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Are consumers loyal to genetically modified food? Evidence from Australia

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Abstract

Purpose – Genetically modified (GM) food has received considerable interest from academics and practitioners. However, research on consumer loyalty towards GM food is relatively sparse. Guided by the theory of planned behaviour (TPB), this research explores the factors that influence consumer repurchase intention and behavioural loyalty towards GM food.

Design/methodological approach – Data were collected from 464 Australian consumer panel members surveyed through a nationwide online survey, with data analysed by structural equation modelling (SEM) using AMOS (v. 22.0).

Findings – The findings reveal that consumer loyalty towards GM food is influenced by the interplay between awareness of benefits and risks, situational and social influences, and attitude and repurchase intention. Female consumers are found to not only possess a relatively more favourable attitude and repurchase intention, but also are more loyal towards GM food compared to male consumers. Unlike older consumers, younger consumers' loyalty towards GM food is influenced by their attitude and repurchase intention. The relevant policy implications of the findings are discussed.

Practical implications – As consumers have contrasting views about GM food, to influence their loyalty, it is important for GM food industries as well as policy makers to better understand how to address consumers' varying concerns about GM food.

Originality/value – This study offers a parsimonious model for explaining the factors that influence consumer loyalty towards GM food.

Keywords: GM food, theory of planned behaviour, loyalty, awareness of benefits, awareness of risks, attitude, intention.

Paper type: Research paper

1. Introduction

Genetically modified (GM) food has triggered lively debate in the public sphere about its acceptability (Kim *et al*., 2014), with contrasting opinions expressed about its production, consumption and marketing processes (Frewer *et al.*, 2014). Abundant scientific research claims that GM food is obtained from crops that are genetically herbicide-resistant, pest-tolerant and resistant to drought and dry climate, and that GM food has significant potential to increase food quality and nutrient composition at more affordable prices than is the case with traditional food (Andersen, 2020; Holban and Grumezescu, 2018). However, critics question whether these

benefits outweigh the risks posed by GM food to human health and the environment (Regis, 2019; Ferry and Gatehouse, 2009). The moral concern of 'unnaturalness' (Munshi and Sharma, 2017) and scientific uncertainty about the long-term adverse effects of GM food consumption (Zhang *et al*., 2016) have also arisen. Despite this ongoing debate, the global production of GM crops has increased significantly in recent years. In Australia, the biotechnology sector that encompasses gene technology products (or GM food) is expected to grow at a rate of 4.4% a year until 2021, bringing revenue worth A$8,675 million to the industry (McKell Institute, 2016). To date, only two types of GM crops – cotton and canola –are produced commercially in Australia (Department of Primary Industry and Regional Development [DPIRD], 2017), with both crops used to produce vegetable oil (Whitfield *et al.*, 2009). Apart from using locally grown GM crops, manufacturers in Australia are allowed to import a wide range of GM food ingredients, such as soybeans, corn, rice, potatoes and sugar beet (Food Standards Australia New Zealand [FSANZ], 2018), to use in various products like breads, pastries, snack foods, baked products, oils, fried foods, confectionery, soft drinks and sausage skins (Carmen, 2004). Australian consumers are thus increasingly exposed to GM food, both home-grown and imported (Potter, 2016).

While it is difficult to avoid GM food due to its abundance in the market, consumers apparently perceive both benefits and risks from GM food (McHughen, 2013). A wide range of studies in the literature have investigated consumer awareness (Agaviezor, 2018), acceptance (Lucht, 2015), purchase intention of GM food (Pino *et al*., 2016) and factors influencing the perceived risk of GM food (Phillips and Hallman, 2013). Yet vital questions remain unanswered in the literature: why do consumers repeat purchase GM food? Are they loyal towards GM food? In addition, although gender influences attitude and behaviour towards a product (Roberts and Wortzel, 1979), and females are more involved in shopping with greater knowledge of relevant brands compared to males (Park and John, 2010; Kinley *et al.*, 2009), little is known about

whether consumer attitude and loyalty towards GM food differ based on gender. Moreover, past research has shown mixed evidence on consumer attitude and preference towards GM food based on age group. For example, Li *et al.* (2002) reported that older respondents were less likely to choose GM rice, whereas James and Burton (2003) found that older people were generally more accepting of the use of GM technology. As GM food is a large industry with GM seed having a global value of US$20.07 billion in 2018 which is expected to reach US$30.24 billion by 2026 (Fortune Business Insights, 2019), determinants of consumer loyalty towards GM food and whether this loyalty varies based on gender and age are indeed worth exploring not only for policy makers but also for GM food industry participants.

This paper aims to explore the relevant factors that influence consumers' behavioural loyalty towards GM food. Guided by the theory of planned behaviour (TPB) (Ajzen, 1991), the study provides evidence that consumer loyalty towards GM food is driven by consumers' attitude, repurchase intention, and social and situational factors. The study also indicates that consumers form a favourable attitude towards GM food based on their assessment of the benefits and risks of using GM food. Furthermore, the study provides empirical evidence that the effects of consumer attitude and repurchase intention on loyalty vary based on gender and age group.

2. Theoretical Framework

Loyalty

Loyalty refers to a deeply held commitment to re-patronise a preferred product, brand or store (Oliver, 1999). It is a favourable perception and/or a biased behavioural response (e.g., revisit or repeat purchase) of customers expressed over time with respect to a specific product (Rabbanee *et al.*, 2015). Loyalty comprises both attitude and behavioural components (Dick and Basu, 1994; Oliver 1999). Attitudinal loyalty stems from consumers' favourable perception about the product or store, whereas behavioural loyalty focuses on ongoing behavioural actions towards a product,

covering both actual repeat purchase and positive word-of-mouth (WOM) (Wolter *et al.*, 2017; Ramaseshan *et al.*, 2013). While loyalty is often attributed to psychological attachment to a brand (Sung and Campbell, 2009), many researchers (e.g., Ehrenberg, 2000; Sharp *et al.*, 2002) have suggested that attitude is not relevant to determining true loyalty: instead, repeat purchase is what defines the actual loyalty of consumers.

While a plethora of research has been conducted on consumer loyalty, researchers have expressed the opinion that not only are the drivers of loyalty complex and dynamic, but they change and evolve over time (Johnson *et al.*, 2006). The conceptualisation of consumer loyalty is even more complex due to the diverse and contrasting consumer perceptions towards GM food. Given that GM food has become increasingly common in daily food purchases (Bhate, 2007) and many food brands now contain GM ingredients (Bawa and Anilakumar, 2013), our study focuses on the behavioural aspect of loyalty towards a food product category. We consider that loyal customers of GM food are those who repeat purchase and spread positive word-of-mouth (WOM) about the targeted product, with this conceptualisation of loyalty in line with the extant research (e.g., Lin *et al.*, 2017).

Theory of planned behaviour (TPB)

The theory of planned behaviour (TPB) (Ajzen, 1991) has been one of the most influential theories for explaining and predicting an individual's behaviour (e.g., Dennis *et al.*, 2009). This theory emphasises attitude and intention in predicting actual behaviour. Attitude captures an individual's overall evaluation of performing the behaviour. A strong intention also indicates an individual's willingness to invest physical and psychological effort in performing the chosen behavioural option. As the TPB is good at predicting consumer intention and behaviour, the theory has been widely and successfully applied in consumer research (e.g., Armitage and Conner, 2001; Dean *et al.*, 2008) including studies relating to consumers' choice of food (e.g., Chen, 2007; Mari *et al.*, 2012), in general, and GM food, in particular (Kim *et al.*, 2014). The

key focus of the TPB is intention, which connotes the individual's cognition combining the pros and cons that s/he takes into account when deliberately reasoning whether or not he/she should perform a behavioural action. This cognitive process of the individual reflects the individual's intention and behaviour (Bamberg *et al*., 2007). A strong intention also indicates an individual's willingness to invest physical and psychological effort in performing the chosen behavioural option.

In the context of GM food, under consumer loyalty, we focus more on repeat purchase. This is more likely to be influenced by consumers' cognitive evaluation, as consumption of GM food involves consumers' deliberate involvement in evaluating both the associated benefits and risks. While the benefits of GM food positively influence consumer attitude, risks associated with GM food adversely affect attitude (Littler and Melanthiou, 2006; Quaddus and Hoffmeyer, 2007). As per the TPB, this assessment of both benefits and risks eventually shapes consumers' attitude towards GM food which influences their repurchase intention. This repurchase intention affects consumer loyalty in terms of repeat purchase behaviour (Mittal and Kamakura, 2001). Therefore, we formulate the following hypotheses:

H1a: Awareness of benefits influences consumer attitude towards GM food.

H1b: Awareness of risks influences consumer attitude towards GM food.

H2a: Attitude has a significant influence on repurchase intention towards GM food.

H2b: Attitude has a significant influence on consumer loyalty towards GM food.

H3: Repurchase intention positively influences consumer loyalty.

In addition, the TPB argues that human behaviour is influenced by control belief and normative belief (Kim *et al*., 2014). Control belief refers to an individual's perceptions of the control s/he has over the respective behaviour. This is termed 'perceived behavioural control (PBC)' and is related to factors that may facilitate or impede performance of the behaviour and whether the individual perceives the behaviour as easy or difficult to perform (Ajzen, 1991).

Perceived behavioural control (PBC) is also termed a 'situational influence' as it includes a set of beliefs prevalent in the given situation that have a role in performing or preventing that behaviour (Fini *et al.,* 2012). In a similar vein, an individual's behaviour towards GM food is subject to obstacles, while an individual's actual behaviour is influenced by his/her perception of how easy or difficult it would be for him/her to carry out the behaviour in a given situation (Ajzen, 1991). Therefore, situational influence or PBC is likely to impact on repurchase intention and loyalty towards GM food. Hence, we hypothesise that:

H4a: Situational influence affects consumer repurchase intention of GM food.

H4b: Situational influence affects consumer loyalty towards GM food.

On the other hand, normative belief is termed a 'subjective norm' and refers to an individual's perception of how a particular behaviour will be judged by their significant others. The more favourable the subjective norm, the more likely the individual will be to perform that behaviour (Kim *et al.*, 2014). Subjective norms are also referred to as social influences (Fini *et al.*, 2012) as this factor includes perceptions of peers or family members about the behaviour. In the GM food context, consumers will repeat purchase a food product if they find that the benefits from their first-time consumption outweigh the associated risks. Social factors, such as the influence of family and peer-based reference groups, influence the repeat purchase of GM food as this consumption takes place in a social setting (Quaddus and Hofmeyer, 2007). Therefore, social influence is likely to influence repurchase intention and loyalty. Hence, we hypothesise that:

H5a: Social influence affects consumer repurchase intention of GM food.

H5b: Social influence affects consumer loyalty towards GM food.

The conceptual framework reflecting the above hypotheses is illustrated in Figure 1.

<< Insert Figure 1 about here >>

3. Method

The conceptual framework shown in Figure 1 is tested in Australia due to its large market that offers a variety of food and other products containing GM ingredients. For example, locally grown GM cotton seeds are widely used in Australia to produce cooking oil for the fast-food industry (Whitfield *et al.,* 2009). Data for the current study were collected through a nationwide online survey using a structured questionnaire. The survey was conducted among members of the Australian Consumer Panel who expressed a willingness to opt in to participating in different surveys. Members of the panel were selected randomly to receive the survey link (developed through Qualtrics) at their nominated email address. The questionnaire started with a definition of GM food taken from the existing literature so respondents could clearly relate to the topic of the survey. A filtering process was used to select respondents, with a question asked about whether or not respondents bought GM food. To ensure that this response was valid, respondents were asked to write down the brand name of at least one GM food that they usually bought. The rest of the questions in the survey instrument (i.e., the questionnaire), including items on repurchase intention and loyalty, were based on the GM food brand that respondents identified in their response to the filtering question. A total of 492 respondents filled in questionnaires that were collected, with 28 questionnaires deleted due to incomplete answers. In total, 464 questionnaires were used for further analysis.

The measures of the constructs were adapted from the existing literature, with contextualisation undertaken as required. The measurement items for awareness of consequences (awareness of both benefits and risks) were adopted from the existing literature, including Zhang *et al.* (2017), after due contextualisation. The TPB constructs, such as attitude, situational influence (PBC) and social influence (subjective norm) were adapted from Kim *et al.* (2014) and Costa-Font and Gil (2009). Repurchase intention was measured by two items adopted from Lam and Hsu (2006). Loyalty items were adapted from Koller *et al.* (2011), which were drawn from

Johnson *et al*. (2006). All the items were adapted to the GM food context and were anchored on a seven-point Likert scale. The item details and their descriptive statistics are shown in Table 1.

<< Insert Table 1 about here >>

4. Data Analysis and Results

We analysed the data through structural equation modelling (SEM) using AMOS (v. 22.0). We chose SEM as it is a state-of-the-art tool for data analysis that allows the examination of a set of relationships between one or more independent variable with more than one dependent variable (Anderson and Gerbing, 1988; Kline, 2005). In addition, SEM has been widely used in academic research. We started the study's data analysis by running a measurement model to assess the convergent and discriminant validity prior to estimating the path relationships through a structural model. We assessed the convergent validity of the constructs by checking the factor loading of the items (Hair *et al.*, 1995) and found that all the items were loaded substantially onto their respective latent construct at the 0.01 significance level. The minimum factor loading of the items was found to be 0.50 (see Table 1). In addition, the minimum value of the average variance extracted (AVE) was 0.64 for awareness of benefits, which supported the convergent validity of the constructs used in the study (Fornell and Larcker, 1981). The correlation values between the constructs were within the acceptable limit to support the discriminant validity of the constructs (Kline, 2005). The lowest value of composite reliability (CR) was 0.87 for awareness of benefits, which indicated adequate internal consistency of the scale items used in the study. The square root of AVE for each construct was greater than the absolute value of the standardised correlation value between the given construct and the remaining constructs (see psychometric properties in Table 2). This result also supported their convergent and discriminant validity (Fornell and Larcker, 1981). In addition, the goodness-of-fit measures[1] for the

[1] Structural equation modelling (SEM) using AMOS provides model fit indices that enable researchers to find whether a model fits well with the given data set (Anderson and Gerbing, 1988). Researchers use these fit indices

measurement model showed a good fit with the data (χ^2 = 833.18; *df* = 321; χ^2/df = 2.59; RMSEA = 0.06; CFI = 0.94; NFI = 0.91; TLI = 0.93; SRMR = 0.05) with the data.

<< Insert Table 2 about here >>

To minimise the effects of common method variance, various procedural and statistical remedies were adopted, as per Podsakoff *et al.* (2003). Firstly, under procedural remedies, we carefully crafted a cover letter for the questionnaire assuring respondents of their anonymity; used pre-validated scales to measure the constructs; and enabled psychological separation between the measurement of predictor and criterion variables by placing them in distinct sections, all of which minimised the effects of common method variance. Under statistical remedies, we tested if all the measurement items in our study loaded onto a dominating factor that accounted for most of the variances between the items. This was done by conducting Harman's one-factor test, which revealed that no single factor accounted for most of the variances between the items (Podsakoff *et al.*, 2003). These procedures indicated that common method bias was not a problem in our study's data set.

The demographic profile of our respondents showed that 66.5% were Australian and 38.9% were male. The average age of respondents was 34 years with an average weekly income of approximately A$1,300. Details of the demographic characteristics of respondents are shown in Table 3.

<< Insert Table 3 about here >>

We then ran the structural model using AMOS (v. 22.0) to test the hypotheses. The fit indices of the structural model showed an acceptable fit with the data (χ^2 = 883.23; *df* = 327; χ^2/df = 2.70; RMSEA = 0.06; CFI = 0.94; TLI = 0.93; NFI = 0.91; SRMR = 0.06). The structural path relationships and corresponding coefficients are shown in Table 4.

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in conjunction with each other to evaluate overall fit (Bagozzi, 1981) by checking whether the cut-off points of the fit indices fall within the acceptable limits. These fit indices are: RMSEA = root mean square error of approximation; CFI = Comparative fit index; NFI = Normed fit index; TLI = Tucker–Lewis index; and SRMR = standardised root mean square residual.

<< Insert Table 4 about here >>

As shown in Table 4, all the hypothesised relationships, except H4a, were found to be significant. Awareness of benefits ($\beta = 0.73$; $p < 0.05$) and risks ($\beta = -0.23$; $p < 0.05$) were found to have significant positive and negative impacts on attitude towards GM food, respectively. Attitude influenced repurchase intention ($\beta = 0.11$; $p < 0.05$) and loyalty ($\beta = 0.11$; $p < 0.05$). Situational influence (perceived behavioural control [PBC]) had an impact on loyalty ($\beta = 0.19$; $p < 0.05$) but not on repurchase intention ($\beta = 0.002$; $p = 0.96$. Social influence (subjective norm) influenced both repurchase intention ($\beta = 0.72$; $p < 0.05$) and loyalty ($\beta = 0.32$; $p < 0.05$). The model explained 41% of the variance of attitude ($R^2 = 0.41$); 52% of the variance of repurchase intention ($R^2 = 0.52$); and 46% of the variance of loyalty ($R^2 = 0.46$).

As reflected in the above results, overall, consumers were willing to repurchase the selected GM food products and were loyal towards them. To reveal further insights into whether consumers' repurchase intention and loyalty varied based on gender (male and female), we ran a multi-group analysis where the data set (N = 464) was divided into two groups: male (N = 181) and female (N = 283). Following Roy and Rabbanee (2015), the chi-square values and degrees of freedom (*df*) of the totally free (TF) model (without restricting any of the paths of the model) were compared to the same values in the fully constrained (FC) model (by restricting all the paths of the model). The fit indices of the TF model were found to be satisfactory ($\chi^2 = 1376.47$; $df = 652$; $\chi^2/df = 2.11$; RMSEA = 0.05; CFI = 0.92; TLI = 0.91; NFI = 0.86). In order to examine whether the two models based on gender (male and female) were statistically different from each other, we compared the fit indices of the TF model (as discussed above) with the fit indices of the FC model. The fit indices of the FC model were also found to be acceptable ($\chi^2 = 1737.47$; $df = 667$; $\chi^2/df = 2.60$; RMSEA = 0.06; CFI = 0.89; TLI = 0.87; NFI = 0.82). Importantly, the differences in the chi-square and degrees of freedom (*df*) values of the TF and FC models were

found to be significant ($\Delta \chi^2 = 361$, $\Delta df = 15$ and $p < 0.05$). Therefore, the path coefficients of the two models (male and female) significantly differed from one another.

As shown in Table 5a, the TF model revealed that, for female consumers, the paths between (i) attitude and repurchase intention ($\beta = 0.21$; $p < 0.05$); (ii) attitude and loyalty ($\beta = 0.16$; $p < 0.05$); and (iii) repurchase intention and loyalty ($\beta = 0.28$; $p < 0.05$) were significant. Each of these relationships was found to be non-significant for male consumers (see Table 5b). In addition, the strength (β value) of the link between awareness of benefits and attitude towards GM food was significantly higher for female consumers ($\beta = 0.75$; $p < 0.05$) compared to male consumers ($\beta = 0.67$; $p < 0.05$).

To examine whether consumers' repurchase intention and loyalty varied based on age group (e.g., younger adults and older adults), we ran multigroup analysis following the same procedure as before, in which the data set (N = 464) was divided into two groups: younger (N = 273) and older (N = 191) adults. The younger group reflected Millennials and Generation Z with ages between 18 to 38 years, while the relatively older group represented Generation X with ages of 39 years or more (Dimock, 2019; Kasasa, 2020). The fit indices of the TF model were found to be satisfactory ($\chi^2 = 1330.60$; $df = 652$; $\chi^2/df = 2.04$; RMSEA = 0.04; CFI = 0.93; TLI = 0.91; NFI = 0.86). In order to examine whether the two models based on age (younger and older) were statistically different from each other, we compared the fit indices of the TF model with the fit indices of the FC model. The fit indices of the FC model were also found to be acceptable ($\chi^2 = 1660.08$; $df = 667$; $\chi^2/df = 2.48$; RMSEA = 0.05; CFI = 0.89; TLI = 0.87; NFI = 0.83). Importantly, the differences in the chi-square and degrees of freedom (df) values of the TF and FC models were found to be significant ($\Delta \chi^2 = 329.48$, $\Delta df = 15$, $p < 0.05$). Therefore, the path coefficients of the two models based on age group (younger adults and older adults) significantly differed from one another.

As shown in Table 6a, the TF model revealed that, for younger consumers, the path between (i) attitude and repurchase intention ($\beta = 0.01$; $p > 0.05$) was insignificant whereas the paths between (ii) attitude and loyalty ($\beta = 0.23$; $p < 0.05$); and (iii) repurchase intention and loyalty ($\beta = 0.15$; $p < 0.05$) were significant. These relationships were found to be in opposite directions for older consumers. As shown in Table 6b, the path between (i) attitude and repurchase intention ($\beta = 0.21$; $p < 0.05$) was significant whereas the paths between (ii) attitude and loyalty ($\beta = 0.02$; $p > 0.05$); and (iii) repurchase intention and loyalty ($\beta = 0.15$; $p > 0.05$) were insignificant for older consumers. In addition, although the links of awareness of benefits and risks with attitude were found to be significant for both younger and older consumers, the strength of the link of awareness of risks with attitude was negatively stronger for older consumers ($\beta = -0.32$) than for younger consumers ($\beta = -0.16$).

5. Discussion

This study explains the widely debated topic of consumer repeat purchase and loyalty towards GM food by exploring their underlying driving factors. The findings reveal that consumer loyalty towards GM food is determined by the interplay between awareness of benefits and risks, social and situational influences, and attitude and repurchase intention. While awareness of benefits and awareness of risks are the primary driving force, these variables influence the shaping of attitude and the development of repurchase intention, which eventually impact on behavioural loyalty in terms of repeat purchase and spreading positive word of mouth (WOM). The findings further reveal that, overall, female consumers possess a relatively more favourable attitude and repurchase intention and are more loyal towards GM food than male consumers. On the other hand, unlike older consumers, younger consumers' loyalty towards GM food is influenced by their attitude and repurchase intention. Older consumers perceives GM food riskier than that of younger consumers.

Our findings on the factors that influence attitude and repurchase intention are in line with existing research. For example, prior research has reported that consumer perceptions of benefits and risks are considered to be major precursors of their attitudes towards GM food (Bredahl *et al.,* 1998) and, thus, influence its adoption (Smyth *et al.,* 2015). Kim (2014) provided empirical evidence that consumers' attitudes, social influences (subjective norms) and situational influences (perceived behavioural control [PBC]) significantly impact on the intention to purchase GM food. Overall, the current study's findings reflect that consumer attitudes towards GM food are primarily driven by their cognitive thinking as they weigh up the benefits and risks. This is in line with Robinson and Leonhardt (2018) who found that consumers' cognitive, but not affective, beliefs predominantly influenced consumer loyalty towards food items. Younger consumers' favourable attitude and repurchase intention influencing their loyalty towards GM food was in line with Grimsrud *et al.* (2002) who found that younger customers (aged less than 41 years) were willing to buy GM bread at a discount rate of 31.8% compared to older customers (aged more than 41 years) who needed an 88% discount rate to be willing to buy GM bread. The non-significant path from attitude and repurchase intention to loyalty for older consumers was also supported by Li *et al*. (2002) who found that older respondents were less likely to choose GM rice.

As consumers have contrasting views about GM food (McHughen, 2013), it is important for GM food companies and policy makers to explore how they can address consumers' concerns about GM food to avoid the eventual diminishment of their attitude and loyalty. The current study's findings indicate that GM food will be acceptable to consumers if perceived benefits outweigh perceived risks. It has also been found that loyalty and repeat purchase of GM food will increase if consumers are aware of the benefits, such as the economic, health and environmental benefits of GM food. Consequently, government bodies and GM food industries should provide consumers with extensive information on the approval process, assessment

criteria and monitoring by regulatory bodies to convey the clear message that GM food is safe and has the same nutritional benefits as non-GM food (Popek and Halagarda, 2017). The regulatory system in Australia, comprising the Commonwealth *Gene Technology Act 2000 (Cth)* (GT Act) and corresponding state and territory legislation, is designed to ensure that GM food is safe for human consumption and that no serious environmental damage is likely to have been caused. In the GT Act, S27 obliges the Regulator (Office of the Gene Technology Regulator [OGTR]) to provide information and advice to the public about the regulation of GM items. It is important that the necessary information is provided to consumers emphasising that laws and policies are in place to address their concerns about GM food. This will motivate consumers to form a positive attitude towards GM food. In addition, an integrated public education scheme should be devised involving both social forces (e.g., peers) and situational forces (e.g., non-governmental organisations [NGOs]) who will eventually influence consumers' purchase decisions, as is evident in this study's findings. Public education on regulatory arrangements can help consumers to better understand the quality and extent of safety assessments relating to GM food, which would play a significant role in influencing consumers' attitudes towards GM food (Yue *et al.*, 2015). Government bodies could leverage various information channels, such as websites, social media platforms, online blogs, online communities, phone hotlines, brochures, pamphlets and TV campaigns, to disseminate relevant information to consumers (Department of Agriculture and Food, 2011). Scientists and experts should be involved in providing unbiased information to consumers in appropriate lucid language on the benefits, risks and approval process of GM food. This information should be comprehensive in explaining the nature of the GM food item, why it is safe, how regulatory bodies ensure that safety is maintained and how any associated risks are mitigated.

The government should also promote public trust in its ability to ensure the safety of GM food (Walls *et al.,* 2011). Public trust in government steps is likely to increase when they learn

that the regulatory body in relation to GM food in Australia (Office of the Gene Technology Regulator [OGTR]) is obliged to ensure that GM foods do not cause any adverse effects to human health and the environment. They would also learn that it is the government's responsibility to ensure the safety of GM food, with appropriate labelling of this information required to be on the respective GM food items, so that consumers can find the desired information when required (Department of Agriculture and Food, 2011). Furthermore, greater stakeholder involvement should be ensured to enhance consumer attitudes and loyalty towards GM food (Walls *et al.,* 2011). Government regulatory bodies need to develop pragmatic and influential methods of stakeholder engagement and consultation to involve consumers in the decision-making process and policy debates (Walls *et al.,* 2011). The function of the Ethics and Community Committee established by the GT Act includes, among others, providing advice on ethical issues relating to gene technology and community consultation in respect to the application process for licences covering dealings that involve the intentional release of a GM item into the environment (s107). Consumers should be given the opportunity to access information about the regulatory mechanisms and to provide their opinions on regulations and product applications. Furthermore, public debate is needed on the broad suite of GM product-related policies, such as the licensing of GM products and particularly safety assessment criteria and labelling criteria, which impact upon consumers' present and future choices about GM food products.

6. Conclusion

This study contributes to the extant GM food literature by offering a parsimonious model for explaining consumer loyalty towards GM food. The study extends the theory of planned behaviour (TPB) by showing its application in the context of consumer loyalty towards GM food. This is a key theoretical contribution of the current study given that consumer loyalty towards GM food is a complex phenomenon, unlike loyalty towards other conventional products or brands. Benefits and risks are involved as well as the involvement of consumers' perceptions of

social and situational forces that affect their loyalty. Besides, variations in consumer attitudes, repurchase intention and loyalty towards GM food based on gender and age advance the existing GM food literature and offer useful insights for GM food managers and government decision makers. Furthermore, the study's findings offer a better understanding of the repeat purchase of GM food, which is of immense importance for the GM food industries. Government organisations, private biotech industries, policy makers, scientists and professionals can benefit by knowing the underlying factors that influence repurchase intention and loyalty towards GM food. Thus, the findings of this study contribute to a better understanding of consumer behaviour regarding GM food, which can lead to establishing a desired product market and the sustainability of the GM food industry.

As with any research, this study has some limitations. Firstly, it did not consider the role of consumer knowledge about GM technology in the model. Prior research provided mixed evidence regarding the role of knowledge in consumer attitudes towards GM food. For example, Hursti *et al.* (2003) mentioned that consumers with a higher level of knowledge regarding GM food had more positive attitudes towards these foods. On the other hand, Huffman *et al.* (2007) demonstrated that consumers with a greater knowledge of GM food had more negative attitudes towards this type of food. Therefore, future research is warranted to explore the role of knowledge about GM food on consumer attitudes and loyalty in the Australian context. Secondly, the current study did not consider whether respondents in the sample (re)purchased the GM food by looking at the food item label. As labelling plays a significant role in making consumers aware of the pros and cons of GM food, further exploration is warranted on the effects of labelling on consumer loyalty towards GM food. Thirdly, this study considered gender and age group as moderating factors influencing consumers' repeat purchase intention and loyalty towards GM food. Future research could focus on examining the moderating roles of other demographic factors, such as income, education and ethnicity. Fourthly, this study did not

consider variations in the extent or level of attitude and loyalty towards GM food. Hence, future research could focus on how different extents (low, medium and high) of attitude and loyalty towards GM food are influenced by the specific benefits and risks of GM food. This would offer useful insights into identifying the specific benefits and risks responsible for generating low, medium or high levels of favourable attitude and loyalty towards GM food. Fifthly, the current study did not consider any control variable, such as brand image and/or consumer past experience or satisfaction, that may have had a direct influence on loyalty: future research could consider these control variables in the model. Finally, the proposed model of this study was found to have a satisfactory fit with the given data set; however, the opinions of respondents in the sample may not be representative of the entire population of Australia. Future research could test the model among a broader sample representing each state, territory and region of Australia which would assure the external validity of the proposed model. It would also be worthwhile to test our model in the contexts of developed countries as well as developing countries to gain an understanding of whether consumer loyalty towards GM food differs based on country or culture.

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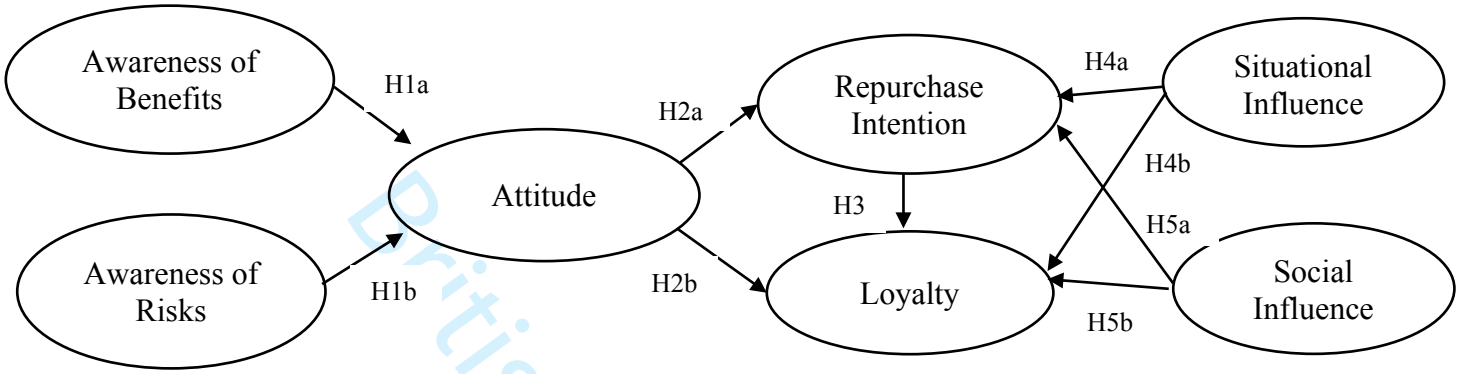
Appendices

Figure 1: Conceptual framework



List of Tables

Table 1: Descriptive statistics and factor loading of the scale items

Code	Scale Items	Factor Loading	Mean	SD
	Awareness of benefits: [reliability (α) = 0.80]			
AB1	GM food enables to have food products at lower production cost.	0.80	4.73	1.11
AB2	GM foods do not have any health concerns.	0.67	4.17	1.32
AB3	GM food contributes to increased farm productivity.	0.73	4.65	1.15
AB4	GM food helps to have food products at lower price.	0.71	4.72	1.12
	Awareness of risks: [reliability (α) = 0.90]			
AR1	GM foods have adverse long-term health effects.	0.68	4.12	1.31
AR2	GM foods have adverse effect on future generations.	0.79	4.20	1.35
AR3	GM foods degrade the ecosystem.	0.92	4.09	1.33
AR4	GM foods involve environmental risks and ecological hazards.	0.88	4.22	1.32
	Attitude: [reliability (α) = 0.93]			
	To what extent do you agree that the production and consumption of GM food is -			
Atd1	- Not useful for the society … Useful for the society	0.70	4.98	1.46
Atd2	- Morally not acceptable for society … Morally acceptable for	0.77	4.62	1.51
Atd3	society			
Atd4	- Should not be encouraged … Should be encouraged	0.89	4.59	1.49
Atd5	- Not good for the society … Good for the society	0.87	4.68	1.47
Atd6	- Adverse effect on human health … No effect on human health	0.77	4.35	1.48
Atd7	- Adverse long term health effect … No long term health effect	0.75	4.30	1.50
	- Adverse effect on future generations … No effect on future generations	0.74	4.34	1.53
	Repurchase Intention: [reliability (α) = 0.85]			
Int1	I intend to buy the GM food more in future.	0.90	4.35	1.19
Int2	It is likely that I will buy the GM food more in future.	0.82	4.41	1.15
	Situational Influence [reliability (α) = 0.82]			
PBC1	How confident are you that it is possible to avoid eating GM food?	0.90	4.18	1.81

PBC2	Not confident at all ..... Fully confident Do you consider yourself able to monitor your diet and avoid GM food? Not at all ..... Yes of course	0.77	4.01	1.79
	Social Influence [reliability (α) = 0.84]			
	The people whose opinions I value would not mind if I eat GM foods.	0.64	4.73	1.19
	The attitude of persons whom I value would be the same toward me if I eat GM foods in future.	0.57	4.90	1.18
	Most people like me eat GM foods.	0.71	4.64	1.26
	People who have common interests with me would support me eating GM foods.	0.84	4.59	1.18
	My friends and peers are in favour of me eating GM foods.	0.77	4.44	1.17
	Loyalty: [reliability (α) = 0.89]			
Loy1	I am loyal to GM foods.	0.78	3.96	1.13
Loy2	I recommend GM foods to others.	0.84	4.03	1.16
Loy3	I consider GM foods as my first choice.	0.84	3.89	1.15
Loy4	I encourage my friends and relatives to buy GM foods.	0.84	3.81	1.26

Table 2: Psychometric properties of the constructs

Constructs	AB	AR	AsR	PN	Atd	PI	PBC	Loy
Awareness of Benefits (AB)	1							
Awareness of Risks (AR)	-0.03	1						
Ascribed Responsibility (AsR)	0.23**	0.42**	1					
Personal Norm (PN)	0.31**	0.21**	0.51**	1				
Attitude (Atd)	0.48**	-0.27**	0.03	0.07	1			
Purchase Intention (PI)	0.56**	-0.05	0.17**	0.17**	0.37**	1		
Behavioural Control (PBC)	-0.52	-0.23**	-.013	0.10*	-0.22**	-.037	1	
Loyalty (Loy)	0.46**	0.11*	0.20**	0.17**	0.41**	0.43**	-0.31**	1
Composite Reliability (CR)	0.87	0.93	0.92	0.93	0.95	0.91	0.89	0.93
Average Variance Extracted (AVE)	0.64	0.78	0.72	0.75	0.74	0.84	0.80	0.79

Note: * => $p < 0.05$; ** => $p < 0.01$

Table 3: Demographic characteristics of the sample respondents

Demographic variables	Number (percentage)
Gender:	
Male	181 (39%)
Female	283 (61%)
Age (year):	
18-24	127 (27.4%)
25-31	78 (16.8%)
32-38	68 (14.7%)
39-45	45 (9.7%)
46-52	38 (8.2%)
53-59	93 (20%)
Above 60	14 (3%)
Weekly Income:	
Less than $500	121 (26.1%)
$500 - $1000	147 (31.7%)
$1001 - $1500	74 (15.9%)
$1501 - $2000	59 (12.7%)
$2001 - $2500	32 (6.9%)
$2501 - $3000	13 (2.8%)
More than $3000	17 (3.7%)
Education:	
Primacy school	2 (0.4%)
High school	117 (25.2%)
Tafe	125 (26.9%)
Undergraduate	169 (36.4%)
Master degree	50 (10.8%)
Ethnic Origin:	
Australian	308 (66.4%)
Asian	65 (14%)
European	64 (13.8%)
American	6 (1.3%)
African	3 (0.6%)
Middle-eastern	8 (1.7%)
Others (New Zealand, Pacific Island)	9 (1.9%)

Table 4: Standardized coefficients, t-values, and p-values of the structural model

Particulars	β	t-value	p-value	Decision
H1a: Awareness of benefits => Attitude	0.73	9.89	0.001	Significant
H1b: Awareness of risks => Attitude	-0.23	-6.01	0.001	Significant
H2a: Attitude => Repurchase Intention	0.11	2.02	0.043	Significant
H2b: Attitude => Loyalty	0.11	2.54	0.011	Significant
H3: Repurchase intention => Loyalty	0.14	2.43	0.015	Significant
H4a: Situational influence => Repurchase intention	0.002	0.05	0.961	NS
H4b: Situational influence => Loyalty	0.19	6.72	0.001	Significant
H5a: Social influence => Repurchase intention	0.72	12.03	0.001	Significant
H5b: Social influence => Loyalty	0.32	5.09	0.001	Significant

Tables 5A and 5B: Multi-group analysis based on gender

Table 5a – Path coefficients of the TF model for female consumers

Particulars	B	t-value	p-value	Decision
H1a: Awareness of benefits => Attitude	0.75	7.82	0.001	Significant
H1b: Awareness of risks => Attitude	-0.22	-4.63	0.001	Significant
H2a: Attitude => Repurchase Intention	0.21	3.17	0.001	Significant
H2b: Attitude => Loyalty	0.16	2.72	0.006	Significant
H3: Repurchase intention => Loyalty	0.28	3.86	0.001	Significant
H4a: Situational influence => Repurchase intention	0.02	0.06	0.47	NS
H4b: Situational influence => Loyalty	-0.17	-4.76	0.001	Significant
H5a: Social influence => Repurchase intention	0.66	9.39	0.001	Significant
H5b: Social influence => Loyalty	0.21	2.61	0.009	Significant
R^2 values: Attitude (R^2 = 0.40); Repurchase Intention (R^2 = 0.55); Loyalty (R^2 = 0.48)				

Table 5b – Path coefficients of the TF model for male consumers

Particulars	B	t-value	p-value	Decision
H1a: Awareness of benefits => Attitude	0.67	6.15	0.001	Significant
H1b: Awareness of risks => Attitude	-0.25	-4.02	0.001	Significant
H2a: Attitude => Repurchase Intention	-0.06	-.846	0.39	NS
H2b: Attitude => Loyalty	0.02	0.35	0.72	NS
H3: Repurchase intention => Loyalty	-0.10	-1.08	0.27	NS
H4a: Situational influence => Repurchase intention	-0.001	-0.02	0.98	NS
H4b: Situational influence => Loyalty	-0.23	-4.51	0.001	Significant
H5a: Social influence => Repurchase intention	0.81	7.61	0.001	Significant
H5b: Social influence => Loyalty	0.54	4.43	0.001	Significant
R^2 Values: Attitude (R^2 = 0.38); Repurchase Intention (R^2 = 0.51); Loyalty (R^2 = 0.47)				

Tables 6A and 6B: Multi-group analysis based on age group

Table 6a – Path coefficients of the TF model for younger consumers

Particulars	B	t-value	p-value	Decision
H1a: Awareness of benefits => Attitude	0.69	7.61	0.001	Significant
H1b: Awareness of risks => Attitude	-0.16	-3.21	0.001	Significant
H2a: Attitude => Repurchase Intention	0.01	0.19	0.846	NS
H2b: Attitude => Loyalty	0.23	3.58	0.001	Significant
H3: Repurchase intention => Loyalty	0.15	2.03	0.042	Significant
H4a: Situational influence => Repurchase intention	-0.02	-0.39	0.690	NS
H4b: Situational influence => Loyalty	-0.19	-4.88	0.001	Significant
H5a: Social influence => Repurchase intention	0.77	9.76	0.001	Significant
H5b: Social influence => Loyalty	0.26	2.97	0.003	Significant
R^2 values: Attitude (R^2 = 0.35); Repurchase Intention (R^2 = 0.54); Loyalty (R^2 = 0.48)				

Table 6b – Path coefficients of the TF model for older consumers

Particulars	B	t-value	p-value	Decision
H1a: Awareness of benefits => Attitude	0.74	6.13	0.001	Significant
H1b: Awareness of risks => Attitude	-0.32	-4.97	0.001	Significant
H2a: Attitude => Repurchase Intention	0.21	3.26	0.001	Significant
H2b: Attitude => Loyalty	0.02	0.40	0.68	NS
H3: Repurchase intention => Loyalty	0.15	1.68	0.09	NS
H4a: Situational influence => Repurchase intention	0.07	1.47	0.14	NS
H4b: Situational influence => Loyalty	-0.19	-4.09	0.001	Significant
H5a: Social influence => Repurchase intention	0.65	7.12	0.001	Significant
H5b: Social influence => Loyalty	0.43	4.10	0.001	Significant
R^2 Values: Attitude (R^2 = 0.47); Repurchase Intention (R^2 = 0.52); Loyalty (R^2 = 0.43)				

RESPONSES TO REVIEWERS' COMMENTS

Manuscript ID: BFJ-11-2019-0832 R1

Title: Are consumers loyal to genetically modified food? Evidence from Australia

Authors' Responses Corresponding to the Editor and Reviewers' Comments

Thank you so much for your and the anonymous reviewer's comments on the earlier version of the manuscript. We are grateful for offering us another opportunity to improve the quality of the paper. We carefully responded to all points and have revised the manuscript accordingly. We offer below our responses to each of your comment in **blue** color while your comments are in normal font. Also, the changes corresponding to your feedback are marked in **blue** color in the revised manuscript.

Response to the Editor's Comment

Comment 1: The reviewer has recommended publication, but also suggests some final very minor revisions to your manuscript. Therefore, I invite you to respond to the reviewer's comments and revise your manuscript. If these revisions are completed to my satisfaction, I will accept the manuscript at that point.

Response 1: I like to thank you and the reviewer for the constructive feedback. We addressed the comments of the reviewer and revised the paper accordingly. The changes are marked as **blue** in the revised paper.

Response to the Reviewer's Comment

Comment 1: This paper would be more interesting if the author could compare and include a multi-group analysis of the GM food loyalty result based on age and education demographic factors.

Response: Thank you for the useful feedback. We have done multi-group analysis of the GM food loyalty based on age group (younger adults and older adults) and included the relevant discussion in the revised paper. Please see page 1, 3, 11, 12, and 13 of the revised manuscript (blue marked). Since literacy rate in Australia is 99%, it is likely that there will not be any variation in the loyalty towards GM food based on education. Hence, we did not run any multigroup analysis based on education; instead, we included this in the future research direction of the paper.

Other Comments:

1. Originality: Does the paper contain new and significant information adequate to justify publication?: Yes

Response: Thank you.

2. Relationship to Literature: Does the paper demonstrate an adequate understanding of the relevant literature in the field and cite an appropriate range of literature sources? Is any significant work ignored?: This paper demonstrate adequate literature of GM food in Australia and other countries.

Response: Thank you.

3. Methodology: Is the paper's argument built on an appropriate base of theory, concepts, or other ideas? Has the research or equivalent intellectual work on which the paper is based been well designed? Are the methods employed appropriate?: Methods are well employed and explained. I recommend to add sampling technique explanation and the recruitment of online respondents.

Response: Thank you. We have added more explanation on the sampling technique and recruitment of the respondents under the Method section in page 7 of the revised manuscript.

4. Results: Are results presented clearly and analysed appropriately? Do the conclusions adequately tie together the other elements of the paper?: Yes. But including a multi-group analysis of the GM food loyalty result based on age and education demographic factors would enhance understanding of the result.

Response: Thank you. We have done multi-group analysis of the GM food loyalty based on age group (younger adults and older adults) and included the relevant discussion in the revised paper. Please see page 1, 3, 11, 12, and 13 of the revised manuscript (blue marked). Since literacy rate in Australia is 99%, it is likely that there will not be any variation in the loyalty towards GM food based on education. Hence, we did not run any multigroup analysis based on education; instead, we included this in the future research direction of the paper.

5. Implications for research, practice and/or society: Does the paper identify clearly any implications for research, practice and/or society? Does the paper bridge the gap between theory and practice? How can the research be used in practice (economic and commercial impact), in teaching, to influence public policy, in research (contributing to the body of knowledge)? What is the impact upon society (influencing public attitudes, affecting quality of life)? Are these implications consistent with the findings and conclusions of the paper?: Yes

Response: Thank you.

6. Quality of Communication: Does the paper clearly express its case, measured against the technical language of the field and the expected knowledge of the journal's readership? Has attention been paid to the clarity of expression and readability, such as sentence structure, jargon use, acronyms, etc.: Clear and concise.

Response: Thank you.