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Attitudes to Biotechnology and Genetically Modified Food : A Review

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Attitudes to Biotechnology and Genetically Modified Food: A Review.

Juliana Rose Cannon

**A report submitted as a partial requirement for the degree of
Bachelor of Arts with Honours in Psychology at
Edith Cowan University**

October, 1999

Declaration

**I declare that this written assignment is my own work and does not include(i)
material from published sources used without proper acknowledgement; or
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Signed by (Juliana Cannon).
Date.....

Attitudes to Biotechnology and Genetically Modified Food: A Review

Abstract

Debate surrounds the introduction of new biotechnological applications such as genetically modified food (GMF). With this in mind a critical review of the debate, it's emerging themes, and approaches to measurement was undertaken. The intention of this review was to argue that while existing empirical measures have advanced our understanding of attitudes to GMF, they are limited both conceptually and methodologically. Overall, the validity and reliability of research support was compromised. Conceptually, attitudes to GMF were composed of a number of potential dimensions that have yet to be measured. Adherence to sound scale construction techniques may facilitate more reliable and valid results, which could be used to understand attitude patterns more thoroughly and facilitate a collaborative approach to the resolution of this important issue.

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Submitted: October, 1999

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USE OF THESIS

The Use of Thesis statement is not included in this version of the thesis.

Attitudes to Biotechnology and Genetically Modified Food: A Review

1. Genetically Modified Food: An Overview and Definition of Terminology

Contemporary society is increasingly being faced with having to decide whether to accept or reject new technologies such as nuclear power, microwave relay stations, cloning, and now biotechnology (Plutzer, Maney, & O'Connor, 1998; Ashley, 1999). Biotechnology involves the attempt to engineer biological processes for the purpose of creating or altering products such as food (Hindmarsh, Lawrence, & Norton, 1998). As a type of modern biotechnology, genetic modification (GM) attempts to control, manipulate, or transfer genes ("Gene Technology," 1999; "Lay Panel Consensus," 1999). Specifically this entails a process where genetic foreign material is inserted into the deoxyribonucleic nucleic acid (DNA) of a plant, animal, or microbe (Thompson, 1997). When this process includes the transference of genes between different species it is referred to as transgenic ("Lay Panel Consensus," 1999). These effects extend further than classical breeding techniques by not relying on the random nature of variation, but achieving results directly by crossing the species barrier (Butler & Reichhardt, 1999; Roller & Harlander, 1998). This means that transgenic plants and animals will contain genetic codes that have never occurred before in any species (Steinbrecher, 1998).

Traditionally scientific knowledge has been labelled as the critical factor in whether genetically modified food (GMF) is accepted or rejected (Wagner, et al. 1999). This view sees public education of the scientific value of biotechnology as the answer to reducing fears of the unknown world of genetics, while simultaneously ensuring scientific and economic progress ("In Defence Of The Demon, 1998;" Zimmerman, Kendall, Stone, & Hoban, 1994). Hence, while arguments have focused upon the scientific merits of biotechnology, its existence

as a social construct has largely been ignored (Hindmarsh, et al. 1998). Yet biotechnology is far from being neutral and existing in a social vacuum, instead it can be seen to be enveloped within political, economic, moral, and environmental agendas which shape, change, and direct societal outcomes (Plutzer, et al. 1998). This emphasises the need for professionals to develop a wider understanding of the influence of the above mentioned factors which have not routinely been included as a component of self report measures of attitudes to GMF (Wagner et al. 1999).

2. The Attitude Framework: Definitions and Model

Nevertheless it is clear that modern biotechnological advances are giving rise to widespread differences in consumer attitudes (Hoban, 1998; Gaskell, Bauer, Durant & Allum, 1999). Attitudes have been defined as the psychological tendency to evaluate some specific entity with a degree of favour or disfavour, goodness or badness, acceptance or rejection (Eagly & Chaiken, 1993). Evaluative responses are not only classified according to differences in direction, that is positive or negative, but also according to intensity (Oskamp, 1991). Although attitudes are not directly observable, and as such are described as latent variables, they have been regarded as outcomes of the tendency to categorise, which subsequently energises and directs behaviour (Chaiken & Stangor, 1987; Tesser & Shaffer, 1990).

Interest in this latent process introduces the issue of which framework is best suited to describe a construct which is unobservable (Eagly & Chaiken, 1993). The Tripartite model has been a common method utilised to explain the structure of attitudes, and although it has been criticised for its lack of operationalisation, has allowed the synergistic relationship between thoughts,

feelings and behaviour to be explored along an evaluative dimension (Pratkanis, Breckler & Greenworld, 1989).

First, from a cognitive perspective, it has been suggested that beliefs function not only to connect attitudes together, but to also link the attitude object with a negative or positive characteristic (Eagly & Chaiken, 1993; Fishbein & Azjen, 1972). For example people may believe that the consumption of GMF will cause damaging health effects, while others may believe that GMF is a cheaper, more efficient alternative (Butler & Reichhardt, 1999; "GMO's-Do We Need," 1999). In both cases the belief links the attitude object, GMF, with either a negative or positive attribute.

Second, emotional or affective responses have also been located on an dimension from extremely positive to extremely negative (Lemon, 1973). As a consequence it has been suggested that people who evaluate an attitude object favourably for example, are more likely to experience positive rather than negative emotional reactions although this may not directly impact upon underlying belief systems (Zajonc, 1980b). In contrast, people who evaluate GMF unfavourably are more likely to experience negative rather than positive emotions (Zimmerman et al, 1994). This illustrates the synergistic relationship between thought and emotion.

Third, while behavioural responses of an evaluative nature can be overt or directly observable they can also be covert, or indirectly observable (Eagly & Chaiken, 1993). Thus although a covert response such as the intention to act, may or may not be executed, it provides an indication of the direction of evaluation (Oskamp, 1991). For example people who positively evaluate GMF would be predicted to be more likely to want to buy the product. In contrast, people who evaluate GMF negatively would be predicted to be less likely to search for the product at the supermarket.

The Tripartite model also incorporates the notion that attitudes do not need to possess all three facets in order for evaluative responses to surface, which means opinions may develop according to one exclusive process (Eagly & Chaiken 1993). For example the degree of direct or indirect exposure to the attitude object may promote learning and therefore beliefs, or the extent of repeated pairing of the attitude object with an affective response may lead to emotionally focused reactions (Zajonc, 1968a). Lastly, the magnitude with which past behaviours associated with the attitude object are rewarded or punished may serve to encourage evaluations based on actions (Oskamp, 1991). Thus the Tripartite model allows attitudes to be viewed according to interactive or exclusive cognitive, affective, and behavioural processes, and has meant that objective indicators can be implemented to assess evaluative tendencies.

3.Aims of Review

The intention of this review is to argue that while existing empirical measures have advanced our understanding of attitudes to GMF, they are limited both conceptually and methodologically. An outline of prior types of attitude measurement will be followed by a critical review of the debate and its emerging themes. This will serve as a basis with which to explore the proposal that attitudes to GMF are composed of a number of dimensions which have yet to be measured. As a result proposals for future research will be introduced so that our knowledge of attitudes in this area can move forward.

4.Overview of Previous Types of Attitude Research

To date there is a lack of any psychometrically valid measure of attitudes to GMF. Despite this, a variety of different methodologies have been employed such

as self-report measures, public discussion forums called consensus conferences, and semi structured interviews ("Lay Panel Consensus," 1999; Muggleston, 1998; Hoban, 1999; Wagner et al. 1997; Zimmerman, et al. 1994).

4.1. Measurement Approaches

Most empirical attitude research has been conducted overseas where a number of comparative studies have explored public perceptions of applications of biotechnology in an effort to ascertain consumers' attitudes to GMF (Wagner et al. 1997). The largest study is the Eurobarometer series which began in 1973 and was last conducted in 1996. Using a multistage random sampling technique, a representative sample of 16,246 respondents, approximately 1,000 in each of the 16 European countries completed surveys (Wagner et al, 1997). The countries that participated included Austria, Belgium, Germany, Denmark, Spain, France, Finland, Greece, Italy, Ireland, Luxembourg, Netherlands, Portugal, Sweden, and the United Kingdom.

4.2. The Australian Approach: Consensus Conferencing

Most people have little knowledge about GMF and so one option is to set up panels to explore issues with experts. The first Australian consensus conference occurred in early 1999 in which a lay panel of 14 citizens and a panel of diverse experts were invited to participate in a discussion of the issues pertaining to the introduction of genetically modified food ("Lay Panel Consensus," 1999). The panel of citizens decided the agenda, which questions would be set, experts selected, and all key facets of the meeting. Conclusions reached included a belief that the current regulatory and advisory bodies such as the Australian and New Zealand Food Authority (ANZFA) and the Gene

Manipulation Advisory Committee (GMAC) have failed to serve community interests, that current legislation needed to be broadened to include environmental and social circumstances, and decisions had occurred too quickly and without public consultation. Concern was also raised about the control of food resources by a small number of multinational companies, and scepticism about the suggestion that food which has been genetically modified would offer a solution to world hunger ("Lay Panel Consensus," 1999). All of the above qualitative accounts echo international reports regarding a lack of trust in official regulatory bodies, and lack of attention to social, moral and environmental issues.

4.3. Qualitative Approaches

While infrequently used in this area, qualitative assessment methods have provided an opportunity to gain some deeper insight into the complexity of the issues surrounding the introduction of GMF. Zimmerman, et al. (1994), examined consumer knowledge and concern about biotechnology. Sixty seven people attended one of six focus groups in either Colorado, Nebraska, New York, Ohio, or Pennsylvania. The aim of the study was to elicit as many different views from the participants as possible. All group discussions were audiotaped, transcribed and cross coded to minimise subjective appraisals. Results were analysed according to semantic content and overall suggested that consumers were less in favour of biotechnological applications that involved animals, were concerned about adequate safeguards from potential health hazards, and lacked confidence in government officials because they were perceived as inefficient people who were not working in the public's best interest. While the study provided a deeper understanding of highly individualised processes, the results were limited by a small and unrepresentative sample of the population, with one quarter of

individuals involved in farming practices and approximately 50% of the participants well educated. Overall this approach can be prone to the effects of investigator interpretation, possible bias, contending with the reduction of large amounts of data, with results dependent upon the degree of insight that the individual possesses (Masling, 1997).

Other variations on a qualitative approach have been used by Frewer, Howard, and Shepherd (1997), who explored the relationship between general and specific biotechnological applications and attitudes. Two different groups of 25 participants were asked to listen to 15 specific and 15 general applications of biotechnology, and respond by first ranking the stimuli in order of concern or benefit, and then explain why that order was chosen. Applications were medical, agriculture or food related. Based on a semi-structured interview, peoples responses were used as the basis for individualised questionnaires. Using Repertory grid and Procrustes analyses a graphical representation of the responses was plotted. Results found applications involving human or animal genetic material were generally perceived as harmful and ethically concerning, while GM plants or micro-organisms were viewed as beneficial and necessary. Overall this technique allowed the respondent to describe concerns without having an experimenter predetermine the discussion of the issue.

5. Emerging Themes: The Social Construction of Risks Versus Benefits of Biotechnology in Health

Much debate on biotechnology has centred on concerns around the technical aspects of risks versus benefits to health (Beun, den Hollander, Overbeeke, & Schalk, 1998; "Cooking with Genes," 1999). Those in industry and science in favour of GMF propose that consumers misunderstand the degree of

risk involved which has resulted in premature rejection of the technology (Anonymous, 1998; Playne, 1994; Playne, 1998). Recombinant DNA technology is being promoted as offering the consumer improved health by improving food quality, nutritional capacity, texture and appearance, as well as a longer shelf life (Roller & Harlander, 1998). Supporters argue that gene technology is just an extension of the way genes have been mixed for centuries, although it's faster, more precise and more efficient ("Lay Panel Consensus," 1999).

In contrast Steinbrecher (1998) has proposed that genetic scientists are ignoring the potential risks to the consumer when transforming food. As a result issues such as potential health damage due to toxic side effects, allergic reactions, antibiotic resistance, loss of nutritional value, and the lack of long term studies on the stability of the newly formed foods are emerging in the debate (Hansen & Halloran, 1999; Steinbrecher, 1998). Those in opposition question the capacity for science to predict, suggesting that not enough is known to be able to foresee risks in the real world so a precautionary principle should be adopted ("Lay Panel Consensus," 1999).

6.Ethics and Morality

Public concerns about GMF are likely to reflect not only scientific and health related issues but also more fundamental aspects of moral beliefs. Moral concerns may act as a block to favouring food which has been genetically modified despite how useful or risky the technology may be, and thus represent a second potential dimension in the structure of attitudes to this issue (Gaskell et al, 1999; Sparks & Shepherd, 1992; Wilkie, 1998). A moral value has been described as that which distinguishes between good or bad, right or wrong, honourable versus corruptible, just versus unjust (Reber, 1985). In the case of GMF, the alteration of the essential

building blocks of life itself has raised numerous concerns regarding control, ownership, and the manipulation of nature (Plutzer, et al. 1998; Serageldin, 1999; Thompson, 1997).

Control can be viewed from two perspectives. Firstly at a broad level the idea that life itself can be owned and therefore controlled via patent laws is abhorrent to many critics (Thompson, 1997). Secondly control is an issue at a personal level, since it is threatened via violations of individuals' rights including the right to chose, the right of informed consent and the right to participate in policy decisions (Hansen & Halloran, 1999).

In the first instance, the underlying belief that nature can be controlled, its unpredictability can be removed, and that this is good, has been contrasted with those who perceive that genes are being altered in a new way which may create unpredictable consequences which may be harmful and impossible to reverse (Steinbrecher, 1998; Wilkie, 1998). Take the example of patenting laws and intellectual property rights. It has been claimed that ten agrochemical companies hold approximately 40% of the global seed market, held in the past by a diverse range of independent seed producers ("Lay Panel Consensus," 1999). Fears have been expressed that patenting laws and intellectual property rights held by such a small group of companies will result in restrictions, controls, and selected research designed for profit rather than human welfare (Steinbrecher, 1998). In some cases patent laws prevent farmers from saving seed from crops, which has meant seed has to be repeatedly purchased each year (Serageldin, 1999). The fact that life forms can now be bought and owned attacks the sacredness of life for some (Thompson, 1997).

Individual control is also perceived to be threatened via violations of the consumer's right for independence and choice (Hansen & Halloran, 1999). In the

case of GMF the removal of personal control has largely occurred via external forces such as a lack of labelling, informed consent, and insufficient opportunities to participate in decision making processes (Macillwain, 1999; Thompson, 1997). For example currently no labelling of GMF occurs in Australia with the food industry appearing resistant to its introduction (Carr, 1999; "Lay Panel Consensus," 1999). This means that consumers have no knowledge of whether a product is or is not GM, and therefore no choice in deciding whether they would be prepared to buy and consume it. As a result, the consumer may be left in a state of negative emotional arousal which may in turn promote an unfavourable view of GMF (Jacoby, Johar, & Morrin, 1998). The range of views on the issues of independence, self-reliance and choice in our cultural values have yet to be investigated in empirical attitude studies.

A further objection to the movement of genes between species is a perceived violation of human limits and spiritual laws (Thompson, 1997). For example dietary laws that pertain to specific religions may forbid consumers to ingest foods from particular sources such as pork, so without labelling of GM food products, the individual's rights are being violated. Vegetarians would not want to consume plants containing animal genes, and other individuals prefer food in its at natural state ("Lay Panel Consensus, 1999). Biotechnology has been little examined for its infringement of the rights and freedoms of human beings (Tatum, 1996).

Interest in the area of moral issues has resulted in broad examinations of moral acceptability internationally (Gaskell, et al. 1999). In Australia Norton, et al. (1998) conducted one of the few mail surveys determine public perceptions of GMF. Seven specific applications were included to explore acceptability, beliefs regarding release into the environment, health effects, expected purchases,

consumption, labelling, and knowledge. Applications included development of a blue rose, a GM tomato, blowfly resistant sheep, and pork containing human genes. Nine hundred and ninety participants responded, in all a response rate of 45%. Descriptive analysis of the findings indicated that those products which were inedible (e.g., blue rose) had the most support while those that were to be ingested were supported the least. Secondly, acceptance of genetic technology decreased depending upon whether the modification occurred by traditional or genetic breeding techniques. For example, any food which had another species' genes inserted was perceived to have harmful long term health effects.

While Norton, et al (1998) provide an insight into issues of acceptability, several limitations exist. First, their exploration of moral issues is tenuous, with only one statement included to cover moral acceptability. Second, no consideration has been given to religious or political views. For example those who are Muslim, or vegetarian may respond on moral or religious grounds rather than in response to the statement. Third, the response format used does not include a number which can act as a neutral point. Those who are undecided and may not have formed an opinion are forced to either polarity. Finally, a number of statements were ambiguous. For example 'health effects' could be good or bad depending upon the respondent's perception of the statement. Overall, these methodological limitations may decrease the validity of results.

7. Food Labelling and Rights

A third potential dimension emerging from the debate about GMF surrounds the issue of human rights. Both economic theory and democratic values assume consumers need to have the right to know and thus have a sense of control over

what they do, including what they eat (Saegusa, 1999). Consumer organisations have voiced the opinion that products from gene technology need to be labelled so that an informed choice can be made (Anonymous, 1999). This illustrates the need for the individual's fundamental right to know, right to information, and most importantly, right to choose rather than have an unknown quantity imposed upon them (Thompson, 1997). Despite the view of the majority of consumers that labelling is essential (Carr, 1999, Saegusa, 1999), some supporters of the technology are concerned that labelling may be perceived as a warning label, or an indication that GM food is unsafe (Masood, 1999). Alternatively, other proponents perceive labelling as a vehicle to reduce the public's resistance to buying GMF, while failing to educate the public (Anonymous, 1997).

Currently in Australia labelling standards are being decided by Federal, State, and Territory health ministers (Kelly & Brooke-Taylor, 1998; J. Day, personal communication, September 29, 1999). Although mandatory labelling appears likely ("Health Ministers Make Vital," 1999), the decision making process has taken little account of consumer opinion, or findings which suggest that consumers do not perceive the government as a trusted representative (Norton, et al, 1998). Consumer acceptance may thus be further thwarted if it is perceived as an imposition rather than a choice ("Lay Panel Consensus," 1999).

8. Environmental Issues

Another area that has received minimal attention in empirical attitude research has been the influence of environmental issues which may reflect in turn moral and political ideologies (Gaskell et al, 1999). Sustainability is been defined as the preservation of natural, non-renewable resources and intergenerational equity ("Lay Panel Consensus," 1999). In terms of sustainability, those in favour of

GMF perceive that its introduction will minimise the use of non-renewable inputs such as pesticides and fertilisers which would thus benefit the environment ("GM Food debate," 1999). In opposition critics have argued that intense agricultural farming with GM crops may result in an increasing use of agricultural chemicals which would pollute groundwater supplies and rivers (Steinbrecher, 1998). In addition there is a risk that pests could develop resistance to GM plants designed to destroy or resist insects, again leading to a return to conventional chemical sprays (Hansen & Halloran, 1999). While supporters argue that research into sustainable methods will lack funding if farmers are denied latest technologies such as gene transfer, opponents counter that the cause rather than the symptoms should be addressed by exploring other sustainable approaches such as organic farming ("Lay Panel Consensus," 1999).

Other potential ecological effects have been raised as concerns. These have included the ability of genes in GMF to transfer across species in field conditions (Crawley, 1999), uncertainty about the degree of mutation in the environment, the potential emergence of new viruses from plantings of virus resistance crops, and the escape of transgenic animals into the wild which could result in major disruptions to the ecosystem ("Lay Panel Consensus," 1999; Steinbrecher, 1998). For example Losey, Rayer, and Carter (1999), recently reported a study about monarch butterfly caterpillars and pollen, which found that exposure of wild hosts to pollen from genetically modified maize plants may increase caterpillar death rates. The ramifications of these environmental concerns can be seen in Britain, where opposition to GMF crops has seen Greenpeace campaigners protesting at plantation sites by dressing in contamination suits and pulling GM crops up from the fields while farmers ram the cars of the activists in an

attempt to save their crops (Crawley, 1999; "GM Food Protest," 1999). Thus, environmental values may form a fourth possible dimension.

9. Trust and Its Relationship to Government Decisions

9.1 The Effects of Attitudes on Policy Approaches to GMF

The role of the government is another contested point in the GMF debate. Considerable differences in opinion are emerging between countries as the regulation of GMF becomes an issue (Kelly, & Brooke-Taylor, 1998; "Lay Panel Consensus," 1999). In the United States regulation is managed through several laws which operate under the assumption that GMFs are the same as any other food. Therefore, a more permissive tone toward the introduction of GMFs appears to exist. In contrast the European commission requires applications for the importation or exportation of GMF to pass through a series of authorities, which appears to indicate that Europe is more restrictive in its approach. In Australia, the regulatory framework is thwarted by a lack of uniformity between various authorities, a situation which has led to a joint review by Commonwealth. The underlying perception of GMF as similar or different to traditional foods can be seen to have a large impact on the way regulatory bodies and laws operate.

9.2. The Effects of Past Experience

Public mistrust of GMF and the scientists who develop it has been further fuelled by the awareness of past scientific errors (Wagner et al. 1997). While the scientific community agree that gene transfers provide less risk than conventional chemical and food breeding techniques, similar claims have been made for alternate technologies such as nuclear power that have subsequently proved harmful or risky (Roller & Harlander, 1998; Wilkie, 1998). The impact of such

experience upon the consumers' ability to trust science, technology, and those who implement policy decisions appears to have been underestimated (Crawley, 1999).

9.3. Trust In National and International Regulatory Bodies

Trust of national and international regulatory bodies has become another major issue of debate, and may represent a fifth possible attitude dimension. In the latest Eurobarometer survey (Wagner et al. 1999), participants were asked which regulatory bodies were most suited to directing biotechnology. Institutions ranged from international organisations such as the United Nations or the World Health Organisation, scientific organisations, and ethics committees to the national parliament. Respondents indicated that they preferred international organisations to either their own national governments or the European Union. This may reflect two things, either that biotechnology has been perceived as an international issue where national bodies are redundant, or that a lack of trust exists in the national parliament's capacity to regulate the technology in the publics' best interests.

Interest in the above question led Wagner et al. (1997) to explore potential sources of involvement and dissemination of information further. Respondents were asked to consider which institutions could be trusted to tell the truth about biotechnology. These organisations included the medical profession, environmental and consumer organisations, farming and animal welfare organisations, universities, national and international public bodies, television and newspapers, industry, religious organisations and political parties. The two examples used were GMF crops grown in fields, and the introduction of human genes into animals to produce organs for human transplants, also called xenotransplants. Findings indicated that people discriminated between

xenotransplants. Findings indicated that people discriminated between organisations, preferring to trust sources which were related to the issue itself. For example respondents said they would trust environmental, consumer or farmers' organisations the most and political parties the least, while people preferred to trust the medical profession or animal welfare organisations when dealing with xenotransplants.

10.Trades and Treaties in Third World Countries: Power and Profit

A sixth potential attitude dimension may reflect issues of power and profit. (Bettelli, Megateli, & Rajamani, 1999). Industry has highlighted that genetic technology would help ensure adequate food supplies in countries which currently have famine, where crops are vulnerable to the effects of climate, effects that may increase in future years with the advent of global warming, and an increasing population (Roller & Harlander, 1998). The image of multinational companies as altruistic, well intentioned bodies who are motivated to care for humanity's needs is portrayed ("GM Food Debate," 1999). In contrast, opponents are cynical about the motives of companies behind GM technology suggesting that third world starvation is a convenient screen to cover their true motive which is to make profit (Steinbrecher, 1998). Critics emphasise that poorer farmers would be unable to afford the new varieties of crops in the first place, and that those crops which are being developed are not those on which developing countries depend (Serageldin, 1999). Opponents of GMF believe world hunger is driven more by imbalances in wealth, equity, and power rather than poor quality food supplies ("Lay Panel Consensus," 1999). At a deeper level these views indicate that power, control and economic interests are central issues in the debate on GMF. This has yet to be explored in empirical attitude research.

11. The European Perspective: A Complex Picture

The characteristics associated with acceptance and rejection in each European country appear complex. Contact, knowledge, image, expectations and feeling toward risk and regulation were assessed by Wagner et al. (1997). Level of contact was examined by two questions that asked if the respondents had heard or talked about biotechnology before. Knowledge was based upon a scale of factual questions about biology and genetics such as 'ordinary tomatoes do not contain genes while genetically modified tomatoes do'. The extent to which individuals possessed menacing images of biotechnological entities was indicated by the extent to which participants agreed or disagreed with statements such as 'by eating a genetically modified tomato a person's genes could become modified'. Next ten paired questions which outlined either positive or negative outcomes of biotechnology in the next 20 years (such as 'curing genetic diseases or 'creating dangerous new diseases') indicated whether people had negative or positive expectations of the technology. Finally respondents were asked whether they thought that the current regulations were sufficient, and believed that some risk needed to be accepted in the interests of economic growth, versus being anxious about risks and regulations.

European countries which demonstrated high levels of support tended to have a corresponding low level of knowledge and an image of biotechnology as menacing. Countries such as Portugal and Spain were included in this group. In contrast countries such as Austria, Denmark, and Sweden whose support was the lowest tended to possess high levels of contact and knowledge, with a matter of fact image and a low level of expectation. These results were interpreted to mean that countries in which biotechnology was well established were the least supportive and other countries where the technology was in its infancy were most

supportive. Wagner et al. (1997) suggested that familiarity with the technology actually provided the opportunity for the emergence of concerns. This had recently occurred in Austria where a three month ban was imposed following concerns over the transference of a gene containing antibiotic resistance that had been introduced into maize (Abbott, 1997). Limitations of this study included the notion that hearing or talking about GMF is very different from actual experience and exposure to the food itself. People may have felt able to discuss concerns but this may be unrelated to the level of actual exposure to GMF.

12. An International Comparison of Characteristics Associated With Attitudes of Acceptance and Rejection

In the United States, Gaskell, et al.(1999), replicated the same key questions as above and compared data collected in 1996-1997 from the European Union along with Norway and Switzerland and compared it with that from consumers in the United States. The purpose of the study was to examine the structural differences in attitudes of people from Europe and the United States. Support for the five applications of technology were again measured. Results suggested that overall both countries supported biotechnology to a weak extent. While both countries favoured the use of GM in medicines, genetic testing, and crops, they opposed the use of GM in transplantation. More specifically, while Europeans favoured genetic testing to a greater extent than the United States, when it came to food crops Europeans were less supportive, and opposed in the case of food. This may reflect the greater trust in official regulatory bodies in the United States coupled with the quick transition into the market place without the stigma of mad cow disease or Bovine Spongiform Encephalopathy (BSE) which has arisen in Europe.

13. The Impact of Media Coverage

Europeans are not only more antagonistic toward GM foods but exhibit a greater lack of faith in the credibility of official regulatory bodies. To explore the influence of information sources, the press coverage was monitored in both countries from 1984 to 1996 (Gaskell et al. 1999). Twelve national newspapers in Europe and The Washington Post in the United States were monitored from 1984 to 1996. Perspectives in which biotechnology was discussed and specific topics pertaining to biotechnology were recorded to assess the degree to which it may have shaped consumers' attitudes. Findings saw a sharp change from 1991 onward in the thematic content of press coverage with the United States covering themes relating to biotechnology from an economical standpoint, and accountability to the public, while Europe focused on biotechnology's progress and ethical issues. Although the European newspapers demonstrated a more positive tone compared to the United States, biotechnology became increasingly negatively portrayed in terms of press coverage. Gaskell et al. (1999) suggested that it was the type and extent of coverage that was correlated with an increase in negative public attitudes of European people. The study appeared constrained by the small sample of newspapers in America, with only one newspaper in the United States compared to 12 newspapers in Europe. Secondly it was presumed that the average consumer had read them. The importance of word of mouth, social group, radio, and television was not considered.

A similar study was conducted in Australia by White (1998), who examined the content of the Sydney Morning Herald. Articles pertaining to biotechnology were collected over a 12 month period. One hundred and eighteen articles were examined for their positive, negative or neutral tone. Sixty seven percent of the

articles were positively framed, 16% were negative and 16% were neutral. The positive articles emphasised health benefits, followed by business and commercial applications. Only four articles specifically dealt with ethical considerations. These results have demonstrated an Australian trend of publishing positive stories but without a corresponding balance of media coverage about issues such as environmental impact and ethical concerns. Of the 118 articles 15 were placed on the front page. Fourteen of these front page items were positive and one was neutral. While this study emphasises the tendency to provide unbalanced information it is limited in the sense that only one paper was monitored so results may be a reflection of the specific newspaper itself.

14. Other Methodological Limitations

14.1. Inconsistent Measurement

The latest Eurobarometer series surveyed individuals in late 1996 (Gaskell et al. 1999). Several items in the survey relate to biotechnology, one of which asked participants to respond on a four point scale to decide whether they thought each of six biotechnologies were useful, risky, morally acceptable, or should be encouraged. One application involved xenotransplantation which involves the use of GM animals in human transplantation. While all biotechnology applications were perceived as useful, those involving crop plants, food production, research on animals and xenotransplants were perceived as risky, and only the use of animals for research and xenotransplantation was viewed as morally unacceptable. In the case of GMF, the example provided was 'using modern biotechnology in the production of foods, to make them higher in protein, keep longer or change in taste'. The example given for research on animals was

'a mouse with genes that cause it to develop cancer'. Multiple regression analysis indicated that perceived risk was a low predictor support for biotechnology, when viewed in relation to moral acceptability and perceived usefulness. This indicates that the issue may be better served by addressing moral issues rather than focusing upon the debate about risks and benefits.

The study by Gaskell et al. (1999) is however limited on three grounds. Firstly the wording of the question regarding the genetically modified food included three different benefits which may confound the response. A respondent may appreciate a change in taste but reject changing food to allow it to last for a longer period. Secondly, all statements listed benefits, while the statement on animal research focused on a risk. This inconsistency in measurement may have affected results and provided a misleading indication of attitudes. Finally, items reflecting attitudes to potential violations of rights, including the right to know, the right to be informed, religious rights, patenting laws, ownership of life, and the right to choice have not been included.

14.2. Conflicting Reports: Inadequate Measures

Conflicting information pervades academic and consumer literature ("Untested Soya Presents Daily Risks," 1999; Hansen & Halloran, 1999). For example claims are made that there is no substantial evidence to suggest that GM foods are more risky compared to conventional foods (Anonymous, 1998), while in contrast Hansen and Halloran (1999) outline a list of scientific evidence which indicated that GM food is dangerous to human health. This includes 37 deaths from the ingestion of the supplement tryptophan which had been genetically modified.

Survey data of public opinion, where it exists, also conflicts on basic issues of support or opposition. Some of this may be due to inadequate methods and measures used. For example discrepancies are further noted between research results from a survey by Hoban (1999) conducted to measure consumer acceptance of biotechnology in Japan, and corresponding reflections by Hindmarsh, et al (1998). Hoban (1999) reported on survey results from a random sample of approximately 1,000 people in both Japan and the United States obtained between 1995 to 1998. Findings were reported to indicate that Japanese were supportive of biotechnology, even more so than the United States (Hoban, 1999). In contrast Hindmarsh, et al (1998) indicated that consumers in Japan are pushing to suspend marketing genetically modified processed foods, with Japan's public opposition so great that the U.S could face decreased market shares as Japan searches for conventional grains in countries such as Australia.

Given that Hoban's (1999) results appeared to contradict European findings (Gaskell et al. 1999) which express increasing opposition to GMF, it becomes important to examine the limitations of the survey instrument that was employed. Firstly, the majority of the research questions were framed in a positive light so that a response set was created. For example acceptability of biotechnology applications referred to food with lower fat and increased vitamin content, crop plants which reduced the need for pesticides, or higher quality soy sauce or tofu. Respondents were not provided with a balanced set of statements that reflected both the benefits and the risks of genetic technology.

Secondly, a list of food items using various technologies were read out in order to establish the participant's perception of food safety risks. The respondent then rated the extent to which it was a hazard on a three point scale. Pesticide residues and microbial contamination were perceived as a high risk and

biotechnology as a low risk. Yet if the term 'genetically modified' had been substituted the results may have been quite different. Specific rather than general terminology may have provided a more meaningful reflection of people's perceptions of genetic technology. Finally according to the figures provided in the report Japan's support for agricultural biotechnology has actually decreased by 8% between 1995 and 1998, while opposition has grown by 4% for agricultural applications, and 9% for medical applications.

15. Attitude Measurement: Psychometric Instruments.

At this stage no study has employed a psychometrically valid method to determine the underlying dimensions or content of attitude structure in relation to GMF. Two types of measures are commonly employed. First, indirect or projective methods using unstructured instruments are designed to validate psychoanalytical concepts such as projection where unconscious motives which are not obvious in overt behaviour can be measured (Cramer, 1987). Second, direct or objective methods rely upon self-report or behavioural observation for the assessment of rational thought processes (Martin, 1996). The differentiation between the two methods has resulted in open dissatisfaction with projective instruments, largely due to validity and reliability concerns, and a utilisation of objective methods, despite their inability to measure fantasies, impulses, and defences (Masling, 1997).

15.1. Models of Measurement For Multiple Item Measures

Psychophysical scaling and psychometric assessment are two traditional models of measurement (Lemon, 1973). Psychophysical scaling such as the Thurstone judgement technique involves two stages (Eagly & Chaiken, 1993).

During the first stage, stimuli such as beliefs are judged and scaled so that the location of the indicator along a psychological dimension of evaluation is predetermined. This results in a set of scale values that reflect the degree of favourability of the item with reference to the attitude object (Roberts, Laughlin, & Wedell, 1999). In the second stage, once indicators receive a scale value, respondents attitude scores are used to locate the person along the attitude continuum (Krebs & Schmidt, 1993). Thus the locations of indicators along different points of a continuum are determined prior to utilisation of the measure.

In contrast psychometric assessments such as Likert scaling involve no attempt to classify indicators along an evaluative dimension prior to measurement (Oskamp, 1991). The aim of this method is to assign a number to an indicator so that the properties of the numbers reflect a relationship between each of the items and the construct being measured (Eagly & Chaiken, 1993). The extent to which a person agrees or disagrees with a statement determines the location of the person along the attitude continuum. Self-report measures thus allow the extent and intensity of an attitude to be measured, usually on a five point scale (Oskamp, 1993; Pratkanis, Breckler, & Greenwald, 1989). These scores are then summed to achieve a total scale score, hence this technique is often referred to as the method of summated ratings (Lemon, 1973). This follows the idea of a dominance response process where people are expected to agree with an indicator to the degree that the underlying attitude is more favourable than the opinion expressed by the statement (Roberts, et al. 1999).

Both approaches to the assessment of attitudes have been criticised on several grounds (Krebs & Schmidt, 1993; Roberts, et al. 1999; Tepper & Tepper, 1993). With a Likert approach the exact level of measurement of scale scores is unknown, and a total scale score includes a range of possible responses from

individuals. In contrast items perceived as extreme indicators are eliminated by judges in the Thurstone technique as they are thought to violate the assumption that items should create a variation in responses (Lemon, 1973). This limits the final scale to items deemed relevant by the judges (Roberts, et al. 1999). Second, Thurstone procedures are criticised for the ability of the judges' own attitudes to effect the predetermined position of attitude indicators (Roberts, et al. 1999). Third, the extent to which relationships among items may be inflated when the data are only obtained from one measure has been raised as a general concern (Tepper & Tepper, 1993). Thus the effects of method variance, or the covariation between items from the same scale that may be attributed to the method of measurement employed, need to be considered in the process of scale construction.

On the whole, while Likert scales have been criticised for their inability to determine the precise level of measurement of scale scores, they continue to be employed widely as psychometrically valid measure of attitudes which assess cognitive, affective, and behavioural indicators (Pratkanis, et al. 1989). As a consequence long cumbersome analyses of individual items are not reported and data is reduced to a manageable degree. The critical difference between psychometric and psychophysical assessment methods appears to be that attitude is represented by the number of positive or negative attitude statements the person endorses, rather than attempting to create a item which is ideal for the person as a statement of their opinion (Lemon, 1973).

15.2. Semantic Differential Scale

The Semantic Differential Scale is also classified as a psychometric assessment technique, having established itself as an connotative measure of concepts which operates by having respondents rate adjectives along a seven

point bipolar continuum (Cogliser & Schriesheim, 1994). Opposing adjectives are listed at each end of a scale and respondents are required to check a point which corresponds to their evaluation about the concept (Krebs & Schmidt, 1993). While classification of these adjectives has traditionally yielded three dimensions known as evaluation, potency, and activity, the evaluation factor has demonstrated itself to be the most synonymous with attitude (Eagly & Chaiken, 1993). While the exact properties of these general scores are not known, the Semantic Differential provides a ready made scale which means that items do not have to be prepared in advance and scaled prior to administration (Oskamp, 1991). This technique also allows comparisons across different attitude indicators and can act as a test of construct validation if a second instrument is used. To date the Semantic Differential approach does not appear to have been employed as a measure of attitudes to genetic technology.

15.3. Item Analysis Technique: Factor Analysis

A nomothetical approach has been used to describe techniques which extract differences in judgements relative to other individuals along a bipolar continuum (Lemon, 1973; Reber, 1985). As an extension to this process evaluatively bipolar items which relate directly to approach versus avoidance behaviours can be meaningfully analysed with item analysis techniques (Krebs, & Schmidt, 1993). As an example, factor analysis not only allows the reduction of data and the meaningful grouping of dimensions, but it avoids having to report numerous item by item findings (Lemon, 1973; Oskamp, 1991). Thus unidimensional or multidimensional psychological constructs that underlie attitudes can be explored.

16. Implications for Public Participation

Tatum (1996) suggests that scientific and technological policy has traditionally evolved in a policy framework where costs versus benefits, or risk analysis is used to determine the value of any potential new technology. In contrast empirical results are revealing that international consumer opinion is becoming increasingly negative (Norton, et al. 1998). This widening gap between the consumer, the biotechnologist and regulatory bodies seems largely unheeded by those in the policy development process ("Lay Panel Consensus," 1999), and has been argued to affect our notions of power, authority, freedom, membership, and justice (Tatum, 1996). For example a lack of perceived public power, regulators who are not perceived as credible, and involuntary exposure to the perceived risks of GMF (Wagner et al. 1997), may all act to shape a negative global attitude to political justice. As a result the need for higher levels of active public participation and decentralised power (Wilkie, 1998) in scientific and technological policy field may be valuable so that a partnership approach to community decision making could develop (Rich, Edelstein, Hallman, & Wandersman, 1995).

16.1. Implications For Future Research

In view of the methodological shortcomings in previous research outlined throughout this paper, research utilising a questionnaire may be best served by firstly developing a reliable and valid multi-item scale. No measure of this kind currently exists. Secondly, items pertaining to dimensions including health, social, environmental, and moral issues need to be included. Thirdly, a balanced scale with equal numbers of negative and positively worded items would avoid possible response bias. In the fourth instance, demographic information pertaining to political preferences may offer an indication of the relationship between ideology

and attitude formation. As a result the scale could be used over the ensuing years to monitor attitude change. This could be utilised by the government and employed as a means to further explore consumers' attitudes if GMF is introduced into Australia. In the fifth instance, the sampling from a representative pool such as consumers who actually do the shopping may provide an indication of the relationship between attitudes and purchasing behaviour. Finally attitudes should be examined on a bipolar continuum to reflect their evaluative nature.

17. Conclusion

In summation, consumer concerns appear unlikely to be served by dissemination of technical information and policy decisions which seek to avoid discussing moral implications. The introduction of food which has been genetically modified is far from being neutral and existing in a social vacuum, instead it can be seen to be enveloped within political, economic, and environmental agendas which shape, change, and direct societal outcomes. International empirical research has made a substantial contribution regarding attitudes to biotechnology applications in general. Conceptually though, it has failed to consider specific environmental, moral, and political issues with respect to GMF. Methodologically, the previous research has many problems including investigator bias, wording difficulties, ambiguity, and an unbalanced representation of views. Future research would benefit from a comprehensive reappraisal of conceptual and methodological foundations, and the development of a valid and reliable instrument to measure attitudes. This information could then be used in policy decision making processes so that the needs and rights of the consumer are safeguarded.

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Development and Validation of the Biotechnology Attitude Index: A Measure of Attitudes to Genetically Modified Food.

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**A report submitted as a partial requirement for the degree of
Bachelor of Arts with Honours in Psychology at
Edith Cowan University**

October, 1999

Declaration

**I declare that this written assignment is my own work and does not include
(i) material from published sources used without proper acknowledgement; or
(ii) material copied from the work of other students.**

Signed by J. Cannon..... (Juliana Cannon).

Development and Validation of the Biotechnology Attitude Index: A Measure of Attitudes to Genetically Modified Food

Abstract

This report describes the development and initial validation of the 30-item Biotechnology Attitude Index (BAI), a self-report inventory designed to assess attitudes toward genetically modified food. Following a pilot study, 297 consumers completed the BAI. An exploratory principal component factor analysis with oblique rotation suggested that the measure consists of two subscales: Benefits and Morality, which were distinct yet related measures. Both subscales had high levels of internal consistency. Construct validity of BAI scores was established with strong convergent correlations with Semantic Differential scale scores. Criterion validity was demonstrated using a group differences approach with different sample groups. A preliminary analysis of consumer attitudes indicated the technology was rejected overall. Females rejected the use of genetic modification in food while males were more supportive. An examination of underlying relationships between attitudes and background demographic measures indicated that higher job status was moderately related to favourable attitudes. Individuals who were affiliated with the Democrats or the Greens had a more unfavourable attitude to GMF compared to people supporting three other political parties. The BAI could be used to understand attitudes of consumer and industry groups, so that common points of agreement could be established. As a consequence discussions may be aimed at promoting group cohesion and collaboration, rather than continual conflict, so that individual rights and values are balanced with societal need for technological progress.

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Development and Validation of the Biotechnology Attitude Index: A Measure of Attitudes to Genetically Modified Food

Despite growing resistance to genetically modified food (GMF), approximately 28 million hectares of crops based on gene transferal will be grown worldwide in 1999 (Abelson & Hines, 1999; Wagner et al. 1997). Defined as the insertion of foreign genetic material into the deoxyribonucleic acid (DNA) of a plant, animal or microbe, genetic modification (GM) has provoked a range of reactions especially as modified food increasingly enters the consumer market (Thompson, 1997). These attitudes range from feelings of moral outrage to optimism (Hansen & Halloran, 1999). Although various definitions exist, an attitude has typically been defined as the psychological tendency to evaluate a specific entity, in this case food which has been altered by genetic technology, with a degree of favour/disfavour or goodness/badness (Eagly & Chaiken, 1993; Reber, 1985). This definition is critical to clarify as minimal attention has been afforded to the inclusion of a structural definition which outlines the theoretical area to be measured and is essential to avoid creating limited or biased measures.

From a conceptual perspective, several themes are emerging from previous studies (Gaskell et al. 1999; Frewer, Howard, & Shepherd, 1997). The largest issue to dominate research pertains to the benefits and risks of biotechnological applications (Hoban, 1994). As a consequence consumer education about the scientific benefits of GMF is viewed as the solution to fostering acceptance (Macilwain, 1999; Playne, 1994; Playne, 1998). Even so, potential moral implications for both the individual and society are surfacing as a significant issue, although not addressed in depth in attitude research (Zimmerman, Kendall, Stone & Hoban, 1994). This moral domain includes a broad range of arguments surrounding labelling and with it the need to maintain democratic rights, freedom of choice and distributive justice (Carr, 1999; Masood, 1999; Wagner et al. 1997; Norton, Lawrence, & Wood, 1998). Not unexpectedly, trust is

identified as a pivotal element in the acceptance or rejection of GMF (Wagner et al. 1997).

More specifically, trends in public attitudes toward different biotechnological applications have been identified by the Eurobarometer series, which has been in circulation over the last 23 years, and continues to measure public attitudes at regular intervals in European countries (Wagner et al. 1997). Findings indicate that despite an increase in consumer knowledge the level of support for genetic modification is decreasing with time. Countries in which biotechnology is well established are generally the least supportive, while other countries where the technology is in its infancy are the most supportive. In the case of GMF, plant applications are more accepted compared to animal or human genetic transference (Frewer et al. 1997). Factors affecting these views centre around a decline in the perceived credibility of government bodies, in part influenced by the positive or negative slant on media releases about biotechnology (White, 1998). The impact of these contrasting attitudes can be seen by comparing the restricting way in which regulatory bodies and laws operate in Europe, with the more relaxed approach in the United States (Kelly & Brooke-Taylor, 1998).

Although these issues have practical significance, deeper inquiry continues in philosophical debate (Abbott, 1997; Ashley, 1999; Butler & Reichhardt, 1999; Steinbrecher, 1998; Tatum, 1996; Thompson, 1997; Wilkie, 1998). Psychological aspects surrounding the potential of people to abuse positions of power (Steinbrecher, 1998), along with political and economic agendas (Serageldin, 1999) have yet to be integrated in attitude research (Prilleltensky, 1997). Individuals may be responding to research based on underlying political principles rather than in direct response to statements. Environmental themes are also receiving minimal attention even though they are surfacing repeatedly in consumer debate (Gaskell, Bauer, Durant, & Allum, 1999; Hansen & Halloran, 1999). Thus, researchers continue to extend earlier investigations without reconsidering conceptual and methodological foundations.

Prior research possesses several methodological limitations. Even though empirical research is identifying multiple potential dimensions, single-item measures of attitudes to GMF continue to be employed (Gaskell et al. 1999; Norton et al. 1998; Zimmerman et al. 1994). Shortcomings of previous research are therefore based upon the use of single item self-report inventories which fail to allow the complexity of the issue to be explored within the context of other observations (de Vaus, 1995). Single-item measures decrease reliability of the instrument as they usually rely on one statement to define an issue (Waner et al. 1997). Secondly, response formats have not included a number which can act as a neutral point so that those who may not have formed an opinion are forced to either attitude pole (Norton et al. 1998). Thirdly, question wording has not contained a balanced number of both positive and negatively worded questions so that only the benefits, rather than the risks and benefits, are measured (Gaskell et al. 1999). These limitations result in limited reflections of public attitudes and may decrease the validity of results.

In Australia understanding attitudes to GMF has partly involved a focus group attending a consensus conference which was organised to explore GMF issues with experts ("Gene Technology in Food," 1999; "Lay Panel Consensus," 1999). Similar themes to European research (Wagner et al, 1997) emerged. These issues included a lack of trust in official regulatory bodies, concern about minimal public consultation, and the inability of current legislation to include environmental and social circumstances. The monopolisation of resources by multinational companies was also perturbing, with scepticism about the idea that GMF would offer a solution to world hunger. From a methodological perspective, the limited number of views combined with the inability to generalise results makes this approach to representing wider consumer attitudes unreliable and potentially invalid. Qualitative approaches can also be prone to the effects of investigator interpretation, possible bias, contending with the reduction of large amounts of data, with results dependent upon the degree of insight that the individual

possesses (Masling, 1997). Consensus conferencing has also been criticised for its inability to disseminate information to the wider public (Muggleston, 1998).

The limitations of these approaches have been outlined to emphasise the necessity for sound methodology, particularly when a controversial issue is explored. Multiple item indicators are advantageous from several perspectives. Firstly, they allow the complexity of the issue to be viewed in the context of other observations which avoids misinterpretation (Oskamp, 1991). Second, multiple-item measures increase reliability by not relying on one statement to define an issue (Lemon, 1973). Third, components of attitudes can be explored while numerous item by item findings are avoided (Krebs & Schmidt, 1993). In the field of psychology the assessment of attitudes has widely relied on derivatives of multi-item scales and test construction principles (Eagly & Chaiken, 1993).

Although single-item measures of attitudes to GMF exist, a review of the literature has uncovered no psychometrically valid method used to determine the underlying dimensions of attitude structure. Psychometric models using multiple-item indicators assign numbers to items so that the properties of the numbers reflect a relationship between each of the items and the construct being measured (Eagly & Chaiken, 1993). The extent to which a person agrees or disagrees with a statement determines the location of the person along the attitude continuum. Multiple-item indicators thus allow the extent and intensity of the attitude to be measured, usually on a five point scale (Oskamp, 1991). These scores are then summed to achieve a total scale score, hence the technique is often referred to as the method of summated ratings (Lemon, 1973). This follows the idea that people are expected to agree with an indicator to the degree that the underlying attitude is more favourable than the opinion expressed by the statement (Roberts, Laughlin, & Wedell, 1999).

There is a clear need for psychologists to investigate attitudes to GMF, not only from a methodological point of view, but for both practical and theoretical purposes.

There is a clear need to construct an easy to administer measure which produces reliable and valid scores. Such a measure could lead to improved comprehension of the consumers' views and needs and could be employed over the ensuing years to monitor attitude change. This instrument could also be utilised by the government, industry and consumer groups as a means to seek information from consumers when considering policy formation and labelling issues, so that a collaborative approach is fostered (Rich, Edelstein, Hallman, & Wandersman, 1995). From a theoretical perspective the investigation of the nature of attitude formation presents the possibility of further understanding the synergistic relationship between thoughts and emotion in attitude development.

The present exploratory study reported in this paper has three major objectives. The first aim is to construct and validate a reliable Likert scale to measure consumer's attitudes toward GMF. Second, to determine a concise, reliable version of the new scale. Third, as a part of this process, to implement this scale in a preliminary pilot study to explore underlying psychological constructs that define consumer attitudes. Fourth, to inductively offer hypotheses and future potential research directions.

Method

The present study was completed in several phases. Phase one included the construction of an item pool to measure attitudes to GMF. Phase two involved a pilot study to evaluate the content validity of the items. The third phase consisted of the data collection with the Biotechnology Attitude Index (BAI) administered to a community sample for two purposes. First to assess the reliability and validity of scores on the instrument, and second, to undertake a preliminary assessment of consumer attitudes to GMF. The final phase involved reducing the scale to a 30 item measure.

Participants

In total 307 individuals from the community participated in this research. Phase two included 10 respondents who were staff employees of an organic shop and 10 fourth year Psychology Honours students from Edith Cowan University. As the primary purpose of the research was scale development and exploratory analysis of attitude patterns, a purposive representative sample was recruited from multiple community sources including 83 people from a public forum on GMF and Biotest at Murdoch University, 102 people from traditional fruit and vegetable shops at shopping centres, and 112 people from two metropolitan organic shops in Perth. In phase three the BAI was completed by 183 females (61%) and 108 males (36%). In total 500 questionnaires were distributed and 297 individuals provided usable replies. This was a response rate of 59%. Ages ranged from 18-81 years ($M=39.17$ years; $SD=13.58$).

All respondents were from the Perth community and undertook the research on a voluntary basis. Psychology students were not permitted to actively partake in phase three of the study. In line with ethical considerations each individual had the right to withdraw at any stage. No reimbursement or debriefing took place at the conclusion of the research and participants were thanked in anticipation of their assistance (see

Appendix A). Each participant was provided with the opportunity to include their name and address if they were interested in being informed of the results (see Appendix B).

Instrument Development

Phase One-Item Development. The first stage involved defining the concept to be measured, in this case attitudes to GMF (de Vaus, 1995). As the meaning of attitudes has been appraised in a variety of ways within the psychological literature, a range of definitions of the concept were elicited and common elements were retained (Eagly & Chaiken, 1993; de Vaus, 1995). This was an important step to guarantee that beliefs and knowledge were excluded from measurement (de Vaus, 1995). As no scale had been developed in previous research a range of less structured methods were employed in the construction phase.

Items were generated from examination of a wide variety of written sources from scientific, health, social and consumer related disciplines (Hindmarsh, Lawrence, & Norton, 1998). Secondly, comments were noted from the questions raised by some of the community members who attended a hypothetical debate about GMF, the essence of which was included in various items. Thirdly, the owner of a local organic shop was interviewed in an unstructured manner in order to develop an appreciation of perceptions, concerns, and issues. A total of 110 items were produced during the initial phase of scale construction.

Phase Two (First pilot test)-Face and Content Validity. In order to ensure face validity, indicators were examined to remove any items that were not clearly related to aspects of attitudes to GMF. The 110 item questionnaire was distributed to 10 fourth year psychology students and 10 staff at an organic shop. Respondents were asked to note questions they found unclear or ambiguous. As a result, of the 110 items, 44 were discarded due to ambiguity, poor wording or doublebarrelled statements. Of the

remaining 76 items, 15 were subsequently rewritten, shortened or simplified to enhance clarity while 3 new items were added to reflect additional suggestions pertaining to issues not covered.

The total possible score on the BAI potentially ranged from 30 (extremely unfavourable attitudes to genetically modified food), to 150 (extremely favourable attitudes toward genetically modified food). The theoretical midpoint of the summated scores was therefore 90 which would reflect a person who had a neutral or undecided attitude to the issue.

Phase Three (Preliminary study). The instrument used consisted of three sections: a) Likert scale b) Semantic Differential scale c) demographics. The first scale contained 76 items designed to represent a variety of perspectives reflecting support and opposition (see Appendix B). It contained equal numbers of positively and negatively worded questions, with a five point response scale, ranging from 1 (*strongly disagree*), 2 (*disagree*), 3 (*neither agree nor disagree, undecided*), 4 (*agree*), and 5 (*strongly agree*). (see Appendix B).

The second scale consisted of a seven point Semantic Differential scale which has become an established measure of general attitudes, and was employed to ensure criterion validity (Eagly & Chaiken, 1993). If both new and accepted measures were highly correlated the BAI would equate with a valid scale (de Vaus, 1995). Eight sets of descriptive adjectives were included to reflect one of three possible conceptual dimensions. In the first instance the evaluative dimension contained the adjectives good/bad, admirable/deplorable, worthless/valuable, and safe/dangerous. The competent dimension contained the adjectives competent/incompetent, and successful/unsuccessful. Finally the activity dimension included the adjectives powerful/powerless and active/passive.

Finally background measures recorded demographic information such as age, sex, extent of direct food purchase, political preference and current perceptions (see Appendix B). Occupational status was scored according to the Prestige Scale devoped by Daniel (1983). This score ranged from 1, a high status, to 7 which represented a low status. Statistical analysis of the data was conducted using Statistical Package for the Social Sciences (SPSS), Windows Version 8.

Procedure

In each setting where individuals were recruited, potential participants were provided with a ledger where they could record their name and address if they were willing to complete a survey. A pack containing a cover letter outlining informed consent and ethical considerations, the BAI with instructions, and a prepaid return envelope was then mailed to respondents (see Appendix B). Ethical guidelines for psychological research provided by Edith Cowan University were followed. Informed consent was essential, each individual being instructed to read and understand the covering letter prior to responding (see Appendix A). This emphasised the confidential nature of the study, which upon completion at home was placed in a reply paid envelope, sealed immediately and returned to the University. A follow up reminder letter was then mailed to participants who had failed to return the questionnaire after one month (see Appendix C).

Results

Final Instrument

Final item inclusion was based on a consideration of item-total correlations, standard deviations and means. Fifteen of the highest item total correlations from each attitude pole were retained. Redundant indicators with extreme means or low standard deviations were excluded to ensure adequate response variation and range. The final version (30 item) contains a balanced item set in which 15 indicators represent a supportive attitude to GMF and 15 indicators represent an unfavourable attitude to GMF. An inspection of the item-total correlations reveals that they are all $> .7$ (see Table 1). The overall mean attitude score on the 30 item BAI ($n = 297$) was 67.13 ($SD = 31.28$).

Exploratory Factor Analysis. There were no systematic cases of missing data so the variable mean was used to replace random missing values. While Factor Analysis is considered robust to assumptions of normality, Bartlett's Test of Sphericity indicated that the factor matrix was suitable for analysis ($p < .0001$) and the Kaiser-Meyer-Olkin measure of sampling adequacy was high (.982). Using sample 2 ($n = 297$), the BAI data (30 item) were submitted to an exploratory (Principal Components) Factor Analysis with an oblique (oblimin) rotation with delta set to zero. Two main factors had eigenvalues of 66.76 and 6.67 which reflected 73.43% of the total variance (See Table 2). This was supported by the scree plot of eigenvalues which was also found to level after two factors. The first factor was labelled "Benefits" as these items reflected the perceived advantages of GMF in areas such as health and the environment. The second factor was labelled "Morality" as these items portrayed the tendency to focus upon moral implications of genetic technology in food. Factor loadings, communalities (\underline{h}^2), and percentages of variance explained following oblique rotation are shown in Table 2.

Table 1

Items and Item Statistics for the Final Version of the Biotechnology Attitude Index

	Item	Mean	SD	Item-Total Correlations
1	It's good to change a plant's genetic makeup to resist pests	2.41	1.41	.80
2	Genetic modification of food should be avoided as it will change the path of natural evolution (R)	3.52	1.41	.72
3	By genetically modifying plants for human consumption we wrongly assume that we own other life forms (R)	3.42	1.33	.73
4	Genetically modifying crops so they could provide immunisation against disease would be welcomed	2.49	1.39	.75
5	Transferring genetic material from one plant to another plant is acceptable	2.51	1.39	.80
6	If society continues to genetically modify food future generations will pay the price of our choice (R)	3.86	1.28	.78
7	Genetically modified food is acceptable as it is a more efficient way of growing food	2.15	1.23	.85
8	Genetic modification is a powerful innovation that should be welcomed	2.35	1.33	.88
9	Gene technology is undesirable as it is taking funding away from exploring other sustainable approaches such as organic farming (R)	3.72	1.36	.87
10	It is ridiculous to consider eating genetically modified foods as they could lead to long term health effects (R)	3.48	1.34	.75
11	Through genetic technology food will be far superior in quality	2.14	1.15	.76

	Item	Mean	SD	Item-Total Correlations
12	It is acceptable for scientists to transfer genetic material from a fish to a tomato to reduce freezing damage	2.08	1.30	.86
13	Eating genetically modified potatoes that have been changed to absorb less oil would be okay	2.33	1.29	.87
14	It scientists can <u>not</u> reverse the process of genetic modification of plants we should never use it (R)	3.79	1.30	.78
15	The thought of food being nutritionally <i>enhanced</i> appeals to me	2.33	1.39	.81
16	It's worrying that changes to the genetic makeup of our food are being made with minimal public debate (R)	4.31	1.01	.73
17	Genetically altering plants takes humanity into areas where we do <u>not</u> belong (R)	3.58	1.38	.82
18	It is acceptable that scientists are changing garlic to increase more of the component that lowers cholesterol	2.46	1.35	.86
19	Eating genetically modified foods would be a violation of my personal values (R)	3.37	1.49	.87
20	It would be better to eat more natural foods to cure illness (R)	4.18	1.10	.74
21	It would be worth the extra expense to shop for foods that have never been genetically modified (R)	3.78	1.33	.83
22	Some other countries have successfully introduced genetically modified foods so Australia should do the same	1.94	1.07	.81
23	It's morally concerning that scientists are transferring human genes into pigs (R)	4.10	1.21	.75

	Item	Mean	SD	Item-Total Correlations
24	I am confident that the regulatory controls for genetically modified foods are adequate	1.95	1.16	.77
25	It is morally incorrect for biotechnology to breach the boundaries between natural and artificial life forms (R)	3.54	1.29	.77
26	To improve nutrition we should add other natural foods to our diet rather than alter existing foods (R)	4.24	1.05	.75
27	Genetic engineers are modifying plants while ignoring the hazards of doing so (R)	3.70	1.22	.81
28	Genetically modified tomatoes would be appealing if they were tastier than naturally grown tomatoes.	2.19	1.23	.82
29	It is good to think that potatoes can be genetically altered to prevent discoloration	2.02	1.16	.79
30	It is okay for genetic engineers to change strawberries so that they contain more anticancer agents	2.37	1.30	.84

Note. (R) at the end of the item indicates the scoring was reversed.

Table 2

Oblique Rotated Factor Loadings and Item Communalities for Individual AttitudeVariables

		<u>Factors</u>		<u>h²</u>
<u>Item</u>		<u>1</u>	<u>2</u>	
40	Immunisation welcomed	.95	...	.75
54	GM anticancer agents	.93	...	.82
27	GM potatoes less oil	.92	...	.86
28	GM means nutritional enhancement	.90	...	.77
32	Lower cholesterol	.89	...	.83
36	Taste	.88	...	.77
19	Efficiency food production	.87	...	.81
44	Introduction in Australia	.86	...	.74
1	GM for pest resistance	.85	...	.74
22	Powerful innovation	.84	...	.84
70	Superiority of food	.83	...	.68
13	GMF plant to plant	.79	...	.71
38	Regulatory control	.77	...	.66
25	GMF animal to plant	.72	...	.79
67	Prevent discolouration	.66	...	.67
47	Moral concern-human to pig	...	.97	.73
45	Natural foods to cure illness	...	.94	.71
24	Reversibility	...	.91	.74
33	Minimal public debate	...	.86	.66
69	Nutrition-add natural foods	...	.83	.68
63	Breach boundaries of life	...	.80	.70
30	Areas it does not belong	...	.78	.75
46	Extra expense for organics	...	.76	.76
4	Change natural evolution	...	.74	.61
14	Future generations pay price	...	.74	.68
49	Ignoring hazards	...	.73	.73
9	Ownership of life forms	...	.71	.60
23	No funding for sustainable approaches	...	.70	.80
31	Violation of personal values	...	.69	.80
21	Long term health effects	...	.64	.62
% of Variance		66.76	6.67	73.43%

Note. Factor loadings reported are from the Pattern Matrix.

h² = Communality

Validity and Reliability

Concurrent Validity. Pearson Product moment correlations were conducted between the total Likert scores and the four evaluative scores derived from the Semantic Differential Scale (good/bad, admirable/deplorable, worthless/valuable, safe/dangerous). A strong positive relationship between the total attitude score and the total evaluation score was significant, $r(291) = .926, p < .05$.

Internal Reliability. Cronbach's alpha was .982 for the 30 item scale, .977 for Factor 1, and .969 for Factor 2.

Comparison Between 'Known Groups'. A one-way analysis of variance (ANOVA) was also computed on attitude scores for the three groups. These groups consisted of people from Biotest and the public forum (ProGMF), consumers of organic produce (Organic), and people who shopped at non-organic fruit and vegetable shops (Community). Although assumptions of normality were violated, $F(2,294) = 18.85, p = .000$, ANOVA is considered robust ($N=83-112/\text{group}$). With alpha set at .05 the result was statistically significant, $F(2,294) = 145.00, p < .05$. Post hoc pairwise comparisons conducted among the three cell means using the Tukey Honestly Significant Difference test (HSD) revealed that the mean attitude score for the people who were affiliated with the organic group was significantly lower when compared with both the community group and those who were supportive of GMF. In addition the mean attitude score for the community group was significantly lower than the pro GMF group and significantly higher compared to the organic group. Finally the mean attitude score of the pro GMF group was significantly higher compared to both the community and organic sample. Descriptive statistics are provided in Table 3.

Table 3
Means and Standard Deviations for Groups with Different Attitude Preferences.

Group	n	Mean	Standard Deviation (SD)
ProGMF	83	98.76*	29.95
Community	102	66.98*	21.66
Organic	112	43.83*	14.96

* $p < .05$

Relationship of Attitude to Demographics

An independent t test was computed on the total sum of the BAI-GMF attitude scores for the two conditions (gender; shopper). Alpha was set at .05 and although assumptions of homogeneity of variance and normality were violated for gender, $F(184) = 17.08$, $p < .05$; $D(296) = .131$, $p < .05$, t test is considered robust ($N=109-186$ /group). For the shopper condition assumptions of homogeneity of variance was satisfactory while normality was violated, $F(294) = 2.94$, $p > .05$; $D(296) = .131$, $p < .05$. Again the t test is considered robust ($N= 239-57$ / group).

The results indicated a significant difference in BAI-GMF attitude scores between males and females, $t(183.66) = 6.22$, $p < .05$; and shoppers compared to non shoppers, $t(294) = -3.30$, $p < .05$. The mean attitude score for males was 81.87 ($SD = 33.81$), compared to 58.47 for females ($SD = 26.12$); and shoppers $M = 64.13$ ($SD = 29.94$), compared to non-shoppers $M = 79.09$ ($SD = 33.10$). Frequency counts indicated that 71% of females and 28% of males completed the shopping.

Pearson product-moment correlations were conducted between age and attitude, occupation and attitude, education and attitude and knowledge and attitude. Two participants had missing data on age, 96 for occupation, 6 for education, and 33 participants for knowledge. A weak negative relationship between age and attitude was significant, and a weak negative association between perception and attitude was significant. In contrast a moderate positive association between occupation and attitude was significant, and weaker positive relationship between education and attitude was also significant (see Table 4). Frequency counts indicated that 59% of females and 41% of males were in paid employment, with double the number of males ($n = 34$) compared to females ($n = 17$) in high status jobs (< 3.00).

Table 4

Correlations of Total Attitude Scores on the BAI with Background Variables.

Variable	n	Correlation
Age	295	-.204**
Occupation (R)	201	-.311**
Education	291	.173**
Perception	264	-.251**

** $p < .05$ (two-tailed test)

Note. Occupation: Only paid employment is included, 32% of respondents were in unpaid employment (mothers, retirees, or students).

Note. (R)= reverse scored. High status job equated to lower scores.

Thirdly, a one-way analysis of variance (ANOVA) was computed on attitude scores for the four types of political membership (No Party, Liberal/National, Greens/Democrats, Labor). Although assumptions for homogeneity of variance were violated, $F(3,276) = 6.98$, $p < .05$, ANOVA is considered robust ($N=51-91/\text{group}$). With alpha set at .05 the result was statistically significant, $F(3,276) = 11.96$, $p < .05$. Post hoc pairwise comparisons conducted among the six cell means using the Tukey Honestly Significant Difference test (HSD) revealed that the mean attitude score for the people who were affiliated with the greens/democrats political party was significantly lower than any other political group. Descriptive statistics are provided in Table 5.

Table 5
Means and Standard Deviations for Groups with Different Political Party Preferences.

Group	<u>n</u>	Mean	Standard Deviation (<u>SD</u>)
Liberal/National	55	79.96	31.40
Labor	51	74.35	33.17
Democrat/Greens	91	52.54*	24.24
No Party	83	69.35	31.45

* $p < .05$ Note. 17 people failed to provide data.

Discussion

A concise instrument was constructed to measure consumers' attitudes to GMF. The final BAI (30 item) is a scale which includes adequate representation from both negative and positive attitude poles, with equal numbers of items reverse coded in order to remove positive response bias. The 30 highest corrected-item total correlations were retained ($> .7$), so that each item was chosen to measure the same underlying concept, attitudes to GMF.

An exploratory principal components analysis generated two factors, both of which yielded eigenvalues greater than one. The pattern matrix was deciphered because of its ease of interpretability. The first component was labelled 'Benefits' as items reflected the usefulness of GMF. This facet accounted for the largest proportion of the total variance in the construct (66.76%). Items loading heavily on this dimension included the potential health related advantages of GMF in immunisation, the prevention of cancer, lowering oil content in foods, enhancing nutrition, decreasing cholesterol or food discoloration. Items also incorporated the general advantages of GM as an efficient, successful, powerful, and superior technology which could be successfully introduced into Australia. Three of the remaining four items pertained to either the environmental advantage of GM crops in 'pest resistance', or the usefulness of genetic transference in plants or animals. One variable reflected confidence in regulatory controls for GMF. Overall, although this dimension reflects the perceived benefits or usefulness of GMF, mean item scores loaded on the negative attitude pole. This infers that consumers consider the benefits of GMF though they do not see any overall advantage over conventional foods at present. This result occurred despite variations in the purpose of the food product.

The second component was labelled 'Morality' and accounted for 6.67% of the variance. Variables loading heavily on this dimension had a tendency to reflect moral

values and included issues such as the transfer of 'human genes to animals', 'breaching the boundaries of life', going into areas we do not belong, ownership of life forms, changing natural evolution, and violations of personal values. Three other items resonated concerns about long term effects, hazards, and the lack of public debate. Environmental concerns about 'reversibility' and 'sustainable approaches' also featured, along with the need for natural rather than GM food to avoid illness or foster nutrition.

The Morality subscale reflects qualities which are universally concerning such as the limits human beings should go to in food production. The data indicate that attitudes to GMF are partially defined by moral values, particularly the transference of human genetic material for food purposes (Item 23). This verifies that consumers' attitudes to GMF from a moral perspective are partially defined according to the type of genetic transfer. Secondly, this dimension reflects the deeper concerns that consumers have about the ability of industry, scientists and governments to balance the need for technological progress with moral obligations to society. For example item 6, concern that 'future generations will pay the price for GMF', reflects the view that proponents of GMF are acting irresponsibly toward others, so that those with power who choose to act whilst disregarding opposition are violating important democratic norms. Therefore even though moral issues account for a minor proportion of the total variance, core moral values appear to be a critical aspect in the process of deciding whether GMF is accepted or rejected.

The 'Morality' subscale reflects other moral issues. Item 16 which highlights concerns over minimal public debate, loaded heavily in this dimension and taps into the deeper issue of valuing human diversity. Consumers are concerned about nonrecognition of their unique views, which leaves more powerful bodies in industry and science to decide the course of GMF, and consumers without the belief that they can have meaningful input into decisions affecting their lives. These additional aspects raise

the point that the rights and values of the individual and the larger society need to be considered in unison with scientific progress.

The present results suggest that a two factor oblique model provided the best fit to the data. This indicates that there are two related yet distinct dimensions to the BAI, and may illustrate that two aspects of the same potential theoretical dimension have been measured. Even though the positive applications of genetic technology in food explained 67% of the variance in attitudes as a construct and moral considerations only 7% of the variance, mean item scores which loaded on the negative attitude pole for both subscales.

Evidence of concurrent validity was established by computing Pearsons product moment coefficients between the total scores on the Likert scale and the total of the four evaluative scores derived from the Semantic Differential scale (good/bad, admirable/deplorable, worthless/valuable, safe/dangerous). A strong positive relationship between the two forms of measurement suggested that the BAI measures attitudes to GMF which involve evaluative tendencies. Higher total scores on the BAI were strongly associated with positive evaluative adjectives such as admirable, while lower scores were strongly associated with negative evaluative adjectives such as deplorable. This provides evidence that the BAI is a valid measure of attitudes to GMF.

In addition the internal consistency statistics for the instrument showed that the BAI-GMF produced highly reliable scores. The 30 item scale possesses an overall Cronbach's alpha of .982 for the 30 item measure which is high. More specifically factor one obtained an Cronbach's alpha of .977 and factor two .969, which indicates that the resulting two subscales produce reliable scores. Overall, this provides evidence of internal homogeneity in the BAI despite the reduction from 76 to 30 items. A scale of high internal homogeneity was constructed to measure the relative support or opposition for GMF.

Criterion-related validity of the BAI was assessed using a group differences approach where differences in attitudes from distinct sample groups was examined. A comparison between groups revealed that the mean attitude score for the people who were affiliated with the organic group was significantly lower when compared with both the community group and those who were supportive of GMF. In addition the mean attitude score for the community group was significantly lower than the pro GMF group and significantly higher compared to the organic group. Finally the mean attitude score of the pro GMF group was significantly higher compared to both the community and organic sample. This suggests that consumers of organic foods regard GMF with the most disfavour, followed by the community to a lesser extent, while consumers who support GMF regard it favourably. Mean scores for those in favour of GMF are only slightly higher than the theoretical midpoint. This may indicate that even those who support GMF continue to harbour some reservations about its introduction. Overall, the instrument can be classed as a valid measure, with BAI scores from distinct groups of people possessing significantly different test scores.

The relationship of total attitude scores to background demographic measures provided additional insight into the complexity of attitudes to GMF as a social phenomena. The preliminary pilot study resulted in an overall rejection by consumers of the use of genetic transference in food. More specifically the results indicate a significant difference in attitude scores between males and females, and shoppers compared to non-shoppers. Females rejected GMF to a significantly greater extent than males, and those who directly purchased food, (73% of whom were women), rejected GMF to a significantly greater extent than non-shoppers. This may reflect that women see fewer benefits or uses for GMF over conventional products, and consider the moral implications more seriously.

Additional correlations among background measures and attitudes reveal that weak to moderate relationships exist. A weak negative relationship between age and attitude suggests that the older people are less favourable their attitudes to GMF. This may reflect the importance of cumulative indirect exposure to technological hazards via the media, and the increasing importance placed on moral values with age. In conjunction a weak association between attitudes and current perceptions exists. The more GMF people perceive to be stocked on supermarket shelves the less GMF is favoured. This question was designed to test peoples' perception rather than knowledge base, and may mirror underlying distrust and credibility of official regulators. In this example, a lack of open and direct information about the extent of GMF on shelves appears to breed distrust and rejection of the product rather than support.

Job status had the strongest effect on attitudes to GMF of all the external variables. Higher job status is moderately related to favourable attitudes. Frequency counts indicated that double the number of men compared to women were in high status positions. This may reflect that professional people, most of whom were men in this sample, are more inclined to focus on the benefits of GMF as a tool for technological progress and economic growth, rather than moral implications for society. This was reinforced by examining educational level where higher scholarly levels were also associated with more favourable attitudes to GMF.

Results also demonstrate that the mean attitude score for the people who were affiliated with the Greens/Democrats political party was significantly lower than for any other political group. This indicates that political affiliation which is based on environmental values contributes significantly to the rejection of GMF. If people perceive that their environmental and political ideologies are being violated via the introduction of GMF then their attitudes to the technology will be unfavourable. Interestingly, environmental issues were enveloped in both the 'Benefit' and 'Morality' dimensions and

did not emerge as a single component. This suggests that environmental concerns about GMF are considered according to its benefit to the environment in conjunction with moral implications.

Taken together, these findings suggest that the acceptance of GMF is mediated by a number of factors. First, the 'Benefits' subscale reflects that attitudes are influenced by the extent to which GMF is viewed as beneficial and therefore useful or needed, although the present results imply that even when gene transfer is linked to positive rational goals such as immunisation in human health, or nutritional enhancement, people on the whole reject the application of gene technology in food. The negative appraisal by consumers also appears to be grounded in potent moral issues which concern the potential for both personal and societal moral violations. background measures suggest a gender basis for acceptance or rejection of GMF. Second, women who do the bulk of direct food purchases view GMF unfavourably, while males who hold professional positions tend to perceive GMF in a positive light. Third, lack of disclosure about the degree of GMF in supermarkets appears to be associated with negative evaluations, proportional to the perceived amount of product on the shelf. Finally, a rejection of GMF by those who support the Greens and Democrats, suggests that they believe that environmental principles are not being endorsed. These people may view GMF as a violation of these personal and societal values, and indicates the need for democratic participation, and a fair allocation of bargaining power, or distributive justice. Therefore it is hypothesised that moral reasoning plays a critical role in attitude formation by acting as a mediator which serves to override the positive rational benefits of the attitude object.

It would be premature to generalise from these results at this stage due to the representative rather than random sample. The sample was adequate for the purpose of test construction and preliminary analysis, but until a more representative sample is studied the conclusions should be interpreted with caution as indicators of the

distribution of attitudes to GMF in the Australian population. Additional relationships may be present among the items on the instrument that are not being investigated in this study. Second, while the present study provides evidence of reliability and validity, further examination of the psychometric properties needs to occur. The stability of the subscale structure needs to be assessed. Finally, the strength of the relationships between background variables and attitude scores were relatively weak and so must be interpreted with due caution. In view of the above results, this report recommends administration of the 30 item BAI to a larger randomised sample of the community. Second, there is a need for a working alliance between trusted organisations and consumer groups be established to provide accurate up to date unbiased information so that informed choices can occur. Third, that labelling is a mandatory procedure so that the consumers' right for choice is safeguarded and distrust is reduced.

From a more general perspective, several uses are suggested for this scale. In practice the BAI could be useful for analysing the attitudes of different consumer and industry groups prior to consensus conferences or meetings in order to assess common points of agreement. This may be a productive way to identify solutions which in the process promotes group cohesion rather than conflict. Secondly, consumer attitudes to GMF can be explored so that the changing needs of the public are considered. Third, this instrument allows interacting determinants of attitudes to GMF to be viewed in context rather than removed from social and political forces so that a bigger picture emerges. This study indicates that resolution of the debate about GMF will only occur if individual rights and values are balanced with societal obligations. Scientific principles and professional practices which have traditionally framed the human ramifications of GMF in an apolitical manner, and from a position of an expert are no longer sufficient. People in positions of power and expertise will need to consider the opposition of many in the wider society.

In summation the BAI is a psychometrically valid and reliable instrument constructed to measure attitudes to GMF. The snapshot of attitudes to GMF in the preliminary analysis indicated that acceptance or rejection is largely formulated according to the perceived need or benefit of GM food, in conjunction with moral values. A strong gender difference in attitudes emerged, with a lack of open and direct information about the extent of GMF on shelves breeding distrust and rejection of the product rather than support. The consumer's attitude to GMF was further defined according to the type of genetic transfer, with variations in the purpose of the end product having minimal impact on attitudes. In practice, rather than continuing to debate the merits and drawbacks of GMF, the BAI could be employed to measure the attitudes of different consumer and industry groups. In this way common points of agreement could be established so that discussions may be aimed at promoting group cohesion and collaboration with a view to closure of this critical contemporary social issue. Resolution of the debate about GMF will need to occur in an environment where individual rights and values are balanced with societal obligations, only then will true social justice occur.

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Appendix A

Dear Sir/Madam,

As part of my course in the Psychology Honours program at Edith Cowan University I am completing a project on people's attitudes to food biotechnology. This research has been approved by the ECU School of Psychology Ethics Committee. As a result I would like to extend an invitation to you to be included as a potential participant.

The project should take less than 15 minutes, and will require you to circle the answer which best describes what you think about a number of statements about food technology. This is a voluntary study so you have the right not to answer any questions you do not wish to and may withdraw at any stage.

All information will remain confidential and only I as the researcher and my supervisor will have access. The results will not be discussed with anyone else. This information may be used in publication and for the purposes of a thesis, however potential participants will not be identified by name and results are completely confidential. By completing this questionnaire respondents acknowledge that they consent to participation.

I would be happy to answer any questions you may have. If you would like further information please feel free to contact me via my Honours Supervisor, Associate Professor Andrew Ellerman, School of Psychology, Edith Cowan University, or phone: 9400 5628. If you state that you are calling about the project on attitudes to food no identification will be required.

If you would be prepared to take part in this project please retain this copy of the information sheet. Feedback on the findings of this study will be made available on request if you fill in the attached slip. This research will hopefully provide information about people's attitudes to food technology, which may assist in public policy decisions. I thank you very much for your help.

Juliana Rose Cannon.

Appendix B

Biotechnology Attitude Index

Below are some explanations of terminology which may be of assistance:

Biotechnology- the use of biological systems to change products such as food.

Gene- the smallest part of DNA containing messages or characteristics that can be passed on between generations.

Genetic Modification- a series of techniques used to transfer genes from one organism to another or to change a gene's expression (Also called genetic engineering).

Please answer each statement by circling the number that best represents your view using the scale below. **There are no right or wrong answers so choose the response which best describes your opinion.**

1 = Strongly Disagree (SD)

2 = Disagree (D)

3 = Neither agree nor disagree, Undecided (?)

4 = Agree (A)

5 = Strongly Agree (SA)

	SD	D	?	A	SA
1. It's good to change a plant's genetic makeup to resist pests.	1	2	3	4	5
2. If genetic technology can lead to greater volumes of food being produced it is a good potential solution to world hunger.	1	2	3	4	5
3. Food should be free of additives such as flavouring agents. ®	1	2	3	4	5
4. Genetic modification of food should be avoided as it will change the path of natural evolution. ®	1	2	3	4	5
5. It's acceptable to genetically change a food so it is less prone to damage during transportation.	1	2	3	4	5
6. If genetically modified foods are so good they should be labelled as a way of promoting them. ®	1	2	3	4	5

® = reverse scored item

	SD	D	?	A	SA
	1	2	3	4	5
7. Genetically modified food should be encouraged as it will produce food that will cope with our changing environment					
8. The Government would never allow genetically modified foods that were unsafe to be sold in the supermarket.	1	2	3	4	5
9. By genetically modifying plants for human consumption we wrongly assume that we own other life forms. ®	1	2	3	4	5
10. When I'm hungry I don't care what I eat as long as it tastes good.	1	2	3	4	5
11. It is encouraging that because of genetic food modification, farmers will be able to produce food much faster.	1	2	3	4	5
12. Genetic mutations are worrying even if they are only the needle in the haystack. ®	1	2	3	4	5
13. Transferring genetic material from one plant to another plant is acceptable.	1	2	3	4	5
14. If society continues to genetically modify food future generations will pay the price of our choice. ®	1	2	3	4	5
15. Genetic scientists should be encouraged in the food industry as they are making courageous breakthroughs.	1	2	3	4	5
16. If genetically modifying plants leads to 'superbugs' or 'superweeds' it would be disastrous. ®	1	2	3	4	5
17. Society has lost touch with what it means to grow and eat natural food. ®	1	2	3	4	5
18. Food biotechnology should be promoted a lot more.	1	2	3	4	5
19. Genetically modified food is acceptable as it is a more efficient way of growing food.	1	2	3	4	5
20. It is okay to genetically modify inedible things such as cotton.	1	2	3	4	5

® = reverse scored item

	SD	D	?	A	SA
21. It is ridiculous to consider eating genetically modified foods as they could lead to long term health effects. ®	1	2	3	4	5
22. Genetic modification is a powerful innovation that should be welcomed	1	2	3	4	5
23. Gene technology is undesirable as it is taking funding away from exploring other sustainable approaches such as organic farming. ®	1	2	3	4	5
24. If scientists can <u>not</u> reverse the process of genetic modification of plants we should never use it. ®	1	2	3	4	5
25. It is acceptable for scientists to transfer genetic material from a fish to a tomato to reduce freezing damage.	1	2	3	4	5
26. Genetic modification of food is about a masculine desire to control the creation of life.	1	2	3	4	5
27. Eating genetically modified potatoes that have been changed to absorb less oil would be okay.	1	2	3	4	5
28. The thought of food being nutritionally enhanced by genetic modification appeals to me.	1	2	3	4	5
29. Genetically modified food is more about profit making for companies than anything else.	1	2	3	4	5
30. Genetically altering plants takes humanity into areas where we do <u>not</u> belong. ®	1	2	3	4	5
31. Eating genetically modified foods would be a violation of my personal values. ®	1	2	3	4	5
32. It is acceptable that scientists are changing garlic to increase more of the component that lowers cholesterol.	1	2	3	4	5

® = reverse scored item

	SD	D	?	A	SA
33. It's worrying that changes to the genetic makeup of our food are being made with minimal public debate. ®	1	2	3	4	5
34. The media provides an accurate picture of genetic modification issues. ®	1	2	3	4	5
35. Through genetic modification of food we are being asked to be involved in a nutritional experiment on a global scale. ®	1	2	3	4	5
36. Genetically modified tomatoes would be appealing if they were tastier than naturally grown tomatoes.	1	2	3	4	5
37. The effect of spraying plants with pesticides is far more concerning than genetic technology.	1	2	3	4	5
38. I am confident that the regulatory controls for genetically modified foods are adequate.	1	2	3	4	5
39. Labelling foods as 'genetically modified' will have little impact upon me as a consumer.	1	2	3	4	5
40. Genetically modifying crops so they could provide immunisation against disease would be welcomed.	1	2	3	4	5
41. Genetically modifying plants to resist pests will mean reduced use of toxic pesticide spray which is good news.	1	2	3	4	5
42. Food biotechnology is a symbol of technology out of control. ®	1	2	3	4	5
43. We should be putting funds into solving the problem of soil salinity in Australia instead of genetically modified food. ®	1	2	3	4	5
44. Some other countries have successfully introduced genetically modified foods so Australia should do the same.	1	2	3	4	5
45. It would be better to eat more natural foods to cure illness. ®	1	2	3	4	5

® = reverse scored item

	SD	D	?	A	SA
46. It would be worth the extra expense to shop for foods that have never been genetically modified. ®	1	2	3	4	5
47. It's morally concerning that scientists are transferring human genes into pigs. ®	1	2	3	4	5
48. The introduction of genetically modified foods will offer more choice for consumers.	1	2	3	4	5
49. Genetic engineers are modifying plants while ignoring the hazards of doing so. ®	1	2	3	4	5
50. Weighing up how each food has been genetically modified is just another thing that I do not have the time to think about. ®	1	2	3	4	5
51. Genetically modifying food is wrong if it leads to the loss of plant varieties. ®	1	2	3	4	5
52. Some of the talk about how genetically modified foods are unsafe is based on myth.	1	2	3	4	5
53. Because the effects of genetic modification are invisible, I tend <u>not</u> to think about the issue. ®	1	2	3	4	5
54. It is okay for genetic engineers to change strawberries so that they contain more anti-cancer agents.	1	2	3	4	5
55. Gene technology is just an extension of the way genes have been mixed for centuries so all the fuss is unwarranted.	1	2	3	4	5
56. Genetically modified foods should be put on supermarket shelves only after long term studies on safety. ®	1	2	3	4	5
57. Not being informed about what is in food violates my individual rights. ®	1	2	3	4	5
58. Possible health benefits from genetically modifying food are worth pursuing even if not all of them occur.	1	2	3	4	5

® = reverse scored item

	SD	D	?	A	SA
59. Because scientists are mixing genetic material between different species for the first time we should be very cautious. ®	1	2	3	4	5
60. Australia cannot afford to be left behind with outdated food technology.	1	2	3	4	5
61. It's frustrating to know so little about the whole area of biotechnology. ®	1	2	3	4	5
62. There are too many unknowns to foresee the risks of genetically modified foods. ®	1	2	3	4	5
63. It is morally incorrect for biotechnology to breach the boundaries between natural and artificial life forms. ®	1	2	3	4	5
64. Gene technology is just another quick fix solution. ®	1	2	3	4	5
65. Food labelled 'genetically engineered' in the supermarket would be worthwhile trying.	1	2	3	4	5
66. It's concerning that new combinations of genes created through genetic modification of food could result in unpredictable reactions in humans such as allergies. ®	1	2	3	4	5
67. It is good to think that potatoes can be genetically modified to prevent discolouration.	1	2	3	4	5
68. Long term sustainable agriculture is more important than genetically modifying foods. ®	1	2	3	4	5
69. To improve nutrition we should add other natural foods to our diet rather than alter existing foods. ®	1	2	3	4	5
70. Through genetic technology food will be far superior in quality.	1	2	3	4	5
71. Even if the risks from biotechnology are very small they should be taken seriously. ®	1	2	3	4	5
72. Landowners should be allowed to do whatever they like to their crops to increase food production.	1	2	3	4	5

® = reverse scored item

	SD	D	?	A	SA
73. Genetic technology is trustworthy.	1	2	3	4	5
74. The broader environmental effects such as the unwanted transfer of genetic information to non modified plants is worrying. ®	1	2	3	4	5
75. The opinions of our elders should be sought out in the debate about genetically modifying food. ®	1	2	3	4	5
76. Food on the table is the most important thing regardless of its origins.	1	2	3	4	5

The purpose of this section is to assess the meaning of some concepts relative to genetically modified food by asking you to make some judgements about them on a series of descriptive scales. The scales are used as follows:

If you feel the concept is **very closely related** to one end of the scale, you should mark the space at the appropriate end

fair : ____ : ____ : ____ : ____ : ____ : X : unfair

If you feel that the concept is **quite closely related** to one or the other end of the scale, you should place your mark as follows:

strong : ____ : X : ____ : ____ : ____ : ____ : weak

If the concept seems **only slightly related**, you should mark the scale one space either side of the mid point as follows:

intense : ____ : ____ : X : ____ : ____ : ____ : mild

The direction towards which you make your mark depends on which of the two ends of the scale seem most characteristic of the concept. If you consider the concept to be **neutral** on the scale, or if both sides of the scale are **equally associated**, place your mark in the middle space.

delicate : ____ : ____ : ____ : X : ____ : ____ : rugged

GENETICALLY MODIFIED FOOD IS-

Good : ____ : ____ : ____ : ____ : ____ : ____ : ____ : Bad ®

Incompetent : ____ : ____ : ____ : ____ : ____ : ____ : ____ : Competent

Powerful : ____ : ____ : ____ : ____ : ____ : ____ : ____ : Powerless ®

Admirable : ____ : ____ : ____ : ____ : ____ : ____ : ____ : Deplorable ®

Worthless : ____ : ____ : ____ : ____ : ____ : ____ : ____ : Valuable

Successful : ____ : ____ : ____ : ____ : ____ : ____ : ____ : Unsuccessful®

Active : ____ : ____ : ____ : ____ : ____ : ____ : ____ : Passive ®

Safe : ____ : ____ : ____ : ____ : ____ : ____ : ____ : Dangerous ®

® = reverse scored item

About Yourself

1. Sex: Male _____ Female _____
2. Age _____ (years or range)
3. Occupation (paid or unpaid)

4. Education: Total number of years of formal education at school and after (convert part time study to the full time equivalent)

5. Do you do most of the shopping in your household?
Yes _____ No _____
6. What percentage of tomatoes currently stocked on supermarket shelves do you think are genetically modified?

None-0-----25%-----50%-----75%-----100% - All

7. Which political party do you most support?

- ☐ None
- ☐ Liberal
- ☐ Labor
- ☐ National
- ☐ Democrats

Other (please specify) _____

Any comments about this survey? Please write below

I (the participant) request that I am informed of the results of the study about peoples attitudes to genetically modified food when they become available.

Name _____

Address _____

Postcode _____

Thank you for your time

12th August, 1999

Dear ,

Several weeks ago a survey was sent to you about attitudes to genetically modified food. So far a good number of people have replied, but as many responses as possible are needed to provide valid results. If you have already sent your reply, thank you. If you have not yet replied, I would greatly appreciate you doing so as soon as possible.

The aim of this research is to test the reliability and validity of a scale which has been created to understand differing attitudes and values held about genetically modified food. It is hoped that this tool may be implemented in future years to measure the formation and change of attitudes with respect to this issue.

The research project conforms to the guidelines for the Ethical Conduct of Research at Edith Cowan University. It is not funded or supported in any way by the government or any group involved in the debate about genetically modified food. To those who have yet to respond your replies will be confidential and will be analysed and reported only when combined with results from other people.

Thank you for all your comments. They are valuable and have largely assisted in the development of this scale. To those of you who have provided a contact address, a summary of the results will be made available by the end of November.

Once again would those who have yet to return their surveys please do so as soon as possible as your input is valued and will be critical to the outcome of the study. Your assistance is greatly appreciated.

Juliana Cannon