

Implications of Neuroscience Developments for Teaching Agricultural Economics/Agribusiness¹

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Abstract

Developments in our understanding of human decision making have important implications for agricultural economics and teaching in general. Psychology, neuroeconomics, and economics deal with decision making in different ways, with economics assuming rational behavior while making decisions, and psychology and neuroeconomics studying how decision making occurs in various situations and in different parts of the brain. Results from a great deal of research suggest there are two competing processes for making decisions. Neuroeconomics makes a crucial distinction between automatic (“hot”) and controlled (“cold”) decision-making processes. Automatic processes are quick, efficient, reactive, and can often be carried out in parallel. These processes frequently originate from emotions and are often based on instant reactions to stimuli. In direct contrast, controlled processes are deliberate, sequential, voluntary, and analytical. Economists base their theoretical models of human decision-making on controlled processes which represent the rational side of human decision-making. Agricultural economists can be more relevant and more realistic in their teaching programs if they accurately reflect how decisions are made. In particular, teaching how both processes work, offers the opportunity to help students better understand economics and help them become more effective decision-makers in all aspects of their lives.

Introduction

Findings from the relatively new field of neuroeconomics, the study of the biological bases for economic decision-making, are valuable not only in helping us understand ourselves and human behavior but also in pedagogy. The rate of new discoveries

about brain structure and function and how they influence human decision-making is astounding. Developing knowledge in this area is frequently reported in the popular media because of its relevance to all of us in our decision making efforts. Keeping up with new knowledge related to decision making will be a challenge, but bringing this knowledge into the agricultural economics classroom can enhance student understanding of decision-making and economic models.

This article will first discuss “brain-based learning” and its relation to economics and applied agricultural economics. Then we will discuss general principles of dual process models of decision-making. These principles will be supported by recent research from the fields of cognitive neuroscience and neuroeconomics. We conclude with future directions for applying neuroeconomics to traditional agricultural economics teaching.

Brain-based Learning

Literature on brain-based learning has been oriented toward teaching in ways that complement and augment how the brain works. Bellah et al. (2008) published a review and historical timeline of brain-based learning studies. They conclude that using knowledge from both cognitive neuroscience and educational psychology can provide greater insight and expanded views of brain function and learner abilities. Chipongina (2007) posited that “teaching and a need for understanding how the ‘organ of learning’ works is now linked as never before.” We concur, and want to emphasize that cognitive neuroscience is a relatively new field that is growing rapidly, providing information about brain function that is extremely important to the teaching profession.

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Although economists are certainly interested in taking advantage of brain processes that facilitate learning, we also are interested in helping students make better decisions, which is one of the most important aspects of learning economics. Students must understand their own decision-making processes to improve them. Decision-making is important, regardless of whether students are deciding whether to attend class, selecting answers on a test, or making personal economic decisions. Moreover, better understanding of decision-making is particularly vital in agribusiness because learning how to make better decisions may be crucial to success in a competitive economic environment.

Economists generally have not questioned or explored how people make decisions. Instead, economists assume people are rational and self-interested, and build models based on these assumptions. Results from these models are intended to provide insights into both consumer and producer behavior. Consistent with their research models, economists also generally teach as though students are consistently rational, logical, and analytical decision-makers. But decades of behavioral research demonstrates that people frequently make decisions based on emotional reactions, interpersonal pressures, and cultural standards, then often apply ad hoc logic and analytical reasoning in an attempt to explain the decisions they have already made (Kardes, 1994). These differences in what economists assume about behavior and how psychologists experimentally describe behavior contribute to making teaching agricultural economics at the undergraduate level a challenging task. Some student difficulties in learning economics stem from the fact that human beings are not always the rational, logical, analytical, self-interested beings that economists assume. Further, students may not recognize themselves when economists describe the rational and self-interested behaviors underlying these models.

Bridging the gap between economics and psychology, neuroeconomics may provide economics instructors with models of decision-making that aid in teaching economics. This growing field applies concepts and theories from psychology and experimental methods from neuroscience to better understand actual human economic behavior. Neuroeconomics, also referred to as decision neuroscience, makes a crucial distinction between automatic (“hot”) and controlled (“cold”) decision-making processes (Sanfey, 2007). Automatic processes are quick, efficient, reactive, and can often be carried out in parallel. In addition, automatic processes frequently originate from emotions and are often based on instant reactions to stimuli. In direct contrast, controlled processes are deliberate, sequential, voluntary, and analytical. Economists base their theoretical models of human decision-making on controlled processes. Controlled processes represent

the rational side of human decision-making. Economists assume that everyone uses controlled, rational modes of thinking during the decision-making process. Neuroscience research supports the distinction between automatic and controlled processing (Camerer, 2008; Sanfey, 2007). In fact, research shows that automatic decisions occur in the emotional centers of the brain (limbic and paralimbic system) whereas controlled processes occur in the planning and organization centers of the brain (orbitofrontal cortex, anterior and dorsolateral regions of the prefrontal cortex) (Camerer et al., 2005; Camerer, 2008; Sanfey, 2007).

Economics, Applied Economics, and Challenges to the Profession

Traditionally, economists resist the idea that individuals might be irrational, emotional, or biased when making decisions. According to McFadden (1999), the rational consumer model is so deeply entwined in economic analysis that many economists have difficulty imagining that failures of rationality could infect major economic decisions or survive market forces. However, McFadden enumerates accumulating behavioral evidence against the rational model. McFadden calls a consumer “Chicago man” if s/he conforms to the standard economic model of perception, preference, and process rationality. He makes four observations about the Chicago man model: it is convenient, successful, unnecessarily strong, and false. The Chicago man model is false because of overwhelming behavioral evidence against literal interpretations of Chicago man as a universal model of choice behavior. McFadden lists 25 major cognitive anomalies. In summarizing the evidence, he concludes that perception rationality and process rationality fail, but he maintains some hope that preference rationality may hold given that evidence against it is primarily circumstantial. He states that confronted with the accumulated experimental evidence, economists must recognize that the Chicago-man model does not apply universally or even regularly to choices made in non-market contexts.

The idea that Chicago man-type behavior cannot be assumed presents problems for the economics profession in general. McFadden suggests that economists should evolve Chicago man, correcting the most glaring deficiencies as a behavioral model and modifying economic analysis so that it applies to more realistic human behavior. This is a difficult task because the major benefit of rationality assumptions is the relative simplicity of the analysis that follows.

Mittelhammer (2009) states that the call for both relevance and accountability in the work of economists is steadily increasing. This spills over to agricultural economists, who frequently view themselves as applied economists (even though Mittelhammer points out no universally accepted definition is associated with the term applied eco-

nomics). Mittelhammer believes an evolution in the profession has arguably led to a narrowing in the scope of professionally acceptable frameworks for conducting applied economics analyses. He argues that this narrowing may be impeding rather than fostering advances in the field. The pendulum may have swung far enough that a correction in the view of what constitutes acceptable applied economics may be beneficial, overdue, and perhaps even already underway. Further, a more varied and comprehensive collection of approaches used to analyze the complex economic issues in the real world will result in stronger analysis through recognition of new decision-making paradigms that more accurately reflect how decision-makers operate.

Undergraduate teachers do not face problems nearly as substantial as those that researchers face in introducing these new models of decision-making. Students can benefit greatly from lively discussions about how people make decisions and comparisons with the theoretical “Chicago man” decision-making model. McFadden (1999) believes that the discipline of economics needs to catch up to the field of marketing to understand the extent to which the mix and presentation of products reflects anomalies in consumer behavior. Students who are aware of their own departures from rationality also will be able to prevent others from taking advantage of these tendencies; that is, they can improve their decision-making by improving their self-awareness.

Ariely (2009) believes that recognizing where humans depart from the ideal rational being is an important part of the quest truly to understand ourselves, and one that promises many practical benefits. Understanding irrationality is important for our everyday decisions and for understanding how we design our environment and the choices it presents to us. He believes that we are not only irrational, but *predictably* irrational—that our irrationality happens the same way repeatedly. If experiments demonstrate this, teaching students about these irrational tendencies is sensible because students benefit from better understanding both their rational *and* irrational tendencies. The beauty of this approach is that it allows for changes in decision-making. If we as economists assume irrationality away, little room exists to recognize and improve how we decide; however, recognizing our irrational biases can lead to more effective decision-making that benefits both the individual and the greater economy.

Dual Process Models of Decision-Making and Supporting Evidence

Traditional economic theory ignores decades of psychological research showing the impact of emotions, interpersonal influences, and cultural norms on decision-making. About 30 years ago, Thaler and Schiffrin (1981) modeled the individual as an organization. They believed that at any point in time, each

individual is both a farsighted planner and a myopic doer. More recently, experts have expanded on this notion and have proposed a dual process framework of decision-making. Fudenburg and Levine (2006) offer a simple dual-self model that provides a unified explanation for several empirical difficulties in explaining behavior. They assert that many types of decision problems should be viewed as a game between a sequence of short-run “impulsive selves” and a long-run “patient self.” Ashraf et al. (2006) reported that behavior was determined by the struggle between the “passions” and the “impartial spectator.” They reported that behavior was under the direct control of the passions, but believed people could override passion-driven behavior by viewing their own behavior from the perspective of an outsider—the impartial spectator. Loewenstein (2000) expands on this notion, asserting that a wide range of emotions, drive states, and feeling states grab people’s attention and affect their behavior. He argues that people are powerfully influenced by their emotional states, and he discusses how to model individuals when they are in a “hot” or “cold” state. Loewenstein et al. (2003) have used state-dependent utility to model decision-making—the mental state of the individual influences the utility received from consumption. They explain projection bias, or the tendency of people to exaggerate the degree to which their future tastes will resemble their current tastes; a variety of domains support the existence of poor decision-making due to this bias. Shiv and Fedorikhin (1999) examine how automatic processes and more controlled processes influence consumer decision-making. They believe that when our rational, analytical cognitive processes are freely available, they have a dominating impact on and influence over our behaviors. In contrast, when our analytical processes are in use or overloaded, our emotions have greater impact on our decisions. Benhabib and Bisin (2004) developed a model of consumption in which individuals have the ability to invoke either automatic processes or alternative control processes. According to their study, automatic processes are susceptible to temptation and control processes are immune to such temptations.

Neuroscience research supports the distinction between automatic and controlled processing (Camerer, 2008; Sanfey, 2007). Early research resulted from disease models of individuals with neurological damage. These individuals showed predictable changes in decision-making. Bechara (2004) discusses several studies of decision-making in neurological patients who can no longer process emotional information normally. Damage to the ventromedial prefrontal cortex renders patients unable to make advantageous, rational decisions. These individuals have no regard for consequences because they do not experience negative emotions associated with outcomes of poor judgments.

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Research also has gone beyond disease models to examine “normal” decision-making. Results from decision-making studies in primates demonstrate that the economic value of items is represented in the orbitofrontal cortex (Padoa-Schioppa and Assad, 2006; Padoa-Schioppa, 2009). Functional neuroimaging in humans has provided another way to examine the neural basis of decision-making in real time. Functional magnetic resonance imaging (fMRI) provides a safe, noninvasive method to study normal human decision-making. A recent study examined the relationship between self-control and decisions (Hare et al., 2009) and showed that goal-directed decision-making produced increased neural activity in the ventromedial prefrontal cortex (the same brain area identified in the aforementioned neurological patients). Exercising self-control required inhibition of this goal-directed activity by increasing activation in the dorsolateral prefrontal cortex. Researchers interested in the influence of uncertainty on decision-making demonstrated that risk and ambiguity are represented in two separate regions of the brain (Hsu et al., 2005).

Cognitive neuroscientists also have examined brain regions involved when people must decide between immediate or delayed rewards. These delayed discounting, or intertemporal choice, paradigms are directly relevant to economic behavior and decision-making. McClure et al. (2004) proposed a model that emphasizes the limbic system's (emotional center's) role in immediate rewards whereas the prefrontal cortex (planning, organization) is involved in choosing larger, delayed rewards. This theory is supported by adolescent behavior and neuroimaging studies. Adolescents are notorious for making impulsive, irrational decisions leading to deviant behavior, unsafe sex behaviors, and drug and alcohol experimentation. Neuroscience research again supports this notion as the reward centers of the teenage brain (areas that make emotional decisions) are hypersensitive to potential rewards and the cognitive control regions (areas that make rational decisions) are underdeveloped (Casey et al., 2008; vanLeijenhorst et al., 2010). Interestingly, when the control regions of the brain (prefrontal cortex) are more developed, the prevalence of risk-taking behaviors decreases (Spear, 2000). Individual differences exist among adults as well in that some people value long-term rewards over short-term benefits. What individuals value is also situation-dependent, as indicated by the results of one recent study that aimed to alter decision-making in adults so that the participants would more greatly value larger delayed rewards (Peters and Buchel, 2010). Researchers were successful in helping participants make more controlled, rational decisions.

Mukherjee (2010) unites neuroscience findings, psychological paradigms, and economic theory into a dual model for decision-making that utilizes both automatic and controlled processes. He indicates that

existing models in economics use only a single system, although he notes that economics is increasingly influenced by a multiple systems approach to decision-making. Mukherjee proposes that we generate values through the use of two psychological processes: valuation by calculation and valuation by feeling. He develops a parameter that represents the relative extent of emotional involvement in decision-making. This parameter provides insight into different decision-making processes used for oneself and for an organization. He argues that his model can be applied to a wide variety of empirical phenomena and can account for many anomalies in present representations of decision-making processes.

Russell James (Texas Tech University) has developed a set of PowerPoint slides that present the dual process model of decision-making and a large number of irrational tendencies and biases that humans have demonstrated. He has made these slides available for download through SlideShare. The slides are nicely illustrated, they invite student interaction, and they keep students' attention.

Conclusion

Reconceptualizing human decision-making as a result of both automatic and controlled processes has many implications for agricultural economics and agribusiness teaching programs. If we teach students to recognize different decision-making processes, they can better understand consumer and producer behavior as well as how they as individuals make all types of decisions. In turn, this will help them to better learn economics and understand that economic models are based on “rational,” controlled processes of decision-making. Both automatic and rational cognitive processes are necessary for advantageous decision-making, but students will learn to emphasize the logical, rational, and analytical processes that are valuable to success in economic and financial decisions. This pedagogical approach also has the potential to help students become more effective decision-makers in all aspects of their lives.

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