Consumer Choice of Genetically Modified Products: the Effect of Media Content

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Abstract

The paper presents a study into the impact of negative and positive media content on the introduction of a new milk that has been genetically modified to eliminate cholesterol. A sample of 1008 consumers were presented with choice scenarios in which there were four purchase choices (existing, new, organic, no purchase) and randomly assigned to one of three media conditions. negative, positive or no media content. Overall respondents preferred an existing product that was not genetically modified. Negative media content had a strong negative effect on choosing the new product regardless of whether it was genetically modified and also caused higher substitution behaviour to avoid genetic modification, as would be expected. Positive media content had no effect on purchases relative to no media.

Introduction

In recent years there has been a substantial increase in research on consumer acceptance of genetically modified (GM) products in Australia and overseas. These surveys indicate that acceptance is likely to be product-specific and dependent on perceived benefits from genetic modifications. For example, in opinion based surveys, Yann et al. (1999) reported just over 50 % of respondents in a sample of 1000 consumers indicated they would consume GM oils if they were healthier, and fruits and vegetables if they tasted better. Millward Brown (2004) also found increased acceptance for modifications that provided health benefits.

In a more rigorous assessment of consumers' potential purchase responses to GM, Frewer et. al. (1996, 1998) used conjoint analysis and reported some increased acceptance of GM food where consumers perceived health or environmental benefits. Grunert et al (2004) found that when respondents tasted a superior tasting cheese and were told it was GM they had a less negative attitude and a greater intention to purchase than the control group. However, Chern and Keneko (2003), among others, found that in the absence of clear benefits a discount of between 30 to 50 % was required for the GM form of vegetable oil, cornflakes and salmon, with salmon requiring the highest discount.

Despite the growing literature on the potential responses to GM, there has been little attention to the effect on acceptance of the prevailing media on genetic modification. The only large scale study randomly allocated 1655 consumers across Europe to one of three information strategies (product-specific, balanced overview, or advertising) and asked respondents to rank a set of beer and yoghurt products. The findings indicated a low level of acceptance of GM foods, and that the form of information strategy had no effect on prior beliefs and probability of choosing a GM product (Frewer et al 2000).

The study reported in this paper adds to these earlier studies by examining the effect of prevailing media content on purchases of genetically modified milk. The study was part of a wider survey of 1008 consumers across mainland metropolitan Australia that examined response to GM in a number of products.

Modelling Strategy

The primary area of interest in this paper is in the effect on choice behaviour of positive or negative media content against no media. Thus we seek to reject H_0: negative (positive) media content on GM has no significant effect on the probability of choosing genetically modified milk. We also report on the general results of choice behaviour when milk is GM. The study employed the stated preference method to collect preference data and develop standard Multinomial Logit (MNL) models for each media condition. The stated preference method is one of various choice modelling approaches that are underpinned by the rigorous and well-tested Random Utility Theory (McFadden 1974; Ben-Akiva and Lerman, 1985). RUT postulates that consumers associate some utility with each product that they consider and try to maximise their utility by choosing the things that they think suit them best, all else being equal. The model can be made operational by formalising the relationships as follows:

1) $U_{ij} = \beta_{0ij} + \Sigma\beta_k x_{ij} + e_{ij}$

Where U_{ij} is the measure of utility derived by individual (i) from alternative (j), which is a function of the sum of the utilities for each (k) attribute $\Sigma\beta_k x_{ij}$ (where β is the weight given to k in the valuation) and e_{ij} an error term which is randomly distributed. The random component allows analysts to express consumer choice in probabilistic terms that enables the underlying preferences for attributes to be extracted: $P_{(ij|A)} = \text{Prob}(U_{ij} > U_{il})$, where $j,l \in A$ and $l \neq j$. In the MNL the error terms of alternatives are assumed to be independently and identically distributed (IID) as Extreme Value Type I variates (Louviere et. al. 2000).

To quantify the effects of responses under the different media conditions we used basic Willingness to Pay (WTP) estimates. Assuming the utility function is linear in the parameters WTP for non-monetary attributes can be calculated simply as $WTP=\boxed{X}/\beta_j$, where β_j is the inverse of a monetary attribute such as price and $\boxed{X}$ is the non-monetary attribute of interest.

Research Design

A random sample of 1008 consumers who had purchased milk in the past month was drawn from metropolitan households across five states of Australia. The research design comprised a set of shopping scenarios where there is a choice between an "existing" milk, newly introduced milk, and organic milk (to conceal the true intention of the research). Both the "existing" and "new" milks could be genetically modified. However, the new milk carried a clear benefit (Cholesterol Free) that is achieved either by replacing fat with oil or through genetic modification. Thus, the contrast is between two types of technologies to eliminate

cholesterol. The attributes used to build the scenarios and their levels are outlined in Table 1 and an example is given in Figure 1. Price points were taken from actual market end points. The design matrix was based on Hahn and Shapiro Plan 11b, which is a 2-level design in 32 runs that allows for six 2-way interactions to be estimated. These interactions were allocated to the price and GM attributes and to the brand attribute for the existing product. The latter was to test whether branding attenuates consumers' concerns with GM, as proposed by Viaene et al (2000).

The full set of scenarios was replicated for each media condition and respondents were randomly assigned to one of these and completed a subset of 16 scenarios. The media contents were presented at the beginning of the questionnaire in the form of mock newspaper clippings which either discussed the relative merits of genetic modification of foods and the high safeguards, or highlighted loop holes in labelling laws covering disclosure of genetic modification in foods (available on request). In the no media condition respondents proceeded straight to a series of questions on current purchases of milk followed by the choice scenarios. The questionnaire included a further set of choice scenarios for other products and ended with the basic demographic information. These are not discussed here. To maximise quality of responses, the questionnaire was administered in face-to-face interviews by trained surveyors.

Table 1: Attributes and levels for the milk design

Attributes	*Existing milk*	*New milk*	*Organic milk*
Brand	Store National	Store National	
Type	Full cream Low fat	Full cream Low fat	Full cream Low fat
Vitamin	None Iron & calcium enriched	None Iron & calcium enriched	
GM	No-label Genetically modified	Chol Free - (fat for oil) Chol Free - (GM)	
Fixed	Use by 10 days	Use by 10 days	Use by 10 days
Price[a]	$0.93 $2.46	$0.93 $2.46	$0.95 $2.50

[a] Organic prices have a small premium over the market at the end points

Figure 1: Choice scenario

6	*Existing milk*	*New milk*	*Organic milk*	None of these. I would not buy milk this week, or I would buy a substitute such as Soy milk or powdered milk
Brand	**Store**	**Store**		
Type	Under 2% fat	Under 2% fat	Under 2% fat	
Label		Calcium and iron enriched Cholesterol Free!		
Use by	10 days	10 days	10 days	
Ingredients		Milk fat replaced with vegetable oil		
Price	1litre $2.43	1litre $0.93	1litre $0.95	
Indicate your choice by a tick (R) in ONE box:	1	2	3	4

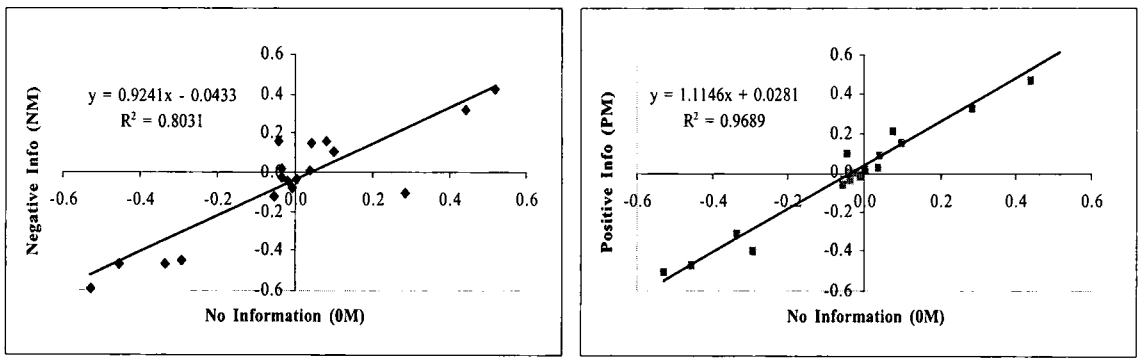
Results and Discussion

Following exclusion of respondents who had not varied their choice over the scenarios (5.6%) there were 952 observations in the sample. The data were analysed using SPSS 10.0, Limdep 7.0. Categorical variables were contrast coded and actual mean centred prices were used. Interactions were simple multiples of the coded attributes.

Separate MNLs were estimated for each media condition and then the Swait and Louviere (SW) (1993) procedure was used to test for significant differences between the models. The SW procedure starts by assuming equality in parameters (H_{1A}: $\beta_1 = \beta_2 = \beta$) and testing whether the scales (variance) of two data sets are equal. If H_{1A} is rejected the next test is whether parameters differ, having accounted for scale differences (H_{1B}: $\mu_1 = \mu_1 = \mu$). Both hypotheses are tested with the standard likelihood ratio (Swait and Louviere, 1993:306). The procedure was operationalised by setting the model for the no media condition as a base that has its scale normalised to 1 and moving the scale of the models in the other conditions through a range to find the point at which the log likelihood for the combined samples is greatest.

Figure 2 contains plots of the model coefficients for negative (NM) and positive (PM) media content against no media (0M). There is a marked difference between 0M and NM but little evidence of difference between 0M and PM. Predicted choice probabilities based on the 0M model for the samples under positive and negative media were 0.78 and 0.75 respectively, compared to an in-sample prediction of 0.83, indicating a reasonable difference from the base model for NM. H_{1A} of the SW procedure was rejected at $p<.05$ for NM and therefore scale equality is also rejected (H_1). H_{1A} was not rejected for PM nor was H_{1B}, indicating that it is essentially the same as the 0M model.

Figure 2: Model coefficients for Negative and Positive against No media (information)



Unfortunately, there is no currently available test to determine whether scale and/or parameter coefficients are the source of rejecting H_{1A} and so assessments rely upon graphic and model differences. Looking at the model coefficients in Table 2, the primary differences between the NM and 0M models are in the intercept of New and the cream coefficients for existing and organic products. The latter response is not readily interpretable and may simply be an artefact of the sample.

The primary change in response to the new product under NM is an increase in no purchase, as indicated by the absence of increases in the intercepts for existing or organic products. The magnitude of the negative coefficient on GN has also increased. This differs from the existing product where the primary change is an increase in the level of substitution (ie GM x GN). In terms of WTP, under NM willingness to pay for the new product decreased by $1.22 (124 %) and, if it was GM, by a further 45 cents. WTP for an existing GM product reduced by 30 % and the value of substitution rose from 1 under 0M to 15 cents under NM.

It is not possible from this study to say whether all negative incidents or publicity would result in significant rejection of a product or for how long consumers would withdraw from its purchase. What is clear is that given feasible alternatives neither brand nor lower prices are likely to counter the effect of negative publicity on a GM product. Price compensation in milk was largely absent as was a significant Brand x GM effect. The presence of a National brand did not increase the probability of choosing a genetically modified product (with no benefits). It is possible that brand may not play a sufficiently strong role in relation to milk and that other products with stronger brand identification may produce different results.

Table 2: Media content models for Milk

	None		Negative		Positive	
Variable	Parameter	t-ratio	Parameter	t-ratio	Parameter	t-ratio
Vitamin (enrich = 1)	0.101	4.36	0.107	4.46	0.144	6.26
Brand (national = 1)	0.039	1.67	0.011	0.45	0.023	1.00
A_EXIST	0.519	11.91	0.424	10.13	0.658	15.03
GM	-0.526	-16.15	-0.588	-18.04	-0.510	-15.98
Pe	-0.453	-10.44	-0.465	-10.70	-0.476	-11.17
Ce (low fat= 1)	-0.042	-1.33	0.161	5.07	0.095	3.05
GM x Pe	-0.036	-0.83	-0.030	-0.69	0.000	0.00
GM x GN	-0.006	-0.19	-0.075	-2.24	-0.023	-0.68
GM x Be	-0.020	-0.63	-0.048	-1.52	-0.005	-0.15
A_NEW	0.285	6.38	-0.109	-2.35	0.325	7.07
GN (no cholesterol)	-0.053	-1.56	-0.121	-3.16	-0.066	-1.91
Pn	-0.292	-6.50	-0.453	-9.05	-0.406	-8.89
Cn (low fat= 1)	0.079	2.34	0.155	4.16	0.212	6.18
GN x Pn	0.002	0.05	-0.037	-0.74	0.013	0.29
GN x GM	-0.034	-0.92	0.015	0.39	-0.038	-1.01
A_ORGANIC	0.441	10.19	0.319	7.65	0.469	10.56
Po	-0.334	-8.05	-0.464	-11.12	-0.317	-7.57
Co (low fat= 1)	0.043	1.36	0.154	4.80	0.086	2.68
Log-L	-6661.1		-6514.7		-6564.7	
R2 Adj	0.05		0.07		0.07	
Obs	310		319		323	

Across all media conditions the GM option was avoided. These results are consistent with previous research, where in the absence of benefit consumers would require a 30 to 50 % discount to purchase a GM rather than non-GM option (Chern and Kanedo 2003), at least in

the early stages of market development. Also common was that the new product was less likely to be purchased than the existing one. Thus, for most of the sample the "no cholesterol" benefit used in this study was immaterial or of no perceived value. This suggests that product benefits from GM must be substantial relative to non-GM options and unique to the gene technology. Certainly in this example there is no expectation that a food with a benefit attached would attract a premium and, as such, commercialisation would be unviable given the additional costs associated with complying with regulation of GM.

Finally, we have employed the stated preference method and discrete choice modelling using scenarios that attempt to mimic the choice situation. A caveat on the results is that choice experiments can elevate attribute awareness whereas in purchase of everyday groceries consumers often purchase without referring to labels. Rather, they buy on brand or a familiar product, or on price. These results should be seen as the worst case given that many other factors are likely to intervene in the actual shopping context (time, lack of appropriate substitutes) and could override consumers' concerns. For example, Noussair, et al., (2002), found that only when respondents were presented with a projected image of the ingredients list for chocolate was there a significant response to the presence of GM ingredients. Similarly, while negative publicity may be prevalent in the media it may not be salient at the time of shopping and so have less impact on choices. Future research methodologies need to be designed with the possibility of these effects in mind.

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