes which require internal commitment but are immune to such temptations. Standard models in behavioral economics ignore such internal commitment mechanisms. We justify our model by showing that much of its construction is consistent with dynamic choice and cognitive control as they are understood in cognitive neuroscience.

The dynamic consumption–saving behavior of an agent in the model is characterized by a simple consumption–saving goal and a cut-off rule for invoking control processes to inhibit automatic processes and implement the goal. We discuss empirical tests of our model with available individual consumption data and we suggest critical tests with brain-imaging and experimental data.

JEL classification: D81; D91; E21

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Neurofinance

- Attempts to explore the relationship between financial decision-making and brain activity
- Particular focus on risk attitudes

Wu, C. C., Sacchet, M. D., & Knutson, B. (2012). Toward an affective neuroscience account of financial risk taking. Frontiers in neuroscience, 6.

The Genetic turn in Neurofinance and Neuroeconomics

- After the initial euphoria at being able to associate brain regions with behaviour attempts were made to study the mechanism
- Links between brain activity and the endocrine system
- Studies identifying the genetic receptors of particular hormones provide additional information for economic experimentalists, e.g. behavioural game theorists working on trust.

Example: Krueger, F., Parasuraman, R., Iyengar, V., Thornburg, M., Weel, J., Lin, M., ... Lipsky, R. H. (2012). Oxytocin Receptor Genetic Variation Promotes Human Trust Behavior. Frontiers in Human Neuroscience, 6, 4. doi:10.3389/fnhum.2012.00004

Studies examining the role of dopamine in mediating risky behaviour

Takahashi, T. (2008). Biophysics of risk aversion based on neurotransmitter receptor theory. Neuro endocrinology letters, 29(4), 399.

- Behavioural game theory and genetics

Cesarini, D., Dawes, C. T., Johannesson, M., Lichtenstein, P., & Wallace, B. (2009). Experimental game theory and behavior genetics. Annals of the New York Academy of Sciences, 1167(1), 66-75.

The Dopamine Receptor Gene DRD4-7R

- Evolution of the gene

Wang, E., Ding, Y.-C., Flodman, P., Kidd, J. R., Kidd, K. K., Grady, D. L., ... Moyzis, R. K. (2004). The Genetic Architecture of Selection at the Human Dopamine Receptor D4 (DRD4) Gene Locus. American Journal of Human Genetics, 74(5), 931–944.

- estimate that the 7R allele arose prior to the upper Paleolithic era (40,000–50,000 years ago)

Eisenberg, D. T., Campbell, B., Gray, P. B., & Sorenson, M. D. (2008). Dopamine receptor genetic polymorphisms and body composition in undernourished pastoralists: An exploration of nutrition indices among nomadic and recently settled Ariaal men of northern Kenya. BMC Evolutionary Biology, 8, 173. doi:10.1186/1471-2148-8-173

- rural Ariaal men have a selective advantage

What is it associated with?

- Risk attitudes, time discounting, political attitudes, novelty seeking

Sweitzer, M. M., Halder, I., Flory, J. D., Craig, A. E., Gianaros, P. J., Ferrell, R. E., & Manuck, S. B. (2013). Polymorphic variation in the dopamine D4 receptor predicts delay discounting as a function of childhood socioeconomic status: evidence for differential susceptibility. Social Cognitive and Affective Neuroscience, 8(5), 499–508. doi:10.1093/scan/nss020

Munafo, Marcus R. et al. Association of the Dopamine D4 Receptor (DRD4) Gene and Approach-Related Personality Traits: Meta-Analysis and New Data Biological Psychiatry , Volume 63 , Issue 2 , 197 - 206

Risk attitudes

Carpenter, J. P., Garcia, J. R., & Lum, J. K. (2011). Dopamine receptor genes predict risk preferences, time preferences, and related economic choices. Journal of Risk and Uncertainty, 42(3), 233-261.

Dreber, A., Apicella, C. L., Eisenberg, D. T., Garcia, J. R., Zamore, R. S., Lum, J. K., & Campbell, B. (2009). The 7R polymorphism in the dopamine receptor D4 gene (DRD4) is associated with financial risk taking in men. Evolution and Human Behavior, 30(2), 85-92.

Risk elicitation methods

- Balloon Analogue Risk Task (BART)
- Questionnaires (see Biosocial surveys below)
- Gneezy, U., & Potters, J. (1997). An experiment on risk taking and evaluation periods. The Quarterly Journal of Economics, 631-645.
- Eckel, C. C., & Grossman, P. J. (2002). Sex differences and statistical stereotyping in attitudes toward financial risk. Evolution and human behavior, 23(4), 281-295.
- The multiple price list method

Some possible questions

- May be possible to relate some biomarker with "preference fanning" (Allais paradox)
- Ambiguity aversion (Ellsberg paradox) is there a gene for this?
- Rabin's calibration theorem - genetic basis?

Many (not) all of these questions are explored by Cesarini et al. in a twin study

Cesarini, D., Johannesson, M., Magnusson, P. K., & Wallace, B. (2012). The behavioral genetics of behavioral anomalies. Management science, 58(1), 21-34.

Applications:

- Economic epidemiology
- Prevalence elasticity of prevention (percent change in preventative behaviour, e.g. vaccination uptake due to a percent change in prevalence) is closely linked to risk attitudes
- Mapping of DRD4-7R in a population could be used to help identify areas of individuals prone to more risky behaviour, e.g. "risk hotspots"
- Biosocial surveys
- Political economy

Political economy/public choice

- Voting attitudes

Settle, J. E., Dawes, C. T., Christakis, N. A., & Fowler, J. H. (2010). Friendships moderate an association between a dopamine gene variant and political ideology. The Journal of Politics, 72(04), 1189-1198.

Biosocial surveys

Weinstein, M., Vaupel, J. W., & Wachter, K. W. (Eds.). (2007). Biosocial surveys. National Academies Press.

Cohen, B., Pool, R., Weinstein, M., & Hauser, R. M. (Eds.). (2010). Conducting Biosocial Surveys:: Collecting, Storing, Accessing, and Protecting Biospecimens and Biodata. National Academies Press.

Where to next

- Collect samples
- Test if the allele can be identified
- simple risk preference elicitation experiment
- Voting behaviour in the upcoming election (perhaps?)