1-2015

The Behavioral and Neuroeconomics of Food and Brand Decisions: Executive Summary

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Comments
This article is published as Bruce, A.S., J.M. Crespi and J.L. Lusk. "The Behavioral and Neuroeconomics of Food and Brand Decisions: Executive Summary." Journal of Agricultural & Food Industrial Organization 2015; 13(1); 1-4. DOI: 10.1515/jafio-2015-0033. Posted with permission.

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Abstract: This executive summary provides the rationale for and summary of the articles of this Special Edition of the Journal of Agricultural and Food Industrial Organization.

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Why is the *Journal of Agricultural and Food Industrial Organization* (*JAFIO*) publishing a special issue titled, *The Behavioral and Neuroeconomics of Food and Brand Decisions?*" Industrial organization examines the structure of firms and markets, especially how firms interact with each other. *JAFIO* readers are familiar with how firms in food and agriculture markets interact, the methods by which they seek to change the competitive structure, and how that structure is impacted by changes to the marketplace from without (e.g. regulation, trade, protests) and within (e.g. prices, differentiation, advertising). Quite often those market changes come about through physical alteration of a product or the perceptual alteration through labeling or branding. The food industrial organization literature devotes a great deal of research on the impacts of brands and labels, along with myriad other product differentiation strategies. *JAFIO* frequently publishes articles on food decision making under product differentiation; covering issues of branding, advertising, warranties, labeling and food safety. Cutting edge economic theory and empirical methods are, likewise, common to *JAFIO*. As such, it is important to bring researchers who work on food industrial organization the latest techniques and findings that can be put to use in this arena. Advances in technology and experimental methods from neuroscience and psychological science are quickly changing our understanding of how humans perceive food choices. Because of that, now is a good time for economists who work on food industry structure and, especially, food and food attribute signals, to become more aware of those advances.

Consider two of the workhorses of product choice modeling: the random utility model (McFadden 1974) and its theoretical counterpart in models of product differentiation, the Mussa-Rosen model (Mussa and Rosen 1978). We know the general formulations of these models as beginning with an index function where individual i has an indirect utility for good j written as $V_{ij} = x_{ij}' \beta_{ij} - \alpha_j p_j + \varepsilon_{ij}$. Here x_{ij} represents the product or in the case of a vector, the product attributes (e.g. sweetness, healthfulness, eco-friendliness) that individual i either knows or perceives to be in good j and/or the individual's characteristics (e.g. income, education, health) that influences i's choice of product j. The product attributes can be experience attributes or credence attributes. The price of good j is p_j and β_{ij} represents the marginal utility for attribute j, here denoted with a subscript i as marginal utility specific to the individual, but could be representative of the product attribute alone ($\beta_{ij} = \beta_j$) and/or as a draw from some probability distribution reflecting consumers' preferences as it usually is in Mussa-Rosen applications. The price multiplier, α_j, is commonly reflective of an index in theoretical applications and quite often set to 1 whereas in empirical applications it is an estimated parameter. Finally the error term, ε_{ij}, reflects idiosyncratic factors specific to an individual, but unobservable to the analyst. The error term usually represents random consumer errors: an "oops" term.

The starting point for the estimation of the random utility model (RUM) or the Mussa-Rosen analysis begins with considerations of the form, "Consumer i prefers j to k whenever $V_{ij} > V_{ik}$." In the RUM, this inequality, along with axioms of error independence and the imposition of an appropriate distribution, sets up the formulation of the multinomial logit model that has been used in multitudes of papers. The largest benefit of the RUM comes about through the interpretation of willingness to pay (*WTP*) as the corresponding slope of an indifference curve whereby $WTP = -\beta_{ij}/\alpha_j$. Similarly, in the Mussa-Rosen analyses, axioms of the properties of the marginal utilities and assumptions about market competition (e.g. Cournot, Bertrand) lead to market models where firms select attributes to affect the ultimate distribution of consumer preferences and, hence, market shares. For example, the single

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attribute, 2-firm, Bertrand model where $\beta_j = \beta_k = \beta$ is distributed uniformly over a unit interval yields the indifferent consumer appearing at point $\beta = [p_j - p_k]/[x_j - x_k] \in [0, 1]$, so that price and attribute differences affect market share in a logical manner: higher prices lower a firm's share and greater differentiation ameliorates competition.

Neuroscience, psychology, and behavioral economics reveal that much of the conventional wisdom underlying these common models of product choice is not so conventional. For example, the marginal utility often taken as simply an unobservable datum, might actually be observable, or at least partially so. Levy and Glimcher (2012) argue that one can begin to see in scans of the brain during consumer choices, something akin to a "neural currency" that correlates positively with the subject's stated valuation of objects. Other research claims to have discovered "subjective value" calculated in the prefrontal region of the brain when subjects are asked to make food choices that are of economic value (Hare et al. 2011; Bartra et al. 2013). Revealed preferences that once were asserted to emerge from a "black box" of utility theory appear to be more observable than once believed. Webb et al. (2013) have proposed a *neural* random utility. It may soon be possible to elicit *WTP* for a product free of genetically modified ingredients not from surveys and experimental shopping trips, but from direct observations of β_{ij} and α_j through a brain scan. This should prove especially useful in contingent valuation studies in which the "good," does not actually exist. How does one put a price on a clean beach? Examining the brain may one day tell us, as Smith et al. (2014) discuss in their aptly titled, "Neural Activity Reveals Preferences without Choices."

We are also learning that many factors impact the underlying parameters of the above models. This was always suspected if not known, but psychological research is demonstrating that the parameters are impacted in ways that may necessarily alter axioms of the models. In the two simple cases presented above, what happens when *ceteris paribus* cannot be assumed away as it is when assuming that price is not an attribute with its own marginal utility? What happens if the demand curve is shaped like an "S"? By this, we do not mean the S-shape proposed by R.G.D. Allen in his famous 1938 tome (p. 113) where demand increases slowly initially as price drops and declines quickly as price nears zero. Rather, consider demand as a true S-shape where very low prices further lower one's *WTP* such that quantity demanded actually falls and very high prices raise *WTP* so that above some high price, quantity demand begins to increase? For example (the following cases are discussed in this special issue by Enax and Weber), what if a higher price of wine causes you to believe that the wine is higher quality? By "believe", we mean that the higher price actually causes changes in your brain that *makes* the wine a higher quality to your tastes? Likewise, a lower price makes the wine actually taste worse. Price is no longer a signal. It is an attribute. The implication is that demand is no longer a one-to-one function. Empirically, this may prove more annoyance than issue. Axiomatically, however, an S-shaped "demand" function cannot be derived from a quasi-concave utility function. *WTP* as constructed above, demands quasi-concavity. Take another example. Economists view nutrition labels as providing information, and economists are interested in the benefit of that information. But research suggests that such labels actually change the brain's response to the taste and satiation of the labeled product. How do researchers using traditional *WTP* analysis control for such an effect?

And finally, what about that unsung error term? The assumption that mistakes are random or mostly random, that they dissipate over repeated purchases and that they have a mean of zero are common throughout the industrial organization and consumer decisions literature. What the research in this issue will show is that there are dynamic feedback effects that impact choices, even choices only seconds apart, in ways that are not as straightforward as a simple "assume a mean zero" hand waving would allow. The decision a consumer made a split second ago can alter the decision process she makes for her next choice. This may give researchers pause, but it may also prove to be a source for future advances in understanding decision making. For example, preference reversals (Tversky and Thaler 1990) and transitivity violations (Loomes et al. 1991) in experimental settings are examples of axiomatic problems with utility. However, greater understanding of the actual decision process in human brains might reveal that, from the perspective of the person making the decision, preferences do not reverse and transitivity is not violated, the decision is completely rational.

Utility, of course, is a theoretical construct: a stand-in for the actual decision-making process. Are the techniques and technology at the point where something akin to a utility function can actually be found in the human brain? No. In fact, that likely may never happen. But, the research is intriguing, the technology is improving, and the appeal of advancing our understanding is limitless. To economists interested in food decisions, progress seen in other fields ought to be exciting. In the articles for this special issue, we gathered information from a wide range

of research related to food decisions from behavioral economics, psychology, and neuroscience. The articles, we hope, will provide a useful reference to researchers examining these techniques for the first time.

The paper, "Cognitive Neuroscience Perspectives on Food Decision-Making: A Brief Introduction" by Lepping et al. begins our presentation for this special issue. Lepping et al. provide a broad overview of techniques used to expand our understanding of the process of decision making. In the past several decades, technology has afforded the ability to examine the decision process from a more precise, neurophysiological basis. Authors discuss functional magnetic resonance imaging (fMRI), electroencephalography (EEG), and magnetoencephalography (MEG). They provide some examples of studies that have examined food decision-making, and then more specifically, studies that have examined the neural responses to advertising and/or branding. Results from these studies have direct application to product packaging, marketing, and certain policies on advertising to children. The authors conclude with a plea for cross-discipline collaboration, including cognitive neuroscientists, economists, policy-makers, and agricultural scientists.

Another overview of techniques and literature is presented in "Marketing Placebo Effects – From Behavioral Effects to Behavior Change?" by Enax and Weber. This article is especially fascinating for industrial organization researchers who study credence labels such as health claims and eco-labeling, claims that cannot be easily discerned by the consumer. Enax and Webber focus especially on how labels, brands, advertisements and logos can act like a placebo effect in medical studies. The information can actually lead to changes in the brain so that the consumer really does experience the product differently depending on how the label is presented. Enax and Weber also include discussion of the impact on children as many of the regulatory proposals for labeling and advertising impact children.

In "The Role of Knowledge in Choice, Valuation, and Outcomes for Multi-attribute Goods," Gustafson investigates the impact of product knowledge on decision making in the context of quality-differentiated wine. After a literature review and a discussion of three prior experimental studies, the author concludes that more knowledgeable consumers make greater use of objective information available to them when making decisions. Decision making quality is also related to knowledge, as more knowledgeable consumers are more likely to make use of objective information to update their valuations. In addition, more knowledgeable consumers are more likely to value options drawn from large choice sets than are less knowledgeable consumers. The results highlight the importance of experience and knowledge in explaining how consumers respond to information and food labels.

In "Brands and Food-Related decision Making: How Does Food Branding Affect Consumer Choice, Preference, and Intake? A Systematic Review of Recent Findings," Boyland and Christiansen review the literature on the effect of brands on food choice. The authors find little commonality across the ten papers they reviewed in terms of the effect of presence of brands and food intake or choice. They argue that more work is needed on the subject, especially in light of the argument that promotion of unhealthy, branded food is partially to blame for obesity and dietary-related disease.

Eye tracking studies are likely new to many readers of this journal. Indeed, economists generally seem unconcerned about the decision process itself whereas eye tracking studies try to expose the process. This issue has two eye-tracking studies. In "Modeling Eye Movements and Response Times in Consumer Choice," Krajbich and Smith provide a detailed guide on eye-tracking methods and the rationale for how they reveal consumer preferences and the relationship between decision time and eventual choice. It is easy to think of choices as if *homo economicus* walks around with a set of stored preferences and upon encountering an affordable choice set makes her decision based upon these preferences. Eye tracking studies have shown this not to be the case even for goods that are well known to the consumer. The studies have revealed some rather surprising regularities such as, one actually takes longer choosing between goods for which one is indifferent. Why wouldn't such a choice be automatic? The process itself is dynamic.

In "Visual Attention and Choice: A Behavioral Economics Perspective on Food Decisions," Grebitus et al., utilize eye tracking methods to study how consumers decide in choice experiments that utilize different designs. The authors conducted two choice experiments that varied in complexity. One choice experiment included products where only three attributes varied and another choice experiment used products varied according to five attributes. The authors find that the more information on a product (i.e., five rather than three attributes) the more time respondents spend looking at the product, although less attention tends to be spent on a single piece of information. In the three-attribute design, the authors find that the longer an individual looks at non-price attributes, the more important is the attribute in determining choice. However, dwell time is largely uncorrelated with choice in the five-attribute design. The authors demonstrate the use of eye tracking as a tool to help guide choice experiment design.

In "Towards Alternative Ways to Measure Attitudes Related to Consumption," Koller and Walla take a

heuristic approach to presenting studies of human behavioral response by beginning their discussion with the most basic of questions from "Why do many consumers love to eat sweets or other treats rich in calories on a regular basis although they know they shouldn't?" to "Why do we have a head with a brain in it where cognitions and emotions interplay?" After discussing several experimental models, they present the importance of the startle-reflex paradigm in models of consumer choice. Startle paradigms are useful in attempts to discern the degree of emotion and motivation in a decision.

In "I Can't Wait: Methods for Measuring and Moderating Individual Differences in Impulsive Choice," Peterson and colleagues discuss proposed mechanisms of delay discounting in both animal models and humans. They define delay discounting, then describe tasks of impulsive choice used in the laboratory and in human testing sessions. They go on to explain four mechanisms of impulsive choice, including timing, reward processing, motivation/industriousness, and working memory. The authors use obesity as a clinical example of impulsive choices. The paper ends with a hopeful note about the potential of behavioral interventions to significantly improve underlying mechanisms which would ultimately improve delay discounting.

How humans make decisions between choices today and choices in the future has been an important aspect of economic research. Much discussion revolves the impact if consumers have so-called hyperbolic discounting where discount rates change over time. How discounting impacts food choices is a budding area of research. In "A Cup Today or a Pot Later: On the Discounting of Delayed Caffeinated Beverages," Jarmolowicz and colleagues examine delay discounting using caffeinated beverages. The authors administered a standard monetary discounting questionnaire (e.g. $100 today versus $150 in one month), but also developed a new questionnaire that requires people to make decisions about caffeinated beverages (e.g. 5 cups of coffee today versus 15 cups of coffee in one week). The caffeine questionnaire was tailored to each person according to how much monetary value s/he placed on one caffeinated beverage. They recruited both habitual (daily) caffeine consumers and occasional caffeine consumers. Caffeine beverages were shown to be discounted at a higher rate than monetary rewards for the occasional users. Then the authors made a direct comparison between habitual (daily) caffeine consumers and occasional caffeine consumers. Unlike results from other substance users (i.e. cocaine, tobacco), the daily consumers did not discount caffeine more rapidly than the occasional users. Overall, the study adds another unique commodity to the growing list examined in light of the construct of delay discounting.

The final paper is an fMRI study with an information intervention. In "Are Consumers as Constrained as Hens are Confined? Brain Activations and Behavioral Choices after Informational Influence," Francisco et al. examined the behavioral and brain effects from videos relating to the confinement of egg laying hens. Participants made choices between eggs based on price, on living conditions of the hens, or where they needed to pay a premium for the more "humane" option. Three separate videos were shown: one promoting restrictions on small confinement, one against restrictions, and a neutral video. Results showed that participants in the "pro" video showed brain changes in a region associated with social risk after watching the video. Overall, this shows the significant influence of information on not only behavior, but on the brain as well.

The variety of papers in this special issue of *JAFIO* should provide readers with a broad introduction to newer methodological approaches to understanding food choices and human decision-making.

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