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Do consumers care how a genetically engineered food was created or who created it?

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ABSTRACT

This paper explores heterogeneity in consumer preferences for foods and policies that relate to different innovative plant breeding technologies. As a starting point in our analysis, we report results from almost four years of monthly surveys with U.S. consumers, which show slight food safety concern for genetically engineered food with no discernable trend of increased or decreased concern over time. We find small differences in consumer preferences for policies related to different plant breeding methods, with the strongest support for the notion that bioengineered crops should be regulated based on health and environmental outcomes rather than the process used to create new crops. Other survey results reveal support or opposition for genetically engineered food depends on consumers' perceptions of who created the technology. We also find that food safety concerns related to genetically engineered food are related to perceptions about the distribution of benefits from the technology across the food supply chain.

1. Introduction

Over the past twenty years, there have been almost a thousand academic articles written about consumers and genetically engineered (GE) food, and interest in consumer attitudes toward the breeding technology shows no sign of abating. From 2000 to 2016 the number of academic articles published on consumers and biotechnology has grown at an average annual rate of about six percent per year.¹ Much of the research was motivated by the gap that exists between widespread acceptance and adoption of GE crops by producers (in locations where it is allowed) on the one hand and consumer aversion to the technology on the other. Consumer aversion is often manifested in preferences for production bans or mandatory labels, and previous research has provided a better understanding of the effects of production bans and labeling policies.

A great deal of empirical work, far more than can possibly be reviewed here, has focused on trying to pinpoint the average consumer attitude toward GE food or average willingness-to-pay (WTP) to avoid GE food (e.g., see reviews in [Dannenberg, 2009](#); [Frewer et al., 2013](#); [Hess et al., 2016](#); [Lusk et al., 2005](#)). Previous research has also sought to uncover some of the heterogeneity in aversion to biotech across

consumers using almost tautological conceptual models related to perceived risks and benefits or the theory of planned behavior (e.g., [Bredahl, 2001](#); [Frewer et al., 2016](#)), responses to information (e.g., [Huffman et al., 2007](#); [Lusk et al., 2004](#)), and psychological factors ([Lusk, Roosen, and Bieberstein, 2014](#)). While much has been written about the nexus of consumers and GE food, this work has largely focused on heterogeneity across *people* not across *products* or *breeding technologies*.

The distinction between heterogeneity across *products* or *breeding technologies* rather than *people* is important because a “GMO” is not a single thing, but rather represents a class of many possible foods and technologies that could have been created for many different reasons by different innovators. The ever-changing capability to modify genomes in new ways requires asking new questions. Understanding consumer reactions to different GE foods, technologies, and innovators is increasingly important as new technologies such as CRISPR (clustered regularly interspaced short palindromic repeats) or gene editing have emerged which avoid transgenic manipulations. Additionally, new start-ups and non-profits have entered the space with new products that differ from those commercialized by large agribusinesses. This paper aims to explore some of the underlying causes of heterogeneity in

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¹ The statements here are based on data from Web of Science collected using the search terms: “consumer and genetically and (modified or engineered)” from 1995 to 2016; annual growth calculated by regressing the natural log of the number of papers published in a year on a time trend.

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consumer preferences for GE food (and GE food policies) that relate to the food and technology itself. This study aims to determine if: (1) certain kinds of GE foods or plant breeding technologies are more acceptable to consumers, (2) consumers prefer that all biotech applications applied to food be regulated identically, and (3) preferences for GE food depend on the innovator. We address these questions by gaining insight from several nationwide surveys conducted in the U.S.

The next section provides more background on consumer perceptions of GE food. Here, and for background context, we present data from almost four years of monthly, nationwide surveys that have been conducted measuring consumer concern for GE food and awareness of news stories about GE food over time. The following section discusses research that has addressed acceptance of GE food that varies by the type of food and specific production technology. Additionally, that section presents new results from a nationwide survey conducted to determine preferences for policies aimed at different plant breeding methods. The penultimate section presents original survey results aimed at how acceptance of GE food varies according to the type of innovator and perceptions of who benefits from the technology. Finally, the last section concludes.

2. Trends in consumer awareness and concern for GE food

Previous meta analyses on consumer WTP and attitudes toward GE food by [Dannenberg \(2009\)](#), [Hess et al. \(2016\)](#), and [Lusk et al. \(2005\)](#) suggested, on average, consumers are averse to GE food. However, these studies also reveal a great deal of heterogeneity across studies that relates to the location of the study, the type of food studied, the way the questions were asked, and more. Given the lack of consistency in the ways studies have been conducted across time, it has been difficult to ascertain temporal changes in consumer concerns.

To address this issue, we turn to the Food Demand Survey (FooDS) which has been conducted monthly since May 2013. The survey is completed by over 1000 U.S. consumers monthly (it is not a panel, as a new sample is drawn each month) and responses are weighted to ensure the sample corresponds with the U.S. population in terms of gender, age, education, and region of residence. The survey contains numerous questions that are repeated monthly, creating a cross-sectional, time-series dataset related to consumer knowledge, preferences, etc., in addition to occasional *ad hoc* questions (see [Lusk, 2017](#) for more details).

Of relevance to the present inquiry is consumer awareness and concern about GE food. FooDS ascertains consumer awareness and concern for 18 different issues, one of which is “genetically modified foods” (note: the order of the issues is randomly varied across respondents to minimize order effects). To measure awareness about GE food, respondents are asked, “Overall, how much have you heard or read about each of the following topics in the past two weeks?” Response categories are: nothing (1), little (2), a moderate amount (3), quite a bit (4), and a great deal (5). [Fig. 1](#) shows the weighted average result from each of the 47 months from May 2013 to March 2017. Over this period, the average response was approximately 2.3, indicating consumers saw between “a little” and “a moderate amount” about GE food in the news. The sampling error each month is approximately 0.075 (i.e., ± 0.075 on the one to five scale or about $\pm 3.3\%$ of the mean value) of the measured mean with 95% confidence. The solid line in [Fig. 1](#) shows a slight trend toward increasing awareness over time. Estimating a linear regression, where a trend was regressed against the natural log of average awareness, reveals a 0.23% increase in awareness per month ($p < 0.001$).

It is important to put awareness of GE foods in the context of the 17 other issues tracked on the survey, which include items such as E. Coli, hormones, antibiotics, bird flu, etc. The dashed line in [Fig. 2](#) shows the mean level of awareness for GE food in each month divided by the mean level of awareness of the 17 other issues in the same month. Over the

entire period, this ratio averaged 1.18, meaning the news awareness was about 18% higher for GE food than the other 17 issues. Awareness of GE food in the news expressed relative to other food issues reveals no significant upward or downward trend. Thus, while consumers indicated hearing or reading slightly more about GE food now than was the case two or three years ago, the same was also true of the other issues tracked by the survey.

To measure concern about GE food, respondents are also asked, “How concerned are you that the following pose a health hazard in the food that you eat in the next two weeks?” Then, the same set of issues was repeated (also in random order). Response categories for this question were coded: very unconcerned (1), somewhat unconcerned (2), neither concerned nor unconcerned (3), somewhat concerned (4), and very concerned (5). [Fig. 2](#) shows the weighted average response for each month from May 2013 to March 2017. On average over the entire period, the mean level of concern was 3.27 revealing consumers were slightly more concerned than not (each month’s sampling error is about ± 0.076 on the one to five scale of concern or $\pm 2.3\%$ of the mean level of concern). Expressed relative to concern for the other 17 issues, the mean level of concern for GE food was about 5% higher. The data illustrated by [Fig. 2](#) reveal no significant trend toward greater or lesser concern for GE food either in isolation or relative to other food issues.

While the data illustrated in [Figs. 1 and 2](#) provide useful background related to possible trends, or intertemporal heterogeneity, in awareness and concern for GE food, responses to this question simply relate to consumers’ reaction to the generic phrase “genetically modified food.” Whether consumers’ perceptions depend on the reasons or causes behind the modification are the subject of the next two sections.

3. Preferences for different technologies

The context of why or how food was modified, regardless of breeding technique, is not often discussed or well understood by many consumers; thus, asking about acceptance of GE foods may provide a false dilemma where consumers feel it necessary to make a binary decision about all GE foods to simplify a complex question and reduce cognitive effort ([McFadden and Lusk, 2015](#); [Gaskell et al., 1999](#)). Even when studying applications for which the consumer does not know why the genetic engineering took place, there are significant differences in acceptance of the technology depending on whether a food is processed or not or whether it is plant or animal-based ([Lusk et al., 2004, 2015](#)). Perhaps more interesting is the finding that consumer acceptance is not uniform across all reasons for modification associated with GE foods. In general, empirical findings have suggested that consumers are more accepting of GE foods that have tangible benefits to consumers like lowering pesticide residues ([Lusk et al., 2015](#); [Gaskell et al., 2003](#)) and improving nutritional content ([Lusk et al., 2015](#); [Colson et al., 2011](#); [Lusk et al., 2004](#); [Grunert et al., 2001](#)). Additionally, consumers are favorable towards GE technology that have environmental benefits ([Delwaide et al., 2015](#); [Lusk et al., 2004](#); [Gaskell et al., 2003](#); [Grunert et al., 2001](#);) and help developing countries achieve nutritional security ([Lusk et al., 2004](#); [Hossain et al., 2003](#)). Telling are the results in [Lusk et al. \(2015\)](#) which shows that slight aversion to GE food turns to slight acceptance once any positive reason for the modification was mentioned. [Lusk et al. \(2015\)](#) found “lower the price paid by consumers” as the second most desirable reason for genetic modification behind “keep crop production in the U.S.”

The technical differences between different breeding techniques are likely beyond comprehension for most consumers. For example, [McFadden and Lusk \(2016\)](#) found that 49% of respondents thought corn always contained the same genes before genetic engineering was possible, and respondents thought genetic engineering was associated with the alteration of more genes compared to selection and

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