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ATTITUDES AND BEHAVIOUR TOWARDS GM FOOD

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Abstract

The aim of this thesis was to examine attitudes towards genetically modified (GM) food and how these translate into behaviour. Research conducted divided quite neatly into two distinct sections. The first section explored explicit attitudes and other socio-cognitive constructs relating to behaviour towards GM food within the framework of different theoretical models including, most notably, the theory of planned behaviour (Ajzen, 1991). The second section measured implicit attitudes held towards GM food and the malleability of these attitudes, using an array of different reaction time tasks, e.g. the implicit association task (Greenwald, McGhee and Schwartz, 1998). A final experiment then linked these two sections by examining both implicit and explicit attitudes alongside various measures of behaviour in order to examine the predictive validity of these attitude constructs and how these may vary depending on the situation.

Results indicated that socio-cognitive concepts of subjective norms, perceived behavioural control (PBC), self-identity and emotional involvement were useful alongside the construct of explicit attitudes in predicting intentions and behaviour towards GM food. In addition, measures of implicit attitude were found to be useful predictors of behaviour towards GM food, over and above explicit attitudes. Interestingly, measurements of implicit attitude were found to be positive when measured in a context free manner but were also found to be malleable and differed considerably depending on the situational context of measurement. Actual behaviour was measured in a variety of different ways and these converged in demonstrating that the majority of participants would try GM food. Overall, findings indicated that within Britain more people than previously thought are likely to try GM food if it becomes more widely available.

List of Publications

Spence, A. and Townsend, E. (in press). Predicting behaviour towards genetically modified (GM) food with implicit and explicit attitudes. *British Journal of Social Psychology.*

Spence, A. and Townsend, E. (2006). Examining consumer behaviour towards genetically modified (GM) food in Britain. *Risk Analysis*, 26, 657-670.

Spence, A. and Townsend, E. (2006). Implicit attitudes towards genetically modified (GM) foods: a comparison of context-free and context-dependent associations. *Appetite*, 46, 67-74.

Spence, A. (2005). Using implicit tasks in attitude research: A review and a guide. *Social Psychological Review*, 7, 2 – 17.

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Chapter One – Introduction

'*Trials of GM crops bring new fears of 'Frankenstein' food*' – Daily Mail (English, 2002)
'*Moral imperative' for GM food to combat world hunger*' - The Guardian (Radford, 1999)
'*Revealed: health fears over secret study into GM food*' - The Independent (Lean, 2005)

GM food is a very interesting and a very controversial issue as demonstrated by newspaper headlines such as these. Potentially GM food has the power to reduce famine, reduce chemical use (and, therefore, environmental damage) and provide health benefits. However, there are risks involved. Could the development and production of GM food have irreparable environmental damage? Might these new bioengineered foods have adverse long term consequences? The topic of GM food is being debated in many countries across the world. This thesis is not concerned with whether GM food should be produced or not however. This thesis is concerned with how people in Britain feel about GM food and how they are likely to react to GM food. The aim of this thesis is to examine attitudes towards, and perceptions of, GM food and to consider how these translate into behaviour.

Given a brief overview of the existing literature regarding attitudes towards GM food, one might be forgiven for assuming that the majority of the British population are firmly set against the introduction of GM food. However, related methodological criticisms, and more in-depth examinations, indicate that this may not actually be the case. This thesis aims to give a more reasonable, unbiased account of explicit attitudes towards GM food and to examine other socio-cognitive variables that relate to GM food. Parallel to this, research was also undertaken in order to gauge individuals' implicit attitudes towards GM food.

In addition, actual behaviour towards GM food was examined using a variety of different measures in order to directly examine how people might respond to GM food in different situations. As well as undertaking empirical evaluations of attitudes, behaviour, and other socio-cognitive constructs, it was aimed that theoretical accounts would be extended through this research.

Much of the previous work examining attitudes and feelings towards GM foods has been qualitative and, therefore, it was thought useful to expand the quantitative data available on this topic so that the generality of findings could be examined. Consequently, although a mixture of qualitative and quantitative methods was used within this thesis, the focus was on quantitative data collection. Several new data collection techniques were borrowed from other domains for use within this research. Tasks, including a card sorting task, a contingent valuation task, and reaction times tasks, were used in order to evaluate attitudes and behaviour towards GM food. The use of new methods was thought likely to provide a fresh perspective within the literature and to highlight areas in which previous methods may have been subject to various methodological biases. This approach, of integrating data from old and new methods, provided a fuller picture of the processes involved in attitudes and behaviour.

1.1. Applied aims of this research

The general aim of the research contained within this PhD is to further the understanding of attitudes and behaviour towards GM food. Research began at ground level and used a qualitative approach in order to measure personal constructs, emotions, and imagery that were associated with perceptions of GM food. Further to this, different types of quantitative attitude measurements, both implicit and explicit, were used and compared in order to provide a more complete idea of preferences regarding GM food. The ways in which these measurements differ, depending on differential salience of categories relating to GM food, or on different contexts in which GM food is encountered, were also considered. Of course, alongside attitudes there are several further postulated influences on behaviour and these were examined empirically, both in terms of their absolute levels and in terms of the relative importance of their influence on behavioural intentions and behaviour. Empirical data gained from these studies may be important in predicting the potential future behaviour of the British public in response to GM food and how this may change over time. Behaviour was also examined in a more direct manner, using different approaches, which provided some concrete data with respect to how many people were willing to accept GM food and how this differed depending on the situation.

1.2. Theoretical aims of this research

The research contained within this PhD was carried out with some specific theoretical and methodological goals. On a general note, the application of novel methods to this area of research provided important information about the robustness and usefulness of these techniques. The card sorting task utilised was the first of its kind to be used in order to examine personal constructs associated with GM food. In addition, the Theory of Planned Behaviour (TPB; Ajzen, 1991) was utilised within the domain of GM food which provided a test of the robustness of the theory. The contributions of several additional variables (self-identity, moral norms and emotional involvement) to the TPB were also assessed within the domain of GM food. Note that the construct of emotional involvement had never before been examined within the TPB.

A particular interest was taken into the theory and methods within implicit attitude tasks, particularly the newly developed implicit attitude tasks of the Extrinsic Affective Simon Task (EAST; De Houwer, 2003a) and the Go No-Go Association Task (GNAT; Nosek and Banaji, 2001). It was aimed to find out which task was most appropriate and effective with respect to the examination of implicit attitudes towards GM food. The differential effects of context and salience on targets within implicit attitude tasks were also explored with the aim of providing information about how generalisable results from implicit attitude tasks can be and how they may be extrapolated to fit different situations. Several different experiments within this thesis examined the relationship between explicit and implicit attitudes and this culminated in a rigorous exploration into how these attitude measures might best be combined in order to predict different behaviours. In conjunction with this, the first ever test of the predictive validity of the GNAT was carried out.

1.3 Outline of thesis

This thesis divides quite neatly into two distinct strands of research. The first half examines explicit attitudes and perceptions of GM food whilst the second half examines implicit attitudes towards GM food. A final data chapter then links these two strands of research together with an experiment which examined both explicit and implicit attitudes alongside behaviour.

The first section of the thesis begins with an introduction to the area of research examining perceptions of GM food. With this aim, chapter two consists of a literature review of previous research. This review examined empirical accounts of attitudes towards GM food as well as both the external environmental factors and the internal cognitive factors that have influenced these attitudes. The aim of chapter two was to provide an overview of the existing literature in which this thesis is grounded so as to provide information about the starting point of the research undertaken for this thesis.

Returning to ground zero, so to speak, the experimental research contained within this thesis began with a bottom-up, qualitative, methodology in order to gain a fresh insight into perceptions about GM food. This took the form of a card sorting task, described within chapter three, that was utilised in order to examine personal constructs associated with GM food. In conjunction with this, imagery and emotions associated with GM food were assessed and relations between personal constructs, imagery and emotions were examined.

Chapters four and five utilised the TPB in order to examine the relative influence of behavioural antecedents, including attitudes, on intentions and behaviour. This was done in order to identify the most important predictors of behaviour in this domain. Chapter four utilised the TPB in order to examine the effects of learning about GM food over time on behavioural antecedents of the behaviour of trying GM food and behavioural intentions to try GM food. Chapter five utilised the TPB, in conjunction with an experimental behaviour task, in order to examine how behavioural antecedents and intentions relate to actual behaviour towards GM food.

The second strand of research within this thesis focused on implicit attitudes towards GM food and again began with a literature review. This is contained within chapter six and consists of an examination of the existing literature surrounding implicit attitudes. The aim of the literature review of implicit attitudes was to provide an introduction to the characteristics of implicit attitudes and the current theoretical understanding of what these constructs are. This chapter also examines methodology relating to the assessment of implicit attitudes and gives in-depth consideration to the most popular tasks that are used to measure implicit attitudes.

Chapter seven examines one of the most popular implicit attitude tasks available, the Implicit Association Test (IAT; Greenwald, McGhee and Schwartz, 1998), in more depth. This chapter reports the details of an experiment that used the IAT in order to examine attitudes towards biotechnology categories of plant, animal and human biotechnologies. Research that has supported the validity of the IAT as well as research that has challenged the validity of the IAT was also reviewed in order to assess the usefulness of the task.

One problem associated with the IAT is that it can only assess attitudes towards one category in relation to another category; it is not possible to examine attitudes towards a category in a context-free manner. For this reason, chapter eight reviews the EAST and the GNAT as potential alternative implicit attitude tasks to the IAT, as these are able to examine implicit attitudes in a context-free manner. Further to this, chapter eight contains the details of an experiment that was conducted to compare the EAST and the GNAT when applied to the domain of GM food in terms of power and reliability. Building on these findings, chapter eight also details an experiment that utilised the GNAT in order to examine attitudes towards GM food, both in a context-free manner and in ecologically valid context categories of ordinary foods and organic foods.

Further to the influence of contrasting context categories that are used within some implicit attitude tasks, it was theorised that both context and salience would have important effects on implicit attitudes even when these are assessed within context-free tasks. Chapter nine examined both context effects and salience effects on attitudes towards GM food. GM food was primed to be viewed as either a food or a biotechnology in order to examine the effects on implicit attitudes towards GM food when assessed in a context-free manner using GNATs. Additionally, other foods and other biotechnologies were used as contrasting context categories within IATs to examine how this altered implicit attitudes elicited towards GM food.

The two different strands of research, explicit and implicit, were brought together in a final large experiment which examined explicit and implicit attitudes together with behaviour; this is described in chapter ten. A structural equation modelling approach was utilised within this experiment in order to rigorously examine the relationships between these concepts. This enabled the theoretical examination of how implicit and explicit attitudes may combine in order to predict behaviour. This study also provided a first-ever test of the predictive validity of implicit attitudes in the domain of GM food and of the predictive validity of the GNAT. Further to this, the utilisation of three different measures of behaviour towards GM food provided useful empirical information with regards to how people may respond to GM food in different situations.

The thesis concludes with a general discussion which reviews the aims of the thesis and assesses both the theoretical and empirical findings contained within it. This enabled the evaluation of the overall contribution of this research to existing literature and the consideration of implications for actors involved with

GM food. Acknowledgements to shortcomings of the research conducted were also made and directions for future research were explored.

Chapter Two – Literature Review: Attitudes Towards GM Food in Britain

As an introduction to this area of research, this chapter outlines and critiques previous research that has examined attitudes towards GM food. The development of attitudes towards GM food in Britain was examined over time and some consideration was given to current opinion in Britain and how this might change in the future. The role of the media in determining public opinion was also reviewed. In addition, a cross-cultural comparison was undertaken of attitudes towards GM food in Britain and attitudes in other countries in Europe, and the US. Attention was also given to underlying socio-cognitive factors that have been outlined in previous research as important in driving attitudes towards GM food, including issues such as risk, trust and control. Finally, individual differences in attitudes towards GM food were examined in order to provide a description of the likely characteristics of individuals who are pro or anti-GM food. The aim of this chapter was to provide the reader with an overview of the current research in the area of GM food and in order to provide an insight into the basis for the research contained in successive chapters.

2.1. The development of attitudes towards GM food in Britain

The first consumer applications of GM food were produced in the 1990s, firstly with the development of 'vegetarian cheese' made with chymosin and then Zeneca's GM tomato puree, which went on sale in two supermarkets in the UK in 1996. Sales of the tomato puree were good but it was later withdrawn as new approval procedures for GM food were put in place in Europe. Also in 1996, an apparently routine shipment of soya from the US to Europe by Monsanto was highlighted as being GM soya, which was to enter the food chain unlabelled (Gaskell, 2004). These events sparked a massive controversy over GM food.

Between 1996 and 1999, support for GM food declined steadily. Further events may have fuelled the criticism of this relatively new technology. For example, the BSE crisis in 1996 may have increased public fear regarding food safety (Gaskell, Allum and Bauer et al., 2003). In addition, the announcement of the cloning of Dolly the sheep in 1997 received a very negative reaction and may have had a detrimental effect on attitudes towards biotechnologies in general.

In 1999, a turnaround in public attitudes was noted and support for GM food was observed to increase between 1999 and 2002. It was suggested that this turnaround was in part due to the Labour government's new commitment to transparency, accountability and public consultations (Gaskell, Allum and Stares, 2003). In line with these commitments, three different advisory bodies dealing with the issue of GM food were set up: the Human Genetics Commission (HGC), the Agriculture and Environment Biotechnology Commission (AEBC) and the Food Standards Agency (FSA). The increase in support for GM food can also be attributed to the de facto moratorium on the commercialisation of GM crops in Europe, which was established in June 1999. This is likely to have helped to engender the public trust on the issue of GM foods.

2.1.1. Current attitudes towards GM food

Probably the most well known and one of the most recent surveys of attitudes towards GM food in Britain is the *GM Nation?* debate (Grant, Bradley, Carmichael, Dale, Devereux, Grove-White et al., 2003). This consisted of a number of debates held across Britain, the results of which were collated and published to illustrate the views of the British population on GM food. Results indicated that the British public were uneasy about GM food, did not support early commercialisation of GM food and were distrustful of the government and of biotechnology companies on the issue of GM food. Overall, perceptions gained were quite negative towards GM food. The GM Nation debate has been the subject of some criticism regarding the sampling technique used however (Campbell and Townsend, 2003; Gaskell, 2004). Those that attended the debates were recruited through advertising, (often by self-proclaimed anti-GM groups such as 'Friends of the Earth'), and therefore attendees consisted of those individuals who were particularly interested or concerned about GM food. In fact, independent evaluators of the *GM Nation?* debate found that of a statistically representative sample of Britain, 71% of participants had not heard of the debate and a further 13% had heard of it but knew nothing about it (Poortinga and Pidgeon, 2004). Consequently, findings are clearly not representative of the British public as a whole although they do provide an insight into the concerns surrounding GM food. Criticisms of the *GM Nation?* debate were countered by claims that the research was not meant to be representative of the British public; it was asserted that this was actually a qualitative investigation into perceptions (Gaskell, 2004). However the presentation of many of the findings in percentages was clearly misleading and these were taken as an accurate representation of the British public by many people, including the British press. Headlines such as, '5 to 1 against GM crops in biggest ever public survey' (Vidal and Sample, 2003), illustrate the conclusions that were drawn from the *GM Nation?* debate.

A more representative investigation of attitudes towards GM food in Britain was carried out by the Eurobarometer series of surveys using a multi-stage random sampling procedure which provided a statistically representative sample of the population. The most recent Eurobarometer report, conducted in 2002, indicated that the British population was actually ambivalent towards GM food (Gaskell, Allum and Stares, 2003; Gaskell, Allum and Bauer et al., 2003). Questionnaire responses within the Eurobarometer were obtained through face-to-face interviews and questions regarding GM food and biotechnologies were just a small section of what participants were questioned on. This means that the individual was unlikely to make the decision of whether to participate or not on the basis of whether he or she was interested in GM food. Altogether, 1,000 respondents were questioned in Britain for each Eurobarometer, however the response rate was not reported and there may be some specific characteristics of people who were more likely to cooperate with the survey.

Another study of attitudes towards GM food in Britain, that examined a representative sample of the British population, was carried out in 2003 by researchers at the Centre for Environmental Risk at UEA (University of East Anglia) in conjunction with the market research company MORI (Poortinga and Pidgeon, 2004). Results indicated that participants were essentially ambivalent towards GM food, although data also indicated that public attitudes were skewed towards being negative towards GM food. For example, more than half of all participants indicated that they were not sure whether GM food should be promoted or opposed, whereas 29% of participants said that GM food should be opposed, 9% said that GM food should be promoted and 8% did not care. Overall, therefore, the majority of people in Britain were ambivalent towards GM food but the mean levels of public attitudes were slightly negative.

2.1.2. Potential future impacts on attitudes towards GM food

Currently, there is no commercial cultivation of GM crops in Britain but the situation has not been ruled out and this may happen in the future. Test trials have previously been cultivated in Britain, however one after another biotechnology firms have withdrawn these due to continued vandalism by activists against GM food. The last of these biotechnology firms, Bayer CropScience, closed its test sites in 2003 declaring that it would not reopen these until conditions in Britain were more favourable (McKie, 2003). As previously noted, the European Union set a self-imposed six-year informal moratorium on the commercialisation and importation of GM food in 1999, in response to growing public concern and until more research could be conducted. However, the moratorium imposed in Europe infuriated producers of GM food and led to the U.S., Canada and Argentina launching trade suits against the European Union over its GM policy (Smyth and Phillips, 2003). This resulted in the eventual lifting of the moratorium in April 2004 alongside new labelling laws. Laws introduced state that foods containing more than 0.9% of genetically modified organisms must be labelled. As a result it is now legal to import GM food into Europe, however there has been little exploitation of this so far due to a lack of demand from food distributors.

Altogether, these changes indicate that the amount of GM food available in Britain may expand in the future. It is difficult to predict the likely impact on attitudes but the increased contact and availability of GM food means that people are less likely to be ambivalent towards GM food and more likely to take a stance on the topic.

2.2. The role of the media

Research indicates that risk perceptions of GM food have risen and fallen along with the discussion of these risks in the media, which was interpreted as an indication of a social amplification of risks (Frewer, Miles and Marsh, 2002). With respect to biotechnologies, media coverage has been positive although this has become more negative over the years, particularly between 1996 and 1999. Media coverage was particularly negative in 1999 and at this point was negative overall towards biotechnologies for the first time. At this time, press coverage was dominated by discussion of GM food and this corresponds to the point in time at which public criticism of GM food was at its peak (Gaskell, Allum and Bauer et al., 2003). Support for biotechnologies in general, including GM food, has increased gradually since 1999 and there have been some suggestions that this may be, at least partially, attributable to increased media coverage of medical biotechnologies which have been viewed fairly positively (Gaskell, Allum and Bauer et al., 2003). Positive views of medical biotechnologies may, to some extent, transfer to all biotechnologies.

The tone of discussion adopted within the media does, therefore, seem to correspond to attitudes observed within the British public. However it is difficult, if not impossible, to discern whether the media leads the public attitudes or whether public attitudes lead the media. In reality, influences are likely to be recursive, whereby both the media and public opinion have an impact on one another.

2.3. Cross cultural comparisons of attitudes towards GM food

Evidence indicates the majority of countries within Europe did not support GM food although there was considerable variation between countries (Gaskell, Allum and Stares, 2003). Spain, Portugal, Ireland and Finland were positive towards GM food whilst France, Greece and Luxembourg were strongly against GM food. The rest of Europe was slightly negative to ambivalent. It would be neat to be able to explain the pattern of attitudes across Europe in terms of religious or cultural differences, or in terms of geographical region, and there have been some limited attempts to do this (Zechendorf, 2002). For example, it was suggested that Northern European countries, e.g. Sweden, which have harsh climatic conditions and respect nature have a strong preference for natural foods, whereas Southern European countries, e.g. Spain, have mild climates in which taste of food is the main priority and concerns over health are relatively low. In reality, national differences noted do not correspond to possible geographical divisions outlined and nor do they correspond to religious or cultural divisions; differences are likely to be more complex than this. National differences in attitudes towards GM food are likely to be due to a variety of influences including the country's individual political stance, regulatory systems and local events (Gaskell, Allum and Bauer et al., 2003).

Significant differences exist between Europe and the U.S. with respect to the acceptance of GM food, with higher acceptance of GM food found in the U.S.; GM food is widely available in the U.S. and is not subject to labelling laws. Transatlantic differences in attitudes towards GM food may be due to the increased number of food scares that have occurred in Europe, and the decreased trust that Europeans have in their governing institutions (Anderson and Jackson, 2003). Recently the issue of GM food has been becoming more controversial within the U.S., evidenced in a decline in the acceptance rates of GM food (Priest, 2000). This is likely to be due to an increased perception and awareness of risks surrounding GM food within the U.S. and a decreased trust in relevant institutions, e.g. the Food and Drug Administration (Moon and Balasubramanian, 2003), which may partly stem from information received regarding protests within Europe.

Examining differences between countries is useful in that these allow us to investigate differing influences on GM food. Research into these differences may allow us to draw inferences regarding why some people are more positive towards GM food than others. It may also help us to understand and predict economic issues regarding GM foods, e.g. the trade dispute already witnessed between Europe and the U.S., Canada, and Argentina.

2.4. The comparison of GM food to other biotechnologies and other foods

Overall, research has pointed to a split in which medical biotechnologies, referred to as red biotechnologies, are considered desirable and food biotechnologies, referred to as green biotechnologies, are considered undesirable (Bauer, 2002). Indeed a variety of studies have found GM food to be the least acceptable form of biotechnology (Zechendorf, 1994; Gaskell, Allum, Bauer, Durant, Allansdottir, Bonfadelli et al., 2000; Bonfadelli, Dahinden and Leonarz, 2002). This negative attitude has been suggested to be based on arguments of GM food products being unnatural or of no benefit (Bonfadelli, Dahinden and Leonarz, 2002).

It seems that the public is readily able to distinguish amongst different types of GM food. For example, GM crops have been consistently found to be viewed more positively than are GM food (Gaskell, Allum and Bauer et al., 2003). This may reflect additional concerns regarding food safety relating to GM food, that exist over and above any environment or ethical concerns associated with GM technology as a whole. Differences in attitudes towards GM food and GM crops may also be reflective of different attitudes towards different processes of producing GM foods. It was found that consumers were significantly more positive towards biotechnologies that are applied to plants than those that are applied to animals or humans (Frewer, Howard, Hedderley and Shepherd, 1997). The fact that the category of GM food encompasses GM foods that are produced from animals as well as those that are produced from plants may explain why this category is perceived more negatively than GM crops alone.

As well as being considered as part of the super-ordinate category of biotechnologies, GM food may also be considered as part of the super-ordinate category of food. It has been found that GM food was perceived more negatively than other food (Noussair, Robin and Ruffieux, 2004; Moon and Balasubramanian, 2003) although studies vary with regards to the extent of differences observed. It is likely that differences between studies are attributable to methodological differences; see chapter five, section 5.2. for a more comprehensive review.

2.5. Important socio-cognitive constructs relating to GM food

There has been an interesting range of research into perceptions relating to GM food which has identified a variety of socio-cognitive constructs that were found to be important within this domain. In general, results indicated that the British population held an array of concerns about GM food, however potential benefits of the technology were also acknowledged.

2.5.1. Perceived risks

Perceptions of risk were found to be important in determining the acceptability of gene technology (Siegrist, 2000) with those technologies associated with higher risks generally being less accepted. GM food was consistently associated with a high perceived risk (Gaskell, Allum and Stares, 2003; Sparks, Shepherd and Frewer, 1994) and this seems to stem primarily from a lack of knowledge and control regarding the risks surrounding GM food (Sparks, Shepherd and Frewer, 1994).

A great deal of research within the risk perception literature has focused on inaccuracies and biases in risk assessment and it is likely that perceptions of risk from GM food are subject to these same errors. For example, it has generally been found that individuals perceive risks to society as greater than risks to the self. This is termed 'optimistic bias' and indeed research indicates that risks associated with GM food were perceived as greater for other people and for society than for the self (Frewer, Shepherd and Sparks, 1994a). The reasons for optimistic bias are unclear, however the implications for communications may be considerable (Sparks and Shepherd, 1994).

Compounding the difficulty of assessing risks associated with GM food is the fact that the long-term impact of producing or eating GM food is still unknown, making associated risks difficult to judge. Of course, the vast majority of the general public do not have the expertise in the area to understand the current situation regarding GM food and as a result scientists are relied on to provide accurate information and risk assessments. Research has indicated that individuals with less knowledge were more reliant on others for information (Sjoberg, 2001). As the scientific community is clearly divided on the issue of GM food, it is extremely difficult for the general public to gauge the magnitude and acceptability of the risks involved. Further complications of risk assessments arise because experts were also found to be subject to biases in estimating risk (Sparks and Shepherd, 1994); in fact this may be one factor accounting for differences of opinions within experts on GM food.

2.5.2. Trust

GM food is associated with risks, however risks can be acceptable or unacceptable and the public's trust of the scientific community was found to be an important factor in deciding the acceptability of risks (Thompson, 1987). In fact, Siegrist (2000) found that trust in institutions using gene technology had a negative influence on the perceived risk associated with the technology (and as a positive influence on perceived benefits) as well as an indirect influence on the acceptance of gene technologies (Siegrist, 2000). Trust in different information sources was extremely variable with consumer bodies, environmental groups such as 'Friends of the Earth', and scientists working for universities being highlighted as being the most trusted sources regarding information about GM food. Food manufacturers, the national government, and the biotechnology industry were found to be the least trusted sources of information (Sparks, Shepherd and Frewer, 1994; Poortinga and Pidgeon, 2004). Poortinga and Pigeon (2004) found that less than half of the British public trusted these sources to tell the truth about GM food.

2.5.3. Control

Perceived control has been found to be an important factor in determining decisions regarding GM food (Sparks, Shepherd and Frewer, 1995; Cook, Kerr and Moore, 2002). Control can be divided into internal and external components. Internal components refer to the individual's own ability to avoid or try GM food and external components refer to outside influences that may prevent or facilitate avoiding or trying GM food. For example, one argument against GM crops is that non-GM crops are not able to subsist alongside GM crops due to natural cross-pollination. This is an issue of external control and may result in the feeling of being powerless to avoid this technology.

2.5.4. Perceived benefits

It is likely that acceptability of risks will be partly driven by associated perceived benefits. The literature on risk perception has noted an inverse relationship between perceived risk and benefit (Fischoff, Slovic, Lichtenstein, Read, and Combs, 1978; Alhakami and Slovic, 1994) and this has been found for a range of technological hazards including GM food (Frewer, Howard and Shepherd, 1998a). It is, therefore, suggested that perceived risks regarding GM food can be lowered through the communication of benefits and vice versa.

Acceptability of GM food was also found to depend on who the beneficiaries of the technology are. Research has indicated that economic benefits were viewed as being less important than other types of benefit such as health benefits (Magnusson and Hursti, 2002; Frewer et al., 1996). In relation to this, it was found that in order for risks associated with GM food to be deemed acceptable, the associated benefits must be perceived as accruing to those exposed to the risk, or the environment, rather than to the industry alone (Frewer, Howard and Shepherd, 1998b).

Some data indicates that the perceived benefits associated with GM food were quite low (Frewer, Howard and Shepherd, 1998b; Sparks, Shepherd and Frewer, 1994), however these were found to vary depending on the particular type of GM food examined. A related construct that emerged as important in relation to this was the perceived need for the technology. Findings indicated that the British public perceived a greater need for applications of GM food in which modifications facilitate the production of the food, e.g. crops that can grow in dry conditions, than for modifications that influence specific product characteristics, e.g. tomatoes with a longer shelf life (Frewer, Howard and Shepherd, 1997).

2.5.5. Other important socio-cognitive constructs relating to GM food

Both perceived risks and perceived benefits were found to be predictive of attitudes towards GM food and related constructs of trust, control and perceived need were also found to be important. In addition, the perceived involvement of ethical issues (Sparks, Shepherd and Frewer, 1994) and how natural (or rather unnatural) the technology is perceived as (Hamstra, 1991; Frewer et al., 1996; Frewer, Howard and Shepherd, 1997; Townsend, Clarke and Travis, 2004) are also found to be key factors in influencing attitudes towards GM food. Perceptions of GM foods as unnatural or as unethical are generally associated with more negative attitudes. These ethical concerns and concerns of unnaturalness seem to be associated primarily with GM food that is developed from animal, rather than plant, sources (Frewer, Howard and Shepherd, 1997).

2.6. The likely characteristics of an individual who is anti-GM food

Differences in perceived risks and benefits, as well as overall attitudes, are likely to be found between different individuals. Overall, it seems that those most likely to be anti-GM are women, the elderly and those with low knowledge about GM food. In addition, ethnic minorities, poorer individuals and people within low socio-economic groups were found to be more likely to perceive risks associated with GM food, and therefore be more negative towards GM food. This has important implications for communications regarding GM food.

2.6.1. Gender

There is a well established gender difference in risk perceptions in that generally women tend to perceive higher risks than men do. Women are also found to rate hazards as more important priorities for the government than men, tend not to trust the government as much as men, and want greater public involvement in risk management processes (Frewer, 2000). Consequently, it is suggested that women may feel like they have less power in relation to the issue of GM food than men. Further to this, higher risk perceptions by women may be associated with traditional roles of women as the nurturer and care giver within the family (Siegrist, 2000). A maternal figure like this may be more likely to take responsibility for, and have concern about, risks that may affect her dependents. This may be particularly true for food hazards, as traditionally women have often purchased the food and prepared the meals in a household.

2.6.2. Ethnicity and socio-economic grouping

It was found that British individuals from an Afro-Caribbean background expressed high levels of perceived risk from hazards in general. Afro-Caribbeans also had a high desire for the government to reduce risks and introduce greater public involvement in risk management (Frewer, 2000). British Asians were found to hold similar high perceived risks for certain hazards. Differences between socio-economic groups were also found with regard to perceived risk. It was found that the top two socio-economic groups perceived less risk from hazards. Similarly, more affluent individuals expressed less concern about hazards and were less concerned about public involvement in the risk management process than were poorer individuals (Frewer, 1999). It was suggested that those who are wealthy or are in a high socio-economic grouping already perceive that they have a high involvement in risk management decisions. In contrast, individuals from minority ethnic groups, poorer people, and those from low socio-economic groups may feel excluded from risk management decisions and have a low trust of the government. This may account for the high perceived risk levels by these individuals (Frewer, 2000).

2.6.3. Knowledge

Several studies have found that individuals who are better educated are more positive towards biotechnologies than those who are less educated (Magnusson and Hursti, 2002; Gaskell et al., 2000; Allum, Boy and Bauer, 2002). This relates to the finding that those with a higher level of knowledge about GM food were more positive towards GM food. Correspondingly, it has often been assumed that liking of GM food can be increased through the provision of information about GM food (Royal Society, 1985). However the causality of the correlation between education and positive attitudes towards GM food is unclear. It is possible that those who are positive towards GM food are more likely to seek out more information and learn further about GM food thus increasing their knowledge, rather than this gain of knowledge resulting in an increasingly positive attitude. The issue of the relationship between attitudes and knowledge will be taken up and explored more thoroughly in chapter four along with a quasi-experimental examination of the impact of learning about GM food on attitudes and other antecedents of behaviour towards GM food.

2.6.4. Age

Eurobarometer reports indicate that supporters of GM food are more likely to be young (Gaskell et al., 2000) and similar differences have been found in other studies (e.g. Magnusson and Hursti, 2002; Sparks, Shepherd and Frewer, 1994). Sparks, Shepherd and Frewer (1994) found that older participants perceived lower benefits associated with GM food than did younger people and also agreed more strongly that ethical issues were involved. The increased negativity towards GM food by older people is not necessarily a surprising finding as it was found that people generally get more risk averse as they get older (Mitchell, 1998). There are various age-related factors that may help to account for this finding, including experience, family responsibilities, financial situation, and deteriorating health.

2.7. Conclusions

In conclusion, attitudes towards GM foods in Britain were found to be ambivalent. Britain is in the middle range of European countries in terms of accepting GM food but is significantly less accepting of GM food that the US. Attitudes towards GM food are likely to have been influenced by a variety of factors including local events, e.g. the BSE crisis, as well as the regulatory systems in place and Britain's political stance. There were strong correlations between tone of media coverage and the attitudes of the British people; however causality can not be inferred. In fact, causality is likely to be bi-directional so that media coverage influences attitudes as well as attitudes influencing media coverage.

In comparison to other biotechnologies and other foods, GM food seems to be perceived as more negative. Acceptance is likely to be driven by a variety of associated cognitive constructs, including perceived risk, perceived benefits, trust, and control. GM food was associated with high perceived risks but also with high perceived benefits. Perceived control was low and trust on GM food issues was found to vary widely between sources; doctors and consumer groups were highly trusted, whereas government and biotechnology institutions were considered to be quite untrustworthy. With regards to individual differences in attitudes, those who were most likely to be anti-GM were also likely to be women, the elderly, have low knowledge about GM, to be of a lower socio-economic grouping, of an ethnic minority and to be poorer than average. Many of these individual factors may relate to differences in perceived control and trust of GM food technologies.

Chapter Three – Use of a Card Sort Task to examine Perceptions of GM Food and related Emotions and Imagery

3.1. Introduction

As reviewed in chapter two, there is an extensive literature on how GM food is perceived and on attitudinal influences. Much of this research seems to have investigated specific socio-cognitive factors, imposing a ready made structure on people's perceptions which may in fact manipulate these perceptions to some extent. It was thought that it would be timely to return to the basics and examine perceptions about GM food along with other biotechnologies, taking a 'bottom up' approach in order to determine what the dominant perceptions about GM food and other biotechnologies are.

The proposed aim of this first experimental thesis chapter was to do just that. A qualitative study is described here in which individuals' cognitions, emotions and imagery associated with GM food and other biotechnologies were gathered, without any pre-composed structure. The task utilised for this purpose was a card sorting task, commonly used within the domain of knowledge evaluation; this technique is described in detail and its previous uses outlined. This type of open qualitative study was not the first of its kind to be applied to biotechnologies and previous similar approaches to examining perceptions of biotechnologies were reviewed. Personal constructs examined by the card sort task were examined theoretically and related to similar concepts of cognitive appraisal dimensions and attitudes in order to determine their significance and importance. In conjunction with the card sort task, related data regarding emotions and imagery was gathered and the relevance of this data to the card sorts generated, as well as to attitude and behaviour concepts, was explored.

3.2. Commonly used qualitative approaches in psychology

There is various research that has employed qualitative techniques in order to examine perceptions of GM food. Many of these techniques allow the individual to generate their own ideas and thoughts that are associated with GM food and avoid the superimposition of pre-defined characteristics on participants' responses.

3.2.1. Interviews

Interviews are a common method for obtaining qualitative information and are useful when approaching a new area of research as this method will generally produce a large amount of rich information on a topic. Interviews vary to the degree to which an interviewer will have a pre-defined structure and specified questions for participants to answer. A structured interview will be subject, to some extent, to the imposition of previous ideas in the choice of which particular issues are discussed. Unstructured interviews, although free from externally imposed meaning, may actually be less informative than structured interviews in some cases because participants may spontaneously produce little information on the required topic. In addition, information that is produced may be irrelevant to the nature of the study being conducted. A semi-structured interview will often use some tool, or technique, in order to direct the information that the participant produces, without undue influence on what that information is.

3.2.2. The repertory grid technique

The repertory grid technique is one method used in order to structure the examination of an individual's thoughts and associations on a particular topic.

This technique is based on George Kelly's (1955) personal construct theory, which asserts that meaning is constructed individually and perceptions of the world are based on an individual's own constructed meaning. The repertory grid technique is a method of deconstructing and reconstructing stimuli, or events, in order to examine an individual's thought processes so that these can be reflected on and, in some cases, restructured (Fransella, Bell, Bannister, 2003).

Procedurally, the technique requires an initial set of elements within the topic area to be identified; these may be generated by the participant or produced through some analysis of existing literature on the topic, e.g. protocol analysis. Participants are then presented with the elements in groups of three. For each set of three stimuli, participants are required to rank the three stimuli according to some criterion. The criterion on which stimuli are ranked is known as a personal construct. The personal construct is noted and participants are presented with three further stimuli to rank; this process is repeated until no further novel personal constructs emerge. Participants are then asked to rate each stimuli presented against each of the personal constructs developed, typically on a continuous bipolar linear scale (Frewer, Howard and Shepherd, 1997). Stimuli can be represented in a two-dimensional space matrix according to the personal construct dimensions developed and these space matrices are the repertory grids. The grid may then be provided to the participant for comment and alterations can be allowed in order to focus the grid. The conceptual structure of the elements within the grid can be further examined analytically using cluster analysis or principal components analysis.

Repertory grids are used in a range of fields and may be utilised in order to examine perceptions, aid learning, or to resolve conflicts, amongst other things

(Fransella, et al., 2003). Within the topic of GM food, these have generally been used to examine individuals' perceptions. For this purpose, repertory grids may be compared between individuals to discover common personal constructs and to examine perceptions of different stimuli.

Advantages of the repertory grid technique include its flexibility, small sample sizes required, its ease of use and the fact that the information generated represents the participant's own thought processes. It is noted that personal constructs produced will only reflect differences between elements presented. Any commonalities amongst all elements examined may be ignored by this technique (Frewer, Howard, Hedderley and Shepherd, 1998).

3.2.3. Card sorting task

Similarly to the repertory grid technique, card sorting techniques (see Rugg and McGeorge, 1997, for a review) also emerged from Kelly's (1955) personal construct theory. Card sorting techniques are widely used in the domain of knowledge acquisition to examine how people structure concepts and related information mentally. The basic idea behind the technique is to ask participants to sort items into groups. These groups may be chosen by the experimenter or produced by the participants (Rugg and McGeorge, 1997).

The card sorting technique is quick and quite easy to use (Rugg, Corbridge, Major, Burton and Shadbolt, 1992). It is also more suited than the repertory grid technique to some types of data; repertory grid techniques can encounter problems when dealing with nominal values however these are easily dealt with in card sorting tasks. The repertory grid technique is more amenable to statistical analyses than card sorting tasks though, to which relatively few statistical techniques can be applied (Rugg and McGeorge, 1997).

With regards to data obtained from card sorts, the types of criteria generated by participants provide an insight into the ways in which people view and appraise these items and agreement between criteria used by different participants indicate how valid that criterion is. Commonalities between items included in categories are also revealing and provide information with regard to how stimuli are commonly perceived.

3.3. Previous qualitative research examining perceptions of GM food

Perceptions of GM food have been examined several times previously in the context of other biotechnologies or in the context of technologies in general. Frewer, Shepherd and Sparks (1994b) used structured interviews with open ended responses to examine the British public's understanding of, and attitudes towards, biotechnologies (including food biotechnologies). Data revealed that participants had a very low level of understanding about all biotechnologies. This did not, however, seem to prevent the formation of opinions on the topic; attitudes were mixed with most participants perceiving both risks and benefits associated with biotechnologies. Perceived benefits elicited included medical improvements, environmental benefits, improvements in quality of life and improvements in food quality and quantity. The most commonly mentioned risks associated with biotechnologies included a lack of control of the technology, safety problems, negative environmental effects, military applications and medical or health related problems (Frewer, Shepherd and Sparks, 1994b).

Interviews may not be the best method for examining perceptions of GM food however and have been criticised for producing only a small amount of information (Frewer, Howard and Shepherd, 1997). It is suggested that little information is generated because participants are lacking in knowledge about GM food and consequently the use of a more structured technique may help to facilitate discussion.

The repertory grid technique has been used several times in order to assess the ways in which people perceive technologies and biotechnologies including GM food. Within the UK, Frewer, Howard and Shepherd, (1997) presented two studies that examined 15 applications relating to biotechnologies phrased in general terms, compared to those phrased in specific terms. The most popular personal constructs generated were: whether the individual had personal objections to the technology; the extent to which they tampered with nature; the morality of the technology; potential effects on welfare; the necessity of the technology; the benefits associated with the technology; and whether the technology might be harmful. Results showed that the use of more specific terms to describe biotechnologies resulted in a greater differentiation of products.

The classification of biotechnologies when phrased in general terms was explained well by two main components. One component was described as rejection factors. At the negative end of this component, constructs were described as personal objections, immoral, unnatural, unethical, harmful, personal worry, negative welfare effects, dangerous, risky, tampering with nature and creation of inequalities. At the positive end of the component, constructs were described as beneficial, advantageous, necessary, progressive and important. The second component was described as the long term effect of biotechnologies and the personal construct described as long term effects loaded heavily on this component. Generally, food applications associated with animal products were related to the negative end of the rejection factors component and food applications associated with plant products were related to the positive end of the rejection factors component. There were no discernable patterns with respect to which biotechnologies were associated with long-term effects and short term effects.

With regards to biotechnologies described in terms of more specific applications, personal constructs also clustered on two main axes. This time axes reflected the different poles of the rejection factor component identified for general applications of GM food; one axis reflected acceptance factors including advantageous, progressive, necessary and important and the other reflected rejection factors including unethical, negative welfare effects, personal objections, harmful, immoral, unnatural, risky, dangerous, tampering, inequalities and personal worry. Within this component space, animal applications were more closely related to the rejection factors axis and plant applications were more closely related to the acceptance factors axis.

Another study that has examined perceptions of GM food in the UK within a study using the repertory grid technique placed GM food in the context of other technologies, rather than other biotechnologies (Frewer, Howard and Shepherd, 1998a). Technologies used within the study, alongside GM food, included those such as, motor vehicles, x-rays, satellites, solar power, nuclear power and pesticide use in agriculture. The most common emerging personal constructs of classification included beneficial, damaging, dangerous, polluting, necessary and unnatural. Two distinct factors were identified from the analysis of these constructs. The first factor was identified as describing risks associated with technology and was linked with personal constructs of controversy, accidents, environmental, errors, harmful, hidden, long term effects, misuse, negative, severe, unhealthy, unknown, unnatural, trusted, damaging, dangerous, harmful, polluting and risky. The second factor was identified as describing benefits associated with the technology and was linked with personal constructs of beneficial, good, knowledgeable, interesting and necessary (Frewer, Howard and Shepherd, 1998a). GM food was found to be linked with both risks and benefits.

There are clearly similarities between the two repertory grid studies conducted by Frewer, Howard and Shepherd, (1997) and Frewer, Howard and Shepherd (1998a) with necessity, benefits, ethics, danger and risk being highlighted as important classification dimensions in both studies. Indeed the emergent axes upon which items were identified were quite similar; one study identified an axis on which acceptance factors loaded at one end and rejection factors at the other and the other two studies (both of which used more specific items) identified two different axes corresponding to acceptance and rejection factors. These personal constructs also have clear relations with constructs identified by previous research that has examined important issues in relation to biotechnology, see chapter two, section 2.4. Perceived risk, perceived benefit, trust and perceived naturalness have all been previously highlighted as important constructs relating to GM food (Gaskell, Allum and Stares, 2003; Sparks, et al., 1994. There are constructs that have been identified in other research as important in relation to GM food that were not identified here, e.g. perceived control. It is possible that omitted constructs relate to all stimuli examined however and therefore were not used to differentiate stimuli (Frewer, Howard and Shepherd, 1997).

An important point in relation to repertory grids is that dimensions of classification are likely to be highly dependent on the particular items that the participant is presented with (Townsend, et al., 2004). This may help to explain differences noted between repertory grid studies. Different personal constructs are likely to emerge for biotechnologies as opposed to technologies and GM food is likely to be rated in a different way in these different contexts. Indeed dimensions such as polluting, hidden, accidents and knowledgeable were utilised for technologies but not for biotechnologies and conversely the dimensions of personal objections, horror, fear, irreversible effects and important were utilised for biotechnologies but not for technologies. It is noted that some differences may also be attributed to differences in classifications made by experimenters.

To date, no study has used a card sorting approach in order to examine personal constructs relating to biotechnologies. Card sorting tasks may be useful methods to apply to the study of perceptions relating to biotechnologies because these are better able to examine nominal data that do not form a semantic scale (Rugg and Shadbolt, 1991). These may, therefore, detect more basic personal constructs that repertory grids can not.

3.4. Theoretical framework

3.4.1. Cognitive appraisal dimensions and personal constructs

Qualitative methods, such as the repertory grid technique and the card sorting technique, involve the generation of personal constructs. Personal constructs are the dimensions used by individuals in order to organise and classify stimuli. The concept of personal constructs is thought to be similar to the concept of cognitive appraisal dimensions. Cognitive appraisal refers to the process by which an organism appraises its environment (Lazarus, 1968) and cognitive appraisal dimensions are the ways in which an individual organises that environment. Both personal constructs and cognitive appraisal dimensions, therefore, seem to refer to criteria used by individuals in order to assess the world around us in a personally relevant way (Parkinson, 1997). In addition, both personal constructs and cognitive appraisal dimensions are thought to underlie attitudes; these concepts are described as being more basic than the construct of attitudes and may precede the development of attitudes (Frewer, Howard and Shepherd, 1998a; Fazio and Olson, 2003a).

3.4.2. The composition and development of attitudes

There are a number of different views regarding how attitudes are composed. The classic view is the tripartite model that claimed that attitudes have three components: cognitive (stemming from cognitive appraisal), affective and behavioural components (Katz and Stotland, 1959; Rosenberg and Hovland, 1960). This model of attitudes provides a useful framework for studying attitudes and matches an intuitive distinction between the components. However, the tripartite view was criticised with regard to some of the inferences that it generates. It was argued that this view implies that all three components should exist in order to generate an attitude and that these components should be consistent with one another, which was not always found to be the case (Fazio and Olson, 2003a; Rosenberg and Hovland, 1960). For example, an individual may understand that smoking is bad for you cognitively, but may still smoke and be emotionally positive towards the activity. Many researchers have, therefore, concluded that a one component view of attitude is preferable to three components (cf. Thurstone, 1946). Zanna and Rempel (1988), for example, regarded attitudes as categorisations of an object along a positive – negative evaluative dimension. This view suggests that attitudes may be formed in multiple ways, either through cognitions, emotions, or behaviour, but strips away problematic assumptions of consistency. Similarly, Fazio (1990; 1995) suggested that attitudes are associations in memory between attitude objects and evaluations.

3.4.3. Relevance of emotions

Conceptually, previous investigations investigating public perceptions and decision-making regarding biotechnologies have generally utilised a cognitive consequentialist model in investigating perceptions (e.g. Sparks, Shepherd and Frewer, 1995). These approaches explain attitudes as being based in the evaluation of cognitions only and emotion and the influence of previous behaviour is often ignored.

There are several existing models of behaviour that have included emotion as a determinant of behaviour, for example Finucane, Alhakami, Slovic and Johnson's, (1990) affect heuristic or Loewenstein, Weber, Hsee and Welch's (2001) risk as feelings hypothesis. One of the most comprehensive and influential accounts of the role of emotion in decision–making is Damasio's (1994) somatic marker hypothesis. This proposed that information required for reasoning and decision making are brought to mind as visual images. Accompanying the images of possible behavioural options are somatic markers, which relate to feelings that have been connected to different scenarios and images through learning. With many types of decisions a logical, cost benefit type analysis of the situation is not feasible due to time constraints or possibly the nature of the decision. In cases like these, somatic markers are suggested to assist the process by providing a short-hand method of assessing options.

Empirical evidence has also suggested that emotional responses have a strong influence on behaviour. Research by Prof. Alice M. Isen and colleagues indicated that positive affect was associated with risk-averse behaviour. For example, Isen and Geva (1987) found that positive affect in participants caused them to be less willing to gamble unless likelihood of winning was very high. Further to this, some evidence has indicated that the specific type of emotion experienced may influence behaviour in different ways. For example, Leith and Baumeister (1996) found that unpleasant moods accompanied by high arousal, such as embarrassment and anger, increased participants' preferences for risky options during a lottery task whereas unpleasant moods without the accompaniment of high arousal, such as sadness, did not increase these preferences. Further to this, Lerner and Keltner (2000) found that the experience of the emotion of fear resulted in pessimistic risk estimates and risk-averse choices whilst experiencing anger resulted in optimistic risk estimates and risky choices. As yet, the impact of different emotions on behaviour remains an important research question and further research is required in order to systematically examine potential effects. Overall, it seems that there is both a strong theoretical and a strong empirical case suggesting that emotions have an important influence on behaviour.

3.4.4. Importance of imagery

Imagery may also be powerful within the decision-making process. Mental imagery has been found to be a more useful aid in memory and learning than other methods of information processing (Bower, 1972). In addition, it has been found to be a useful method of altering attitudes and behaviour (Strack, Schwarz and Gschneidinger, 1985; Pham and Taylor, 1999; Blair, Ma and Lenton, 2001). For example, Blair, Ma and Lenton (2001) found that participants who generated counter stereotypic mental imagery produced significantly weaker implicit stereotypes than those who generated neutral imagery or no imagery at all. The production of mental imagery has been found to increase the accessibility of related cognitive, emotional and behavioural representations (Carroll, 1978). In this way, mental imagery may function in a similar way to priming.

The power of mental imagery may be attributable to the similarities between mental imagery and real experiences. Research has indicated that perceived images and recreated mental imagery utilised the same brain mechanisms (Farah, 1988; Damasio, Grabowski, Damasio, Tranel, Boles-Ponto, Watkins and Hichwa, 1993). In addition to the neurological mechanisms, mental images and perceived images were found to be similar in detail, causal sequences and logical constraints which suggests that the production of mental imagery is similar to a real experience (Matlin, 1998; Blair, et al., 2001).

Within the domain of biotechnologies, sociological examinations have found that public attitudes towards cloning and GM food and crops are influenced by science fiction imagery and metaphors, e.g. Frankenstein foods (Nerlich, Clarke and Dingwall, 1999). It is concluded that, at least under some circumstances, imagery is involved in attitude formation and behaviour;

moreover, when imagery is utilised it may carry a disproportionate weighting in its influence. The examination of imagery associated with an attitude object may, therefore, reflect the most important influences underlying behaviour.

3.5. Current aims

The study described within this chapter utilised a card sorting task in order to elicit personal constructs relating to GM food. GM food was presented in the context of biotechnologies, which was considered an ecologically valid context category. The card sorting task was used to elicit personal constructs because this type of task gives the participant freedom in generating constructs whilst providing a structure with which to do this.

It was hypothesised that personal constructs produced by the card sort task will relate to dimensions previously outlined as important in relation to attitudes towards GM food (when these were presented alongside other biotechnologies) including personal feelings, the extent to which they tamper with nature, moral issues, effects on welfare, necessity of the technology, benefits of the technology and whether the technology might be harmful (Frewer, Howard and Shepherd, 1997). The card sort task may produce a wider range of personal constructs than has previously been produced by repertory grid tasks though, including those that may have nominal values and do not easily form a semantic scale.

Participants were also asked to provide descriptions of emotions and imagery that they related to the biotechnologies used within the task. Although often ignored, evidence indicates that emotions and imagery are important influences on attitudes and behaviour. It was of interest, therefore, to examine the types of emotions and imagery generated in relation to biotechnologies and how these relate to personal constructs generated.

Emotions associated with biotechnologies were thought to be both positive and negative as previous research has indicated that the majority of the British public are ambivalent towards GM food (Gaskell, Allum and Stares, 2003). In addition, these were thought to consist of a range of different emotions, corresponding to emotions highlighted in previous studies in relation to GM food, e.g. fear (Frewer, Howard and Shepherd, 1997). It was hypothesised that emotions associated with biotechnologies would vary greatly between different biotechnologies. It was expected that generally medical biotechnologies would be viewed positively and agricultural biotechnologies would be viewed negatively, consistent with previous research (Bauer, 2002). Further to this, biotechnologies that are associated with medicine or agriculture were predicted to be further differentiated according to processes that they utilise; biotechnologies that are perceived as being conducted on humans or animals were generally viewed more negatively than those perceived as being conducted on plants (Frewer, Howard, Hedderley and Shepherd, 1997).

Imagery associated with biotechnologies was thought to reflect media images of biotechnologies as well as direct images of the biotechnologies and processes surrounding these. Categories of imagery were predicted to relate to personal constructs generated in relation to biotechnologies and it was anticipated that these may highlight any particularly influential constructs that exist.

3.6. Method

3.6.1. Design

A within subjects design was employed here in which all participants completed the same task and responded to the same questions. A single criterion card sort task was utilised in order to elicit personal constructs relating to GM food and other biotechnologies from participants. In addition, imagery and emotional constructs, associated with GM food and other biotechnologies examined, were recorded.

3.6.2. Participants

Forty participants were recruited through posters advertising the study displayed around the University of Nottingham campus and also through a study day conducted in the School of Psychology at the University of Nottingham. A topic blind method of recruitment was used (Campbell and Townsend, 2003), in order to ensure that participants' participation decision was not influenced by the topic of the study. Altogether 40 participants were recruited (25 female and 15 male) with an age range of 18 to 32 years; all participants were students at the University of Nottingham.

3.6.3. Materials

Participants were provided with a standardised instruction sheet, which detailed the procedure of the card sort task and gave an example of how it should be carried out. For a demonstration task, ten pieces of cards with different types of sport printed on them were used and for the actual task, 20 pieces of card with different types of biotechnology printed on them were used. Biotechnologies, as described on the cards, were: Golden rice (enhanced vitamin A); Human cloning; Animal cloning; Biosensors; Stem cell research; DNA fingerprinting; Xenotransplantation; Blood substitutes; Eugenics; Pharmocogenetics; Gene therapy; Herbicide resistant crops; Gene sequencing; Human insulin; Tissue culture; Bio-remediation; Pest resistant crops; Faster growing animals; GM strawberries (enhanced levels of a cancer fighting compound); GM fruit and vegetables with increased flavour. These were chosen as real examples of GM food which are or may become available in the future, that are well known, and that represent the broad spectrum of biotechnologies. These were phrased in quite specific terms in order to encourage greater differentiation between products. A digital voice recorder was also used in order to record descriptions made by the participants during the task.

A short questionnaire was used to examine emotions and imagery associated with each biotechnology. These were formatted so that for each biotechnology, participants had separate spaces to describe associated emotions and associated imagery, and were prompted to do so. During analyses, EZSort and EZCalc software (Dong, Martin and Waldo, 2001) was used to examine frequencies of associations between factors.

3.6.4. Procedure

The procedure of the card sort task was explained to participants and a demonstration of the task was given using different cards relating to the topic of sport. Once the participant indicated that he or she understood the task, the demonstration was terminated and the actual task began. The participant was then provided with the cards displaying different biotechnologies relating to the actual task. The repeated single criterion card sort task that was utilised in this study requires the cards to be organised according to any one dimension that the participant could think of (Rugg and McGeorge, 1997). This procedure was repeated until the participant could not think of any further ways in which to organise the cards. Participants were asked to explain how, and why, they organised the cards in the ways that they did. Participants' explanations were recorded using a digital voice recorder so that they could be reviewed for accuracy of interpretation. Once the cards had been organised in a particular way and the participant was satisfied with the organisation, the experimenter noted the different concepts in each group as well as the description that the participant had given to the way that concepts had been organised and the different names of individual groups within the sorting dimension used. No time limit was provided for the task and time taken for completion varied between 20 minutes to 90 minutes.

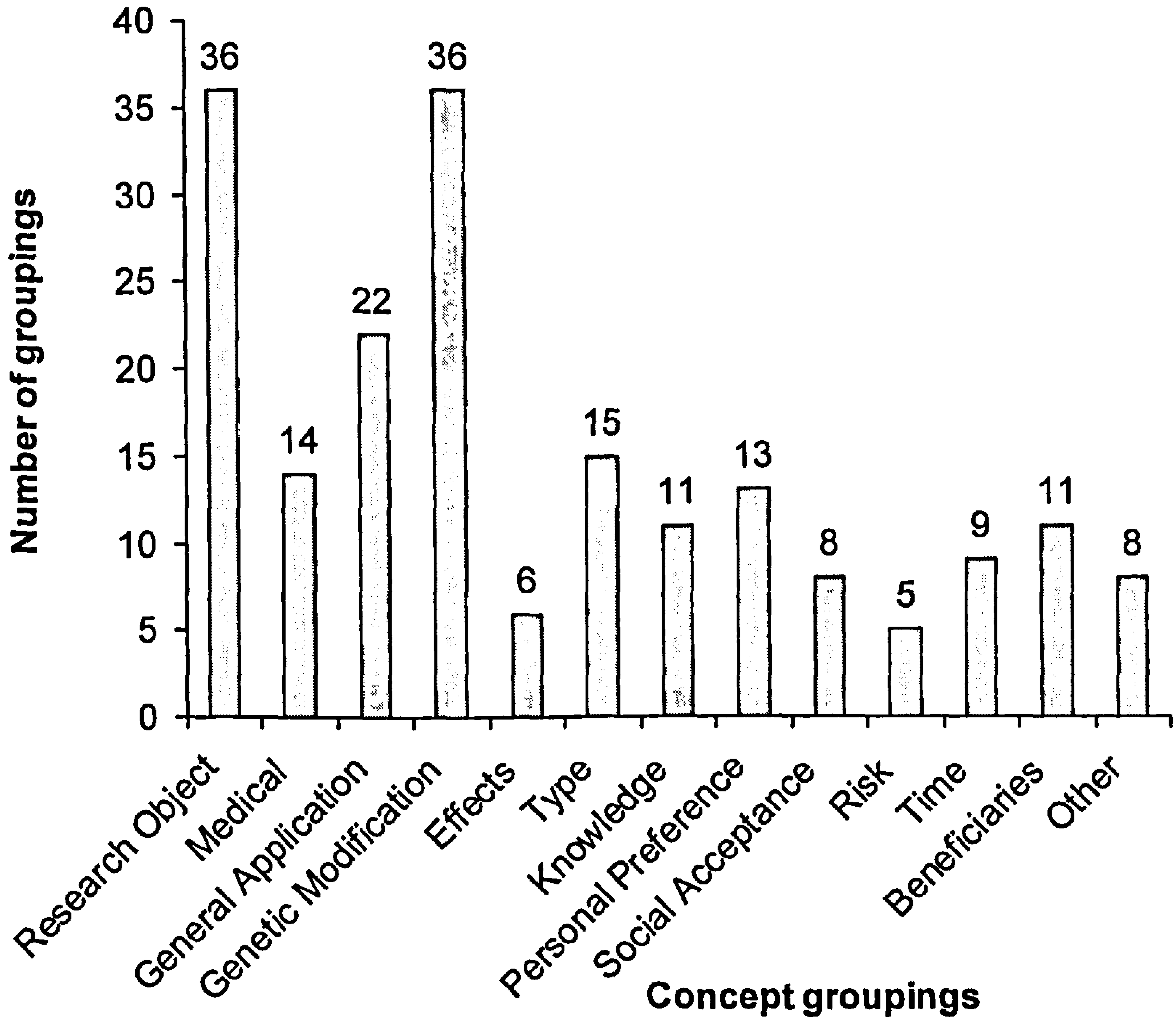
Participants were then asked to think of emotions and imagery that they associate with the biotechnologies that they had been sorting and were given a questionnaire to prompt and record their responses. There was space for participants to list several emotions and images that they associated with each biotechnology and participants were encouraged to list as many as possible for each one. It was acknowledged that this may be hard but participants were instructed to try and think of at least one emotion or image for each and that only if they really could not think of any associated emotions and images should they leave a blank space. On completion, the purpose of the experiment was discussed with the participant and any questions that they had were answered.

3.7. Results

3.7.1. Card sort groupings

The different ways in which participants sorted the cards were collated in a spreadsheet and those that were of a similar nature were grouped together. To minimise researcher bias, three researchers carried out groupings and the naming of groups individually; agreement was 77% and those that were not agreed on were discussed until agreement was reached.

Figure 3.1 – Card sort groupings



Several themes emerged from this, see Figure 3.1. In order of frequency from most frequent, sorting criteria used were, 'Research object', 'Genetic modification', 'General application', 'Type', 'Medical', 'Personal preference', 'Knowledge', 'Beneficiaries', 'Time', 'Social acceptance', 'Effects', 'Risk' and 'Other'. The group entitled 'Other' encompassed sorts that were not categorised into larger categories as well as several small categories of 'Necessity', 'Ethics' and 'Ease of process', each of which were only made up of a couple of sorts.

Cluster analysis was then conducted on each type of card sort grouping using EZSort and EZCalc software. This quantified the data produced by the card sorting task by calculating similarity scores based on how often participants placed concepts in a common group; results were displayed in the form of tree diagrams, see Figure 3.2. Within each type of sort, this method was used in order to discover the average methods of grouping across participants. Resulting tree diagrams displaying the average sort for each sorting criteria were then compared to examine the groupings within different criteria. It also enabled the examination of similarities between sorts and the groups that were formed within these.

Average groupings of biotechnologies were only examined within sort types that had been carried out a minimum of nine times or above as this was considered to produce a reliable agreement between groups; within smaller sized sort types there was much less agreement between groups produced. In addition, the sort type described as 'General applications' was not analysed as there was not enough agreement between types of groups generated within sorts. Therefore, groups were analysed within seven sort types, 'Research objects', 'Medical', 'Genetically Modified', 'Type', 'Knowledge', 'Personal Preference' and 'Time'. Average methods of grouping within these sort types are presented in Table 3.1.

Figure 3.2. – Tree Diagram (Average method of grouping across participants)

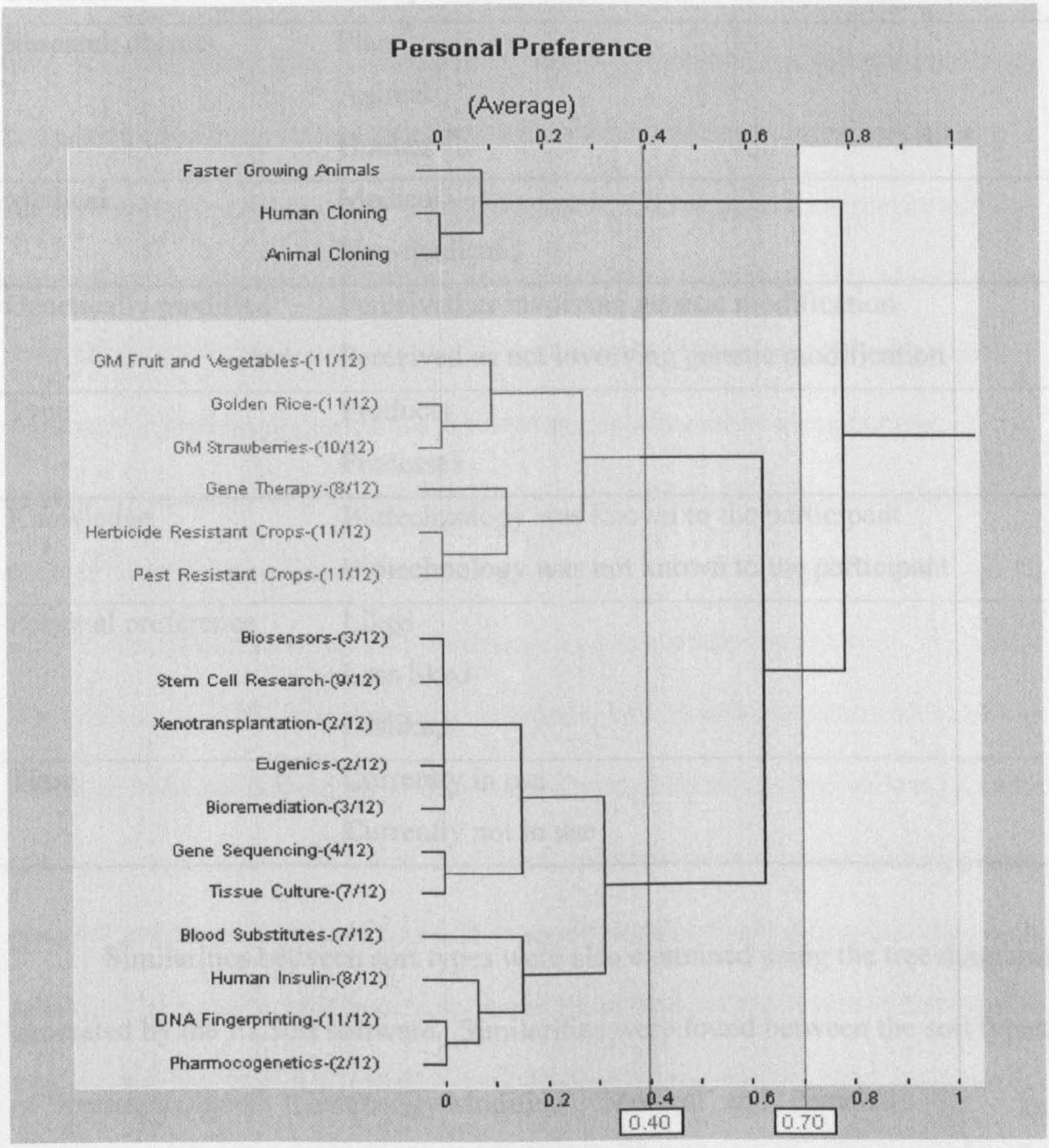


Table 3.1. – Average methods of grouping within most common card sorts.

Card Sorts	**Groups within sort**
Research objects	Plant Animal Human
Medical	Medical Non-medical
Genetically modified	Perceived as involving genetic modification Perceived as not involving genetic modification
Type	Products Processes
Knowledge	Biotechnology was known to the participant Biotechnology was not known to the participant
Personal preference	Liked Less liked Disliked
Time	Currently in use Currently not in use

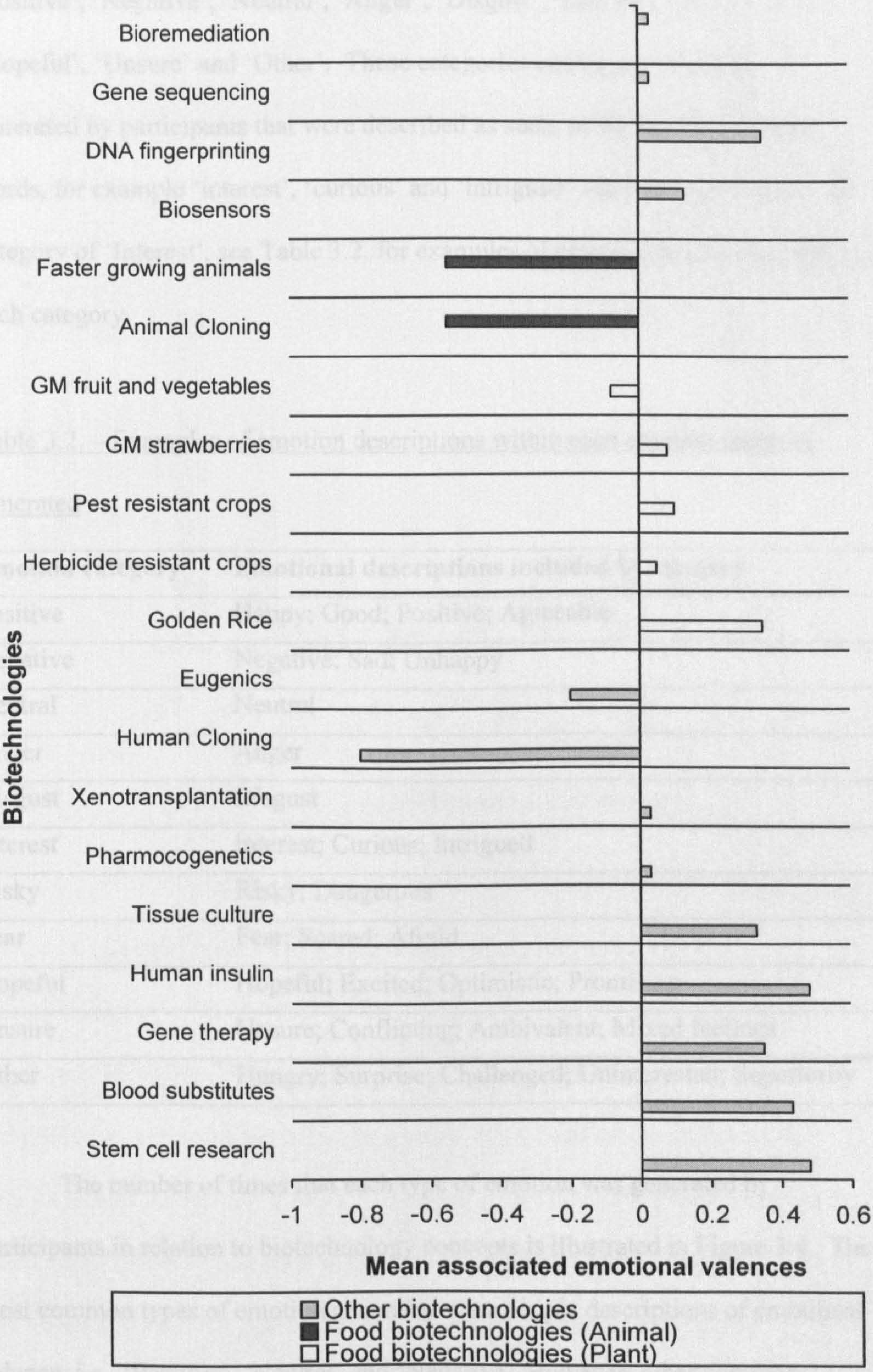
Similarities between sort types were also examined using the tree diagrams generated by the EZSort software. Similarities were found between the sort types of 'Research object', 'Genetically Modified', 'Medical' and 'Personal Preference', see Appendix one. It emerged that, generally, biotechnology concepts grouped as being associated with animals and plants were perceived as genetically modified, non-medical, and as less liked and disliked. Conversely, those grouped as being associated with humans were perceived as not involving genetic modification, medical, and as being liked. The sorting criteria of 'Type', 'Knowledge' and 'Time' did not align with other sorting criteria in any logically apparent way.

3.7.2. Related emotions

Most participants generated at least of one or two emotions relating to each biotechnology concept. Emotions relating to the different biotechnology concepts were also collated and examined. Associated emotions were coded according to the valence of the emotion, as well as into general categories of emotion. Two different individuals carried out coding and then codes were compared. Agreement was high (71%) and where disagreements existed, these were resolved through discussion. A third person was asked to categorise emotions according to categories generated as a further reliability check and agreement was high (83%).

Associated valences were examined across different types of biotechnology. A score of one was used for a positive emotion and a score of minus one was used for a negative emotion; neutral emotions had a score of zero. These scores were used to calculate a mean valence rating for each biotechnology concept, see Figure 3.3. The graph indicates that most biotechnologies were rated as neutral or positive. Medical biotechnologies, with the exception of human cloning and eugenics, were associated with positive emotions. Food biotechnologies that are developed from plants were mostly positive whilst those developed from animals were negative. Other biotechnologies included were positive.

Figure 3.3 – Mean valence rating for each biotechnology



Several different categories of emotion emerged from analysis, these were, 'Positive', 'Negative', 'Neutral', 'Anger', 'Disgust', 'Interest', 'Risky', 'Fear', 'Hopeful', 'Unsure' and 'Other'. These categories encompassed emotions generated by participants that were described as such, or by similar emotional words, for example 'interest', 'curious' and 'intrigued' were subsumed under the category of 'Interest', see Table 3.2. for examples of emotion descriptions within each category.

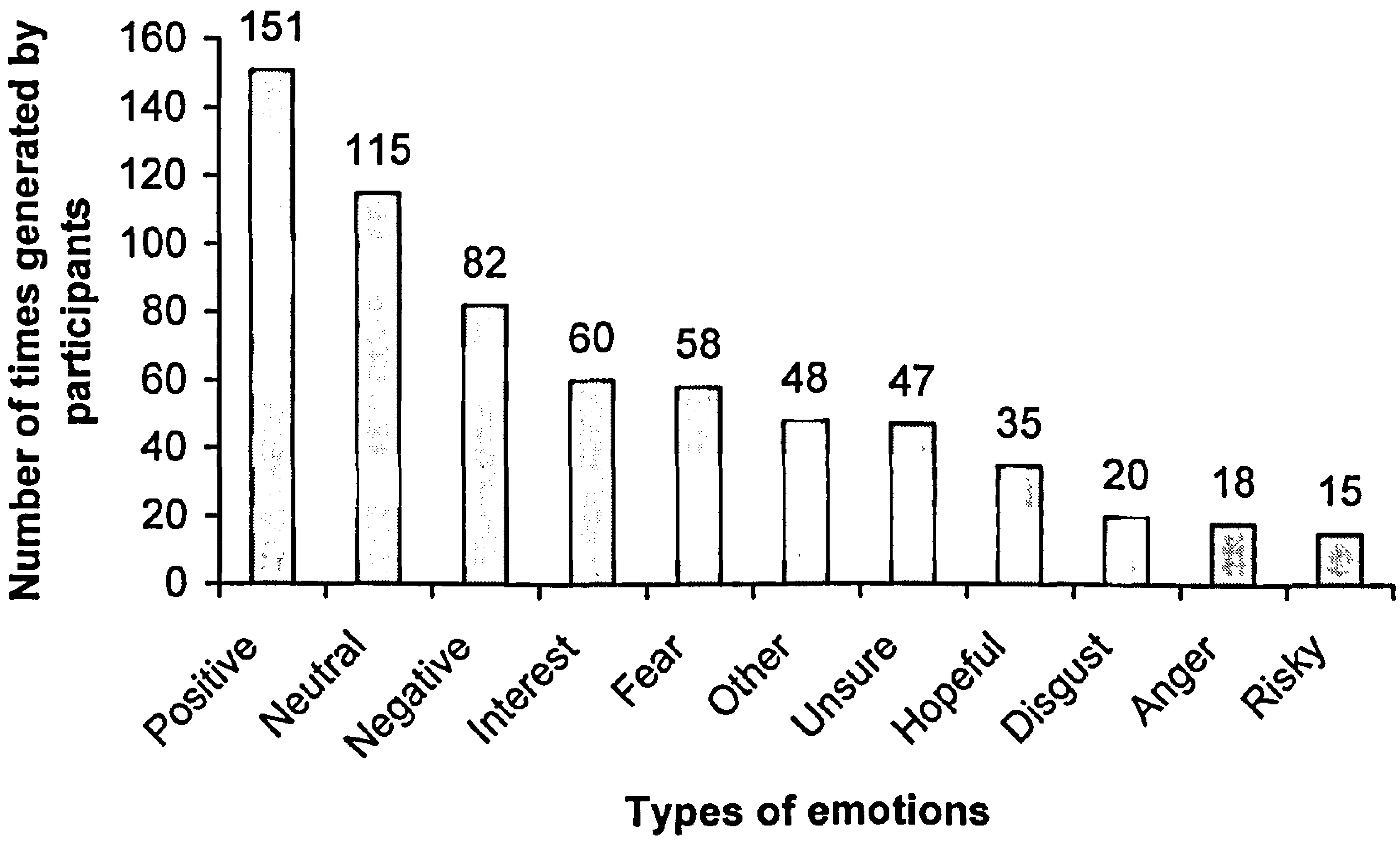
Table 3.2. – Examples of emotion descriptions within each emotion category generated

Emotion category	**Emotional descriptions included in category**
Positive	Happy; Good; Positive; Agreeable
Negative	Negative; Sad; Unhappy
Neutral	Neutral
Anger	Anger
Disgust	Disgust
Interest	Interest; Curious; Intrigued
Risky	Risky; Dangerous
Fear	Fear; Scared; Afraid
Hopeful	Hopeful; Excited; Optimistic; Promising
Unsure	Unsure; Conflicting; Ambivalent; Mixed feelings
Other	Hungry; Surprise; Challenged; Uninterested; Superiority

The number of times that each type of emotion was generated by participants in relation to biotechnology concepts is illustrated in Figure 3.4. The most common types of emotion generated were simple descriptions of emotional valence, i.e., 'Positive', 'Neutral' and 'Negative. However, other common categories of emotions generated were 'Interest', 'Fear', 'Unsure' and 'Hopeful'.

Some emotions did not fit super-ordinate categories well and these were collated in a category titled 'Other'.

Figure 3.4 – Types of emotions generated in relation to biotechnologies



Types of emotions generated were also examined for each biotechnology, see Table 3.3; categories were listed, if they were associated with that biotechnology more than twice across participants, and in order of frequency generated. Biotechnologies were grouped by type of technology in order to examine similarities within these categories. Most medical biotechnologies including stem cell research, blood substitutes, tissue culture, gene therapy and human insulin were associated with emotions categorised as 'Positive', 'Neutral' and 'Interest' and often with those categorised as 'Hopeful' and 'Unsure'. However the biotechnologies of pharmocogenetics and xenotransplantation, which are associated with medical research, were only associated with categories of emotions described as 'Neutral' and 'Unsure', and also 'Positive' in the case of xenotransplantation. Certain other technologies that are related to medicine, namely human cloning and eugenics were associated with more negative categories of 'Negative', 'Disgust' and 'Unsure'; human cloning was further related to emotion categories of 'Fear', 'Anger', 'Risky' and 'Interest'.

It seems that, with regards to GM food, those that are vegetal (golden rice with enhanced vitamin A, herbicide resistant crops, pest resistant crops, GM strawberries with enhanced levels of a cancer fighting compound and GM fruit and vegetables with increased flavour) were associated with a mixture of emotions. Associations with those classed as 'Positive' were most prevalent but these were also associated with those classed as 'Negative', as well as 'Neutral', 'Fear' and 'Unsure'. Amongst these vegetal GM foods, two were highlighted as having health benefits (golden rice with enhanced vitamin A and GM strawberries with enhanced levels of a cancer fighting compound). Golden rice was associated solely with positive emotion categories of 'Positive' and 'Hopeful' as well as 'Neutral', however GM strawberries were associated with similar emotions as other agricultural GM foods.

Table 3.3 - Categories of emotion associated with each biotechnology

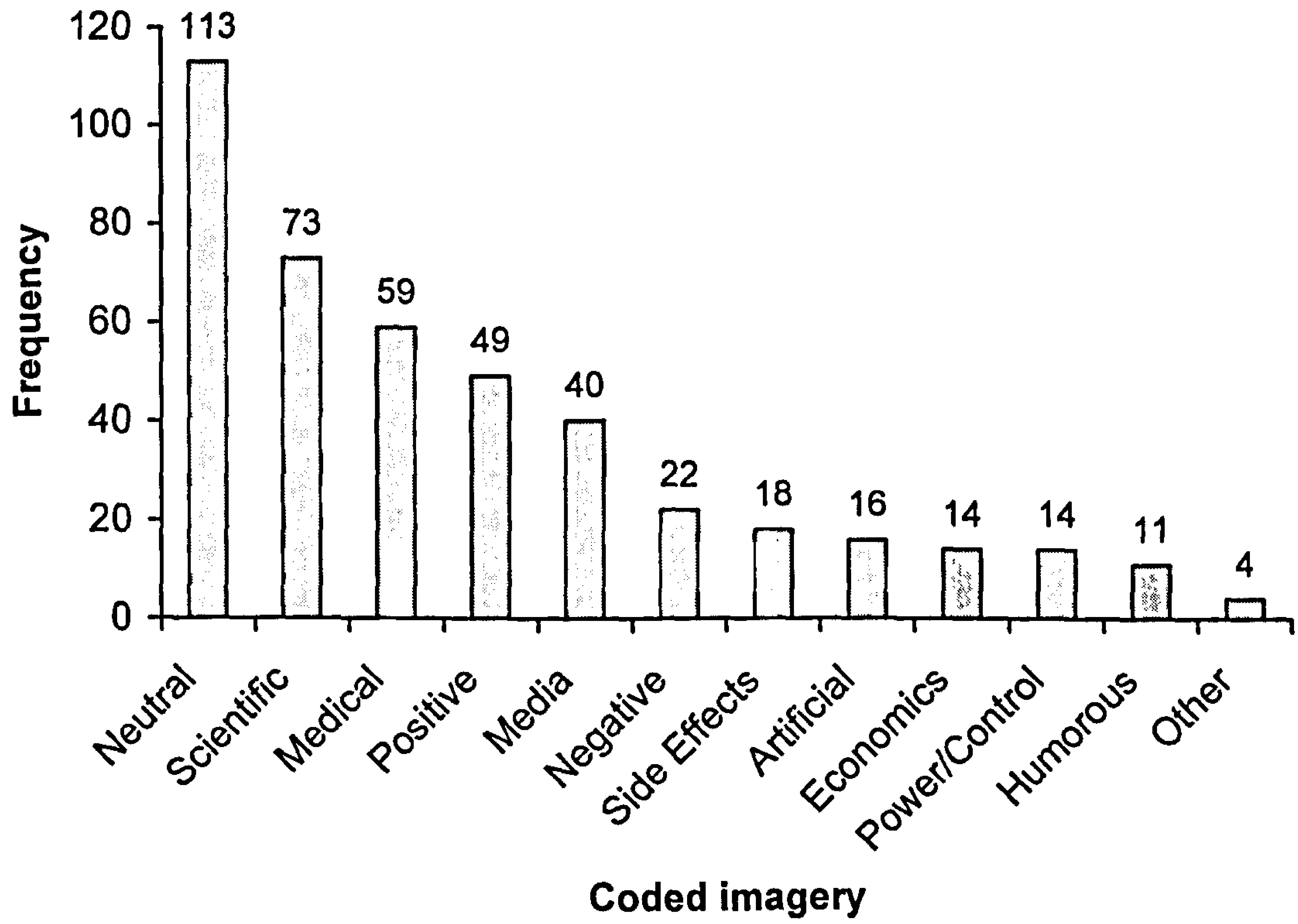
Type of Biotechnology	Biotechnology	Categories of emotion (frequency generated)
Medical Biotechnology	Stem cell research	Positive (12); Interest (8); Neutral (7)
	Blood substitutes	Positive (17); Neutral (4); Unsure (4); Interest (3); Hopeful (3)
	Gene therapy	Positive (12); Neutral (6); Interest (5); Hopeful (5); Unsure (4)
	Human insulin	Positive (16); Neutral (7); Interest (3)
	Tissue culture	Positive (9); Neutral (9); Interest (3)
	Pharmocogenetics	Neutral (6); Unsure (3)
	Xenotransplantation	Neutral (4); Unsure (4); Positive (3)
	Human cloning	Fear (14); Negative (12); Disgust (5); Risky (4); Anger (3); Interest (3); Unsure (3)
	Eugenics	Negative (4); Disgust (4); Unsure (3); Neutral (3)
Food Biotechnology (Vegetal)	Golden rice (enhanced vitamin A)	Positive (10); Neutral (10); Hopeful (4)
	Herbicide resistant crops	Positive (15); Fear (10); Neutral (6); Unsure (4)
	Pest resistant crops	Positive (14); Neutral (7); Negative (6); Fear (6)
	GM strawberries (enhanced levels of a cancer fighting compound)	Positive (9); Neutral (7); Interest (5); Negative (4); Fear (4); Unsure (3)
	GM fruit and vegetables with increased flavour	Positive (8); Negative (8); Neutral (5); Interest (4); Fear (3); Unsure (3)
Food Biotechnology (Animal)	Animal cloning	Negative (10); Interest (6); Fear (4); Disgust (4); Neutral (4)
	Faster growing animals	Negative (10); Anger (6); Fear (6); Disgust (4); Unsure (4); Interest (4); Neutral (4)
Other Biotechnologies	Biosensors	Neutral (7); Positive (4); Interest (4)
	DNA fingerprinting	Positive (15); Interest (5); Neutral (6)
	Gene sequencing	Neutral (9); Positive (3); Unsure (3); Fear (3)
	Bioremediation	Neutral (4)

With regards to those animal biotechnologies that are linked with GM food (animal cloning and faster growing animals), associated emotional categories were 'Negative', 'Fear', 'Disgust', 'Interest' and in the case of faster growing animals, 'Anger'. Other biotechnologies that are not related to medical or food biotechnologies were biosensors, DNA fingerprinting, gene sequencing and bioremediation and these were related to emotion categories of 'Neutral', 'Positive', and 'Interest' and variously, 'Hopeful' and 'Unsure'.

3.7.3. Related imagery

Most participants generated one image for each biotechnology concept. Imagery that participants associated with the biotechnologies presented was collated and examined. These were coded into general categories of imagery for examination. Two different individuals carried out coding and then these were compared. Agreement was high (69%) and discussion resolved any differences. A further check on the reliability of these codes was conducted by providing the imagery and the codes to a third person who was required to categorise the imagery into the codes. Again agreement was high (82%) and differences, where these existed, were quickly resolved through discussion.

Figure 3.5. – Frequencies of images generated by category



Eight main categories of imagery emerged, 'Scientific', 'Medical', 'Media', 'Artificial', 'Side Effects', 'Economics', 'Power' and 'Humorous', see Figure 3.5. Further categories of 'Positive', 'Neutral' and 'Negative' were used to group images produced that were direct descriptions of the biotechnology in accordance with the evaluative slant of the description. An 'Other' category was also used for several imagery descriptions that were more disparate and did not fit well into emergent categories; see Table 3.4. for examples of each category.

Table 3.4. – Examples of types of imagery generated by imagery category

Imagery category	**Image described (Biotechnology that image was associated with)**
Scientific	'Scientist bent over a microscope' (Gene sequencing) 'People in white coats in a lab environment' (Tissue culture)
Medical	'Patient recovering from illness' (Gene therapy) 'Diseased people having a new organ' (Tissue culture)
Media	'Scenes from The Matrix' (Human cloning) 'Godzilla' (Faster growing animals)
Artificial	'Plants too perfect to be true' (Herbicide resistant crops) 'Huge red juicy unnatural strawberries' (GM strawberries)
Side Effects	'Pigs with arthritis that can't walk' (Faster growing animals) 'Human genetic mutants caused by Genetically Modified Organisms (Herbicide resistant crops)
Economics	'People buying British' (GM fruit and vegetables with increased flavour) 'Helping with third world hunger' (Golden rice)
Power/Control	'Nazi doctors experimenting on twins' (Eugenics) 'People becoming slaves to Science' (DNA fingerprinting)
Humorous	'Vampires drinking canned blood substitutes' (Blood substitutes) 'Corn stalks with fly swatters' (Pest resistant crops)
Positive	'Brightly coloured fruit' (GM fruit and vegetables with increased flavour) 'Fields crowded with flourishing plants' (Golden rice)
Neutral	'Yellow coloured rice' (Golden rice) 'Salmon, twice the normal size' (Faster growing animals)
Negative	'Sad animals' (Faster growing animals) 'Fields of dead crops' (Pest resistant crops)
Other	'Sunday roast' (GM fruit and vegetables with increased flavour) 'Putting together different coloured Lego bricks' (Gene sequencing)

Table 3.5. – Categories of imagery associated with each biotechnology

Type of Biotechnology	Biotechnology	Categories of imagery (frequency generated)
Medical Biotechnology	Stem cell research	Scientific (9); Medical (7); Neutral (7)
	Blood substitutes	Medical (12); Neutral (7); Scientific (3)
	Gene therapy	Medical (11); Scientific (8)
	Human insulin	Medical (15); Scientific (5)
	Tissue culture	Scientific (11); Medical (3); Neutral (3)
	Pharmocogenetics	Medical (5)
	Xenotransplantation	Medical (3)
	Human cloning	Neutral (10); Media (7); Artificial (4)
	Eugenics	Negative (5)
Food Biotechnology (Vegetal)	Golden rice (enhanced vitamin A)	Neutral (17); Economics (4); Positive (6)
	Herbicide resistant crops	Side effects (5); Positive (8); Neutral (8); Negative (4); Economics (3)
	Pest resistant crops	Positive (10); Neutral (12); Side effects (3); Economics (3)
	GM strawberries (enhanced levels of a cancer fighting compound)	Positive (11); Neutral (10); Artificial (4); Side effects (3)
	GM fruit and vegetables with increased flavour	Positive (9); Neutral (9); Artificial (4)
Food Biotechnology (Animal)	Animal cloning	Media (15); Neutral (4); Negative (3)
	Faster growing animals	Neutral (11); Side effects (4); Humorous (4); Artificial (3)
Other Biotechnologies	Biosensors	Scientific (12)
	DNA fingerprinting	Scientific (14); Media (8); Power/Control (5); Neutral (4)
	Gene sequencing	Scientific (8); Neutral (4)
	Bioremediation	-

Types of imagery were also examined across different types of biotechnology. See Table 3.5. for a list of categories of imagery associated with each biotechnology; categories were listed, if they were associated with that biotechnology more than twice across participants, and in order of frequency generated. Again, biotechnologies were grouped by type of technology in order to examine similarities within these types. It was found that food biotechnologies were generally related to imagery that was coded as 'Artificial', 'Side Effects', and 'Economics'. Medical biotechnologies in contrast were generally related to imagery that was coded as 'Scientific' and 'Medical'. Specific biotechnologies were also associated quite strongly with certain images, for example human cloning and eugenics in particular evoked images categorised as 'Power/Control' and 'Media'. Certain biotechnologies, e.g. bioremediation, did not provoke many descriptions of imagery.

3.8. Discussion

3.8.1. Card sorts

The examination of card sorts formed by each participant provided an insight into participants' personal constructs used to evaluate biotechnologies. It was hypothesised that sorts formed would relate to personal constructs that have previously been pinpointed by repertory grid studies investigating the public's perceptions of biotechnologies. Although personal constructs generated by participants in this study did not align in any systematic way with personal constructs generated by previous repertory grid studies that examined GM food amongst other biotechnologies (Frewer, Howard and Shepherd, 1997), there do seem to be common themes between constructs generated. The sorting criteria of 'Personal preference', 'Knowledge' and 'Risk' generated within this study seem to relate directly to the constructs described as 'Personal objections', 'Personally unknowledgeable' and 'Risk' respectively, within the repertory grid study conducted by Frewer, Howard and Shepherd (1997). In addition, the sort utilised within this study described as 'Genetic Modification' that divided biotechnologies according to those that involved genetic modification and those that did not may relate to the previous construct identified as 'Tampering with nature' (Frewer, Howard and Shepherd, 1997). Further sorting criteria generated such as 'Beneficiaries', Effects' and 'Social acceptance' do not directly correspond to personal constructs identified by Frewer, Howard and Shepherd (1997), however they may relate to several different constructs to some extent, e.g., 'Negative effects on welfare', 'Beneficial' and 'Change in lifestyle'.

Other sorting criteria including 'Research object', 'General Application', 'Type' and 'Medical' are constructs that do not seem to have emerged from previous repertory grid analyses that have investigated personal constructs relating to biotechnologies. This may partly be due to differences between the stimuli used within the studies, although differences may also be due to differences in the task employed. The card sort task utilised here may have produced a wider range of more basic personal constructs. The nature of the task means that stimuli used can be sorted by simpler nominal categories that do not have to have a scale. This allows a wider variety of dimensions to be used and may be helpful for those participants with low knowledge about biotechnologies to produce card sorting criteria.

Differences between the study documented here and the previous study carried out by Frewer, Howard and Shepherd (1997) may also be attributed to differences in participant samples. Participants within this study were recruited using a topic blind method, whereas, the sample recruited by Frewer, Howard and Shepherd (1997) were informed of the topic of the study during advertising.

Participants within this study documented here are, therefore, likely to be less interested and engaged with the topic of GM food than were the sample used within Frewer, Howard and Shepherd (1997) study. Although the sample used here was small, due to the unbiased sampling method used it may be more representative of views held by the general British public that those obtained by Frewer, Howard and Shepherd (1997).

Main personal constructs previously identified that were seemingly omitted from the card sorts included trust, control, morality and necessity (Frewer, Howard and Shepherd, 1997; Siegrist, 2000; Frewer, Shepherd and Sparks, 1994a). It is possible, however, that these were subsumed within the card sorts generated, for example morality may be subsumed under social acceptance. Card sorts are evidently quite a basic way of organising stimuli and for this reason more abstract constructs may simply not be considered. The card sorts generated within this task were considered to provide a useful insight into very basic dimensions by which biotechnologies may be categorised. Another reason that personal constructs may have been omitted from card sorts generated is that participants may have felt that all biotechnologies presented were very similar with regards to these constructs and, therefore, would not have used these constructs to distinguish between them. For example, it is possible that participants associated trust issues in biotechnology companies or policy makers with all biotechnologies presented to the same degree. Alternatively, personal constructs that were not elicited here may have been less salient than card sorts that were elicited, at least to participants in this study who were not particularly engaged with the topic of biotechnologies.

Groupings of individual concepts were found to be similar between criteria and revealed two main meta-categories which highlighted the main perceptual divide between red (medical) and green (food) biotechnologies (Bauer, 2002). It seems that concepts categorised as food biotechnologies were also classed as animal and plant biotechnologies, non-medical biotechnologies and products (as opposed to processes). These were also disliked and perceived as genetically manipulated. Concepts categorised as medical biotechnologies, on the other hand, were classed as human biotechnologies, medical biotechnologies and as processes (as opposed to products); these were liked and perceived as not genetically manipulated.

Of course, there were also criteria groupings formed that did not match up so well with these two main emergent meta-categories and this lack of correspondence itself was informative. Both the criteria of 'Time' and the criteria of 'Knowledge' did not align well with these meta-categories. The fact that the groupings within the 'Time' criteria did not map on to other criteria examined indicated that it was not the case that those biotechnologies that were in use were liked and others were disliked. The lack of agreement in groupings within the 'Knowledge' criterion implies that understanding does not have a direct relationship with liking. This indicated the situation is more complex than simply suggesting that those biotechnologies that are known and better understood will be liked and that those that are less known and less understood will be disliked, as has been indicated by some previous research (Magnusson and Hursti, 2002; Gaskell et al., 2000; Allum, Boy and Bauer, 2002). Results instead support research that has found that the relationship between knowledge and attitudes is more complex than a simple linear association between knowledge and liking (Evans and Durant, 1995)

3.8.2. Emotion

Biotechnologies presented elicited a wide range of emotions from participants. Categories of emotions generated included those that were direct evaluative descriptions, e.g., 'Positive', and those that were categorised into more complex emotional categories, e.g., 'Anger', 'Interest'.

Interestingly, the majority of biotechnologies were rated positively overall. The most positively viewed biotechnologies were medical biotechnologies and the majority of medical biotechnologies were associated with qualitatively positive emotions that indicated that participants viewed these as hopeful and interesting technologies. It was surprising that pharmocogenetics was not viewed in the same way as other medical biotechnologies but it was suggested that this was because the majority of participants did not list any emotions in association with this construct, which may be due to low knowledge. Similarly xenotransplantation, which relates to medical biotechnology, was associated with very few emotions and this is also likely to be due to a lack of knowledge. Other biotechnologies, that relate to medicine (eugenics and human cloning), were viewed as negative and participants also viewed these as disgusting. Human cloning was further related to emotions of 'Fear', 'Anger', 'Risk' and 'Interest'. It is noted that both of these biotechnologies are very extreme forms of medical biotechnology and, in fact, it is debateable whether these should be included in this category.

GM food was associated with quite a wide range of emotions including both positive and negative emotions. This supports previous research that found that the British public were generally ambivalent about GM food (Gaskell, Allum and Stares, 2003). Vegetal GM food was most frequently associated with positive emotions though these were also associated with negative emotions. Participants additionally viewed vegetal GM food as both fearful, and hopeful, and felt unsure about them. This supports previous research that finds that the British public, generally, feels quite positive about agricultural GM products (Gaskell, Allum and Stares, 2003).

With regards to the specific vegetal GM food of golden rice with enhanced vitamin A and GM strawberries with enhanced levels of a cancer-fighting compound, it was expected that these products would be viewed more positively than other GM food due to their additional health related benefits. Indeed, golden rice was viewed more positively than other vegetal GM food however GM strawberries were not. It is unknown why participants distinguished between the two vegetal GM products with health benefits; there may be some differentiation between the need for the different health benefits. Alternatively, differences might be attributed to participant's perceived feasibility or effectiveness of the two products.

GM food that involves animals were generally associated with negative emotions; participants also viewed these as fearful and disgusting but interesting and often felt unsure about them. In addition, the biotechnology of faster growing animals inspired anger in some participants. These findings were supported by previous research that indicated that individuals were generally more negative towards the process of genetically manipulating animals than plants (Frewer, Howard, Hedderly and Shepherd, 1997). Other biotechnologies presented within this study that were unrelated to medical or food biotechnologies were viewed quite positively, and as interesting, although again participants were quite unsure about these.

An emotional response may form the basis of an attitude and, therefore, emotions provided by biotechnologies may be indicative of attitudes held towards them. Emotions have also previously been suggested to have an important influence on behaviour and may be a particularly strong influence when there are time constraints, or uncertainty, associated with the decision. Emotional responses to biotechnologies are likely to vary between individuals however there were some commonalities in the types of emotions that biotechnologies elicited. The emotional responses elicited by particular biotechnologies provided an indication as to the type of behavioural response that could be expected when that biotechnology is encountered. For example, a biotechnology associated with the negative emotional category of 'Anger' (e.g. faster growing animals) would be more likely to elicit a proactive negative behaviour, whereas, a biotechnology associated with the negative emotional category of 'Fear' (e.g. herbicide resistant crops) would be likely to provoke negative behaviour that is avoidant (Lerner and Keltner, 2000).

3.8.3. Imagery

Participants produced a range of imagery in association to the biotechnology concepts that they were provided with. Previous research has indicated that imagery may have a particularly powerful influence on behaviour and, therefore, imagery generated may provide a good indication of likely behaviour.

The majority of images produced in response to biotechnologies were direct descriptions of the technologies, and these were categorised according to the evaluative slant of the description, i.e., 'Positive', 'Neutral', 'Negative'. Imagery categories also included those that related directly to how technologies were perceived, i.e., 'Artificial', 'Side effects', 'Humorous', and those that were indirectly associated with the technologies, i.e., 'Scientific', 'Medical', 'Media', 'Economics', 'Power/Control'.

The categories of 'Scientific' and 'Medical' were very common categories and seemed to be descriptive of processes involved in biotechnologies. These categories may reflect a lack of knowledge held by participants about biotechnologies; participants may only understand the general area that the biotechnology relates to rather than it's specific nature and, therefore, may be only able to picture the environment under which that biotechnology might be encountered or used. Interestingly, the categories of 'Scientific' and 'Medical' were only used in association with biotechnologies that were perceived quite positively (medical biotechnologies and biotechnologies that are not related to either food or medicine) which suggests that images of science and medicine may be quite positive.

Human cloning and eugenics, which are associated with medicine, were associated with slightly different imagery categories than other medical biotechnologies. Eugenics was simply associated with very negative images. Human cloning was associated with artificial images and images from the media. This is probably due to the controversy surrounding human cloning which means that this has been featured frequently in both fiction and non-fiction media.

Again, it is noted that these are very extreme forms of medical biotechnology that may not always be subsumed within this category.

Vegetal biotechnologies were associated with artificial images as well as images associated with economics and side-effects and both positive and negative direct descriptions of the biotechnologies. Images associated with economics may be associated with thoughts of who may benefit from the food biotechnologies; examples of these images include 'third world farmers' and 'buying British' and images associated with side-effects may reflect fears associated with food biotechnologies.

In a similar way to associated emotions, the vegetal biotechnologies that had health benefits, namely golden rice (with enhanced vitamin A) and GM strawberries (with enhanced levels of a cancer fighting compound) were associated with different categories of imagery from one other. Golden rice was linked only with quite positive categories of imagery whilst GM strawberries were linked with similar categories to other agricultural biotechnologies. The reason for this was not understood, however it is possible that these types of health benefit were differentiated in some way or the food types themselves were differentiated in some other way.

GM food which was related to animals was associated with different images than vegetal GM food. Similarly to human cloning, animal cloning was linked with media images and also negative images. Faster growing animals were linked with artificial images and images of side effects, as well as humorous images. These associations again reflected the increased negativity that was evident towards the process of genetically modifying animals compared to plants (Frewer, Howard, Hedderly and Shepherd, 1997).

The types of imagery generated only have limited associations with personal constructs generated. The categories of 'Scientific' and 'Medical' imagery are likely to relate to constructs that divided biotechnologies according to 'General Application', 'Medical' and 'Genetic Modification'. Other categories of imagery do not relate well to personal constructs however and any relationships that do exist are likely to be tangential. Similarly, categories of imagery do not seem to align with emergent categories of emotion. The imagery categorised as 'Side effects' may relate to emotion categories of 'Fear' and 'Risky' but no other clear associations are apparent.

It is tentatively suggested that those personal constructs that do align with imagery categories generated may be criteria that is particularly influential on behaviour. Although it seems that most sorting criteria do not align with imagery categories, this does not mean that these are not associated with one, or more, of these categories of imagery; those that are associated with imagery may have disproportionate influence on behaviour.

3.9. Conclusions

Overall, the use of card sorting has proved a useful method in examining perceptions of biotechnologies. The card sorts generated here did not align precisely with personal constructs highlighted by previous research, however did display some commonalities. Personal constructs produced within this study seemed to be more basic divisions of biotechnologies and may have encompassed more simplistic, nominal divisions that were not easily elicited by the repertory grid technique. In this way, the card sort task may be more suitable for those with less knowledge about a subject, as generally characterises the British population with regard to the area of biotechnologies (Gaskell, Allum and Bauer, et al., 2003). However, there were also several personal constructs that have previously been identified in relation to biotechnologies, which were not elicited here. This may be because this technique is unsuitable for identifying certain types of construct, however it may also be due to the unbiased participant sample utilised here who were likely to be less engaged with the topic of biotechnologies than previous samples.

Some commonalities in biotechnology groupings were found between sorting criteria which enabled the examination of semantic associations for different types of biotechnologies. Associated emotions and imagery generated for different biotechnologies seemed to cluster according to the type of biotechnologies, furthering the understanding of how different biotechnologies are perceived. In addition, clusters of emotions and imagery were consistent with previous differences identified between biotechnologies. On the whole, medical biotechnologies were perceived positively and agricultural biotechnologies were perceived negatively (Bauer, 2002).

Results must be limited, however, to the participant sample that was used here who consisted entirely of students and were, therefore, not statistically representative of the British population. Participants can be considered to have had no particular interest in the topic of biotechnologies though and this was ensured by using topic blind recruitment so that participants were not aware of the subject of research before agreeing to participate.

<u>3.9.1. Future research</u>

As there is so much variation in perceptions of different biotechnologies, more in-depth research is recommended into individual biotechnologies. It would also be theoretically interesting to examine if images associated with a product are linked with the most influential factors determining attitudes and/or behaviour. In this way, it is recommended that future research asks participants to generate images in association with personal constructs associated with a product as well as with the product itself. In addition, it would be useful to examine the importance of different socio-cognitive constructs in predicting the formation of intentions and behaviour towards GM food in order to assess how meaningful the current findings are. Chapter four makes some progress with this aim by utilising a modified TPB model to examine behavioural intentions towards GM food. This enabled the assessment of the importance of attitudes and other socio-cognitive constructs in predicting intentions to try GM food.

Chapter Four - TPB and GM Food: Examining Group Differences over Time and the Impact of a Learning Intervention

4.1. Introduction

In addition to qualitative information, quantitative information is extremely useful in determining the most important influences on behaviour. Information regarding the central influences on behaviour and their differential importance can be used to make predictions about behaviour change, or used to target behaviour interventions.

This chapter evaluated the Theory of Planned Behaviour (TPB) as a structure with which to assess the relative importance of attitudes and other socio-cognitive constructs in the domain of GM food. The nature of the concepts outlined within the theory were examined along with other concepts that have frequently been added to the model. The TPB itself was also closely examined along with issues that have been raised in connection with the model. These included problems associated with the self-reporting of measures, the causality of the model, whether the TPB is falsifiable and whether the TPB accesses, or creates, cognitions. Previous literature that has applied the TPB to food behaviour, and in particular GM food behaviour, is also described and critically reviewed. Further research that has utilised the TPB in order to investigate learning was also examined in order to ascertain the likely effects of an increase in knowledge on TPB components. The experiment reported here added the constructs of self-identity, moral norms and emotional involvement to the TPB model and applied this to the general intention to try GM food, which had not previously been examined using the TPB in Britain. This extended TPB model was utilised within a quasi-experimental framework in order to evaluate the relative importance of behavioural influences (with respect to GM food behaviour) and how these change over time in response to learning about GM food.

4.2. The Theory of Reasoned Action (TRA) and the Theory of Planned Behaviour (TPB)

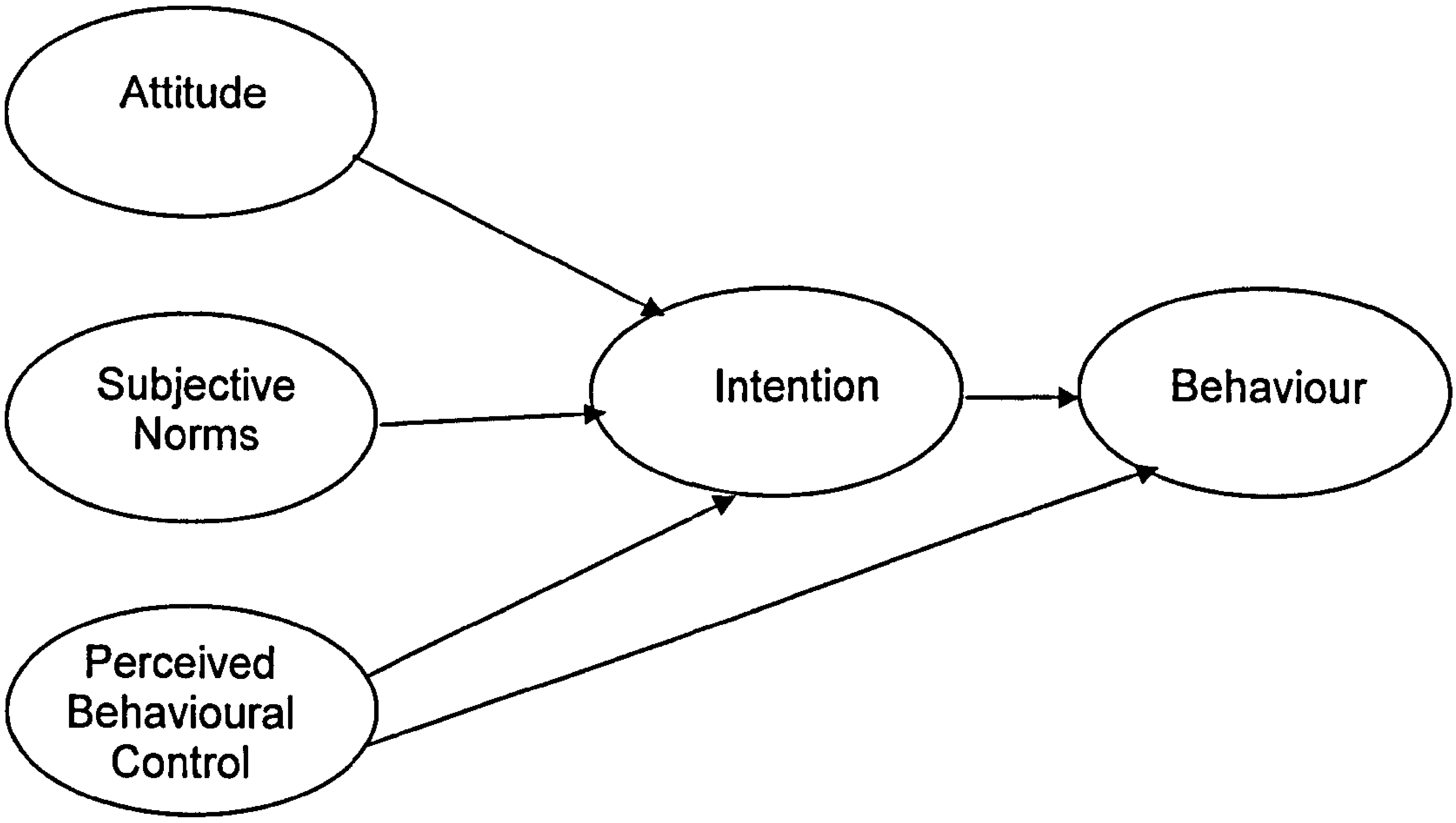
4.2.1. The Theory of Reasoned Action

The theory of reasoned action (TRA; Fishbein and Ajzen, 1975) has been one of the most useful and widely used conceptual frameworks used to link attitudes and behaviour. This model proposed that subjective norms and attitudes together determine behavioural intentions, which in turn determines behaviour. Underlying attitudes towards behaviour are behavioural beliefs, which are described as the perceived likelihood of salient outcomes of engaging in that particular behaviour weighted by the value attached to those particular outcomes. Subjective norms describe the perceived social pressure to engage in a particular behaviour and these are proposed to be underlain by normative beliefs. Normative beliefs describe the perceived social pressure from close family and friends, whose opinions are considered important, weighted by the motivation to comply with those referents (Ajzen and Fishbein, 1980).

4.2.2. The Theory of Planned Behaviour

One limitation of the TRA is that it only predicts voluntary behaviour (Ajzen, 1991). An individual may intend to perform a behaviour, but may not actually complete the behaviour due to external constraints, a lack of ability, or some other factor. Due to the difficulty in measuring actual control over behaviour, Ajzen (1991) suggested that the factor of perceived behavioural control (PBC) should be included in the model as a substitute. The TRA, when extended to include PBC, was termed the theory of planned behaviour (TPB). Meta-analyses indicated that the addition of PBC to the TRA significantly improved the prediction of behaviour (Ajzen, 1991; Armitage and Conner, 1999a)

Figure 4.1: The Theory of Planned Behaviour (Ajzen, 1991)



It was theorised that PBC impacts upon behaviour both directly and indirectly through intentions (Figure 4.1). The indirect influence of PBC on behaviour was explained by the reasoning that greater perceived control of behaviour would indicate that success in the performance of that behaviour is more likely, thereby increasing intentions to attempt or avoid that behaviour. PBC will also directly influence behaviour to the extent that PBC is likely to reflect actual behavioural control. So the higher the control over a behaviour, the more likely it is that that behaviour will be achieved. In a similar way to the attitudinal and subjective norm components of the TPB model, it is theorised that PBC is determined by belief components, namely beliefs concerning the perceived frequency of facilitating or inhibiting factors multiplied by the power of these factors.

The TPB model has been broadly successful in explaining behavioural variance and is one of the most widely used models in examining behaviour, in particular within health applications. A meta-analysis of 185 independent studies, published before 1997, indicated that the TPB accounted for 27% of variance in behaviour and 39% of variance in intentions (Armitage and Conner, 2001). It is emphasised that the predictive power of the TPB does vary between applications though. Ajzen (1991) noted that factors within the model may be non-significant in some domains and there may be utility in adding further potential predictors to the model in some particular domains.

4.2.3. Attitudes

An individual's attitude towards a behaviour is thought to represent their overall positive or negative evaluations of performing that behaviour (Armitage and Conner, 2001). Attitudes tend to be the strongest predictor of behavioural intentions; one meta-analysis indicated that attitudes accounted for around 24% of variance in behavioural intentions (Armitage and Conner, 2001).

A related construct to attitudes is attitude ambivalence, and this has also been examined in association with the TPB. Attitude ambivalence is defined as the extent to which people can simultaneously evaluate attitude objects as positive and negative (Armitage, 2003). It was found that when beliefs underlying attitudes are heterogeneous and therefore attitude ambivalence is high, attitudes were significantly less predictive of behavioural intentions, and subsequent behaviour, than when underlying beliefs were homogeneous (Armitage, 2003).

4.2.4. Subjective norms

The construct of subjective norms is generally found to be a weak, and often non-significant, predictor of behavioural intentions (Sheppard, Hartwick and Warshaw, 1988; Trafimow and Findlay, 1996). This may partly be due to poor measurement as many authors have used single items, rather than multi-item scales, when measuring subjective norms (Armitage and Conner, 2001). Another suggested reason for the weak explanatory power of subjective norms is that the conceptualisation of this construct is inadequate in some way. There has been a wide array of alternative conceptualisations suggested to replace the subjective norms component. These include group norms, defined as the extent to which an individual identifies with their social group (Terry, Hogg and White, 1999) and role belief, defined as perceived accepted behaviour for people in certain positions in society (Triandis, 1980). Thus, it is possible that the importance of the subjective norms construct will depend on how this is operationalised. There is also some evidence that has indicated that there may be some utility in including further normative components in addition to a subjective norm component, e.g. self-identity, see section 4.2.7.1.

4.2.5. Perceived behavioural control

Empirical data has indicated that the component of PBC has a strong relationship with behavioural intentions (Sheeran and Taylor, 1999; Armitage and Conner, 2001; Godin and Kok, 1996). A meta-analysis conducted by Godin and Kok (1996) found a sample-weighted average correlation of 0.46 between PBC and intention and PBC was found to be a significant predictor of intentions in 65 out of 76 applications examined using the TPB. PBC was also theorised to impact directly on behaviour when two conditions are fulfilled: when behaviour is not under complete control and when PBC reflects actual control. When behaviour is under complete control, the PBC construct becomes irrelevant and the TPB is reduced to the TRA. This was supported by a study of ten different behaviours that compared the performance of the TRA and the TPB for behaviours that were considered easy to perform (e.g. 'listening to an album') and behaviours that were considered less controllable (e.g. 'getting a good nights sleep'). It was found that the TPB only outperformed the TRA for less controllable behaviours (Madden, Ellen and Ajzen, 1992). Evidence also exists to support the latter condition: research indicated that the more accurate an individual's PBC, the stronger was the relationship between PBC and behaviour (Sheeran, Trafimow and Armitage, 2003).

However, there have been some problems with the construct of PBC. Definitions of PBC have been varied and measures of PBC have, on occasion, been found to be unreliable (Chan and Fishbein, 1993; Sparks, 1994). These problems may be explained if PBC is actually considered as an amalgamation of two variables, which are sometimes highly correlated, and sometimes not. Many researchers have drawn a distinction between constructs of self-efficacy and of perceived control as distinct components of PBC (Sparks, Guthrie and Shepherd, 1997; Armitage and Conner, 1999b; Trafimow & Trafimow, 1998). Self-efficacy refers to the extent to which a behaviour is perceived to be under an individual's personal control, whereas, perceived control refers to the extent to which a behaviour is perceived to be easy or difficult to carry out with regards to the external environment (Trafimow, Sheeran, Conner and Finlay, 2002).

It has been suggested that a measure of perceived difficulty could capture both of these aspects of control (Sparks, et al., 1997). However, this construct was criticised on the basis that the concept of difficulty is highly open to different interpretations and leaves the concept vaguely defined (Armitage and Conner, 1999b). To add to the confusion, it seems that different authors have used the term perceived difficulty to describe different things. Perceived difficulty has been used to describe an, all encompassing, construct of control (Sparks et al., 1997) but has also been used to refer to solely the internal component of control, so that it is synonymous with self-efficacy (Trafimow et al, 2002). To clarify, this thesis used the term self-efficacy to refer to internal constraints on behaviour and perceived control to refer to external constraints on behaviour.

Factor analytic techniques have confirmed a two factor division within perceived behavioural control measures so that items such as 'under my control – outside my control' load on one factor whereas items such as 'easy – difficult' load on a second factor (Sparks et al., 1997; Manstead and van Eekelen, 1998). Further to this, both correlational and experimental evidence have indicated that self-efficacy and perceived control are distinct constructs. The two proposed components are found to predict independent portions of variance in intentions (Trafimow and Trafimow, 1998) and behaviour (Povey, Conner, Sparks, James and Shepherd, 2000) and, on occasion, have actually been found to have different associations with intentions and behaviour (Manstead and van Eekelen, 1998). In addition, self-efficacy and perceived control were found to be differentially influenced by experimental manipulations and were found to be differentially important for different behaviours (Trafimow et. al., 2002).

It seems conclusive that PBC is indeed made up of two distinct components, of self-efficacy and perceived control. Researchers should ensure that both of these aspects of control are measured within TPB studies and should consider separating PBC into its component parts if the measurement of PBC is found to be unreliable. This will increase the reliability of measurement and will enable researchers to pinpoint more precisely which factors are driving intentions and behaviour, facilitating understanding and interventions.

4.2.6. Behaviour intentions

Behavioural intentions were defined as encompassing an individual's motivation to try to perform a particular behaviour (Ajzen, 1991). Within TPB applications, the definition of behavioural intention has not always been as clear as Ajzen's (1991) original formulation though. Researchers have used such constructs as expectations (Sparks, Shepherd and Frewer, 1995) and self-predictions (Sheppard, Hartwick, and Warshaw, 1988) in place of the construct of intentions.

Within a meta-analysis of the TRA, Sheppard et al., (1988) found that self-predictions had a stronger relationship with behaviour, than did behavioural intentions, and argued that self-predictions were better predictors of behaviour because these are more likely to include the consideration of factors that may potentially facilitate, or inhibit, behaviour. However, Armitage and Conner (2001) suggested that the factor of PBC may effectively encompass the consideration of facilitating or inhibiting factors and the findings from their meta-analysis supported this proposition. The potential utility of the construct of self-predictions may, therefore, have been undermined by the addition of the PBC construct to the TRA model.

A meta-analysis of TPB studies indicated that intentions accounted for around 22% in behaviour (Armitage and Conner, 2001), which leaves a lot of variance in behaviour unexplained. In fact, the difference between intentions and behaviour is well documented and has been termed the intention-behaviour gap, see Chapter five, section 5.1.1, for a further discussion.

4.2.7. Extensions of the TPB

There are a vast number of studies that have proposed the addition of extra components to the TPB and have often found that components added are useful in predicting additional variance in intentions and/or behaviour. Ajzen himself (1991, page 199), was open to including further predictors of behaviour in the model and stated that the TPB is, 'open to the inclusion of additional predictors if it can be shown that they capture a significant proportion of the variance in intention, or behaviour, after the theory's current variables have been taken into account'. In a similar way to the original components of the TPB, the importance of added components have also been found to vary across behavioural domains, and are only significant in certain domains and contexts. It is likely that it is for this reason that no further components have achieved permanent status within the TPB model.

4.2.7.1. Self-identity

Self-identity is defined as the salient part of an individual's self that relates to the behaviour in question. This was thought to reflect the extent to which an individual sees themselves as fulfilling a particular societal role, e.g. mother

(Conner and Armitage, 1998). There have been a variety of studies that have included self-identity as an additional predictor of intentions within the TPB model and have found that self-identity significantly increased the amount of variance in intentions predicted (Sparks and Shepherd, 1992; Sparks et al., 1995; Terry et al., 1999). A review of the role of self-identity within the TPB found that self-identity accounted for an average of one percent of variance in behavioural intentions, over and above existing TPB variables (Conner and Armitage, 1998).

There have been some suggestions, however, that measures of self-identity may overlap with measures of moral norms as some self-identities may be associated with some values that are essentially moral by nature, e.g. religiousity (Sparks and Shepherd, 1992). However, the fact that self-identity has been found to have independent predictive effects on behavioural intentions alongside moral norms indicated that these constructs are sufficiently dissimilar to be separable (Sparks and Guthrie, 1998).

4.2.7.2. Moral norms

Moral norms are described as an individual's perception of the moral correctness or incorrectness in performing a behaviour (Ajzen, 1991). It was argued that moral norms are theoretically distinguishable from existing TPB components (Manstead, 2000) although it is possible that there may be some overlap between constructs depending on their definition. For example, a question designed to assess PBC that asks how easy a behaviour is, could be taken as referring to how easy an individual might find it to make the right (moral) decision about the behaviour. Careful operationalisation of these constructs should ensure that each are distinct from each other.

Moral norms are likely to have an important influence on those behaviours which have a moral or ethical dimension and have indeed been found to predict a significant amount of variance in behaviours such as dishonest actions and ethical decision-making. In certain behaviours, however, morality is less of an issue and in these cases the related construct of personal norms (Cialdini, Kallgren and Reno, 1991) may be of more utility. The concept of personal norms has a greater emphasis on an individual's own personal values; these may be in line with moral values in many cases but in others may be more closely aligned with an individual's self-identity. For example, an individual may not feel morally obliged to eat healthily but may have personal values associated with healthy eating (Conner and Armitage, 1998).

4.2.7.3. Emotional involvement

The TPB has been criticised for omitting to include any affective influences in the prediction of behaviour (Conner and Armitage, 1998). For this reason, several studies have measured affective components alongside original TPB components as additional influences on behaviour, e.g. anticipated affect (Richard, de Vries and van der Pligt, 1998; Simonson, 1992; O'Connor and Armitage, 2001). It is suggested that the slightly different affective construct of emotional involvement may also be useful within the TPB model. Emotional involvement is defined as the extent to which the individual is engaged with (or disinterested in) the behaviour at hand. Level of engagement with biotechnologies has previously been examined as an influencing factor of support of biotechnologies. It was found that individuals who were more engaged with biotechnologies were more supportive of biotechnologies, even after the moderating effect of knowledge was removed (Gaskell, Allum and Stares, 2003).

In addition, many studies that have investigated perceptions of GM have been criticised for their recruitment methods in that participants were often told what the study was about before deciding whether to take part. The topic of the study is likely to influence an individual's participation decision and an individual who is interested in the topic of research will be more likely to take part in that research. In fact, the recent *GM Nation?* debate (Grant et al., 2002) was criticised on just this point; debates were advertised directly with the topic made clear and advertising was mostly carried out through anti-GM pressure groups which had a large impact on findings (Campbell and Townsend, 2003). Criticism of research conducted in this way implicitly assumes, therefore, that an individual's interest, or level of emotional involvement with an issue, is a key factor in determining an individual's view on the topic.

4.2.8. Issues surrounding the TPB

There are a variety of issues relating to the TPB that have been outlined within the literature. These mostly relate to which constructs should be included in the model, the way in which the TPB is measured, the causality of the model, the extent to which the TPB is falsifiable, and whether the TPB accesses or creates cognitions.

4.2.8.1. Self-report vs. objective measures

The vast majority of TPB studies have used self-report, rather than objective, measures of constructs (Ogden, 2003; Armitage and Conner, 2001). It may not be possible to obtain measures of cognitions in any other way, however with regards to behaviour it is preferable to use objective measures. As might be expected, intentions and PBC were found to be better predictors of behaviour when this was self-reported, rather than measured objectively (Armitage and Conner, 2001). It may be the case that self-report measures of behaviour were operationalised in a very similar way to cognitions that are assessed. This could result in the production of analytic truths, which are true by definition (Ogden, 2003). However, it is also possible that self-reported behaviour will correlate more highly with cognitions than objective measures of behaviour because measurement correspondence will be maximised (Armitage and Conner, 2001). So the specific definition of behaviour that is employed within a self-report measure is likely to correspond better with the behaviour descriptions used within measures of intention, and PBC, than an objective measure of behaviour. For example, self-report behaviour to the question 'Did you eat a low fat diet?' is more likely to correspond to cognitions regarding diet than a measure of percentage of calories eaten. The most rigorous way of measuring behaviour may be through using multiple objective measures of behaviour (Armitage and Conner, 2001). Ajzen and Fishbein (2004) point out that it is difficult, and in some cases almost impossible, to obtain objective measures of some behaviours, e.g. condom use. Where objective measures of behaviour can not be obtained, the use of self-report behaviour is necessary as a substitute. Although biases associated with self-report behaviour, e.g. socially desirable responding, may inflate correlations between cognitions and behaviour, these do not invalidate the theoretical model (Ajzen and Fishbein, 2004)

4.2.8.2. Causal nature of the TPB model

The TPB model assumes a certain causality between its components, namely that attitudes, subjective norms, and PBC cause intentions, which in turn cause behaviour. The validity of this assumption is a concern because a large amount of studies aim to perform behaviour interventions and assume that the constructs within the TPB have this causality. If the model is only useful in predicting behaviour then interventions based on the assumed causality may have little effect on behaviour (Armitage and Conner, 1999a).

The majority of TPB studies are cross-sectional which may not address the causality of the model. The use of a cross-sectional analysis implicitly assumes that there is a very brief causal lag between the variables, however, if the causal lag is not so brief, a prospective design may be more appropriate to investigate causality (Sutton, 2002). Ideally, the length of the prospective design should be approximately equal to the expected length of the causal lag, which is difficult to estimate. If the follow-up period is too short, the effects will not have been produced yet and if the follow-up period is too long, other further effects may have had an impact on variables.

Armitage and Conner (1999a) used a prospective design within a TPB study in order to examine the causal ordering of components and found some support for the causal ordering within the TPB model. However, it was concluded that the TPB is most useful as a predictive model rather than as a basis for intervention. Further investigations of the causality of the TPB are deemed necessary in order to clarify its usefulness.

4.2.8.3. Is the TPB falsifiable?

One major criticism of the TPB is that, although pragmatically it may be useful, conceptually it can not be tested (Ogden, 2003). In fact, when results are gathered that show that any of the predictor variables of attitude, subjective norms, and PBC do not predict intentions or behaviour, an explanation is provided. The model is never rejected for this failing but rather explanations for the failing are offered, indicating perhaps that the variables are not operationalised well enough, sample characteristics may be to blame, or results are specific to the particular behaviour examined. Ogden's (2003) conclusion was that the model is unfalsifiable; it seems that no data can be collected that would disprove the model. Ajzen and Fishbein (2004) refute Ogden's claim however, and protest that the original model did state that the individual contributions of predictors in the model may vary from application to application. They argued that the model would be disconfirmed if all three of these predictors did not predict intention or if PBC and intention did not predict behaviour. In addition, Ajzen and Fisbein (2004) asserted that it would be possible to falsify the TPB if theory based interventions influenced predictors but failed to effect intentions or behaviour.

4.2.8.4. Does the TPB access, or create, cognitions?

One problem with the measurement of TPB components is that the completion of questionnaire items during measurement may actually create new cognitions, or change existing cognitions, rather than just assess existing cognitions (Ogden, 2003). The simple consideration of questionnaire items may prime related evaluations and constructs that may not have otherwise have been considered. For example, questioning students about their diet and snacking behaviour (Masalu and Astrom, 2001) may activate health considerations that may not otherwise have been thought of and could have significant effects on subsequent measures of behavioural intentions and behaviour. This may particularly be the case if a new, unfamiliar, behaviour is being assessed.

It is difficult to estimate the impact of the completion of a questionnaire on cognitions, however Ajzen, Brown and Carvajal (2004) conducted a study in which assessment of cognitions either preceded, or followed, behaviour assessment. They found that there was no difference in behaviour depending on when cognitions were assessed, which provided some indication that any influence that questionnaire completion had on cognitions was likely to be minimal.

4.3. Applications of TPB to foods

The TPB has frequently been applied to health behaviours and eating behaviours and has also been used to investigate behavioural intentions regarding GM food several times. The TPB model has been applied to GM food behaviour in Italy (Saba and Vasallo, 2002) and New Zealand (Cook, Kerr and Moore, 2002), as well as Britain (Sparks and Shepherd, 2002; Sparks et al.,1995).

With regards to original TPB constructs, attitude was found to be consistently significant in predicting intentions towards GM food (Cook et al, 2002; Saba and Vasallo, 2002; Sparks et al., 1995; Sparks and Shepherd, 2002). However, evidence with regards to PBC and subjective norms was mixed. PBC was found to be a significant predictor of intentions to purchase GM food in New Zealand (Cook, et al., 2002), of intentions to eat GM tomatoes in Italy (Saba and Vasallo, 2002) and of expectations about eating food produced by gene technology within the next 15 years in Britain (Sparks et al., 1995). It was found to be a non-significant predictor of expectations of supporting the use of gene technology in food production in the future though (Sparks et al., 1995) and of intentions to eat GE (genetically engineered) tomatoes or pork in Britain (Sparks and Shepherd, 2002).

Subjective norms were not found to be a significant predictor in either of the British studies which examined expectations towards GM food (Sparks et al.,1995) and intentions to try GE tomatoes or pork (Sparks and Shepherd, 2002). However, these were significant in the study conducted in Italy that investigated intentions to try GM tomatoes (Saba and Vasallo, 2002) and in the study conducted in New Zealand that investigated intentions to purchase GM food (Cook et al., 2002).

These studies have variously added the components of moral norms and self-identity to the TPB with the aim of better predicting intentions towards GM food and have achieved mixed success. Moral norms were found to be significant predictors of intentions to eat GE tomatoes, but not GE pork, in Britain (Sparks and Shepherd, 2002). These were also found to be non-significant predictors, of intentions to eat GM tomatoes in Italy (Saba and Vasallo, 2002), and of expectations with regards to GM food in Britain (Sparks et al., 1995).

Self-identity was found to be a significant predictor of intentions to purchase GM food in New Zealand (Cook et al., 2002). However, in Britain, although this construct was a significant predictor of expectations about eating food produced by gene technology within the next 15 years, it was also found to be non-significant in predicting expectations about supporting the use of gene technology in food production (Sparks et al., 1995). Overall, evidence was therefore mixed with regards to the utility of including self-identity and moral norms as additional predictors when investigating behaviour towards GM food.

The importance of the constructs of PBC, subjective norms, moral norms and self-identity with regards to behaviour towards GM food is likely to be dependant on the specific definition of intention employed and the particular sample of participants that are recruited. Two studies examined intentions to try quite specific GM food stuffs (Saba and Vasallo, 2002; Sparks and Shepherd, 2002), one study examined intentions to purchase GM food stuffs (Cook et al., 2002) and one study examined expectations, rather than intentions, towards GM food (Sparks et al.,1995). The population samples of the studies also varied in terms of nationality, age, size and method of sampling. Amount of variance accounted for in behaviour towards GM food was fairly high in all studies varying from around 41% (Saba and Vasallo, 2002) to around 88% (Sparks et al., 1995) indicating that the TPB is a useful model with which to predict, and analyse, behavioural intentions towards GM food.

4.4. TPB and learning

To date, the impact of learning on behaviour, and behavioural influences, towards GM food had not been investigated. Effects will, of course, be highly dependent on the type of learning experienced. The TPB has been used in various ways to investigate the impact of learning in different behavioural domains. However, the learning interventions that were applied were generally of a persuasive nature, designed to change the behaviour of the participants involved in the study (Hardeman, Johnston, Johnston, Bonetti, Wareham and Kinmonth, 2002), such as media campaigns to reduce speeding by motorists (Stead, Tagg, MacKintosh and Eadie, 2005). As interventions were designed to be persuasive it is unclear what the effects of a general increase in knowledge would be, without an agenda of changing attitudes.

4.4.1. Knowledge and attitudes

Various studies have examined the relationship between knowledge and the specific component of attitudes. As mentioned previously, it was generally found that individuals with a higher level of education were more positive towards GM food than those who were less educated (Gaskell et al., 2000; Allum et al., 2002). Correspondingly it was often assumed that learning about GM food may increase liking for it (Royal Society, 1985). However, the causality of the relationship between education and liking of GM food remains unclear. It may be that those who are more positive towards scientific advancements such as GM food tend to be more likely to seek further education about science and thus increase their knowledge.

There is actually some data that contradict the finding that a higher level of education was associated with more positive attitudes towards GM food. For example, findings from Noussair et al., (2004) indicated that individuals with a higher level of education were actually more negative towards GM food suggesting that the relationship between education and optimism towards GM food may be more complicated than the linear relationship previously implicated. Furthermore, Evans and Durant (1995) found that although a greater understanding of science was weakly related to more positive attitudes towards science, a greater understanding of science was actually associated with more coherent attitudes that tended to be stronger, whether these were positive or negative. In support of this, studies in other domains have also found a positive association between knowledge and attitude strength (Krosnick, Boninger, Chuang, Berent and Carnot, 1993; Wood, Rholes, and Biek, 1995) as well as between knowledge and the influence of attitudes on behaviour (Davidson, Yantis, Norwood and Montano, 1985). It may be that a greater knowledge actually serves to strengthen attitudes no matter what the direction.

4.4.2. Knowledge and perceived behavioural control

Some evidence also exists relating to knowledge and PBC. Frewer et al., (1994a) found a direct relationship between perceived knowledge and perceived control associated with food related hazards indicating that as knowledge increased, PBC was likely to increase. Supporting this, studies that have examined the impact of educational programmes in different domains have found an increase in self-efficacy (a sub-component of PBC) following participation in the programmes (McCormick, Masse, Cummings and Burke, 1999; Warschburger, von Schwerin, Buchholz and Petermann, 2003). Theoretically, an increase in knowledge about a behaviour should increase PBC over that behaviour because the individual knows that he or she has more information to help in the enactment (or avoidance) of that behaviour with regards to both internal and external constraints. Increasing knowledge about a particular behaviour, therefore, seems to be associated with an increase in PBC.

4.4.3. Knowledge and subjective norms

There is little information available on the impact of increased knowledge on subjective norms. However, the impact of behavioural interventions on subjective norms has generally been minimal (Armitage and Conner, 2002). Subjective norms may be less susceptible to change by communication alone as this factor comprises external dimensions which are not so amenable to change in this way. Indeed those intervention studies that have produced changes in subjective norms have typically used an interactive intervention approach such as, for example, theatre intervention in improving children's road safety (Evans and Norman, 2002). Interactive approaches may be particularly useful in helping an individual to alter their perception of how other people may view their actions. It, therefore, seems unlikely that an increase in knowledge alone will have a significant impact on subjective norms.

4.4.4. Knowledge and behaviour

Regarding impact on behaviour, a review of behaviour change interventions utilising the TPB indicated that around half of the interventions evaluated were effective in changing intentions and two-thirds of these were effective in changing behaviour (Hardeman et al., 2002). These interventions were designed with the purpose of changing behaviour however. It is assumed that change will be less likely as a result of learning interventions that are not designed with the aim of persuasion. Overall, the impact of increased knowledge on behavioural intentions and behaviour itself is unclear and likely to be variable and highly dependent on the particular behaviour and the type of knowledge received

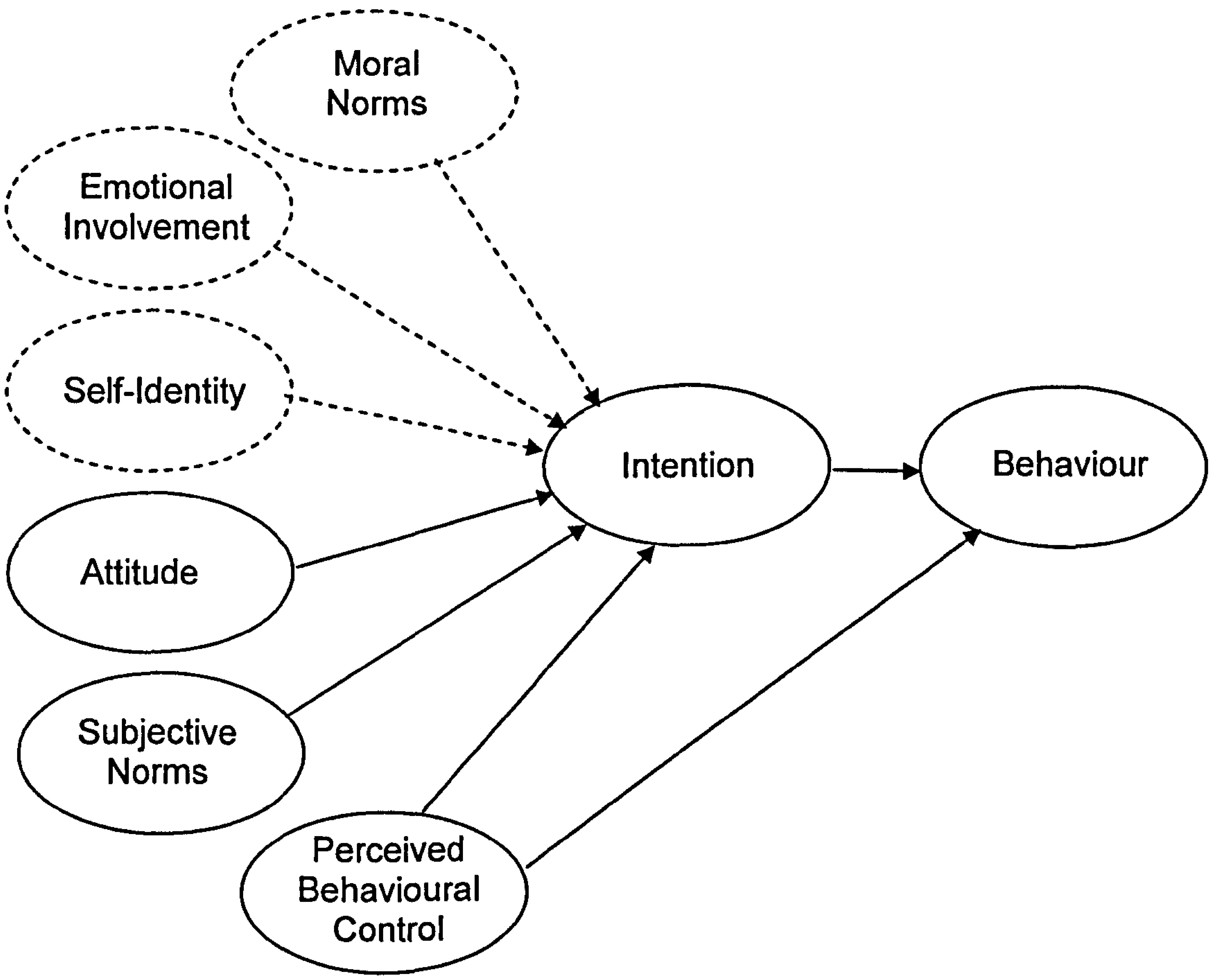
4.5. Current Aims

In the following study, the TPB was applied to a British population sample with regards to the general behavioural intention of trying GM food. This had not previously been examined within the TPB in Britain. The TPB model that was applied was a slightly extended version of the original that included the constructs of self-identity, moral norms and emotional involvement as additional predictors, see Figure 4.2. Perceived moral norms and self-identity were included as additional predictors as they have previously received mixed results when included as additional predictors in the TPB when applied to GM food. Emotional involvement had not previously been included within the TPB but was included here as it has been pinpointed as an important factor in the acceptance of biotechnologies in previous studies (Gaskell, Allum and Stares, 2003; Campbell and Townsend, 2003)

This extended TPB model was applied to two different population samples, psychology students and biology students (henceforth these groups shall be referred to as psychologists and biologists respectively). It was predicted that attitudes displayed by biologists would be more positive than psychologists towards GM foods due to the nature of their grouping as those who were studying GM food.

Previous research has indicated that GM food was perceived as a relatively controllable issue, so PBC was hypothesised to be positive (Townsend, Clarke and Travis, 2004). Subjective norms were thought to be negative towards GM food as it is thought that previous negative evaluations of GM food may have been, at least partly, due to societal considerations (Noussair et al., 2004). Moral norms were included in this model and previous TPB studies as previous research has suggested that eating GM food may be considered morally wrong (Magnusson and Hursti, 2002). Moral norms were, therefore, expected to be negative in both psychologists and biologists. Of the participants recruited, biologists were expected to be engaged with the issue of GM food as a topic which they would be studying, however, psychologists were not as they are not likely to have any links with the topic; levels of emotional involvement were, therefore, predicted to be positive for biologists and neutral for psychologists. It was unknown whether participants would identify themselves as individuals who would try or avoid GM food and whether participants would intend to try or avoid GM food. (Previous studies within the UK have only examined expectations with regard to GM food or intentions towards specific GM foodstuffs).

Figure 4.2. – The extended Theory of Planned Behaviour model



N.B. Original TPB components are illustrated with solid lines and components that have been added to the TPB are illustrated with dashed lines.

This study also measured TPB variables at a later time point in order to examine the influence of further learning about GM foods. The TPB has frequently been used as a tool by which particular behavioural influences can be targeted to change behaviour, however, it is emphasised that this was not the purpose of this study; in this study the TPB was used simply as a tool with which to examine any changes in behavioural influences and intentions. Information specifically regarding the risks and benefits associated with GM food was taught to the biologists in a bioethics class. The psychologist sample was used as a control group in order to give confidence that any differences observed could be attributed to material learnt, and not to other external factors. It was hypothesised that as knowledge increased, attitudes would become stronger and the influence of attitudes on intentions would increase. It was thought that absolute levels of PBC over behaviour would increase with knowledge, resulting in an accompanying increase in the influence of PBC on intentions. Behavioural intentions were expected to change as a result of learning and underlying changes in behavioural influences, however the direction of this change was unknown.

4.6. Method

4.6.1. Design

The design of this quasi-experiment was mixed. TPB variables were examined within subjects over time and also compared between two different population samples, biologists and psychologists.

4.6.2. Participants

Overall, 323 participants were recruited for this study, all of whom were second year undergraduate students at the University of Nottingham. Students were recruited by request at the beginning of lectures and were required to complete the questionnaire at that time.

This sample comprised a total of 194 psychologists recruited from a compulsory second year 'Social Psychology' class and 129 biologists recruited from a compulsory second year 'Bioethics' class. Of the psychologists, 143 took part in the time one data collection (30.01.04) and 144 took part in the time two data collection (23.02.04) which was roughly one month later; 93 of these students were matched between time points. Within biologists recruited, 127 students took part in the time one data collection (27.01.04) and 72 students took part in the time two data collection (02.03.04) which was also roughly one month later; 70 of these students were matched between time points. For the purpose of this study only those who completed questionnaires at both time points were included in analyses (163).

Within those used for analyses, gender ratios showed that more female participants were included in this study than male participants. Forty-two males took part in this survey compared with 120 females; the data for one participant for this question was missing. The gender ratio was similar across groups though the sample of psychologists had a slightly higher proportion of females. Overall, in the sample of psychologists, 22 students were male and 71 were female and in the sample of biologists, 20 students were male, 49 were female and the gender data for one student was missing.

4.6.3. Materials

Data collection was carried out through the use of a questionnaire. This included questions asking participants their name and gender as well as questions assessing the six hypothesised factors within the model tested, and questions assessing the self-presentation bias of the respondent. Participants' names were required so that questionnaires could be matched between time points but it was emphasised that responses would remain anonymous beyond this.

Questions were formulated to assess factors directly (rather than indirectly using underlying beliefs); these questions were then piloted to examine the consistencies of responses and only those that produced consistent responses, with Cronbach's alphas of 0.7 or higher, were included in the final questionnaire, see Appendix two for a full list of questions.

Intention was assessed directly using three questions that were considered to examine individuals' intentions to try GM food. For example, 'When eating, I intend to make sure that my food does not contain GM ingredients.' Responses for all questions were measured on seven point, semantic differential scales with appropriate adjectives at each end, e.g. in this case 'true' and 'false' were used where one = false, four = neutral and seven = true. Response format was counterbalanced so that half of all statements were responded to with positive responses on the left and half with negative responses on the left. This was done to ensure that participants were attending to questions properly and not responding in a random fashion.

Attitude was measured in the manner suggested by Ajzen (2002). This consisted of a question, 'In general I believe that the use of gene technology in food production is:' that had to be responded to on a variety of different semantic differential scales marked with a selection of adjective pairs, eight scales were used in all. Adjectives were selected during a pre-test from a much larger selection drawn from the list of published adjective scales that were found to load highly on the evaluative factor of the semantic differential (Osgood, Suci and Tannenbaum, 1957).

The assessment of subjective norms was carried out using four direct questions that were considered to evaluate perceptions of what close friends and family feel about GM food. For example, one question was 'The people in my life who are important to me would not mind if I ate GM food' and the response scale was marked with the adjective pairs of agree and disagree.

Questions assessing PBC were designed to represent both of its components of self-efficacy and perceived control; seven questions were utilised in all. For example, in evaluating self-efficacy, one statement that was to be responded to was 'Personally, I would find it easy to keep to a GM free diet.' and this was to be responded to on a scale marked true - false. To examine perceived control, one question asked 'How confident are you that it is possible to avoid eating GM food?' and this scale was marked very confident - not very confident.

The component of self-identity was assessed using questions that examined the respondent's self-belief about whether they were the kind of person that would eat GM food. This was done using three questions, e.g. 'I am the type of person that would eat GM food.' Moral norms were assessed using four questions that evaluated how respondents felt morally about GM foods, e.g. 'It would be wrong of me to eat genetically modified food.' The component of emotional involvement was assessed using five questions, e.g. 'How emotional do you feel about the decisions taken to produce GM food?' These were designed to examine to what degree the respondent was engaged with the issue at hand.

A shortened version of the Marlowe-Crowne social desirability scale (Strahan and Gerbasi, 1972) was included at the end of the questionnaire to examine the extent to which respondents were likely to provide responses that are given with the aim of being perceived positively. This version was included rather than the full version so that it would take less time to complete and because this version was found to have similar levels of internal consistency as the original measure.

The learning intervention used was the attendance of an undergraduate class titled 'Bioethics' that was compulsory for all second year biology students at the University of Nottingham. During the period of time between assessment time points, participants attended five lectures. These provided information on the history of GM food, different applications of GM food in both plants and animals, and ethical issues relating to GM foods. Although attendance of participants was not checked, it was likely that the majority of students did attend lectures and read additional material pertaining to these topics because learning was tested with an exam on completion of the class.

4.6.4. Procedure

Participants were recruited opportunistically during lecture times in a 'Bioethics' class and a 'Social psychology' class. It was explained to each class what the questionnaire was and how it should be filled out before it was distributed in the lecture theatre. Participants completed the questionnaire during lecture time and returned them when they were finished. Roughly one month later, the same classes were asked to fill in an identical questionnaire. Again the questionnaire and the procedure for filling it out were explained and lecture time was used for this to be completed. Those individuals who had completed the initial questionnaire, but were not present in class to complete the second questionnaire, were contacted by e-mail with a request to do so and a copy of an electronic version of the same questionnaire. Those who completed the questionnaire electronically and returned this within one week were included in the study.

4.7. Results

The scaling of questions was reversed as appropriate so that the direction of responses was equivalent. Higher numbers were chosen to represent more positive attitudes towards GM foods. The values of attitudes, intentions, subjective norms and self-identity were, therefore, higher for those who were more positive towards GM food. Higher values of moral norms indicated that the individual did not feel morally obliged to avoid GM food. Higher levels of PBC indicated higher perceived control over behaviour and with respect to emotional involvement, higher levels indicated a higher level of associated emotional involvement (whether this be positive or negative).

4.7.1. Mean component levels

Results for each student in each sample were combined to obtain a mean score for each model component. All scores were normally distributed apart from those obtained from biologists for the components of intentions, moral norms and self-identity which were negatively skewed and, therefore, reflected and square rooted for further analyses (Tabachnik and Fidell, 1996). Means and standard deviations are presented as untransformed scores for clarity. Consistencies of responses for questions for each component were high with Cronbach's alphas ranging from 0.70 to 0.95, which were all above the accepted level of consistency (see Table 4.1).

Table 4.1. – Internal consistencies (Cronbach's alpha)

Factor	**Psychologists**		**Biologists**	
	Time 1	**Time 2**	**Time 1**	**Time 2**
Attitude	0.91	0.91	0.91	0.93
Subjective norm	0.73	0.71	0.76	0.82
PBC	0.87	0.88	0.88	0.95
Self-identity	0.84	0.85	0.90	0.86
Emotional involvement	0.80	0.81	0.78	0.80
Moral norms	0.83	0.84	0.87	0.83
Intention	0.70	0.72	0.72	0.72

Means displayed by both samples were neutral to positive (neutral is at point four of the scale from one to seven) for most components examined. These are presented within Table 4.2.; means that are significantly different from the midpoint of the scale are indicated with a star and the effect sizes of these differences are provided in Appendix three. Scores are generally more positive for the sample of biologists. Mean attitude ratings and mean intention ratings were neutral in psychologists at both time points but were significantly positive within the sample of biologists at both time points. Results obtained for components of subjective norms, moral norms, self-identity and emotional involvement were, on the whole, significantly positive for both groups at both time points. PBC, however, was slightly below the midpoint of the scale in both groups, at both time points, indicating a lack of perceived control; this was only significantly negative within biologists at time one, however,

Table 4.2 – Means (and standard deviations) of model components in student groups at times one and two

Component	Psychologists		Biologists	
	Time 1	Time 2	Time 1	Time 2
Intention	4.16 (1.24)	4.25 (1.10)	4.64 (1.36)*	4.71 (1.26)*
Attitude	4.12 (1.00)	4.13 (0.97)	4.77 (1.08)*	4.76 (1.14)*
Subjective Norms	4.33 (0.93)*	4.33 (0.90)*	4.30 (1.12)	4.49 (1.11)*
PBC	3.79 (1.06)	3.90 (1.07)	3.41 (1.42)*	3.86 (1.69)
Moral Norms	4.86 (1.23)*	4.82 (1.25)*	5.50 (1.41)*	5.49 (1.31)*
Self-Identity	4.80 (1.42)*	4.76 (1.35)*	5.41 (1.57)*	5.56 (1.46)*
Emotional involvement	4.62 (1.11)*	4.71 (1.09)*	4.51 (1.29)*	4.39 (1.30)

* Significant after Bonferroni's adjustment of $p < 0.05 / 32 = 0.0016$

4.7.2. Differences between mean component levels between groups and over time

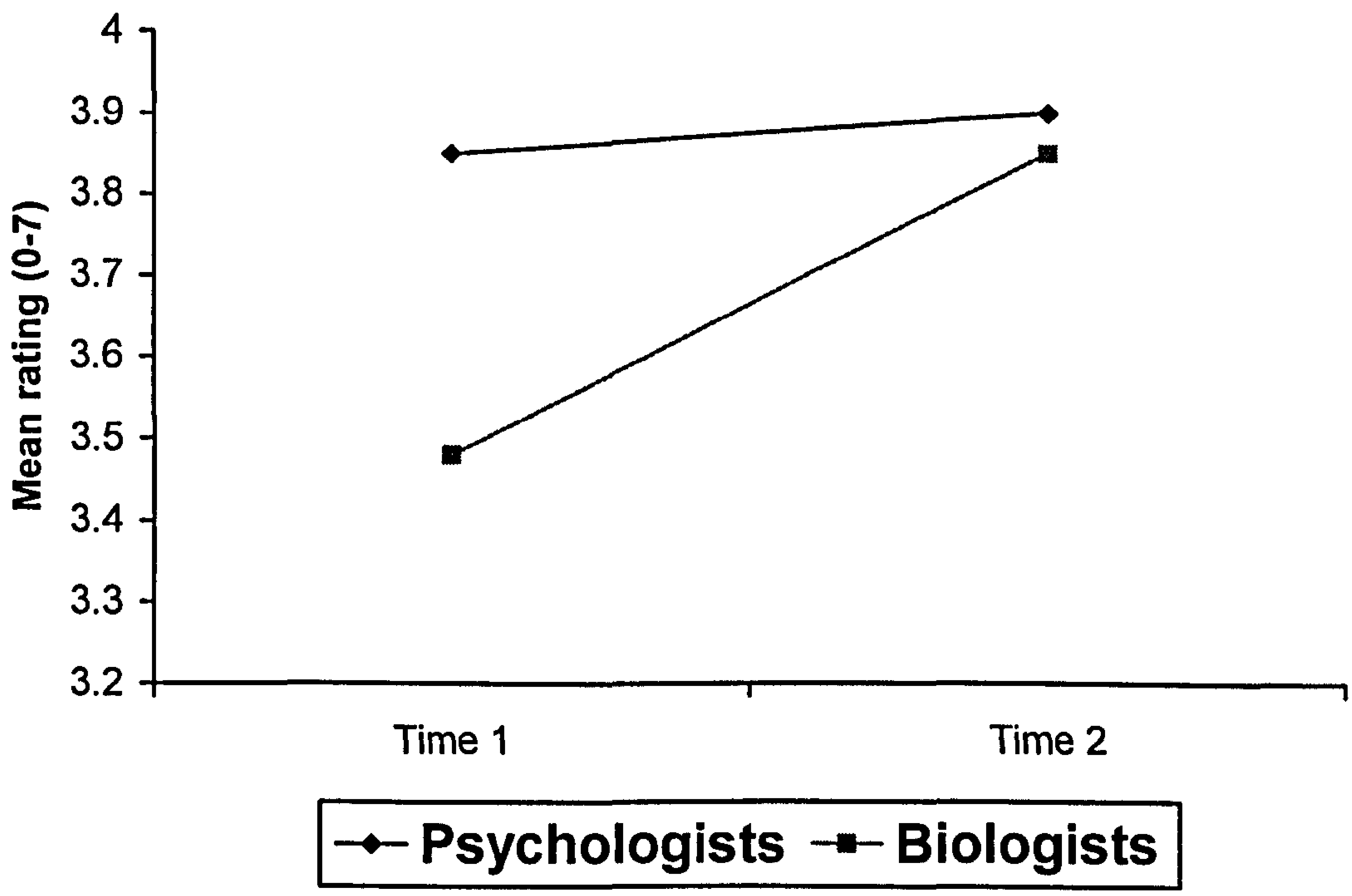
Differences between means were examined using a mixed design ANOVA[1]. This showed that there was a significant difference between student groups ($F(7,155) = 6.022$, $p<0.001$; $\eta_p^2 = 0.214$). Measures of intention to try GM food were found to be significantly more positive ($F(1,161) = 7.756$, $p<0.05$; $\eta_p^2 = 0.046$) in the sample of biologists than the sample of psychologists as were measures of attitude ($F(1,161) = 16.260$, $p < 0.001$; $\eta_p^2 = 0.092$), moral norms ($F(1,161) = 11.464$, $p < 0.01$; $\eta_p^2 = 0.066$) and self-identity as someone who would eat GM food ($F(1,161) = 10.488$, $p < 0.01$; $\eta_p^2 = 0.061$).

There were no significant differences found over time ($F(7,155) = 0.044$. $p = 1.00$; $\eta_p^2 = 0.002$) but there was an interaction effect between groups over time ($F(7,155) = 2.222$, $p < 0.05$; $\eta_p^2 = 0.091$). This difference was attributed to

[1] Boxes test of equality of covariance matrices for the mixed design ANOVA was found to be significant indicating that covariance matrices were not equal and Levene's test of individual equality of error variances was significant for the PBC component at times one and two indicating that error variances were unequal for this component and caution should be taken when interpreting results.

differences in PBC ($F(1,161) = 3.800$, $p = 0.053$; $\eta_p^2 = 0.023$) as this was the only component that differed marginally significantly over time between groups. Examining means, it can be seen that the level of PBC exhibited by psychologists remained fairly constant over time from 3.85 at time one to 3.90 at time two, whereas, the level of PBC exhibited by biologists increased over time from 3.48 at time one to 3.85 at time two, see Figure 4.3.

Figure 4.3. – Interaction effect between groups over time in PBC



4.7.3. Correlations between TPB variables

Correlations between TPB variables measured were all positive and fairly high, with the exception of PBC which mostly demonstrated low and non-significant correlations with other factors (see Appendix four for tables of correlations for each group at each time point). Correlations between the factor of self-identity and intention were high, over 0.8 in psychologists at time two and in biologists at time one. Correlations between self-identity and attitudes were also over 0.8 in biologists at time two. This indicated that there may be some collinearity between self-identity and other factors measured.

4.7.4. Relative influences of TPB predictors on behavioural intentions

In order to examine the relative influence of TPB predictors on behavioural intentions, a multiple regression (with blockwise entry) was conducted in which class group was included as a predictor of behavioural intentions alongside TPB predictors so as to examine group differences. In order to examine differences over time, the dataset was stacked (sometimes referred to as pooled) so that each participant had data on two different rows, corresponding to the different time points, within the dataset (Stimson, 1985; Tillie, 1995). Time was also then included as a predictor of behavioural intentions so as to examine the significance of differences over time. The data matrix was weighted by 0.5 for each row in order to counteract the increase in participant numbers caused by the data stacking and to ensure that Type 1 errors did not result from this. One participant was removed from analysis as data indicated that their case displayed an unusually high residual which may have skewed the model.

The multiple regression models indicated a good fit to remaining data with an R^2 value of 0.61 for the original TPB model. Within the original TPB model, the attitude and subjective norm components were found to be significant predictors of behavioural intentions, see Table 4.3. There were no significant effect of group or time, however, indicating that there were no significant difference either between groups or over time. The extended TPB model significantly improved the fit of the model with an R^2 value of 0.73; the F-value of the change was 22.06 ($p < 0.001$). Here, the factor of self-identity was found to be a significant predictor of behavioural intentions in addition to attitude and subjective norms.

Table 4.3. – Multiple regression for students for both original and extended TPB models

Determinant	**Original TPB Model**			**Extended TPB Model**		
	β	t	VIF	β	t	VIF
Class group	0.007	0.128	1.131	0.004	0.089	1.242
Time	0.047	0.930	1.011	0.044	1.049	1.013
Attitude	0.629	10.455***	1.461	0.205	2.756**	3.134
Subjective norms	0.245	4.265***	1.338	0.110	2.119*	1.539
PBC	-0.058	-1.160	1.022	-0.671	-0.503	1.041
Self-Identity				0.492	6.392***	3.361
Moral Norms				0.105	1.466	2.931
Emotional Involvement				0.058	1.028	1.832

*Note: Sig of t *p<0.05, **p<0.01, ***p<0.001.*

VIF levels within regressions were examined in order to examine potential collinearity problems. It is evident that VIF levels within the original TPB model are of an acceptable level see Table 4.3. Although VIF levels within the extended TPB model are higher, particularly for self-identity and attitude, these are also of acceptable levels (Myers, 1990).

4.7.5. Self-presentation

Levels of self-presentation, as measured by the shortened version of the Marlow-Crowne social desirability scale (Strahan and Gerbasi, 1972) were found to be fairly high. Psychologists evidenced a mean of 8.55 (sd = 3.58) at time one and a mean of 8.24 (sd = 3.55) at time two. Biologists had a mean of 9.36 (sd = 3.84) at time one and a mean of 9.16 (sd = 3.65) at time two. Each participant's score on this scale was correlated with each component mean to examine if this had any influence on a particular factor. However, all were found to be non-significant.

4.8. Discussion

4.8.1. Responses to individual components

Attitudes to try GM food were neutral within psychologists at both time periods, which supports results from the Eurobarometer report (Gaskell, Allum and Bauer et al., 2003) that finds that people are ambivalent towards GM foods. If participants are ambivalent and hold both positive and negative feelings towards GM food this is likely to be expressed as overall neutral on a bipolar measure such as was used here. Intentions were also found to be neutral within psychologists, indicating that psychologists did not intend to either try or avoid GM food.

Subjective norms and moral norms were positive in both groups, at both time periods. This indicated that participants felt that their family and friends would be positive towards GM food and also that participants felt that eating GM food was morally acceptable. This contrasted with previous suggestions that negative results found by previous examinations of attitudes and intentions towards GM food may be attributable to wider social considerations (Noussair et al., 2004). This also contradicted previous research which indicated that people may have moral qualms about eating GM food (Magnusson and Hursti, 2002);

differences in findings are likely to be due to differences in sampling. Further to this, self-identity was found to be positive in both groups indicating that the majority of participants identified themselves as people who would try GM food. Participants' levels of PBC were neutral, so people did not appear to feel either particularly in control or not in control over their choice in eating GM food, which contrasted with previous research that found GM food to be rated as a relatively controllable concern (Townsend et al., 2004). However, Townsend et al., (2004) examined controllability quite generally, rather than personal controllability, and also presented GM food in the context of other issues, which may explain differences in findings between these studies.

Emotional involvement was significantly positive in both groups at both time points (apart from in biologists at time two) and, contrary to expectations, the extent of emotional involvement was not significantly different between student groups. This is likely to be due to the topical nature of GM food; both samples examined may have felt engaged with the topic owing to its current relevance and related frequent media discussions.

In line with hypotheses, biologists were found to be significantly more positive towards GM food than psychologists in terms of the levels of their attitudes towards GM food. In addition, biologists were more positive towards GM food in terms of their moral norms, their self-identity and their intentions to try GM food. This was attributed to the nature of the sample of biologists; people who have chosen to study in an area of science related to GM food are likely to be more positive towards this type of scientific application.

Self-presentation levels were found to be fairly high; however, this measure did not correlate significantly with any other factors. This indicates that self-presentation did not have a particular influence on responses provided.

4.8.2. Influence of knowledge intervention on mean component levels

Over time, mean levels of the individual components measured remained very similar and, in fact, the majority of components did not evidence any significant difference over time in either student group. PBC did vary over time between groups however. As expected, the level of PBC displayed by biologists over time increased significantly whilst that of psychologists remained very similar. This difference was attributed to the learning intervention experienced by biologists. So, as the biologist's knowledge about GM food increased, the amount of PBC increased. It was noted that this finding should be treated with some caution due to unequal error variances for PBC measurement between groups, however this finding does support results from previous research which found a direct relationship between perceived knowledge and PBC (Frewer et al., 1994a). The information that participants received about GM food was likely to have given participants a greater sense of ability to choose to avoid or to try GM food.

4.8.3. Model fit

As hypothesised, the original TPB fitted data collected well and the extended TPB made a significant improvement in accounting for variance in the data. R^2 values obtained indicated that a large proportion of variance, 61% of behavioural intentions in the original TPB model and 73% in the extended TPB model, was explained. The explanation of this proportion of variance was much greater than most TPB studies (Armitage and Conner, 2001) and was similar to the amount of variance explained by Spark's and Shepherd's (2002) examination of intentions towards genetically engineered tomatoes, and genetically engineered pork, in which variance explained was 56% and 68% respectively.

When the original TPB model was tested, attitude was the strongest predictor of intentions to try GM food and this is consistent with previous studies (Sparks et al., 1995; Cook et al., 2002). Subjective norms were also a strong predictor of intentions indicating that the perceptions of family and friends were important in determining behaviour towards GM food. This contrasts with several previous findings that have found subjective norms to be a non-significant predictor of intentions with regards to GM food in the UK (Sparks et al, 1995; Sparks and Shepherd, 2002), however, is in accord with other studies conducted in other countries that found subjective norms to be a significant predictor of intentions to eat GM food (Saba and Vasallo, 2002; Cook et al., 2002). Differences may, therefore, be due to variations in samples examined. Both samples examined here were students and of a fairly young age, whereas, previous UK studies used members of the general public. It is possible that subjective norms have a greater significance for younger individuals who may rely more on friends and family for direction in their behaviour. Attitudes and subjective norms both positively predicted intentions indicating that if levels of these factors become more positive towards GM food, intentions to try GM food will increase.

PBC did not significantly influence behavioural intentions indicating that participants did not view control as an important issue in determining their behavioural intentions towards GM food. This supported some previous research which has also found the role of PBC negligible in predicting behavioural intentions towards GM food (Sparks and Shepherd, 2002; Sparks et al., 1995) but contrasted with other research that has found PBC to be significant in predicting intentions (Cook et al., 2002; Saba and Vasallo, 2002; Sparks et al., 1995). The importance of this predictor is likely to depend on the characteristics of the sample examined. PBC is liable to be an important predictor for those who either feel a particularly low level of control, or those who feel confident in their control, over the behaviour. It is acknowledged, however, that because actual behaviour was not measured in this study, the hypothesised direct influence of PBC on behaviour could not be examined.

Interestingly, the factors 'group' and 'time' were both non-significant in predicting behavioural intentions. This indicated that there were no significant differences between groups in the pattern of factors that predicted behavioural intentions. Rather surprisingly, participants showed no differences in the patterns of factors that predicted behavioural intentions over time either. This meant that the information that the biologists received had no impact on the pattern of influences that predicted their behavioural intentions. In other words, learning more about GM food did not affect the way in which biologists made their decisions regarding whether to try GM foods. This contrasted with hypotheses that predicted that the influence of PBC and attitudes would increase with learning. Data also contrasted with previous research that found that the influence of attitudes on intentions increased with an increase in knowledge (Davidson et al., 1985). Although absolute levels of PBC seemed to increase with knowledge, this apparently did not increase the influence that PBC had on attitudes. Differences in findings may be related to differences in the type of information received by participants. It is emphasised that the information provided to biologists regarding GM foods was not provided in an attempt to influence their behaviour towards GM food but simply to provide a balanced view of the issues associated with GM food. Information that is provided with the aim of persuading individuals to try, or to avoid, GM food may therefore have a greater effect on the pattern of factors that influence behaviour.

The extension of the TPB model to include the additional predictors of self-identity, moral norms and emotional involvement found self-identity to be, by far, the strongest predictor of behavioural intentions. Self-identity positively predicted intentions indicating that the more strongly a person identifies as someone who would eat GM food, the more likely that person is to intend to try GM food. The other components that were added to the model, namely moral norms and emotional involvement, did not predict a significant amount of variance in behavioural intentions to try GM food. This indicated that neither moral issues, nor how engaged participants felt with the issue of GM food, were important in the formation of behaviour intentions to try, or to avoid, GM food. It is expected that moral norms will only reach significance in samples for which moral norms are particularly important, e.g. religious groups or environmental groups, and in behaviours that have a particular moral significance. Emotional involvement was included in the TPB model due to previous research that found that the levels of engagement that individuals had with GM food influenced their level of support of GM food (Gaskell, Allum and Bauer et al., 2003). It is noted that this study examined intentions to try GM food rather than levels of support for GM food. In addition, it is possible that cognitive factors already included in the TPB, e.g. attitudes, may encompass the variance in intentions that emotional involvement may predict on its own. Emotional involvement had not previously been included within the TPB model and data obtained from this study indicate that it is unlikely to be a useful addition.

A methodological issue that has been raised since this study was conducted relates to the correspondence between questions assessing TPB components. Ajzen and Fishbein (1975) stated that TPB components must assess precisely the same behaviour otherwise any relations between components may be underestimated. Due to an unfortunate oversight, some questions utilised within this study to assess TPB components referred to an individual's feelings towards GM food in general whilst the majority referred to an individual's feelings towards the behaviour of trying GM food. This divergence in what questions actually addressed means that the relationships between constructs may be diminished somewhat. The examination of Cronbach's alphas, however, indicated any effects are likely to be minimal. For example, although questions that are used to assess the subjective norms component diverged with regards to the precise behaviour assessed, Cronbach's alpha for this component was quite high indicating that responses to the different questions were very similar. It was acknowledged that questions assessing the attitude component all measured general feelings towards GM food and none of these addressed behaviour towards GM food. This indicated that the relationship between attitudes and intentions, as well as attitudes and other components, may have been underestimated to some extent.

4.9. Conclusions

Overall, this study showed that the TPB model was useful in evaluating factors that influence behavioural intentions towards GM food. Factors of attitude and subjective norms were found to be the most important influences on intentions to try GM food within the original TPB model. In addition, the factor of self-identity was found to be a useful addition to the original TPB model in the domain of behaviour towards GM food. The concepts of PBC, moral norms and emotional involvement were not found to be useful predictors of intentions to try GM food.

The impact of the learning intervention received by biologists was to increase PBC of behaviour towards GM food. However, PBC was found to only have a very small influence on intentions indicating that changes in this factor were unlikely to have a significant impact on intentions. It was noted, however, that PBC also had a hypothesised direct impact on behaviour and, therefore, it is possible that learning may influence behaviour directly in this way. Overall, biologist's intentions to try GM food did not alter significantly over time. In addition, the pattern of factors that were found to have influenced behavioural intentions towards GM food did not change significantly over time, indicating that the learning intervention did not have an effect on the way in which participants formed intentions with regard to the behaviour of trying GM food. The pattern of factors that influenced behavioural intentions also did not differ significantly between groups indicating that factors that influenced the formation of intentions of psychologists and biologists regarding behaviour towards GM food were quite similar.

4.9.1. Directions for future research

Contrary to previous research, this study found that learning did not have a significant impact on attitudes. It is of note, however, that the learning intervention applied within this study was not directed at producing attitude change and an intervention with this aim may have a greater influence on behaviour and behavioural influences. It would be fruitful to examine the impact of learning on attitudes in a more rigorous manner by including measures of different aspects of attitudes, such as attitude strength or attitude ambivalence, within analyses. In addition, results indicated that subjective norms had a significant influence on behaviour here, whereas, in other studies it did not. The explanation suggested for this was that subjective norms have a greater influence on behaviour for younger, rather than older, people and future research should test this hypothesis formally.

This study examined the influence of PBC on intentions; however PBC also has a hypothesised influence on behaviour directly, which was not measured in this study due to practical issues, the effect of which may have been more extensive. Future studies of this type would do well to include some measure of behaviour if possible, so as to clarify the effect of learning on PBC, and actual behaviour. There are of course practical reasons for why this has not been done so far, namely because GM food is not on general sale in the UK. There are, however, methods by which behaviour can be examined in an experimental setting, using such techniques as vignettes, (Finch, 1987) or revealed preference tasks (Noussair et al., 2004). Chapter five describes a further experiment subsequently carried out that included an experimental behavioural measure alongside a TPB survey which enabled the examination of how TPB components, e.g. attitudes, impacted on actual behaviour as well as how closely intentions related to behaviour within the domain of GM food.

Chapter Five – The TPB, GM Food and Actual Behaviour

5.1. Introduction

The prediction of behaviour towards GM food is important for a variety of individuals and organisations including policy makers, food manufacturers and biotechnology companies. However, there is a lack of research that examines actual behaviour towards GM food. In fact, studies in all behavioural domains often ignore actual behaviour in favour of measuring behavioural intentions, or other proxies for behaviour, because these are easier to measure. As these behavioural proxies often have very low correlations with real behaviour this is considered a problem.

This chapter begins by examining the disparity often noted between behavioural proxies, e.g. intention, and actual behaviour and by reviewing reasons that have been suggested to explain this disparity. Methods that have been used to examine actual behaviour in an experimental manner are then described and evaluated. A critical evaluation of studies that have examined actual behaviour towards GM food, both in the UK and abroad, is also undertaken. This is followed by the description of a study that was conducted with the aim of expanding on this literature. This study utilised an experimental behaviour task in order to examine actual behaviour along with TPB components. This enabled an evaluation of potential behaviour towards GM food in the U.K. as well an assessment of the relative importance of TPB constructs in relation to actual behaviour in this domain.

5.2. The intention-behaviour gap

The majority of studies that have utilised the TPB have not measured actual behaviour and have instead focused on the mental antecedents to behaviour.

In fact, the TPB has been criticised for encouraging a focus on mental antecedents and giving plausibility to the practice of ignoring actual behaviour, which is more difficult to measure (Foxall, 1994). There is actually a well-documented gap between behavioural intentions, as the proposed antecedent of behaviour within the TPB, and behaviour (Kuhl, 1985; Gollwitzer, 1993; Sheeran, 2002). A meta-analysis conducted by Armitage and Conner finds that across 185 TPB studies examined, intentions predict an average of 22% of variance in behaviour. Evidently, intentions only explain a proportion of the variance noted within behaviours and leave a large proportion unexplained.

It is plain that, on a basic level, the correspondence of intentions and behaviour will be limited by the way in which these are measured. Both measurements must refer to precisely the same behaviour and situation otherwise divergence should be expected (Fishbein and Ajzen, 1975). The length of time taken between measurements of intention and behaviour is also important. The longer the time interval between measurements, the more likely it is that intentions may have changed (Davies et al., 2002). In addition, in order to obtain an accurate measurement of the relationship between intention and behaviour, the measurement of the two should be dissociated in the participant's mind. The measurement of behaviour should ideally, therefore, be unobtrusive. If self-reported behaviour is used, as has been done in many studies, relationships reported between intentions and behaviour may be spurious (Ogden, 2003), see Chapter four, section 4.2.8.1., for a further discussion of the use of self-reported behaviour.

Individual differences may partially account for variations in the relationship noted between intentions and behaviour. Conner and Armitage

(1998) distinguished between action-orientated individuals and state-orientated individuals. Action-orientated individuals are people who focus on fully developed plans of action and are more likely to persist with these plans and, therefore, have a higher correspondence between intentions and behaviour. State-orientated individuals, on the other hand, are more likely to attend to current internal or external states that are unrelated to the behaviour and are likely to have a lower correspondence between intentions and behaviour.

The degree to which intentions held by an individual are well formed may also be important in understanding the relationship between intentions and behaviour (Boldero, 1995). Poorly formed intentions are thought to diminish the intention-behaviour relationship and reduce the mediating role of intentions within the TPB model. This may occur for two reasons: poorly formed intentions are more likely to be reported with uncertainty than well formed intentions, which will provide a less reliable measure of intentions, and poorly formed intentions are also more likely to change over time and thus correspond less well with behaviour (Bagozzi and Yi, 1989).

The TPB has been criticised for not clarifying the exact nature of the relationship between intentions and behaviour (Eagly and Chaiken, 1993; Baron and Kenny, 1986). Consequently there has been much research into how best to 'bridge the intention-behaviour gap'. One of the best known theories is Gollwitzer's (1993) idea of implementation intentions. The theory of implementation intentions describes a second stage of achieving behaviour that involves forming plans to actually carry out that behaviour. Empirical research has examined a multitude of potential moderators and mediators of the intention-behaviour relationship and findings have lent support to Gollwitzer's (1993) theory. For example, detailed action planning, perceived self-efficacy and self-regulatory strategies were found to be significant mediators between intentions to exercise and actual physical activity (Sniehotta, Scholz and Schwarzer, 2005). In fact, Cooke and Sheeran (2004) identified seven different properties of cognitions (accessibility, temporal stability, direct experience, involvement, certainty, ambivalence and affective-cognitive consistency) that significantly moderated the intention-behaviour relationship, as well as the attitude-behaviour relationship. It is likely that there are numerous potential moderators and mediators of the intention-behaviour relationship and the importance of these is likely to vary with the particular behaviour examined, as is the case with other factors within the TPB model.

5.3. Behaviour towards GM food

To date, TPB studies of GM food have not included any measures of actual behaviour with regard to GM food. It is likely that this was mainly due to practical reasons in that GM food has not been widely available in Britain. However, behaviour in response to GM food has been examined in other (non-TPB) studies.

5.3.1. Methods of examining behaviour

A variety of experimental techniques are available for examining behaviour and these are particularly useful for behaviours that are not amenable to direct observation including, for example, behaviour towards GM food.

5.3.1.1. Contingent valuation tasks

The main method that has been used to examine behaviour towards GM food is the examination of valuations of GM products using contingent valuation tasks. Contingent valuation tasks are used to find out the perceived value of a good by asking people how much they would be willing to pay, or willing to accept, for a good. These are popular nonmarket techniques for finding out a good's perceived worth and have been commonly used within environmental economics in order to find out individuals' valuations of public goods (Venkatachalam, 2004).

However, there is a well documented disparity between willingness-to-pay (WTP) estimates and willingness-to-accept (WTA) estimates (Mitchell and Carson, 1989; Shogren, Shin, Hayes and Kliebenstein, 1994; Venkatachalam, 2004). Individuals are generally willing to pay less than they are willing to accept for the same good. There are a number of suggested reasons why this disparity may exist. Differences may be attributed to income effects in that WTP estimates will be constrained by an individual's income constraint whereas WTA estimates are not (Willig, 1976). Differences may also be due to loss aversion differences. WTP estimates will include a loss aversion to money effect, whereas, WTA estimates will include a loss aversion to goods effect (Tversky and Kahneman, 1991); to the extent that these differ, WTP and WTA estimates can also be expected to differ. Another reason that WTA and WTP estimates may differ is due to differences in transaction costs. Transaction costs are likely to exist when an individual is selling a good, and therefore WTA estimates will include these costs, but are not likely to exist when buying a good, and therefore WTP estimates will exclude these costs (Brown and Gregory, 1999).

No matter the cause, it remains that WTP and WTA estimates can be quite different. This led to the development of the equivalent gain task (Bateman, Munro, Rhodes, Starmer and Sugden 1997a). An equivalent gain task asks the individual whether they would prefer a certain quantity of one good or a certain amount of money (or quantity of alternative good). The amount of money offered as an alternative to the good is steadily increased in order to find out the amount of money that is preferred to the good in question and thus discover its perceived value. Equivalent gain tasks utilise two WTA options so income effects do not influence results and as both the money and the good are treated symmetrically as gains, any influence of loss aversion effects or transaction costs are also effectively removed (Bateman et al., 1997a).

5.3.1.2. Conjoint analysis

Conjoint analysis is a similar technique to contingent valuation that is used in order to compare products in terms of specific attributes (see Green, Krieger and Wind, 2001, for a review). When an individual is asked to determine the relative importance of product attributes outright, they generally find it quite hard to do so. Conjoint analysis is a method that allows a subset of possible product attributes to be utilised in order to determine the relative importance of each feature. This technique is based on the fact that the value of attributes is easier to consider when these are presented jointly than when in isolation. The most straightforward version of this method simply asks that participants arrange a series of products in decreasing (or increasing) order of preference.

5.3.1.3. Experimental auctions

Experimental auction tasks are a more realistic method of determining the value of a good as they simulate a real market environment. There are a range of auction tasks in use (see Lusk, 2003 for a review) including, for example, the traditional English auction in which the highest bidder wins the good. These are relatively difficult to implement however and in many auctions participants tend to lack the understanding necessary in order to make rational choices. Performance can be improved through learning though, so after repeated experience with such auction tasks participants do learn to choose rationally (Loomes, Starmer and Sugden, 2003).

5.3.1.4. Experimental observation

Another experimental method of examining an individual's behaviour is by simply putting the person in a situation in which they have to decide what to do. This method is frequently used when individuals are asked to self-report their behaviour. Individuals are provided with different scenarios involving the behaviour in question and they are required to report what they think they would do in that situation. Surprisingly it seems that, to date, this method of self-reporting likely behaviour has not been used with regards to GM food behaviour. This technique is susceptible however, to the same biases as are associated with all self-report measures including self-presentation effects and demand characteristics.

A more objective, and realistic way, of obtaining a measure of an individual's likely behaviour in some situation is by observing behaviour directly. With regards to GM food, it is not possible to do this in the real world because

GM food is not, as yet, widely available within the UK. It is possible, however, to invite individuals into the laboratory and place them in a situation in which they have to make a decision regarding their behaviour towards GM food. Indeed as long as the participants believe that the food they are interacting with is GM, this need not necessarily be the case.

5.3.2. Behaviour towards GM food in the U.K.

Empirical data on behaviour towards GM food in Britain was found to vary greatly between studies and this is likely to be due, in part, to differences in methodology. Moon and Balasubramanian (2003) used a contingent valuation technique in order to assess behaviour towards GM food in Britian. They found that, if prices were equal between GM and non-GM alternative products, 71% of UK consumers would prefer to purchase non-GM foods, and 25% had no preference, or would prefer to purchase GM foods. Questions also asked if consumers would be willing to pay a premium for non-GM food, if GM food was introduced; 56% of consumers said that they would pay the higher price and 22% of consumers said that they would not. On closer examination of actual levels of a price premium consumers would be willing to pay for non-GM foods, it was found that as the premium increased, fewer consumers were willing to purchase non-GM (Moon and Balasubramanian, 2003). Data regarding specific willingness-to-pay levels differed depending on the response format used however. With closed ended response formats, in which participants were simply asked if they would pay one size of premium to avoid GM food (and this was varied across participants) the mean willingness-to-pay to avoid GM food was $1.39 (roughly £0.81). With open ended payment cards, in which the premium offered to avoid GM food was increased incrementally so participants had the choice of a range of values, the mean willingness-to-pay to avoid GM food was \$0.75 (£0.44). Moon and Balasubramanian (2003) found that the values obtained by the two different formats were significantly different. They also suggested that the open ended payment card format was likely to be more accurate than the closed ended response format. Participants were thought to want to fulfil two objectives when answering questions: they want to answer truthfully and they also want to indicate how favourably they view the issue (Brown, Champ, Bishop and McCollum, 1996). The open ended payment card format fulfils both of these objectives, however the closed ended response format does not and participants may find the objectives conflicting and agree to a higher premium in order to indicate their negative attitude towards GM food or vice versa.

Another factor that was likely to have had a large impact on willingness-to-pay values was the particular food that was being examined. Moon and Balasubramanian (2003) examined consumer's willingness-to-pay for a non-GM breakfast cereal; breakfast cereal can be considered as a staple food and consequently willingness-to-pay estimates may be lower than for food that may be considered as non-essential luxury goods, such as chocolate for example.

One aspect of this study that must also be taken into particular consideration when interpreting results is the type of questions used. As previously discussed (section 5.2.1.1), values provided in response to questions examining an individuals' willingness-to-pay are generally much lower than questions examining an individuals' willingness-to-accept. It is possible, therefore, that willingness-to-pay questions were underestimating the premium that consumers would be willing to pay to avoid GM food.

It should also be highlighted that the phrasing of these questions may have had some influence on participants' responses. If the situation had been described with regards to GM foods being cheaper than non-GM foods, rather than non-GM foods including a premium, responses may have been quite different. In fact, follow up questions do indicate that some participants made 'protest responses', indicating that they said they would not pay a premium for non-GM food on principle (Moon and Balasubramanian, 2003). This means that of those who said that they would not purchase non-GM food at a higher price, some people (data indicates around 22% of those who responded 'No') protested the idea of paying a higher price for non-GM food.

Further to this, the sampling method of the study by Moon and Balasubramanian (2003) must be examined to consider how generalisable the results obtained actually are. Participants were obtained from a database of around 9,000 British consumers that are registered with the National Panel Diary Group (a market research company) online survey panel. Consumers within this database were all e-mailed details of the study in order to elicit participation and around 2,570 responded. Participants, therefore, may have self selected themselves to participate in this study due to a particular interest in GM food. In addition, it is noted that the specific demographics of those individuals within the National Panel Diary Group may not accurately represent British demographics.

Behaviour towards GM food in UK has also been assessed using conjoint analysis (Burton, Rigby, Young and James, 2001). Data obtained was split according to three groups of consumers, defined in terms of the frequency with which consumers purchased organic foods: infrequent, occasional and committed buyers. Data indicated that infrequent consumers of organic food were likely to purchase GM food at some price. Occasional and committed purchasers of organic food were unlikely to purchase GM food at a feasible price; however all participants indicated that they would purchase some types of GM food under certain circumstances. Statistics regarding the overall proportion of the population sample that were likely to purchase GM food were not available.

A criticism of both the contingent valuation and conjoint analysis studies that have been applied to GM food behaviour in Britain is that these tasks have all been hypothetical; participants therefore did not see any real consequences to their actions. Hypothetical questioning is susceptible to influence from social desirability effects and demand characteristics. In fact, previous research has found that hypothetical decisions made within contingent valuation experiments differed quite substantially from when real consequences were provided for decisions (Bishop and Heberlein, 1979; Kachelmeier and Shehata, 1992). It would be beneficial, in circumstances when behaviour can not be directly observed, to place participants in a more realistic consumer role in which choices made have real life outcomes that impact participants, in order to encourage honest responding.

Studies have also used direct observation methods in order to evaluate behaviour towards GM food within the U.K. Townsend and Campbell (2004) utilised a taste-test paradigm which invited participants to compare the taste and appearance of three apples that were purportedly grown either organically, traditionally, or using GM technology. All apples were actually the same and the real purpose of the experiment was to examine how many participants were willing to try a GM apple. It is noted that participants were told that they did not have to try the products and the test could proceed without them doing so. Results showed that, an overwhelming, 93% of participants were willing to try the, purportedly GM, apple. It is acknowledged though, that behaviour with regards to trying GM food does not necessarily generalise to the behaviour of purchasing GM food.

Overall, research examining behaviour towards GM food in the U.K. is quite sparse; although what little research has been done does indicate that a significant proportion of individuals were likely to buy and eat GM food. A larger amount of people were found to be willing to try GM food than were found to be willing to purchase GM food. Two main factors were highlighted in explaining differences. One is the fact that purchasing behaviour has only been measured hypothetically, whereas real choice situations have real consequences. The other is the fact that participants were not required to pay for the GM food in the direct observation study and were, therefore, not subject to any effects of loss aversion.

Some disparity is evident between empirical data regarding attitudes and behaviour towards GM food. Empirical examinations of behaviour towards GM food are, on the whole, more positive than measurements of attitudes towards GM food, which have generally been found to be neutral (e.g. Gaskell, Allum and Bauer et al., 2003, see section 2.1.1 for a discussion). It was difficult to compare behaviour towards GM food with intentions towards GM food as data regarding intentions is meagre. The only study that has examined intentions towards GM food in Britain examined intentions towards specific GM food stuffs and did not provide an interpretation of means, instead focusing on the prediction of intentions (Sparks and Shepherd, 2002). Results from the experiment reported within chapter four, in this thesis, did provide an indication of intentions towards

GM food though; here intentions were found to be neutral in the control group of psychologists, which contrasts with empirical data on behaviour in the same way as measurements of attitude.

5.3.3. Behaviour towards GM food measured outside the U.K.

Experimental behaviour tasks have also been used to evaluate behaviour towards GM food in studies in other countries. For example, Noussair et al., (2004) investigated willingness-to-pay information for GM food in a representative sample of French consumers. Overall, it was found that 65% of participants in this study were willing to accept GM food at some price. Similarly to empirical data gathered in Britain, these results regarding behaviour towards GM food were far more positive than data regarding attitudes towards GM food (Noussair et al., 2004).

Experimental evidence obtained in Denmark, Finland, Norway and Sweden, revealed a similar disparity between attitudes and behaviour. Although attitude surveys revealed that attitudes were negative towards GM food within these countries, behavioural evidence indicated that a majority of participants recruited within these four Scandanavian countries wanted to take at least one piece of (purportedly) GM cheese home with them when offered a selection of cheeses to keep (Lahteenmaki, Grunert, Ueland, Astrom, Arvola and Bech-Larsen, 2002).

Overall, the limited evidence that exists implies that behaviour towards GM food is likely to be more positive than attitudes. Differences between attitudes and behaviour are likely to exist for a number of reasons. Whereas attitude surveys elicit responses from participants as citizens, who are likely to make judgements from the point of view of society as a whole, behavioural decisions elicit responses from participants as private consumers (Noussair et al., 2004). It is also evident that in addition to attitudes, a variety of other factors, e.g. remaining TPB components and volitional factors, are likely to influence behaviour.

5.4. Current aims

This study applied a modified TPB model, accompanied by an actual behavioural measure, to a British sample in order to gain a more comprehensive idea of behaviour with regard to GM food and the relative importance of behavioural influences in this domain. Behaviour was measured using an equivalent gain task and, in order to increase the accuracy of results provided by participants, participants were actually provided with a prize relating to their choices as an incentive to provide truthful responses. It was also thought useful to apply the extended TPB model, that was utilised within chapter four, to a community sample in order to compare these results with those from a student population.

The TPB model that was applied here was an extended version of the original that included the constructs of self-identity, moral norms, and emotional involvement. Self-identity and moral norms have previously received mixed results with regards to behaviour towards GM food, see section 4.4.1. for a review. It was, therefore, considered important to further examine the contribution of these factors in this domain. The construct of emotional involvement had not been investigated in previous incarnations of the TPB model (see section 4.2.3. for a discussion of the construct of emotional involvement);

however it was examined within the TPB study reported within chapter four of this thesis. Data indicated that this construct was non-significant, but it was considered useful to further examine this construct within a community based sample.

Data collected for the TPB variables were hypothesised to provide a good fit to the theorised model. In addition, mean levels of TPB components were expected to reflect levels of mean components found within the control group of psychologists examined within the TPB study conducted within chapter four. Levels of attitudes, intentions and perceived behavioural control were, therefore, hypothesised to be neutral; subjective norms, moral norms, self-identity and emotional involvement were expected to be significantly positive. With regards to behaviour, it was predicted that non-GM chocolates would be preferred to GM chocolates, as GM food has generally been perceived more negatively than ordinary food (Moon and Balasubramaniam, 2003; Burton et al., 2001). However, on the basis of past studies it was also predicted that most people would accept GM food at some price (Moon and Balasubramaniam, 2003; Townsend and Campbell, 2004).

5.5. Method

5.5.1. Design

This experiment had a within subjects design. TPB variables were examined using direct questions with the exception of the behavioural measure, which was examined using a) an equivalent gain task and b) the number of participants willing to accept GM at some price.

5.5.2. Participants

In total 99 participants took part in this study, recruited from two different call centres within the city of Nottingham in England. Participants were recruited topic blind in order to avoid sampling biases in favour of individuals who are particularly interested in GM food issues (Campbell and Townsend, 2003; Townsend and Campbell, 2004; Townsend et al., 2004). In total, 63 males and 36 females took part in the study, and ages ranged from 17 to 55 years with a mean of 25.

5.5.3. Materials

The materials used consisted of a questionnaire that included three sections. The first section consisted of an equivalent gain, behavioural lottery task (Bateman et al., 1997a). This consisted of two pages of questions that asked participants to choose between a series of options consisting of a monetary amount and a box of chocolates, e.g., 'We give you £0.60 or we give you a box of 8 chocolates'. One page offered a box of eight GM chocolates as an alternative to the monetary options and one page offered a box of eight non-GM chocolates as an alternative; which version was presented first was counterbalanced between participants. Twenty options were provided on each page and these increased in increments of £0.30, starting from £0.00 and finishing at £5.70. As an incentive to be truthful in their choices, it was emphasised to participants that they would actually receive one of these options drawn from one of the lotteries. A random number generator (Haahr, 2000) was used in order to pick which option each person actually received. These were all drawn from the page that gave non-GM chocolates as an alternative due to the difficulty of actually obtaining GM chocolate in this country. Chocolates provided were a box of eight 'Classic' chocolates bought from Thorntons Plc. at a cost of £3.00 a box.

The second section consisted of a series of questions examining TPB variables as well as the additional postulated factors included. Questions used were a subsection of those used within the TPB study reported within chapter four. In order to keep the time taken to complete the questionnaire to a minimum, several questions were eliminated from the questionnaire that was used within chapter four whilst ensuring that those that remained had good internal consistencies, see Appendix four for a list of questions used within this study.

The questionnaire also had a third section that consisted of a shortened version of the Marlow-Crowne social desirability scale (Strahan and Gerbasi, 1972) headed with the title 'Personal beliefs'. This was included in order to assess the extent of social desirability within responding in participants' responses on the TPB. The shortened version was included, rather than the full version, because it has a similarly high internal consistency to the full version and so that the questionnaire would take less time for participants to complete.

5.5.4. Procedure

An individual at each call centre was recruited in order to provide questionnaires to their colleagues. All call centre staff were asked to participate and the majority agreed to fill in questionnaires. For recruitment purposes individuals were simply asked if they would fill in a questionnaire and the topic of GM food was not revealed. None of those who initially agreed to take part withdrew after starting the questionnaire and encountering the topic of GM food. Participants provided their name and contact details at the end of the questionnaire and it was made clear that this was to provide them with their lottery prize only and their actual responses would be associated only with a randomly assigned participant number. A random number was generated for each participant and this determined which option their prize was drawn from. Participants received the choice they had made for that numbered option. Prizes, consisting of either money or chocolates, were then provided to the contact within each call centre to pass on to his relevant colleagues and signatures were obtained to make sure that this was done.

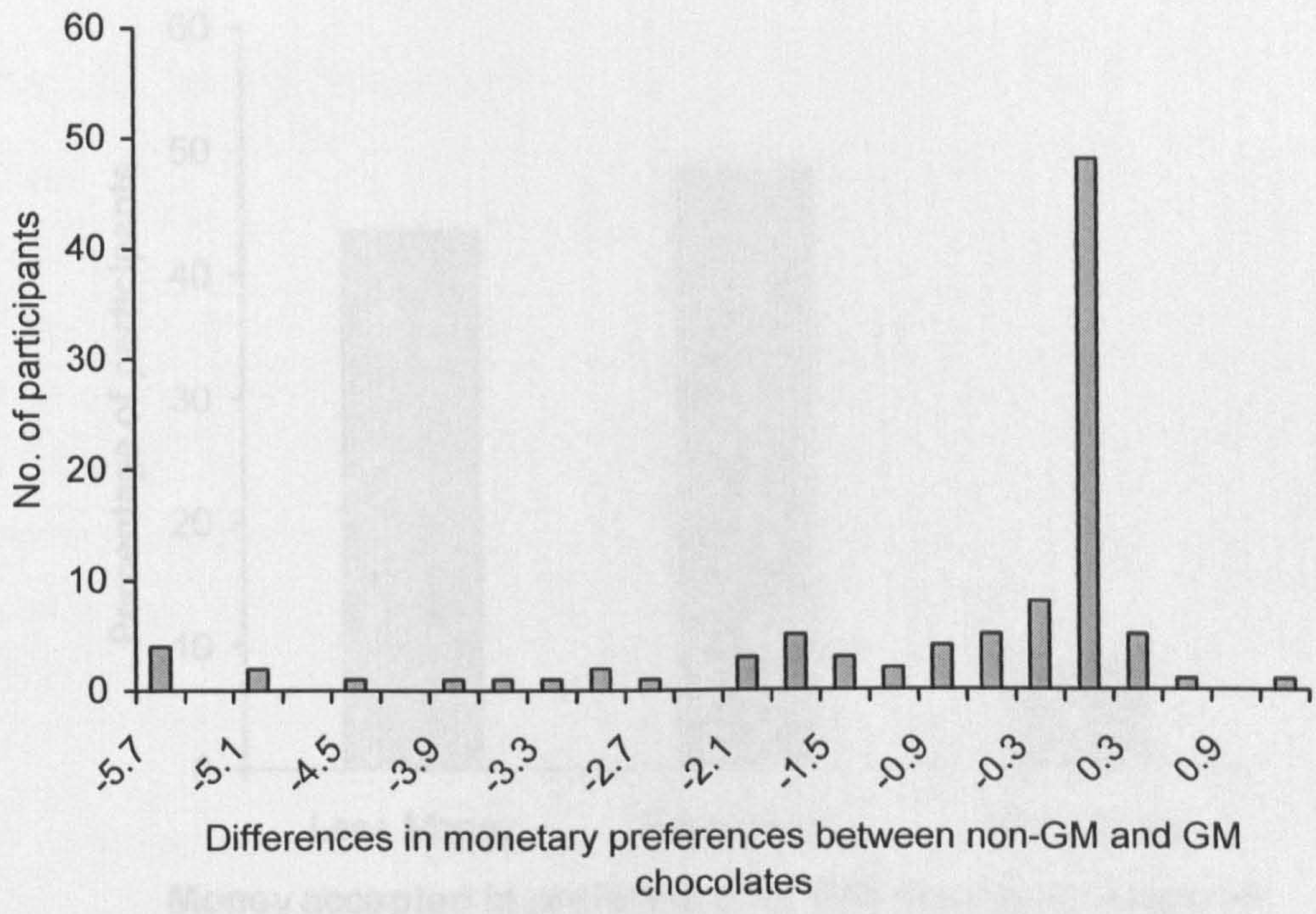
5.6. Results

5.6.1. Equivalent gain task

The amounts of money participants were willing to accept in preference to a box of GM chocolates were positively skewed with a median of £1.20 and a full range from zero up to the maximum value of £5.70. With regard to monetary amounts participants were willing to accept in preference to a box of non-GM chocolates, again a positive skew was evident and the median amount was £2.10 with a range of £5.70. A Wilcoxon signed ranks test demonstrated that the monetary amounts accepted in preference to GM chocolates were significantly lower than the monetary amounts accepted in preference to non-GM chocolates ($z = -5.10$, $p<0.001$). The difference between the median amounts of money accepted in preference to a box of GM chocolates and a box of non-GM chocolates was £0.90.

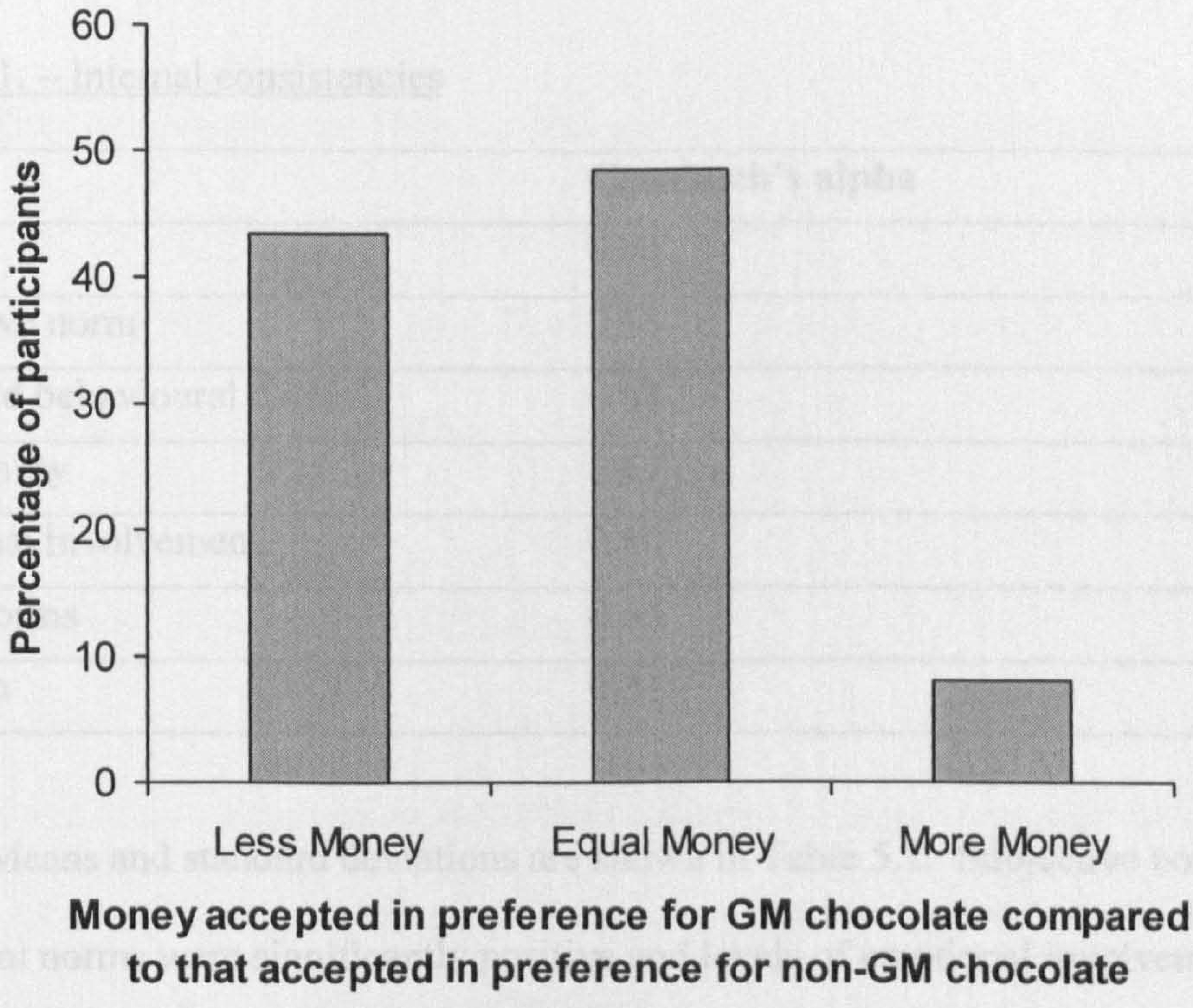
In order to remove the influence of inter-individual variation in preference for chocolates, the behavioural measure was calculated as the amount of money the participant preferred over a box of GM chocolates minus the amount of money the participant preferred over a box of non-GM chocolates (henceforth, this measure is referred to as the valuation of GM food). This measure was again very positively skewed and very kurtotic with an almost unimodal distribution at zero; the median of this measure was zero, see Figure 5.1. One outlier, which was over three standard deviations away from the mean, was present in the data and this was removed.

Figure 5.1. – Range of differences in monetary preferences between non-GM and GM chocolates



Overall, 43.4% (43/99) people would accept less money instead of GM chocolates as compared to non-GM chocolates. 48.5% (48/99) people would accept the same amount of money instead of GM and non-GM chocolates and 8.1% (8/99) people would accept more money instead of GM chocolates than instead of non-GM chocolates, see Figure 5.2. In addition, it was found that of those who would accept either kind of chocolates at all (94.9%), 74.5% people (70/99) would prefer GM chocolates over money at some level and only 25.5% (24/99) would not. In other words, most people accept GM chocolates at some price.

Figure 5.2. – Percentage of participants prepared to accept more, equal or less amounts of money instead of GM chocolates compared with that accepted instead of non-GM foods



5.6.2. TPB components

Questions examining TPB components were reverse scored as necessary so that on the scale from one to seven, the middle point indicating neutrality was four with one indicating a negative stance towards GM foods and seven indicating a positive stance towards GM foods. With regards to emotion, one indicated a lower amount and seven indicated a higher amount of emotional involvement felt and with regards to PBC, one indicated a lower amount and seven, a higher amount of perceived control. All components were within the accepted limits of normal distribution.

Internal consistencies for each component were examined using Cronbach's alpha, see Table 5.1. All measures displayed reasonable, to good, levels of internal consistency, except for intention, which displayed a lower internal consistency level of 0.51 indicating that the interpretation of this factor should be treated with some degree of caution.

Table 5.1. – Internal consistencies

Factor	**Cronbach's alpha**
Attitude	0.92
Subjective norm	0.63
Perceived behavioural control	0.68
Self-identity	0.67
Emotional involvement	0.80
Moral norms	0.63
Intention	0.51

Means and standard deviations are shown in Table 5.2. Subjective norms and moral norms were significantly positive and levels of emotional involvement were significantly lower than the scale mid-point. No other differences approached significance.

Table 5.2. – Mean levels of factors examined within the TPB, the significance of differences from scale midpoints and the effect sizes of differences

Factor	**Mean level (standard deviation)**	**Significance of difference from scale midpoint (t-value)**	**Effect size (Cohen's d)**
Attitude	3.84 (1.34)	-1.22	-0.17
Subjective norms	4.39 (1.21)	3.20*	0.46
PBC	3.77 (1.37)	-1.63	-0.24
Emotional Involvement	3.28 (1.41)	5.08*	-0.72
Self-identity	4.38 (1.65)	2.31	0.33
Moral Norms	4.48 (1.40)	3.40*	0.48
Intention	4.39 (1.45)	2.67	0.38

* Significant at Bonferronis corrected level of significance, 0.00625.

Correlations between TPB components were all positive and highly significant, see Appendix five, with the exception of PBC which did not correlate highly with most other components. None of these were high enough to cause concerns about collinearity though.

5.6.3. Predicting intention from TPB components

A linear regression with a forced method of entry of variables indicated that TPB variables predicted around 51% of variance in intentions which was found to be a significant amount of variance accounted for (see Table 5.3). When the TPB was modified to include self-identity, emotional involvement, and moral norms, around 66% of variance in intentions was accounted for by the model (a significant increase). In the original TPB model, attitude was found to be the strongest predictor of intentions followed by subjective norms and PBC. However in the extended TPB model, self-identity became the strongest predictor of intentions followed by attitude, emotional involvement and PBC. Moral norms were not found to be a significant predictor of intentions. Subjective norms became non-significant when the additional components were added indicating that some collinearity may exist between the construct of subjective norms and the components added to the original TPB model. VIF levels were, therefore, examined to check for multicollinearity but these were considered to be of an acceptable level (Myers, 1990).

Table 5.3. – Linear regression of predictors on intention

Determinant	**Original TPB Model**			**Extended TPB Model**		
	β	t	VIF	β	t	VIF
Attitude	0.533	6.278***	1.403	0.234	2.613**	2.180
Subjective norms	0.211	2.466*	1.424	0.039	0.497	1.633
PBC	-0.169	-2.328*	1.030	-0.125	-1.983*	1.081
Self-identity				0.393	4.449***	2.119
Moral Norms				0.065	0.783	1.876
Emotional Involvement				0.202	2.539*	1.712

Note: $^*p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$.

5.6.4. Predicting behaviour using the TPB

In order to examine the amount of variance that the TPB could account for in behaviour towards GM food, the valuation of GM food (calculated as the difference in monetary amounts accepted in preference to GM and non-GM chocolates) was first transformed (reflected and log-transformed) in order to normalise data for further analysis (Tabachnik and Fidell, 1996). Linear regression, with a forced entry method, was then used in order to regress intentions and PBC on behaviour. This demonstrated that intention was found to significantly predict behaviour when behaviour was conceptualised as the valuation of GM food, see Table 5.4. PBC did not predict behaviour. The regression analysis revealed that 19.4% of variance in behaviour, a small but significant proportion, was predicted by intention and PBC. Again VIF levels were examined and these were low indicating that no collinearity was present.

We also examined whether TPB variables could predict willingness to accept GM. To this end, the dichotomy between whether people would accept GM chocolates over some amount of money or not was used as a measure of behaviour. A logistic regression, with a forced entry method, was employed to examine how well the TPB model could predict behaviour measured in this way, see Table 5.5. Again, it was found that intention was a significant predictor of this measure of behaviour, whereas PBC was not. The model was able to correctly classify 74.7% of cases and a chi-square test indicated that the model significantly improved predictive power. McFadden's pseudo R^2 was calculated and this was found to be 0.137 indicating that the inclusion of intention and PBC as predictor variables does improve the model.

Table 5.4. – Linear regression of intention and PBC on behaviour†

Determinant	**Original TPB Model**		
	β	t	VIF
PBC	-0.08	-0.78	1.08
Intentions	0.41	-4.29***	1.08

*Note: *p<0.05, **p<0.01, ***p<0.001.*

† *When defined as difference in amounts of money accepted over GM or non-GM food*

Table 5.5. – Logistic regression of intention and PBC on behaviour†

Predictor		Behaviour
PBC	B	0.018
	Wald	0.005
	Exp(B)	2.707
Intentions	B	0.996
	Wald	12.074***
	Exp(B)	1.018
Cases classified correctly		74.7%
McFadden's pseudo R^2		0.137
Chi-square		16.144***

*Note: *p<0.05, **p<0.01, ***p<0.001.*

† *When defined as whether the participant would accept GM food over some amount of money.*

5.6.5. Mediating role of intention

The role of intentions in mediating the effects of predictor variables on behaviour was tested in the way set out by Baron and Kenny (1986). This method states that to establish mediation, the predictor variables must affect intentions and also behaviour and intentions must affect behaviour. Importantly, the effect of predictor variables on behaviour must be less than the effect of intentions on behaviour. It was found that with regard to behaviour, as measured as the valuation of GM food, all effects of TPB predictor variables (attitudes, subjective norms, PBC, self-identity, moral norms and emotional involvement) on behaviour were found to be partially mediated by intention. However, when the significance of mediation effects were tested using the Sobel test (Sobel, 1982), none of the mediation effects were found to be significant, see Table 5.6.

Table 5.6. – Sobel test statistics showing the significance of mediation effects on behaviour as measured as the valuation of GM food

	Original TPB model	Extended TPB model
Attitude	-0.85	-1.18
Subjective norms	0.67	0.09
PBC	0.24	0.36
Self-identity	-	1.40
Moral Norms	-	0.09
Emotional Involvement	-	1.23

*Note: *p<0.05, **p<0.01, ***p<0.001.*

Mediation effects were also tested with regard to simple choice behaviour, i.e. whether a participant would try GM food at all. Again, all effects of TPB predictor variables on behaviour were found to be partially mediated by intention; however none of these effects were significant, see Table 5.7.

Table 5.7. - Sobel test statistics showing the significance of mediation effects on behaviour as measured as simple choice behaviour

	Original TPB model	Extended TPB model
Attitude	-0.17	0.68
Subjective norms	1.16	0.43
PBC	-0.16	0.29
Self-identity	-	1.04
Moral Norms	-	0.26
Emotional Involvement	-	1.80

*Note: *p<0.05, **p<0.01, ***p<0.001.*

5.6.6. Self-presentation

Self-presentation levels, as measured by a shortened version of the Marlowe-Crowne, were found to be fairly high with a mean of 9.67 (3.54). Correlation analyses were carried out to determine whether there was a relationship between the levels of self-presentation and responses on TPB variables. No significant relationships were uncovered in this analysis.

5.7. Discussion

5.7.1. Acceptance of GM food

The overall ratings of TPB components measured offer some insight into the feelings towards GM food of individuals who work in a call centre who can be considered to be members of the public with no special interest in the topic of GM. When behaviour was measured as the difference in amounts of money participants were willing to accept in preference to GM food as opposed to non-GM food, participants were found to accept less money over GM food than over non-GM food.

Specifically, this study showed that the mean difference in value between GM and non-GM food was £0.90. This is larger than that indicated in the study by Moon and Balasubramanian (2003) who, in their equivalent open ended payment card format, found a difference of approximately £0.44. This discrepancy is likely to be due to a number of differences between the studies. Importantly, Moon and Balasubramanian (2003) investigated valuations of breakfast cereals, whereas here valuations of chocolates were investigated. Chocolates can be considered as more of a luxury food item than breakfast cereal and it is possible that consumers' valuations of GM goods are moderated by their perceived necessity. Consumers may demand a greater cost difference between GM and non-GM versions of luxury items in order to induce them to purchase GM. It was noted, however, that valuations within this study were not precise, and increased in increments of £0.30, which means that the monetary estimations gained must only be used as indications of perceived value.

Although a large proportion of participants would accept a lower amount of money in preference to GM chocolates than in preference to non-GM chocolates, the majority of participants were indifferent between GM and non-GM chocolate alternatives and would accept an equal amount of money in preference to either type of chocolates. In addition, a small minority of people were prepared to accept a larger amount of money in preference to GM chocolates than in preference to non-GM chocolates. This finding may be due to participants having a general interest in trying some GM chocolates (which are not yet available in the UK). Interestingly, of those people willing to accept either type of chocolates in preference to money, it was found that 74.5% were prepared to accept GM chocolates in preference to some amount of money. This indicates that around three-quarters of participants would buy GM food at some price.

These figures are more positive than many previous studies, both in terms of those investigating attitudes towards GM (Gaskell, Allum and Bauer et al., 2003) and those investigating behaviour towards GM using contingent valuation methods (Moon and Balasubramanian, 2003). Behavioural studies are likely to differ from attitudinal surveys partly due to the influence of other important factors, e.g. subjective norms on behaviour and partly due to reasons given by Noussair et al., (2004), namely that public valuations provided in surveys may differ from private valuations due to a free rider effect.

Differences between the behavioural task used here and previous tasks may have arisen due to the enhanced reality of the situation provided by the task used here, which is likely to have elicited more authentic responses than the hypothetical questions utilised in previous tasks (because participants were told that they would be provided with their preference selected at random from one of the lotteries used). It could be argued that social desirability effects and demand characteristics may still have influenced responding in this task. However, these influences were likely to have been greatly reduced due to the real outcomes associated with responses and also due to the assured anonymity of responses. In addition, it was found that participant's responses on the shortened version of the Marlow-Crowne social desirability scale did not correlate with responses given. The disparity between results presented here and other studies may also have arisen because an equivalent gain task was used here. The equivalent gain task differs from previous contingent valuation tasks that have employed willingness-to-pay tasks due to loss aversion to money effects inherent in willingness-to-pay tasks.

For these reasons, responses provided in this task are likely to provide a more accurate idea of valuations of GM foods than previous tasks. It is acknowledged, however, that the sample examined here is not representative of the British population and to this end future research should examine a stratified sample in order to draw reliable conclusions as to valuations of GM food. But of critical importance to the reliability of current results was the fact that a community-based sample was used, which was recruited topic blind. Crucially, this means that the results of this study are unlikely to be influenced by self-selection biases that have plagued prior research into GM and will give a good indication as to the behaviour of the majority of the British population who are not particularly interested or involved with GM food.

5.7.2. Mean levels of TPB components

Results suggest that attitudes and intentions are fairly neutral towards GM foods; this is in line with results for psychologists from chapter four and with Eurobarometer studies that indicate that explicit measures of attitudes in the British population generally find people to be ambivalent towards GM food (Gaskell, Allum and Bauer, 2003). It was noted that the levels of behavioural intention, as measured within this study, are limited to the behaviour of trying GM foods; results may differ with regards to other types of behaviour regarding GM food, e.g. repeatedly eating GM foods. Further to this, any interpretation of the construct of intention must be cautious as internal consistencies of this construct are slightly lower than acceptable levels. It is possible that this may be because intentions are not well formed due to the novelty of the behaviour examined (Bagozzi and Yi, 1989).

PBC was found to be neutral; again in line with results from chapter four, indicating participants did not feel either particularly in control or not in control of their choice in eating GM food. Self-identity was also found to be neutral here which contrasts with psychologists examined in chapter four, who identified as people who would try GM food. This indicated that participants obtained from a call centre population did not identify themselves as people who would try GM food nor as someone who would avoid GM food. Differences between findings are attributed to differences in the population samples examined. Here, participants were obtained from a call centre, whereas, the study described in chapter four recruited participants from a university; it is therefore not surprising that differences in self-identity exist.

Levels of subjective norms and moral norms were significantly positive towards GM food, in agreement with results obtained within chapter four. This indicated that participants felt that their close friends and family would be positive towards eating GM food, and that participants felt that it was morally acceptable to eat GM food. Here, emotional involvement was found to be significantly negative and this suggested that those investigated did not feel strongly emotionally involved in the topic and were not particularly concerned about GM. This contrasted with results from chapter four in which participants were significantly engaged with the topic of GM food and may reflect the differences in education between the call sample examined here and the university sample examined within chapter four. The low emotional involvement noted also contrasts with results from past studies which have reported high levels of hostility toward GM (e.g. Grant et al., 2003).

5.7.3. Fit of TPB model

Results showed that the standard TPB model accounted for around 51% of variance in intentions and all hypothesised predictors (attitudes, subjective norms and PBC) accounted for significant proportions of variance. Attitudes and subjective norms positively predicted intentions so increases in these factors are likely to result in a positive increase in intentions and PBC negatively predicted intentions indicating that as PBC increases, the likelihood of intending to try GM food decreases. The pattern of influences found here support those of some previous studies (Saba and Vasallo, 2002; Cook et al., 2002) but contrasts with other studies (Sparks et al., 1995; Sparks and Shepherd, 2002). This may be due to differences in the particular definition of intention employed or due to differences in population samples, or possibly both. These results are in accord with Cook et al., (2002), which was the only other TPB study applied to GM food that examined the general intention to try GM food, although Cook et al.'s (2002) study was conducted in New Zealand. This indicated that differences in behavioural influences between Britain and New Zealand may be minimal.

Results obtained here were in accordance with those obtained within chapter four, with the exception of PBC which was a significant predictor of behavioural intentions here but was not in the study reported within chapter four. Levels of PBC were found to be neutral in both studies but it seems that within the population examined here, considerations of control had a more important influence on behavioural influences. Differences are again attributed to differences in characteristics of the population samples. It is likely that the sample examined here was of a lower socio-economic grouping and were poorer than the students examined within chapter four. Previous research has indicated that people who are in lower socio-economic groups and who are relatively poor perceived themselves as less involved with risk management decisions and had less trust of decision-makers (Frewer, 2000) which may explain why control was a more important issue within this group. This is supported by the finding that emotional involvement within the sample examined here was significantly negative, indicating that individuals felt uninvolved with the issue of GM food.

When the TPB was extended to include the additional predictors of self-identity, moral norms, and emotional involvement, the amount of variance in intentions accounted for increased significantly to around 66%. Here, emotional involvement and self-identity accounted for significant proportions of variance in intentions along with attitudes and PBC. These additional factors have positive influences on intentions indicating that as levels of these factors increase, so would intentions to try GM food.

The significance of the self-identity factor in predicting behavioural intentions indicated that the way that participants view themselves was important in determining whether they would try GM foods or not. This finding was supported by the study conducted by Cook et al., (2002) which also examined the general behavioural intention to try GM food, as well as the study conducted by Sparks et al., (1995) which examined expectations with regards to eating GM food within the next 15 years. Emotional involvement was also significant in predicting variance in behavioural intentions, in contrast to results found within chapter four. This indicated that participants' engagement with the issue was an important influence on whether they intended to try GM food or not. Differences in findings between the study reported here and the study reported within chapter four may relate to differences found within empirical levels of emotional involvement; the population sample examined within chapter four had neutral levels of emotional involvement, whereas, the population sample examined here exhibited significantly low levels of emotional involvement. Emotional involvement may only influence behavioural intentions to try GM food when levels are particularly low, and possibly particularly high.

Moral norms did not predict intentions and this supported findings from chapter four. In fact, moral norms have only been found to be a significant predictor of intentions with regard to GM food in one study in which intentions to try the specific foodstuff of GE tomatoes was measured (Sparks and Shepherd, 2002). It is, therefore, concluded that moral norms are not generally important in predicting behavioural intentions to try GM food; however it is possible that this factor may be a useful predictor in certain populations in which morality plays a larger role, e.g. in certain religious groups.

The addition of the constructs of self-identity, emotional involvement and moral norms to the model resulted in the component of subjective norms becoming non-significant. This indicated that there may be some degree of overlap between factors; however the examination of VIF levels did indicate that collinearity was not a problem within the model.

Our results showed that attitudes, subjective norms, PBC, emotional involvement and self-identity predicted behavioural intentions to try GM food. It was also found that, in turn, intentions positively, and significantly, predicted around 20% of variance in behaviour, when behaviour was defined as the difference in amounts of money willing to accept in preference to GM chocolates compared to non-GM chocolates. This indicated that as intentions to try GM food increase, the likelihood that participants would choose GM food over money also increases. A second measure of behaviour was also examined. This was, whether participants were prepared to accept GM food over any amount of money, and this was considered a more appropriate measurement in this context as questions asked in relation to intentions all pertained to the behaviour of actually trying GM food. Here a logistic regression indicated that in this behavioural context, 74.7% of participants were classified correctly regarding whether they would accept GM food or not.

There was evidently a large proportion of variance in behaviour left unaccounted for however and there may be other predictors that can help to explain variance in behaviour and potential moderators of the intention-behaviour relationship that have not been examined. It is also possible that the factor of intention was not very well formed, indicated by its low internal consistency, and this may have attenuated the intention-behaviour relationship somewhat.

Again, it is noted that (as with the study reported within chapter four), the correspondence between questions used to assess TPB components was not precise. Whereas most questions utilised here to assess TPB components referred to an individual's feelings towards the behaviour of trying GM food, some questions (within the subjective norms and attitude components) actually referred to an individual's feelings towards GM food in general. This lack of correspondence means that the relationships between constructs measured may have been diminished to some extent. The implications of this are that the predictive value of attitudes and subjective norms may actually be higher than was found here.

5.7.4. Mediation effect

The role of intentions as a mediator between predictor variables and behaviour within the TPB was found to be non-significant in this study. It was difficult to compare this result with other studies of the TPB because the majority of studies have not specifically examined the role of intention as a mediating variable. It was suggested that journal editors have been generally less interested in the question of the mediating role of intentions within the TPB than the question of how much variance in behaviour could be accounted for (C. Armitage, personal communication, August 10, 2005). Therefore, papers submitted to journals for publishing were encouraged to ignore the question of whether intentions mediate the influence of predictor variables on behaviour in favour of answering other questions.

The lack of a significant mediation effect found with regards to the construct of intention questioned the role of this construct within the model and indicated that further investigations are necessary. The comparison of the construct of intentions and other proposed constructs of desire and self-prediction should be further examined within the TPB.

However, it was found that the construct of intention was associated with a low internal consistency here, suggesting a high measurement error. The presence of high measurement error in mediating variables tends to result in an underestimate in the effect of the mediator and an overestimate of the effect of predictor variables on outcome variables (Judd and Kenny, 1982). This may, at least partially, explain why intention was not found to be a significant mediating variable here.

5.8. Conclusions

In conclusion, most people would choose GM food over some amount of money. GM food was found to be valued significantly less than non-GM food; however the majority of individuals were indifferent between GM and non-GM options. Results from this experiment indicated that a higher proportion of individuals were prepared to accept GM food than previous studies have indicated. Differences can be attributed to the fact that, a) in the present study a private, rather than a public decision was made with regards to GM food (using an equivalent gain task to avoid loss aversion effects) and b) this study used a real choice situation rather than hypothetical questions. Hence, this method of measuring valuations may be considered to have yielded more realistic responses than previous measures. With regard to important behavioural influences, we found that attitudes, subjective norms, PBC, self-identity and emotional involvement were all significant determinants of behavioural intention and that behavioural intention was a significant predictor of behaviour.

5.8.1. Future research

The TPB model is clearly a useful tool with which to examine behaviour towards GM food and facilitates the analysis of the impact of behavioural interventions. A variety of problems remain with this model however. There are evidently some problems of collinearity within the model and the constructs of subjective norms, self-identity and emotional involvement in particular should undergo rigorous examination in order to better define these constructs and how these are developed. This study (along with the study described within chapter four) was the first investigation of the construct of emotional involvement and further research into this concept would be fruitful, particularly into how this may develop and how it relates to similar concepts.

The role of intentions as a mediator within the model should also be examined in more depth although the lack of mediation effects reported within this chapter may also be attributed to internal consistency problems with the intention construct. Future examinations of novel behaviours, such as behaviour towards GM food, should utilise a larger number of measures of intention in order to ensure the validity of the measure; a more rigorous statistical procedure such as structural equation modelling would also help to identify and remove measurement error.

It is evident that variance in behaviour accounted for within this study, though significant, was still quite low and although some may be attributed to error variance it is likely that further portions of variance may be explained by further factors that were not examined here. It may be that the inclusion of additional constructs such as the perceived benefits of GM food or the individual's trust of policy makers and industry may help to explain additional variance in intentions and behaviour (Siegrist, 2000; Poortinga and Pigeon, 2004).

In addition, behaviour is likely to consist of both deliberate and spontaneous processes. Only deliberate processes are examined by explicit questions such as those asked during this study, hence, it is possible that spontaneous processes account for some of the variance in behaviour unaccounted for in the present study. Indeed research has demonstrated that implicit attitudes (which measure spontaneous associations) were better predictors of actual behaviour than explicit attitudes (which measure deliberate associations) in some circumstances (Dovidio, Gaertner and Kawakami, 2002; Poehlman, Uhlmann, Greenwald and Banaji, 2005). It is recommended that future research into choices relating to GM food utilises tasks that examine implicit attitudes in conjunction with tasks that explicitly evaluate cognitions. The rest of this thesis documents preliminary research that investigated implicit attitudes towards GM food, how these compared to explicit attitudes, and how these fared in predicting actual behaviour.

Chapter Six - Literature Review: Implicit Attitudes

To date, the assessment of attitudes towards biotechnologies, including GM foods, has been conducted solely through explicit methods such as questionnaires, interviews, or focus groups. This leaves a huge gap in the literature with regards to implicit attitudes towards biotechnologies and GM food which have yet to be empirically evaluated. Implicit attitudes are a relatively novel concept within the field of social psychology. As yet, these are not well defined and are associated with a variety of theoretical and methodological issues. This chapter will, therefore, take some time to describe and explore the concept of implicit attitudes.

The implicit attitude construct itself will be considered, along with its associated characteristics. In addition, the relationship between explicit and implicit attitudes will be examined, both theoretically and empirically. Common reaction time tasks that are used to measure implicit attitudes will be described and the processes involved in each task will be considered using an in-depth structural analysis. It is hoped that this chapter will provide a comprehensive overview of implicit attitudes that will be a useful precursor to the second main section of this thesis which encompasses several experiments that use different tasks to examine implicit attitudes towards biotechnologies and in particular GM food.

6.1. Measuring implicit attitudes

Implicit attitudes are defined as 'introspectively unidentified (or inaccurately identified) traces of past experience that mediate favourable or unfavourable feeling, thought, or action toward social objects' (Greenwald and

Banaji, 1995, p8). In other words, these are valent associations, developed through previous experience, that are held (possibly without conscious knowledge) towards attitude objects. Implicit attitude measurements are not controlled in the way that explicit attitude measurements are, rather they measure automatic or spontaneous responses. Forms of implicit attitude measures range from examinations of non-verbal behaviour to the more frequently used reaction time tasks. In contrast, explicit attitude measurements generally take the form of direct questions about how one feels about a particular topic. Explicit attitude measurements are, therefore, susceptible to influences such as self-presentation effects and demand characteristics, whereas the spontaneous nature of implicit attitude measurements means that many of these external influences are reduced.

6.2. Characteristics of implicit attitudes

Implicit attitudes differ from explicit attitudes in a variety of ways. There is a range of evidence that suggests that implicit attitudes may develop in different ways to explicit attitudes and implicit attitudes have often been considered to relate more directly to emotions than explicit attitudes. In addition, people are usually considered to be quite unaware of what their implicit attitudes are and are thought to be unable to control these implicit attitudes. These characteristics shall be considered in turn.

6.2.1. The development of implicit attitudes

Implicit attitudes are thought to develop through two main routes, a non-associative route and an associative route (Hermans, Baeyens and Eelen, 2003). The non-associative route describes a process in which a person simply experiences repeated exposure to a stimulus which results in an increased liking for that stimulus. This is referred to as the mere exposure effect (Zajonc, 1968). The associative route describes a process in which attitude objects are paired with other valent objects (or feelings) over time which results in the acquisition of an association with that valence. This process is referred to as evaluative conditioning (see De Houwer et al., 2001 for a review).

Interestingly recent evidence indicates that implicit attitudes may be formed, at least to new attitude objects, through supposition alone (Gregg, Seibt and Banaji, 2006). Gregg et al., (2006) examined methods of developing and changing implicit attitudes in some detail. Implicit attitudes towards fictitious groups, e.g. Niffites, were induced in participants through an evaluative conditioning task wherein participants were repeatedly exposed to associations between the groups and either positive or negative attributes, e.g. excellent. When participants were informed that the two groups that they had previously learnt associations with were equivalent to two further fictitious groups, the associations to the first groups were found to transfer to the second groups (Gregg et al., 2006). Different ways in which the implicit attitudes that had been developed could be reduced were also explored. It was found that explicitly providing further information that claimed that the associations that they had been provided with were incorrect and, in fact, diametrically opposite to the truth did not reduce the implicit attitudes previously formed, although explicit attitudes were altered accordingly. Therefore, the act of simply providing information that discredits an implicit attitude was ineffective in changing implicit attitudes, and this was found to be true whether the discrediting information was provided prior to, or after the learning task. It was further demonstrated that it was possible to alter implicit attitudes using a full counter-learning procedure to reverse associations previously learnt. There, therefore, seems to be an asymmetry between the ease with which implicit attitudes are acquired or extinguished. Although supposition will not change existing implicit attitudes, it will readily transfer pre-existing implicit attitudes to novel stimuli.

6.2.2. Awareness of implicit attitudes

The description of attitudes as 'implicit' stems from cognitive psychology in which individuals are described as having implicit memory for an event because their performance shows evidence of the influence of this prior event though they have no explicit memory of the event. Characterised in this way, implicit attitudes would be considered as attitudes for which individuals' lack awareness. Supporting this it has been found that implicit attitudes can be developed through evaluative conditioning processes without the individual's awareness of this happening (Olson and Fazio, 2001). The feasibility of creating implicit attitudes without an individual's knowledge does not mean that the individual remains unaware of this attitude however, nor that all implicit attitudes will develop and exist outside awareness.

More recent results indicated that individuals may have some awareness of their implicit attitudes. Monteith, Voils and Asburn-Nardo, (2001) examined implicit racial attitudes using the IAT and found that the majority of individuals were aware of their performance to the extent that they realised that they performed better with some category pairs than with others. Participants varied, however, with regard to what they thought this indicated. Some participants attributed their performance to racial factors and generally felt guilty about it, others (usually those with smaller biases) tended to attribute the biases that they detected to non-racial factors and generally did not feel guilty. There remains some controversy over what the IAT really is measuring, however, (see chapter seven, section 7.1.2. for a review) so it is difficult to ascertain whether participants are correct in their attributions. It may be possible that procedural factors within the IAT do lead to small biases. Overall, it seems that some individuals may display an awareness of their implicit attitudes when these are measured. However, awareness is likely to vary between tasks and it is possible that this is increased through task completion.

6.2.3. Are we able to control our implicit attitudes?

The spontaneous nature of the way in which implicit attitudes are measured has led to the conclusion that implicit attitudes are unable to be influenced deliberately; indeed this is heralded as one of the advantages of examining implicit attitudes. Supporting this assertion, several researchers (e.g., Banse, Seise, and Zerbes, 2001; Asendorpf, Banse, and Mucke, 2002) have found that it is not possible to fake responses within the IAT.

However, participants who are more informed about the IAT and the processes that it involves may be able to influence their responses on the IAT. Kim (2003) found that participants who were taught about the IAT were able to slow responses on certain blocks within the task thus altering task results. Steffens (2004) also found that the IAT is susceptible to faking by participants who have had some prior experience with the task.

In a different way it has been found that engaging in counter-stereotypic imagery can affect responses on the IAT as well as on the Go No-Go Association

Task (GNAT). Blair, Ma and Lenton (2001) found that when participants engaged in counter-stereotypic imagery production, stereotypic responses on these tasks were significantly inhibited. This indicates that an individual with knowledge of this finding could, to some extent, fake results on these tasks by engaging in the production of imagery that is in accordance with the attitude that he/she wants to display.

6.2.4. Are implicit attitudes linked to emotion?

Implicit attitudes have, on occasion, been characterised as affective in nature (Epstein and Pacini, 1999; Marsh, Johnson, & Scott-Sheldon, 2001), however evidence of this is mixed. Intuitively, it seems quite appealing to be able to conceptualise implicit attitudes as being 'upstream' evaluations that are associated with emotional information and only influenced by cognitive information further 'downstream' in the thought process. Parallels can be drawn here with Zajonc's (1968) concept of emotion without cognition and is thought to be useful when attempting to explain phobias and other logic defying behaviour. This explanation of how implicit and explicit attitudes may be measuring slightly different things might also help to explain low correlations often found between implicit and explicit attitudes. It would be elegant to be able to align the distinction between affective and cognitive components of attitudes with the distinction between implicit and explicit attitudes. However, the situation is likely to be more complex than this.

One of the main studies cited as evidence for the association between implicit attitudes and emotions examined implicit racial attitudes and neural activation. This study found that implicit attitudes towards Black people covaried with amygdala activation in White people exposed to photos of Black people (Phelps et al., 2000). As the amygdala is associated with emotional learning, it was thought that implicit attitudes may be linked to emotional experiences in particular. However, the amygdala has also been linked with evaluative decision-making situations that may not elicit conscious emotions which indicates that the role of the amygdala may be more generally evaluative rather than being linked to specific emotional experiences (Bechara, Damasio, Tranel and Damasio, 1997). It is also noted that this finding may be due to this particular attitude having an emotional basis; it does not necessarily mean that all implicit attitudes have an emotional basis.

Further research has indicated that the affective component of an attitude was accessed faster than the cognitive component of the attitude (Verplanken, Hofstee and Janssen, 1998). This may help to explain the links between affect and implicit attitudes, which are typically assessed at very fast speeds. However, on closer investigation it was demonstrated that the affective component of attitudes was only accessed faster than cognitive components when the attitude object had an affective basis (Giner-Sorolla, 2004). Overall, the evidence seems inconclusive regarding the relationship between implicit attitudes and emotion; the examination of this issue is taken up in chapter eight, section 8.1.2.

6.3. Theoretical relationship between implicit and explicit attitudes

There are two main theoretical stances regarding the relationship between implicit and explicit attitudes. The dual attitude model (Wilson, Lindsey, and Schooler, 2000) postulates that implicit and explicit attitudes are distinct concepts. This model suggests that an individual can hold two differing evaluations of the same attitude object at the same time (and possibly more than two). The theory postulates that which attitude is endorsed at any one time will depend on the situation. If the individual has the cognitive resources with which to retrieve their explicit attitude and if this overrides their implicit attitudes then the explicit attitude will dominate, otherwise the implicit attitude will dominate.

The opposing theoretical stance to the dual attitude model is the single attitude model. This is the dominant view held and is the stance taken by dual process theorists. Dual process theories (e.g. Chaiken, 1980; Fazio, 1990; Devine, 1989) explain behaviour as a function of spontaneous and deliberate processes (see Smith and Decoster, 2000, for a review). This group of theories agree on the general characteristics of the two processes postulated. Spontaneous processes are learnt over many experiences and occur automatically and without awareness, forming associations that are grouped by similarity and contiguity. Deliberate processes, on the other hand, can be learned in as little as one experience. Deliberate processing occurs consciously and draws on symbolically represented rules that are grouped by language and logic.

Implicit attitudes are thought to measure spontaneous processes and explicit attitudes are thought to measure deliberate processes. In this way, implicit and explicit attitudes are thought to be two ways of measuring the same thing, rather than two entirely separate constructs. For this reason, Fazio and Olson (2003b) argue that these should be referred to as implicit and explicit measures of attitude rather than implicit and explicit attitudes[1].

One of the central differences between dual process theories regards the postulated relationship between spontaneous and deliberate processing (Smith and

[1] Within this thesis, the terms 'implicit attitude' and 'explicit attitude' will be used, however this is not meant to indicate an adherence to a particular theoretical viewpoint.

Decoster, 2000). Certain models, e.g., the heuristic-systematic model (Chaiken, 1980), suggest that the two types of processes occur in parallel with each other, so that both determine attitudes. Other models, e.g., the MODE model (Fazio, 1990), suggest that the two processes are mutually exclusive so it is only possible for one process to determine attitudes at any one time. Further models, e.g., Devine's stereotype use and suppression model (1989), suggest that processes operate sequentially so that one process will precede the other.

A more general theoretical approach is taken by the Reflective-Impulsive model (Strack and Deutsch, 2004) and integrates the dual processes viewpoint with motivational influences and behaviour. This model suggests that reflective (corresponding to deliberate) and impulsive (corresponding with spontaneous) processes operate in parallel and interact at various stages of processing. It is postulated that perceived information will always be processed in the impulsive system. Depending on the intensity of the information and the attention it is given, it may also be processed in the reflective system. The impulsive and reflective processes then combine in a final common pathway to determine behaviour; this is thought to consist of behavioural schemata (e.g. Norman and Shallice, 1986) of varying levels of abstractness. Behavioural schemata are described as being part of the impulsive system but as also being linked to the reflective system through the process of intending (e.g. Gollwitzer, 1993). Behaviour is produced when schemata are activated above a certain critical threshold. A motivational dimension (e.g. Cacioppo, Priester and Berntson, 1993) is also included in the model in that it is proposed that the valence of processing within the impulsive system will ready behaviour for either approach or avoidance. Thus, the Reflective-Impulsive model quite neatly integrates elements from existing theories in order to explain attitudinal and behavioural processes.

6.4. Empirical relationship between implicit and explicit attitudes

Correlations between implicit and explicit attitudes vary greatly depending on the particular domain of measurement. Generally, correlations are low and non-significant within areas of high controversy, e.g. prejudice (Kawakami and Dovidio, 2001; Rudman and Kilianski, 2000), and are higher and significant in less contentious areas, e.g. identification with science or the arts (Nosek, Banaji and Greenwald, 2002). These data seem to support the view that explicit attitudes are influenced by self-presentation effects to a greater extent than implicit attitudes. Self-presentation effects are likely to be low in less controversial areas which may account for higher correlations between implicit and explicit attitudes.

If implicit and explicit attitudes only diverged due to the influence of self-presentational effects than it is likely that these are simply differing measures of the same underlying construct rather than measures of different constructs. Indeed, Dambrun and Guimond (2004) find that, although direct correlations between implicit and explicit attitudes are non-significant, when participants' individual motivations to adjust their responses were included as a moderator in the analysis, correlations became significant. These findings might be taken as support for the single attitude model.

Evidence indicates, however, that self-presentational factors are not always able to completely account for the observed differences between implicit and explicit attitudes. In addition, a significant correlation between two measures does not necessarily mean that these measures are examining the same underlying construct. A more rigorous way of examining the relationship between implicit and explicit attitudes is to use a rigorous latent factor approach to examine whether a one factor or a two factor model best fits the data. This is the approach taken by Nosek and Smyth (in press) in an enormous study that made use of data collected through a well known internet web site known as 'Project Implicit' (http://implicit.harvard.edu). Results illustrated that, across 56 different domains, a two factor model separating implicit and explicit attitude constructs consistently fitted data better than a one factor model. This is not necessarily proof that the two constructs are actually measuring different underlying structures though; it is still feasible that these two significantly different constructs are simply alternative ways of measuring the same underlying structure. It does indicate, however, that implicit and explicit attitudes are meaningfully distinct constructs and that there is utility in examining these separately.

6.4.1. Moderators of the relationship between implicit and explicit attitudes

It is evident that implicit attitudes and explicit attitudes are not directly equivalent. Research has, therefore, begun examining potential moderators of this relationship. As previously discussed, self-presentation is the most commonly cited moderator of the implicit – explicit attitude relationship, e.g. Dambrun and Guimond (2004). It is suggested that participants in psychology experiments tend to respond in a socially desirable manner which may result in inaccuracies in responding on explicit measures. Participants may not even be aware of this type of deception; participants may intentionally deceive the experimenter and dishonestly answer questions, but it is possible that they may also unintentionally answer in a socially desirable way and be genuinely unaware of their true attitudes

(Paulhus, 1984; Greenwald, Banaji, Rudman, Farnham, Nosek and Mellott, 2002). Other factors that have been identified as moderating the implicit – explicit attitude relationship include attitude strength, attitude dimensionality and perceived self-group discrepancy, i.e. perceptions of how one's own attitude differs from social norms (Nosek, 2005).

A recent paper by Hofmann, Gschwendner, Nosek and Schmidt (2005) organises moderators of the implicit – explicit attitude relationship into five factors. These are properties of implicit assessment, properties of explicit assessment, translation between implicit and explicit representations, additional information integration for explicit representations and research design factors. Properties of implicit assessment and properties of explicit assessment are important because the degree of consistency between implicit and explicit attitudes will be a function of the extent to which the indicators of these constructs reflect the latent factors. Properties of explicit assessment will include such factors as self-presentational influences and context effects. Properties of implicit assessment include such factors as context effects and task associated measurement error (Hofmann et al., 2005). It is noted that to the extent that the same extraneous factors may influence explicit assessment and implicit assessment, these may actually serve to strengthen the observed relationship between implicit and explicit attitudes.

The relationship between implicit and explicit attitudes will also be dependent on the extent to which associative representations (measured by implicit attitudes) are translated into propositional representations (measured by explicit attitudes). It is theorised that associative representations form the basis for propositional representations and that propositional thinking can in turn shape associative representations held. The degree of consistency between implicit and explicit attitudes may, therefore, be influenced by the strength of the representations, the degree to which concepts had provoked cognitive elaborations, and the extent of prior experience with the attitude object, amongst other things (Hofmann et al., 2005).

Propositional representations are theorised to be based on further information alongside associative representations and, therefore, other sources of information about an attitude object are also likely to impact on the consistency observed between implicit and explicit attitudes (Hofmann et al., 2005). For this reason, other information relating to the attitude object, e.g. price, which has not already been incorporated into the implicit attitude towards that object will impact upon the explicit attitude held towards that object.

There are also a variety of design factors related to the measurement of implicit and explicit attitudes that may influence the relationship between these factors. For example, methodological issues of sampling or the order in which measurement tasks are presented to participants may influence results to some extent. Particular participant samples may be more or less likely to respond in socially desirable manners for instance (Hofmann, et al., 2005). With regards to task measurement order, it is possible that the completion of an explicit attitude measurement prior to an implicit attitude measurement may prime particular associations that are more likely to be assessed within the implicit attitude measurement. Equally however, the completion of an implicit attitude assessment prior to an explicit attitude assessment may increase consistency between concepts because the activation of associative representations during the implicit attitude assessment may influence propositional representations to a greater extent during explicit attitude assessments.

Overall, there are a variety of factors that are thought to influence the degree of consistency observed between implicit and explicit attitudes. These may be more or less influential depending on the methods and design of measurement, the particular attitude object in question, and the cognitive representation of that attitude object. It is noted that evidence relating to moderators of the implicit – explicit attitude relationship is mostly concentrated in specific domains, particularly those with high social sensitivity where divergence between implicit and explicit attitudes might be expected. Further research should examine implicit and explicit attitudes, along with potential moderating factors, in a wider variety of domains.

6.5. Predicting behaviour

Proponents of both the single attitude model and the dual attitude model agree on the fact that implicit attitudes and explicit attitudes will dominate in influencing behaviour in different situations. It is thought that explicit attitudes mainly predict deliberate behaviour and implicit attitudes mainly predict spontaneous behaviour (Strack and Deutsch, 2004; Fazio and Olson, 2003b). Fazio's (1990) MODE (Motivation and Opportunity as DEterminants of processing) model was developed as an integrative framework to explain when behaviour would be spontaneous and best predicted by implicit attitudes, and when behaviour would be deliberate and best predicted by explicit attitudes. As the name of the model indicates, the two factors highlighted as important influences on the type of processing undertaken are motivation and opportunity.

When an individual is motivated, and when the opportunity to reason carefully about a decision exists, deliberate processing of information will occur. If an individual does not have the time or resources to be able to consider decision alternatives in this manner then a spontaneous, implicitly driven, approach is likely to be taken.

This is supported by studies that have examined racial attitudes, which have found that spontaneous, non-verbal behaviour was predicted by implicit attitudes and deliberate, verbal behaviour was predicted by explicit attitudes (Dovidio, Kawakami and Gaertner, 2002; Dovidio, Kawakami, Johnson, Johnson and Howard, 1997; McConnell and Leibold, 2000). For example, Dovidio, Kawakami and Gaertner (2002) found that explicit racial attitudes, but not implicit racial attitudes, predicted ratings of verbal friendliness towards a Black confederate and the participants' perceived friendliness of interactions. In contrast implicit racial attitudes but not explicit racial attitudes, predicted ratings of non-verbal friendliness towards a Black confederate and the perceptions of the friendliness of the interactions by the Black confederates. See Chapter ten (section 10.3) for a continuation of the discussion of predictive validity of implicit and explicit attitudes.

6.6. Implicit attitude measures

There are a range of tasks available with which to measure implicit attitudes. These vary with regards to the exact procedure used, the structural make up of the task and also mental processes required. Different tasks may, therefore, be more or less useful for different purposes.

6.6.1. Common tasks used to measure implicit attitudes

6.6.1.1. The Implicit Association Task

The Implicit Association Task (IAT) was developed by Greenwald, McGhee and Schwartz (1998) and is probably the most common task used to investigate implicit attitudes. It examines the differential association of two contrasting target stimulus categories (e.g. flowers and insects) with chosen attribute dimensions (e.g. pleasant and unpleasant). In the critical section of the task, the participant is required to categorise individual exemplars of each category (e.g. spider, daffodil) to one of two combined target-attribute pairs (e.g. flowers + pleasant and insects + unpleasant) which are paired through a common response key. Responses are facilitated when the target is related to the attribute it is paired with and this finding enables the IAT to be used to investigate differential associations between stimuli and attributes.

6.6.1.2. The Affective Priming Task

Affective priming (Fazio, Sanbonmatsu, Powell and Kardes, 1986) requires participants to categorise target stimuli as positive or negative. Target stimuli are preceded by different prime stimuli which either inhibit or facilitate responses to the targets. The valences of prime stimuli are determined by examining their effect on responses to the valent target stimuli.

The affective priming task can be administered using either supraliminal or subliminal prime stimuli. Masked affective priming (Frings and Wentura, 2003), with subliminal presentation of prime stimuli is particularly useful in its unobtrusiveness, making it less likely that participants will guess the experimental procedure. In a masked affective priming task, primes are presented at very fast speeds (around 28ms) and then replaced by a mask stimulus so that participants remain consciously ignorant of what they have just viewed. In a supraliminal priming task, stimuli are presented at slower speeds and participants are aware and recognise the prime stimuli presented prior to target words.

6.6.1.3. The Affective Simon Task

The Affective Simon Task (AST: De Houwer and Eelen, 1998) is a reaction time task that requires participants to respond to target stimuli on the basis of a non-affective stimulus feature (e.g. grammatical category). Responses required are themselves valent, in that participants are asked to respond verbally, saying the word 'Good' or the word 'Bad' to stimuli. For example, if grammatical category was used as the target stimulus feature to be attended to, participants might be asked to respond 'Good' to nouns and 'Bad' to adjectives. It was found that, although participants were not required to attend to the valence of target stimuli, this interfered with responding so that when the valence of the response and the valence of the target stimuli matched, responding was facilitated. In other words, responding was easier when participants were required to respond positively to positive stimuli and were inhibited when participants were required to respond negatively to positive stimuli and vice versa for negative stimuli.

6.6.2. Reliability and validity of implicit attitude tasks

An important consideration when choosing which implicit attitude task to use is the reliability and validity of that task. Unfortunately, it seems that the choice of task may completely alter findings as correlations between different implicit attitude tasks have been found to be extremely low. Bosson et al., (2000) examined a series of implicit tasks measuring self-esteem with regards to their levels of validity and reliability. Included in this study were the supraliminal priming task, the subliminal priming task, the Stroop colour-naming task and the initials and birthday preference tasks[2]. It was found that the convergent validity of tasks examined was extremely low and non-significant. Several investigations have focused on the relationship between the IAT and priming measures. Rudman and Kilianski (2000) examined gender and role status and found that IAT results correlated with the priming measures on some, but not all, measures. Most other investigations of the correlation between the IAT and priming measures have yielded non-significant results (Marsh et al., 2001; Fazio and Olson, 2003b). However, one particularly rigorous study that utilised structural equation modelling to control for measurement error whilst investigating the relationship between the IAT and priming measures did find a significant relationship between measures (Cunningham, Preacher and Banaji, 2001). It seems that the low convergent validity between implicit attitude tasks is likely to be, at least partly, attributable to measurement error within implicit attitude tasks.

Some tasks that have been used to measure implicit attitudes are unreliable. For one, internal reliabilities are found to vary quite widely for implicit attitude tasks. Cronbach's alphas for conventional affective priming tasks range from around zero to around 0.50 (Banse, 1999), whereas Cronbach's alphas for IATs are generally reported at around 0.80 (Banse et al., 2001). Therefore, affective priming tasks may encounter reliability problems.

Test re-test reliabilities of implicit attitude tasks are also typically very low. In fact, Bosson et al., (2000) found that they were unacceptably low in all

[2] This task examines the extent to which respondents like their birthday number above and beyond the average popularity of these numbers.

implicit attitude tasks examined, apart from the IAT and the initials and birthday preference tasks which displayed test re-test reliabilities of 0.69, 0.63 and 0.53 respectively. Affective priming was found to display unacceptably low test re-test reliabilities by Bosson et al., (2000). However, reliabilities vary between different types of affective priming. The versions tested by Bosson et al., (2000) were a supraliminal and a subliminal affective priming task without a response window. These evidenced test re-test reliabilities of 0.08 and 0.28 respectively. More reliable versions of the affective priming task seem to be versions that include a response window of 200ms-600ms; these have been found to evidence test re-test reliabilities of around 0.6 (Cunningham et al., 2001).

It is possible that low test re-test reliabilities might be explained by slight changes in context or experience. However, low reliabilities are problematic no matter what the cause; if measures lack consistency, they will have little predictive use. Overall, measurement error is a serious problem for implicit attitude tasks and this should be monitored and reduced where possible. It is possible to improve reliability of tasks through procedural factors such as increasing the number of trials used, introducing a response window and refining scoring techniques. It is questioned whether measurement error can be entirely responsible for the lack of convergent validity between implicit attitude tasks though; it may be that the low correlations between implicit attitude tasks indicate that tasks are actually measuring slightly different processes.

6.6.3. Theory behind implicit attitude tasks: response conflict and spreading of activation accounts

The development of implicit attitude tasks stems from the finding that the presentation of an attitude object will automatically activate the evaluation that an individual associates with that attitude object. There are two main accounts of the potential mechanisms responsible for the operation of implicit attitude tasks, spreading of activation and response competition.

The spreading of activation account (Fazio et al., 1986) suggests that the presentation of an attitude object will temporarily increase the activation level of the associated evaluation. As a result, only a smaller amount of further activation by a target adjective will be required for the evaluation to be retrieved. The valence of an incongruent stimulus, on the other hand, will not have received any activation and, therefore, will take longer to be identified. Within the response competition account (Klauer, RoBnagel and Musch, 1997; Wentura, 1999) the evaluation automatically activated by the target stimulus will prepare the individual to respond in accordance with that valence, particularly when the choices of response are themselves valent in nature. When an incongruent stimulus is presented, the response activated will differ from the correct response and time will be required in order to resolve this response conflict.

The spreading of activation account and the response competition account are very similar and both involve the same initial step in which the evaluation associated with the attitude object is automatically activated. According to the spreading of activation account this activation then facilitates the encoding of related material and according to the response competition account this readies an initial response tendency.

It may be that both of these processes are important within tasks used to examine implicit attitudes and the process that dominates may vary from task to task. It is possible that depending on the processes operating within the task, results of the tasks may differ to some extent. It would be expected that tasks that operate due to spreading of activation processes are more likely to correlate with other tasks operating in the same way and similarly for those tasks operating due to response competition processes. This may also then account for a lack of convergent validity between implicit attitude tasks. This hypothesis remains to be tested experimentally.

6.6.4. De Houwer's taxonomy of implicit attitude tasks

One way of examining the underlying processes involved in a task is to examine its structural make-up. De Houwer (2003b) describes a taxonomy that can be used to classify implicit attitude tasks, see Table 6.1. This taxonomy distinguishes three types of compatibility that are possible within implicit attitude tasks: a/ relevant Stimulus-Response (S-R) compatibility, b/ irrelevant S-R compatibility and c/ Stimulus-Stimulus (S-S) compatibility. Relevant S-R compatibility refers to the situation in which the relevant feature of a particular task that the participant is required to respond to is manipulated so that it varies between being compatible or incompatible with the required response. Irrelevant S-R compatibility refers to a task in which an irrelevant task feature that the participant is not required to respond to, but that impinges on the task, is compatible or incompatible with the required response. Finally, S-S compatibility refers to the similarity between stimuli or between different features of the same stimulus. If the compatibility of these features is varied between trials, then this will influence responses; trials in which features are compatible will receive faster responses than trials on which features are incompatible. Tasks assessing implicit attitude may feature one or more of these types of compatibility either in a confounded, or an un-confounded, manner.

Table 6.1: A taxonomy of implicit attitude tasks (adapted from De Houwer 2003b)

	Is there a manipulation of:		
Task	**S-S compatibility**	**Irrelevant S-R compatibility**	**Relevant S-R compatibility**
Affective priming	Yes	Yes	No
IAT	No	Yes*	Yes
AST	No	Yes	No

*But only on target concept trials

The examination of how implicit attitude tasks vary with regards to these different types of compatibility will clarify the nature of this taxonomy. With regards to the IAT, both relevant S-R compatibility and irrelevant S-R compatibility are manipulated. Within the IAT, the category to which a particular target stimulus belongs is the relevant feature of the task; these target categories may be intrinsically positive, e.g., 'flowers', or intrinsically negative, e.g., 'insects'. Responses within the IAT become imbued with an extrinsic valence due to associations introduced using attribute categorisations, e.g., a left key to be pressed for 'positive' words and a right key to be pressed for 'negative' words. On some trials the intrinsic valence of the target stimuli (the relevant feature) will be compatible with the extrinsic valence of the response, e.g., 'flowers' and 'positive'. On others the intrinsic valence of the target stimulus will be incompatible with the extrinsic valence of the response, e.g., 'flowers' and 'negative'; this is a manipulation of relevant S-R compatibility. With regard to individual category exemplars, these are required to be categorised according to their semantic category; the valence of individual stimuli is actually an irrelevant feature of the task. However, the individual valence of category exemplars also may or may not be compatible with the extrinsic valence of response assignments and this is referred to as irrelevant S-R compatibility (De Houwer, 2003b).

Affective priming, on the other hand, features S-S compatibility and irrelevant S-R compatibility. Within affective priming, stimulus words are flashed up on the computer screen before attribute words and participants are required to respond to attribute words whilst ignoring stimulus words. However, viewing stimulus words interferes with responses that participants make to attribute words and these may be compatible in valence or incompatible in valence; this is referred to as S-S compatibility. Participants have to indicate whether attribute stimuli are good or bad by either stating this out loud (in which case responses are intrinsically valent) or by pressing a response key (in which case responses are extrinsically valent). On some trials, the prime stimulus words may be compatible with this response and on other trials, the prime stimulus words may be incompatible with this response. This is a manipulation of irrelevant S-R compatibility.

With regards to the AST, this task features irrelevant S-R compatibility but no relevant S-R compatibility or S-S compatibility. Within the AST, participants are required to categorise stimuli according to a non-affective feature, e.g. grammatical category; this is the relevant task feature. Participants are required to respond to these by saying 'Positive' or 'Negative' and, thereby, responses are intrinsically valent. It was found that the affective properties of stimuli (the irrelevant task feature) interfered with responding to the non-affective feature; the task therefore features irrelevant S-R compatibility (De Houwer, 2003a). Structurally, it can be noted that the AST is similar to an IAT with neutral categories, in which only irrelevant S-R would remain, and the valence of individual stimulus exemplars could be inferred.

This taxonomy of implicit attitude tasks enables the examination of the structure of the tasks beyond their superficial elements of, for example, the type of stimuli used within the task. This allows the comparison of these tasks in a more in-depth way. Similarities and differences between implicit attitude tasks on a structural level may help to account for similarities and differences in results obtained as well as in the reliabilities and effect sizes associated with these tasks.

6.7. Conclusions

In summary, a review of the previous literature that has examined implicit attitudes indicates that these are measurements of spontaneous evaluative associations with a particular attitude object. With regards to the characteristics of implicit attitudes, research indicates that these can be acquired through either evaluative conditioning, through mere exposure, or through supposition. Implicit attitudes may also be particularly associated with emotion although evidence in relation to this is tenuous so far. People do seem to be aware of their implicit attitudes to some extent, although implicit attitudes are largely uncontrollable unless appropriate training is undertaken.

Implicit attitudes may be a different way of measuring explicit attitudes, as theorised by single attitude models, or may be a completely different construct, as theorised by the dual attitude model. No matter which theoretical stance is adhered to, it is found that implicit and explicit attitudes often do not correlate. Several moderators of the implicit – explicit attitude relationship have been noted and these can be organised into meta-factors of properties of explicit assessment, e.g. social desirability, properties of implicit assessment, e.g. context influences, translation between implicit and explicit representations, e.g. attitude strength, additional information integration for explicit representations, e.g. price, and research design factors, e.g. participant sampling. It is noted that implicit and explicit attitudes are found to be differentially predictive of different behaviours; implicit attitudes are more predictive of spontaneous behaviours and explicit attitudes are more predictive of deliberate behaviours.

Implicit attitudes can be measured using a variety of different tasks and some of the most common include the IAT, affective priming, and the AST. Implicit attitude tasks differ with regards to their levels of validity and reliability as well as with regard to the exact processes that they utilise; they can be distinguished structurally according to the compatibility of stimuli and responses required by the task. Differences in processes utilised within different implicit attitude tasks may help to account for the lack of convergent validity frequently found between tasks. It is concluded that the examination of implicit attitudes towards an attitude object is useful but the choice of task used to measure implicit attitudes must be careful in order that reliability of results is ensured and interpretation of results is accurate.

6.7.1. Future Research

The definition and characteristics of implicit attitudes remain far from clear. Further research will help to clarify this construct and what it represents. In particular, research should focus on developing accurate and reliable measurement tools with which to examine implicit attitudes. It is clear that implicit attitudes are meaningful constructs and significantly different from explicit attitudes indicating it is important to examine both constructs separately in relation to attitude objects. It is, therefore, proposed that future research examining attitudes towards biotechnologies and GM food should measure both implicit and explicit attitudes.

Chapter Seven – Assessing Implicit Attitudes Towards GM Foods and Other Biotechnologies

7.1. Introduction

Implicit attitudes have been found to be meaningfully different from explicit attitudes and can provide important information with regards to predicting behaviour. There are a variety of tasks available with which to measure implicit attitudes, as reviewed within chapter six, but these vary wildly with regards to their reliability. The Implicit Association Test (IAT: Greenwald et al., 1998) has emerged as one of the most reliable tasks and therefore this task was utilised here in order to examine implicit attitudes towards biotechnologies. Implicit attitudes towards biotechnologies have not previously been measured and the examination of these is considered important in providing a clearer understanding of the processes involved in evaluating biotechnologies. Implicit attitudes are also likely to help to provide a more accurate prediction of likely behaviour towards biotechnologies. This chapter describes a study that utilised IATs in order to examine implicit attitudes towards biotechnologies. Findings are integrated with previous research that has examined attitudes towards biotechnologies and the implications and the validity of findings are discussed in depth.

7.2. The IAT

The IAT is one of the most valid and reliable tools available to measure implicit attitudes and has demonstrated a continuously high predictive performance (for a review see Nosek, Greenwald and Banaji, in press or Fazio and Olson, 2003b). There is much experimental evidence regarding IAT effects that show that these differ as expected between known groups. For example, Japanese Americans and Korean Americans were found to differ with regard to their implicit attitudes towards their respective ethnic groups, favouring their in-group (Greenwald et al., 1998). Similar differences have been found between East and West Germans (Kuehnen, Schiessl, Bauer, Paulig, Poehlmann and Schmidthals, 2001), smokers and non-smokers (Swanson, Rudman and Greenwald, 2001) and Jews and Christians (Rudman, Greenwald, Mellott and Schwartz, 1999) amongst others. Evidence has also demonstrated predicted individual differences within groups. For example, Greenwald et al., (1998) found that the strength of the implicit in-group preference held by Japanese Americans and Korean Americans was predicted by how immersed individuals were within their respective cultures.

In addition, IAT measures often correlate with self-report measures. For example, Banse et al., (2001) found that an IAT that examined attitudes towards homosexuality correlated highly significantly with explicit attitudes. One meta-analysis of 81 studies indicated that the average effect size of the correlation between IAT and self-report measures was $r = 0.24$ (Hofmann, Gawronski, Gschwendner, Le and Schmitt, 2004).

The IAT has also been found to be predictively valid. For example, research has shown that results from IATs that measure racial attitudes significantly predict non-verbal behaviour towards an African American (Dovidio et al., 2002; Dovidio et al.,1997; McConnel and Leibold, 2001). In fact, a recent meta-analysis found that the IAT significantly predicted a variety of behaviours, with an average effect size of $r = 0.27$ (Poehlman et. al., 2005). Overall, evidence indicates that the IAT is a valid measure of implicit attitudes and is useful in predicting behaviour.

7.3. Implicit attitudes towards GM food

There have been no previous attempts, to this author's knowledge, to measure implicit attitudes towards GM food. As yet, implicit evaluations of the more general category of biotechnologies have not been assessed either. Measures of implicit attitudes have been used to examine a range of non-GM foods however. The affective priming task was recently found to be useful in identifying both strong and moderate attitudes towards different food stimuli (Lamote, Hermans, Baeyens and Eelen, 2004). In addition, the IAT has been used to compare attitudes towards different foodstuffs. Maison, Greenwald and Bruin (2001) utilised the IAT to measure attitudes towards fruit juices and soda drinks and found that fruit juices were preferred to soda drinks which mirrored explicit attitudes. The study concluded that the IAT was useful in assessing food attitudes.

7.4. Current aims

This research employed several IATs in order to examine differences in implicit attitudes towards common groupings of biotechnologies that emerged from the card sort task described within chapter three. Attitudes towards biotechnologies have previously only been assessed explicitly and due to widely differing opinions evident and the controversial nature of the subject examined it is considered that responses are susceptible to external influences such as self-presentation biases and demand characteristics. Implicit attitudes may, therefore, differ from explicit attitudes and it is considered useful, both theoretically and empirically, to investigate these. Measuring implicit attitudes towards biotechnology groupings is useful theoretically in order that these can be compared to explicit attitudes and the reasons for differences or similarities considered. Empirically, the evaluations of implicit attitudes towards biotechnologies are useful as these have been found to be important predictors of behaviour (Poehlman et al., 2005).

The card sort task, described within chapter three of this thesis, found that the most common way in which people structured their perceptions of biotechnologies was in terms of the research object that undergoes the biotechnology process. Most people divided biotechnologies according to whether these were 'Human', 'Plant' or 'Animal' biotechnologies. It was thought that this would be a good starting point with which to examine implicit attitudes towards different types of GM food. GM food can belong to either the 'Plant' category or the 'Animal' category depending on what type of food is being modified. In addition, it was considered useful to examine implicit attitudes towards the superordinate category of 'Biotechnologies' in comparison to 'Other technologies' to see if there were any differences in valence between these categories as a whole.

Previous research indicates that the British population generally hold ambivalent explicit attitudes towards biotechnologies, being positive towards medical biotechnologies and negative towards food biotechnologies (Gaskell, Allum and Stares, 2003). In contrast, British people have been found to be quite positive about science and technologies in general (Gaskell, Allum and Stares, 2003) and, therefore it was thought that implicit attitudes would be more positive to the category of 'Other technology' than to the category of 'Biotechnology'.

It was further hypothesised that implicit attitudes held towards human biotechnologies would be perceived more positively than animal and plant biotechnologies. This is because data obtained from the card sort task, carried out within chapter three, indicates that human biotechnologies were generally associated with medical biotechnologies, which are perceived positively, and that animal and plant biotechnologies were generally associated with food biotechnologies, which elicit ambivalent attitudes (Gaskell, Allum and Stares, 2003; Bauer, 2002). Furthermore, research that has examined perceptions of biotechnology processes has found that people are more positive towards the genetic manipulation of plants rather than animals (Frewer, Howard, Hedderley and Shepherd, 1997). It was therefore hypothesised that plant biotechnologies would be perceived more positively than animal biotechnologies.

7.5. Method

7.5.1. Design

This experiment employed a repeated measures design. All participants completed four IATs. One of these compared implicit attitudes towards biotechnologies and other technologies. The other three IATs compared attitudes towards plant, animal and human biotechnologies. Presentation order of the IATs that examined plant, animal and human biotechnologies were counterbalanced between individuals.

7.5.2. Participants

Participants were recruited through posters displayed in the school of psychology within the University of Nottingham. In addition to this, participants were also recruited at a study day where a large number of students within the University of Nottingham were invited to visit the school of psychology in order to take part in a large number of different experiments. Recruitment was carried out in a topic blind fashion so as participants would not selectively take part in the study on the basis of an interest in biotechnology (Campbell and Townsend, 2003). All participants were students at the University of Nottingham. Forty individuals took part altogether (25 females and 15 males) and ages ranged from 18 to 32.

7.5.3. Materials

The IATs were conducted using E-Studio (version 1.1) software. Exemplars used within each category are listed within Appendix 6. Within the first IAT that compared the categories of 'biotechnologies' and 'other technologies', ten exemplars of each category were used. In addition, ten exemplars of the 'pleasant' and 'unpleasant' attribute categories were used; these were selected from norms reported by Bellezza, Greenwald and Banaji (1986). Within the IATs that examined plant, animal and human biotechnologies, five exemplars were used for each of the categories, 'human biotechnologies', 'animal biotechnologies' and 'plant biotechnologies' along with five of the previously used exemplars from the 'pleasant' and 'unpleasant' attribute categories selected at random. Exemplars were chosen as being concepts that were fairly well-known as well as with the purpose of representing a good cross-section of each category. These were provided to participants at the beginning of each IAT along with their associated category label to ensure that participants understood which category each exemplar belonged to.

7.5.4. Procedure

Participants were tested individually and each person completed four IAT measures in succession. Participants were offered a short break between each task although the majority did not use this time. The IAT procedure followed that of Greenwald et al., (1998) and consisted of five sections which were completed consecutively, see Table 7.1.

Stages one and two were practice sections that required the participant to practice categorising exemplars of the target categories and the attribute categories by pressing the appropriate key on the keyboard. Responses were made using the 'a' key with the left hand and the '5' key (on the numeric keypad) with the right hand. Stages three and five were critical combined sections in which exemplars of both target categories and attribute categories appeared. In the critical sections, exemplars were categorised in the same way as before but each response key corresponded to both a target category and an attribute category. IAT measures were obtained by comparing the two critical combined sections. Stage four was a further practice stage that was presented between the two critical combined sections in order to counteract any practice effects acquired during the previous combined stage. Each IAT had two versions which reversed which category-attribute pairing was presented to the participant first. For example, within the biotechnology - other technology IAT the pairings 'biotechnology' + 'pleasant' and 'other technologies' + 'unpleasant' were presented first in one IAT version and in the other version, the pairings 'biotechnology' + 'unpleasant' and 'other technologies' + 'pleasant' were presented first.

Table 7.1. – IAT procedure (adapted from Greenwald et al., 1998)

Stage	Procedure	Stimuli
Stage 1	Initial concept categorisation task	*Biotechnologies vs Other Technologies*
Stage 2	Associated attribution categorisation task	*Pleasant vs Unpleasant*
Stage 3	Initial combined concept and attribution categorisation task	*Biotechnologies and Pleasant vs Other Technologies and Unpleasant*
Stage 4	Reversed concept categorisation task	*Other Technologies vs Biotechnologies*
Stage 5	Reversed combined concept and attribution categorisation task	*Other Technologies and Pleasant vs Biotechnologies and Unpleasant*

Within IATs used within this study, practice sections (stages 1, 2 and 4) each consisted of 40 trials and critical combined sections (stages 3 and 5) consisted of 120 trials. A relatively high number of trials were utilised so as to ensure reliability. Exemplars were presented on the computer screen until the participant made a response and feedback on each categorisation made was provided in the form of a red cross for incorrect answers and a green star for correct answers.

The IAT which compared implicit attitudes towards the categories of 'biotechnologies' and 'other technologies' was completed first by all participants. The two different versions of the IAT were counterbalanced across individuals so that each version was presented to an equal number of participants. Following this, three other IATs were presented to participants and the order of their presentation was counterbalanced between participants to prevent any order effects. These IATs compared 'plant biotechnologies' with 'animal biotechnologies', 'plant biotechnologies' with 'human biotechnologies', and 'animal biotechnologies' with 'human biotechnologies'. Again two versions of each IAT were used which reversed which category-attribute pairing was presented first and these were counterbalanced across participants.

7.6. Results

Reaction times were examined and outliers above 3000ms or those below 300ms were re-coded to these levels in accordance with recommendations made by Greenwald et al., (1998)[1]. In addition, data was log-transformed, and the first two trials of each block were removed. See Table 7.2. for full details of reaction times in each IAT. All IATs displayed good internal consistencies. The IAT that compared biotechnologies and other technologies had an average split-half correlation of $r = 0.68$, $p < 0.001$ (after adjustment using the Spearman-Brown correction; Nunnally, 1978). The IATs that compared plant and animal biotechnologies, plant and human biotechnologies and animal and human biotechnologies displayed average split-half correlations of $r = 0.86$ ($p < 0.001$), $r = 0.91$ ($p < 0.001$) and $r = 0.87$ ($p < 0.001$) respectively (after Spearman-Brown correction).

[1] Data was collected before the revised IAT scoring algorithm was published and unfortunately data recorded was not of sufficient detail to enable this algorithm to be used for analysis.

Table 7.2. – Mean reaction times obtained within each IAT

IAT	Category – Attribute pairing	Mean reaction time (ms)	Standard deviation (ms)
'biotechnology' vs 'other technology'	'biotechnology' + 'pleasant'	1072.43	308.94
	'biotechnology' + 'unpleasant'	1078.18	331.81
	'other technology' + 'pleasant'	1021.54	241.22
	'other technology' + 'unpleasant'	1063.80	268.01
'plant biotechnology' vs 'animal biotechnology'	'plant biotechnology' + 'pleasant'	900.66	279.29
	'plant biotechnology' + 'unpleasant'	959.83	289.33
	'animal biotechnology' + 'pleasant'	894.97	309.90
	'animal biotechnology' + 'unpleasant'	850.69	211.50
'plant biotechnology' vs 'human biotechnology'	'plant biotechnology' + 'pleasant'	916.70	346.69
	'plant biotechnology' + 'unpleasant'	895.61	307.36
	'human biotechnology' + 'pleasant'	908.46	321.77
	'human biotechnology' + 'unpleasant'	958.21	365.90
'animal biotechnology' vs 'human biotechnology'	'human biotechnology' + 'pleasant'	840.67	233.75
	'human biotechnology' + 'unpleasant'	997.51	332.07
	'animal biotechnology' + 'pleasant'	897.37	277.03
	'animal biotechnology' + 'unpleasant'	779.26	225.50

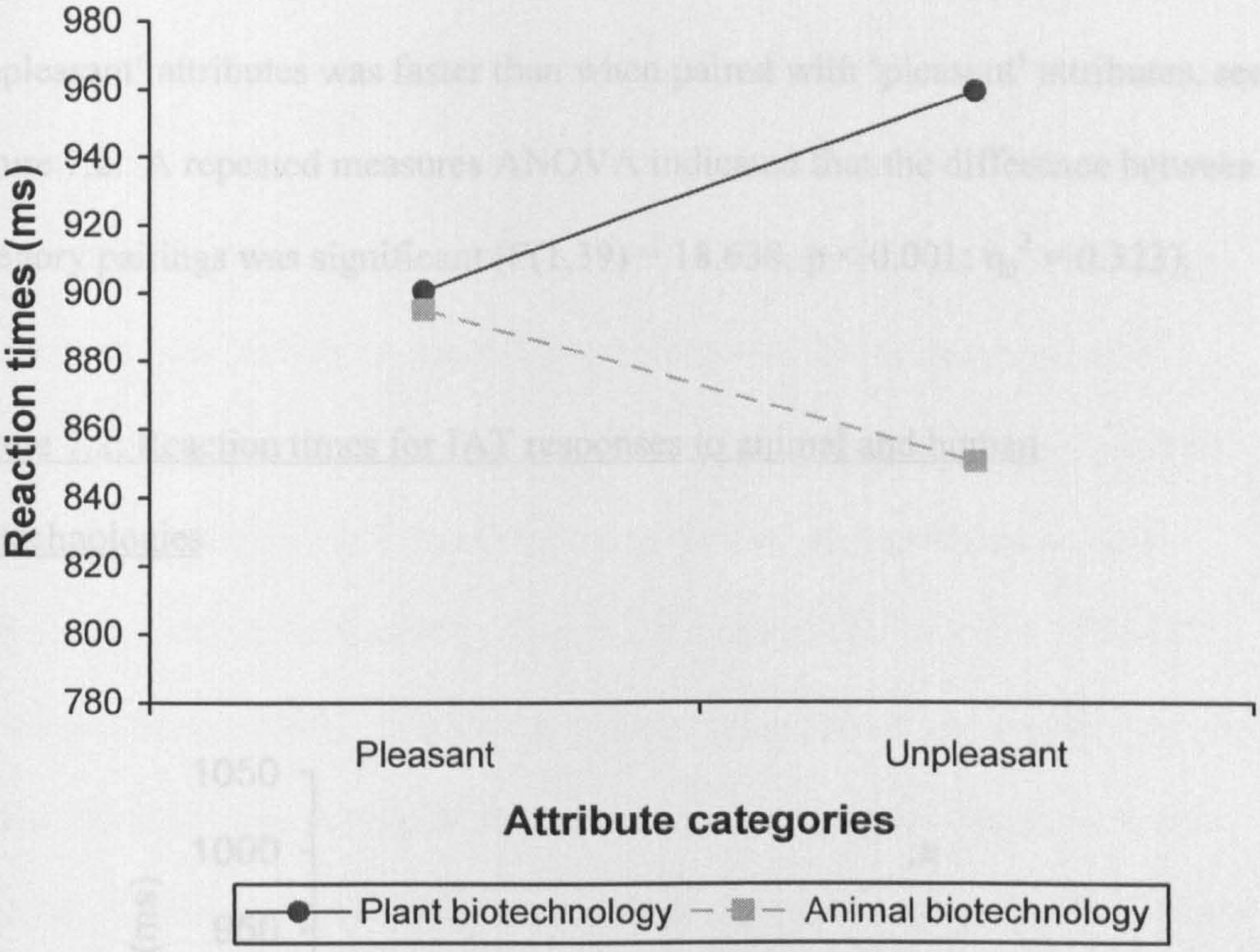
7.6.1. Biotechnologies vs. Other Technologies

The category of 'biotechnologies' was responded to slightly faster when paired with 'pleasant' attributes than when paired with 'unpleasant' attributes. Mean reaction times for categorising 'other technologies' were also faster when paired with 'pleasant' attributes than when paired with 'unpleasant' attributes. A repeated measures ANOVA indicated that the difference between category pairings was non-significant ($F(1,39) = 0.263$, $p = 0.611$; $\eta_p^2 = 0.007$).

7.6.2. Plant Biotechnologies vs. Animal Biotechnologies

When participants were required to respond to 'plant biotechnology' and 'animal biotechnology' categories, the categorization of 'plant biotechnology' constructs was faster when paired with 'pleasant' attributes than when paired with 'unpleasant' attributes. When categorizing 'animal biotechnology' concepts, reaction times were slightly faster when these were paired with 'unpleasant' attributes compared to when these were paired with 'pleasant' attributes, see Figure 7.1. A repeated measures ANOVA tested the significance of the difference between attribute pairings and found that the difference was marginally significant ($F(1,39) = 3.513$, $p = 0.056$; $\eta_p^2 = 0.083$).

Figure 7.1.: Reaction times for IAT responses to plant and animal biotechnologies



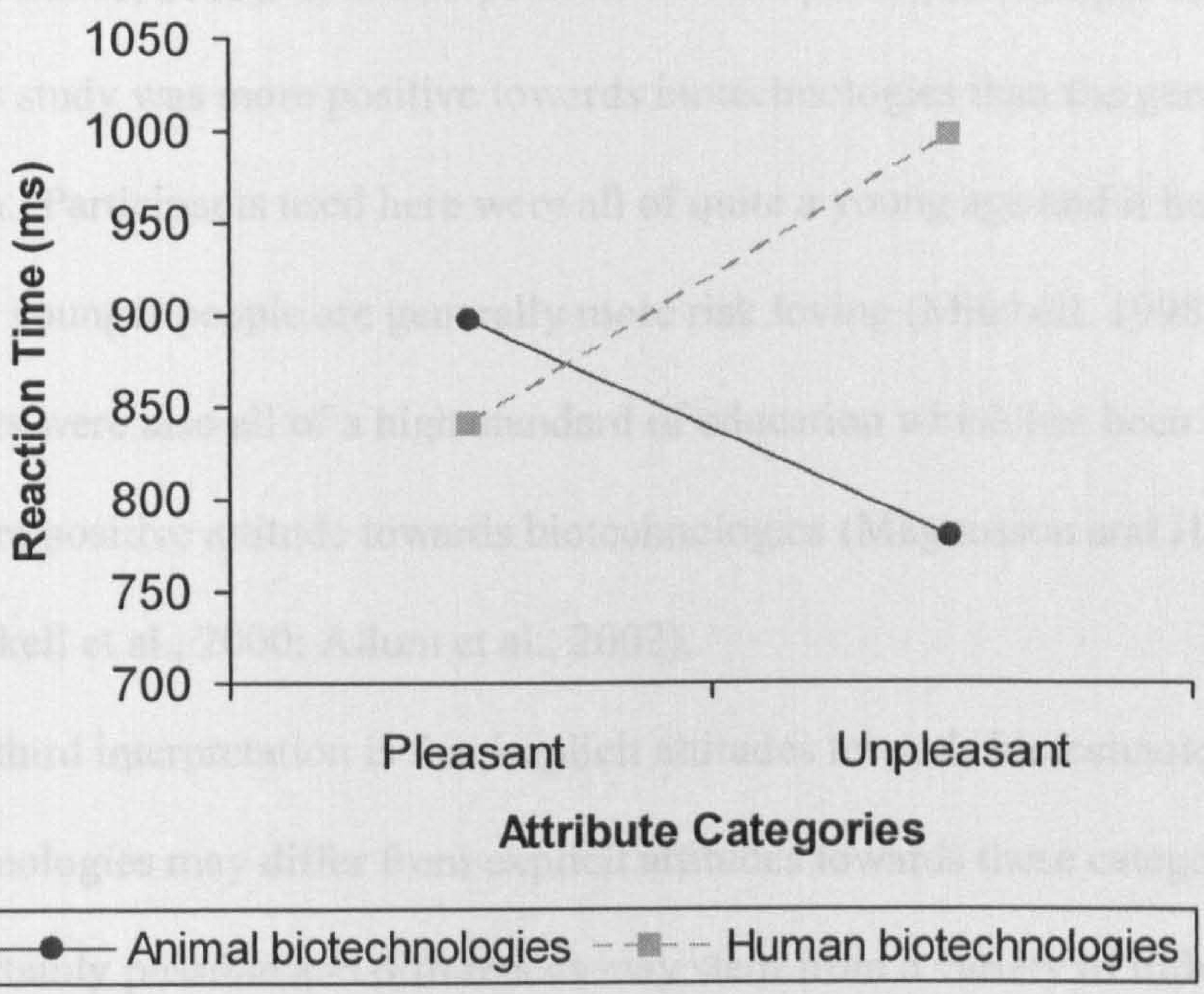
7.6.3. Plant Biotechnologies vs Human Biotechnologies

Participants responding to 'plant biotechnologies' and 'human biotechnologies' displayed faster reaction times when the category of 'plant biotechnologies' was associated with 'unpleasant' attributes than when associated with 'pleasant' attributes. When categorizing 'human biotechnologies', participants displayed faster reaction times when these were associated with 'pleasant', than when associated with 'unpleasant', attributes. A repeated measures ANOVA demonstrated that the difference between category pairings was non-significant ($F(1,39) = 1.049$, $p = 0.312$; $\eta_p^2 = 0.026$).

7.6.4. Animal Biotechnologies vs. Human Biotechnologies

When responding to animal and human biotechnologies, the mean reaction time to the category of 'human biotechnologies' when paired with 'pleasant' attributes was faster than when paired with 'unpleasant' attributes. For the category of 'animal biotechnologies', mean reaction time when paired with 'unpleasant' attributes was faster than when paired with 'pleasant' attributes, see Figure 7.2. A repeated measures ANOVA indicated that the difference between category pairings was significant ($F(1,39) = 18.638$, $p < 0.001$; $\eta_p^2 = 0.323$).

Figure 7.2: Reaction times for IAT responses to animal and human biotechnologies



7.7. Discussion

7.7.1 Biotechnologies vs. Other Technologies

Contrary to hypotheses, data showed that implicit attitudes towards the category of 'biotechnologies' were not significantly different from implicit attitudes towards the category of 'other technologies'. This contrasts with findings from explicit data that indicate that new technologies are perceived positively, whereas people are generally ambivalent about biotechnologies (Gaskell, Allum and Stares, 2003). These findings can be interpreted in (at least) three possible ways. One interpretation is that attitudes towards technologies are less positive than previous research has indicated; however there is no known evidence to indicate this. A second interpretation is that attitudes towards biotechnologies are not as negative as previous research has indicated. Indeed surveys have indicated that the optimism of the British population towards biotechnologies has been steadily increasing over the past few years (Gaskell, Allum and Stares, 2003). It is also possible that the participant sample examined within this study was more positive towards biotechnologies than the general population. Participants used here were all of quite a young age and it has been found that younger people are generally more risk loving (Mitchell, 1998) and participants were also all of a high standard of education which has been linked with a more positive attitude towards biotechnologies (Magnusson and Hursti, 2002; Gaskell et al., 2000; Allum et al., 2002).

A third interpretation is that implicit attitudes towards biotechnologies and other technologies may differ from explicit attitudes towards these categories. This is certainly possible and differences may stem from a variety of influences, including self-presentation biases.

7.7.2. Implicit attitudes towards plant, animal and human biotechnologies

Results showed that there were some differences in implicit attitudes towards human, plant and animal biotechnologies. Implicit attitudes held towards the category of 'animal biotechnologies' were significantly more negative than those held towards the category of 'plant biotechnologies' and the category of 'human biotechnologies'. Implicit attitudes held towards the categories of 'plant biotechnologies' and 'human biotechnologies' were not significantly different from one another.

The fact that measurements of implicit attitudes held towards human biotechnologies were more positive than measurements of implicit attitudes towards animal biotechnologies supports hypotheses and fits in with previous research that distinguishes between desirable medical biotechnologies and undesirable food biotechnologies (Bauer, 2002). The category of 'human biotechnologies' is likely to be associated with medicine and the category of 'animal biotechnologies' is likely to be associated with food (see chapter three, section 3.7.1.). Implicit attitudes towards 'animal biotechnologies' were also more negative than implicit attitudes towards 'plant biotechnologies' and this is likely to reflect process considerations; people have been found to be more negative towards the process of genetically manipulating animals than towards the process of genetically manipulating plants (Frewer, Howard, Hedderley and Shepherd, 1997).

No significant differences in implicit attitudes were found between 'plant biotechnologies' and 'human biotechnologies' however, indicating that implicit attitudes towards plant and human biotechnologies were similar in valence. These results contrast with predictions which suggested that 'plant biotechnologies', which are associated with food, would be perceived more negatively than 'human biotechnologies', which are associated with medicine. These surprising results may be due to either human biotechnologies being more strongly associated with a negative valence than expected or plant biotechnologies being more strongly associated with a positive valence than expected.

It is possible that differences between hypotheses and results may be attributable to an increase in optimism regarding 'plant biotechnologies'. Recent surveys show that whilst optimism regarding medical biotechnologies has maintained a high level, previous levels of declining optimism regarding GM crops noted between 1991-1999 actually stablised between the period 1999-2002 (Gaskell, Allum and Stares, 2002) and it is possible that levels of optimism regarding GM crops may have increased more recently. However, even if levels of optimism regarding GM crops have increased, it is perhaps unlikely that these have increased to the extent that attitudes towards plant biotechnologies have become as positive as those noted towards medical biotechnologies.

Alternatively, results may be due to the specific sample of participants used within this study. As previously noted, participants used here were all quite young and of a high education level, characteristics which have been associated with a higher level of risk taking (Mitchell, 1998) and with more positive attitudes towards biotechnologies respectively (Magnusson and Hursti, 2002; Gaskell et al, 2000; Allum et al., 2002). It is possible that participants may also exhibit a different pattern of preferences so that food biotechnologies are deemed as positive as medical biotechnologies. It is logical that younger individuals may be less interested in health research than older individuals because they are less likely to have health problems (Idler and Kasl, 1991). A further suggestion is that implicit attitudes towards 'plant biotechnologies' and 'human biotechnologies' may differ from explicit attitudes. This is certainly feasible as there are a variety of potential moderators of the implicit – explicit attitude relationship.

7.7.3. Influence of context

The examination of findings shows clear differences in implicit attitudes depending on which categories are contrasted with one another indicating context effects are occurring. This is one practical difficulty associated with the IAT. For example, the finding that implicit attitudes were positive towards the category of 'human biotechnologies' only occurred when these were paired with 'animal biotechnologies' but not when paired with 'plant biotechnologies'. Because the IAT utilises two contrasting target categories, results for each category are dependent on the category this is contrasted with. Of course, this need not always be considered a problem and in some cases may be considered a more ecologically valid method of measurement.

7.7.4. Problems associated with the IAT

There have been a variety of conceptual challenges to the IAT which have questioned what exactly the task measures. It is possible that the IAT effect may include extraneous influences such as salience asymmetries, familiarity effects and environmental associations. It is further proposed that the IAT may be a measure of general similarity rather than a measure of semantic associations between stimuli and evaluations.

7.7.4.1. Salience asymmetries

Participants may simplify the task they are asked to do within the IAT by recoding the task. This could result in participants focusing on only one category within the task, leading to the so-called figure-ground problem A strategy of this type would reduce the classification task to a single search task in which participants respond to one category and do not respond to the other (Rothermund and Wentura, 2001; Rothermund and Wentura, 2004). This is more likely when categories differ significantly in their salience so, for example, if the two categories of 'alcohol' and 'soda' were used, participants may solely attend to the category of 'alcohol' and respond accordingly when this category appears and respond discordantly when it does not appear. This would mean that the premises on which the IAT is based would be disrupted as participants would not be keeping the categories and their attribute associations in mind when responding and, therefore, responses would not reflect these associations.

Greenwald, Nosek, Banaji, and Klauer (2005) acknowledge that it is theoretically possible that salience asymmetries can account for IAT effects; however they argue that it is implausible that salience asymmetries are more important than the influence of nominal features. The debate continues with regards to what extent salience asymmetries may account for effects and whether these may present a threat to experimental evidence acquired using the IAT.

7.7.4.2. Environmental associations

A fundamental conceptual problem associated with the IAT is that it may measure environmental associations along with personal evaluations (Karpinski and Hilton, 2001). Depending on one's conceptual leanings this may be considered more or less of a problem however. It has been argued that it may be difficult to separate the two and that personal evaluations may necessarily incorporate environmental associations (Banaji, 2001).

It may be possible to address this issue by adjusting the methodology of the IAT. For example, a variant of the IAT developed by Olson and Fazio (2004) apparently reduces extra-personal associations by utilising more personally relevant attribute labels, 'I like' and 'I dislike', in place of the commonly utilised 'Pleasant' and 'Unpleasant' attribute labels and by removing error feedback. An alternative suggestion is that the measurement of environmental associations by the IAT may be reduced by activating the participant's concept of self prior to the completion of the IAT in order to activate their self-knowledge structure (Perugini and O'Gorman, 2005). Indeed, both of these methodological alterations were found to increase the predictive validity of the IAT (Olson and Fazio, 2004; Perugini and O'Gorman, 2005).

7.7.4.3. Familiarity effects

Another consideration when interpreting IAT effects is the possible impact of differential familiarity of concept exemplars. Various studies were carried out by Greenwald and colleagues (Dasgupta, McGhee, Greenwald and Banaji, 2000; Greenwald et al., 1998) that indicated that IAT effects remain when familiarity was controlled for. However, these results do not rule out the possibility that a familiarity effect occurs with this task; it proves that the IAT effect occurs over and above a familiarity effect but one cannot conclude that familiarity does not exert an effect at all.

Brendl, Markman and Messner (2001) have also investigated familiarity within the IAT. Brendl et al., (2001) examined implicit attitudes towards unfamiliar categories (created using artificial words) and found that these were evaluated negatively. This occurred even when the unfamiliar categories were actually described as neutral or when paired with an opposing category of 'insects' (known to be perceived negatively). This may be due to the well-known finding that familiar stimuli are perceived more positively than unfamiliar stimuli (Zajonc, 1968). However, it may also be possible that participants used the salience of the category to recode the task.

IATs have been shown to primarily measure category associations rather than associations at the level of the exemplar. In other words, the relevant stimulus feature carries more weight than the irrelevant stimulus feature (De Houwer, 2001). However, individual exemplar associations do exert an effect; it was found that individual exemplar associations did exert a significant effect when category level associations were neutral (De Houwer, 2003b). Extrapolating from this it seems that differential familiarity of exemplars (the irrelevant feature) may well exert an influence on response times when included in a concept category that is neutral in valence (relevant feature). Overall it seems that familiarity is a possible confound that should be considered both at the category level and at the level of the exemplar, particularly when categories used are neutral in valence.

7.7.4.4. The IAT as a general measure of similarity

De Houwer, Geldof and De Bruycker (2005) have advanced the proposal that the IAT is actually a general measure of similarity. They propose that this can account for evidence that has been presented for both the nominal feature[2] account and the salience asymmetry account of IAT processes as well as more recent evidence that indicates that an IAT effect can stem from perceptual similarity between stimuli (Mierke and Klauer, 2003). De Houwer et al., (2005) found that participants were faster at responding to stimuli pairings of coins and

[2] Nominal features are the description of the attribute that distinguishes one target category from the other, e.g. the nominal feature of a 'Male-Female' IAT would be gender. The nominal feature account is the dominant view of how IATs operate.

pizzas and of snakes and rivers but only when these stimuli were perceptually similar, i.e. only when pictures of coins and pizzas were both round and when pictures of snakes and rivers were both winding. When the functional value of objects were made salient (specifically whether items were edible or not), performance was better when snakes and pizzas were paired and coins and rivers were paired. It is asserted that crucially this result can not be explained by the salience asymmetry account or the nominal feature account of IAT effects but only by the view that IAT performance can be influenced by perceptual similarity. The data from these experiments are taken as an indication that the IAT does indeed measure similarity between stimuli, whether this is perceptual similarity, semantic similarity or a similarity in salience.

Similarity may, of course, occur for any of these reasons and stimuli may be similar for several different concurrent reasons; this remains a point for investigation (De Houwer et al., 2005). It is of interest whether stimuli that are similar in a number of ways will produce a comparatively higher IAT effect than stimuli that are similar in a smaller number of ways. It is possible that one type of similarity may outweigh another kind, so semantic similarity might dominate over perceptual similarity or vice versa. This is an important area for future research.

7.7.4.5. What did the IATs measure?

The IATs, used within the study presented within this chapter, were used in order to measure evaluative associations that participants held towards the categories of 'biotechnology' and 'other technology' as well as sub-categories of biotechnology. It is likely that effects found do reflect these evaluative associations; however it is possible that other factors also influenced effects. It could be argued that associations between target and attribute concepts, noted within the IAT, could arise from any type of similarity, including similarity in salience or perceptual features, as well as similarity in valence. It does seem that similarity in valence is the most likely type of similarity that this task might be measuring because there were little perceptual differences, and there were no obvious salience asymmetries, between category labels. The only target categories that may have differed in salience were the categories of 'biotechnologies' and 'other technologies', however this IAT found neutral effects indicating that any differential salience did not have a significant influence on results. Differential familiarity of target categories may similarly have influenced results but again categories were likely to be similar in familiarity with the exception of the IAT comparing 'biotechnologies' and 'other technologies' which found only neutral effects indicating that familiarity did not impact on results. It is possible that IAT effects measured environmental associations with target categories as well as personal evaluations but depending on one's conceptual leanings this may or may not be an issue.

It is also possible that IAT effects may have arisen in part due to evaluative associations held towards individual exemplars of categories, i.e. the irrelevant feature of the task rather than the relevant feature (De Houwer, 2001). The effect of individual exemplars has only previously been found to be significant when category level associations were neutral though and it is thought that IATs will primarily measure category associations. Individual exemplars of each category were chosen as being representative of each category examined.

7.8. Conclusions

Data indicates that implicit attitudes did not differ significantly between biotechnologies and other technologies. Implicit attitudes towards plant, animal and human biotechnologies were mostly in line with expectations. Animal biotechnologies were perceived more negatively than plant and human biotechnologies. However, implicit attitudes towards plant and human biotechnologies did not differ significantly.

Overall, findings are in line with hypotheses with the exception that implicit attitudes did not differ between biotechnologies and other technologies and between plant and human biotechnologies as expected. Results obtained may be caused by divergences in explicit and implicit attitudes held towards these categories. Alternatively, attitudes held towards these concepts may differ from the populations examined in previous research; it is feasible that attitudes held towards these technologies have changed in recent times or that attitudes observed here are specific to the population sample examined which was not representative of the British population. It is also possible that effects noted may be due to extraneous influences, e.g. salience asymmetries; however it is concluded that any of these effects are likely to be minimal, and results are likely to be attributable to evaluative associations with target concept categories.

7.8.1. Future research

Implicit attitudes towards biotechnologies should be the subject of further investigations. It would be useful to examine implicit attitudes towards biotechnology product groups, i.e. medical biotechnologies and food biotechnologies, separately from the examination of implicit attitudes towards biotechnology processes, i.e. those used within plant, animal and human biotechnologies. Attitudes towards biotechnology products and processes were confounded in this study making it difficult to draw out meaning.

Further research would also benefit from utilising explicit attitude measures alongside implicit attitude measures in order to make comparisons between the two. This would enable the research to pinpoint whether differences between data obtained from implicit attitude measures and previous explicit attitude research were due to the different type of attitude measurement or to differences in attitudes in the population examined. It would also be interesting to utilise a measure of self-presentational biases and other potential moderators alongside implicit and explicit attitude measures. This would help to define the relationship between implicit and explicit attitudes within this domain.

It would also be useful to examine implicit attitudes towards more specific biotechnology products in order to make inferences regarding behaviour towards that product. In order to accurately examine implicit attitudes towards a particular product it would be beneficial to utilise a task that does not incorporate a context as results produced using the IAT necessarily depend on the context utilised. This idea is taken up in the following chapter in which two, fairly new, context free implicit attitude tasks were examined further with regards to their suitability for assessing implicit attitudes towards GM food as a specific biotechnology product.

Chapter Eight – Assessing Implicit Attitudes in a Context-Free Manner

8.1. Introduction

The Implicit Attitude Task (IAT) is probably the most common task used to measure implicit attitudes. However, as noted within chapter seven, IATs can only measure implicit attitudes towards an attitude object by contrasting it with some other thing. It is useful and may be ecologically valid to measure attitudes in this manner but it would also be useful to measure implicit attitudes in a context-free manner in order to gauge the valence of implicit attitudes towards that object alone. Recently developed tasks, the Extrinsic Affective Simon Task (EAST) and the Go No-Go Association Task (GNAT) may be useful tools with which to examine implicit attitudes in a context free manner. Unfortunately, due to the novelty of these tasks, associated research examining these tasks is still sparse.

This chapter will describe the EAST and the GNAT in more depth, along with their procedures and research carried out so far on these tasks. In particular, the associated reliability and the power of these tasks are of interest and a study that was carried out to assess these aspects of the tasks, when they are applied to GM foods, will be described. As it will become clear, the GNAT emerged as the favoured task and for this reason research utilising the GNAT to examine attitudes towards GM foods was extended. A further experiment, reported within this chapter, utilised the GNAT in order to measure implicit attitudes towards GM foods in a context-free manner, as well as in contexts of other foods and of organic foods. Both experiments described within this chapter included measurements of explicit attitudes alongside implicit attitude measures so that implicit and explicit attitudes could be compared in this domain.

8.1.1. Implicit tasks that measure implicit attitudes in a context-free manner

There are several implicit attitude tasks available with which to measure implicit attitudes in a context-free manner. The most well-known of these is probably the affective priming task (Fazio et al., 1986) or the affective Simon task (AST: De Houwer and Eelen, 1998). However, as described within chapter six (section 6.6.) these tasks are associated with problems of low reliability (in the case of the affective priming task) and with low effect sizes (in the case of the AST), making these less useful. There are two relatively new implicit attitude tasks however, that can examine implicit attitudes in a context-free manner and may be more reliable and produce higher effect sizes than previous tasks. These are the go no-go association task (GNAT: Nosek and Banaji, 2001) and the extrinsic affective Simon task (EAST: De Houwer, 2003a).

8.1.2. The Go No-Go Association Task (GNAT)

The GNAT (Nosek and Banaji, 2001) is a proposed modification of the IAT (Greenwald et al., 1998) and may solve some of the methodological problems associated with the IAT. The procedure of the GNAT essentially requires the categorisation of single attitude objects against different contextual backgrounds. This enables the examination of how that attitude object is evaluated in different contexts. A context-free version is also proposed in which the contextual background used is composed of attributes only. The procedure in the context-free version requires participants to respond to stimuli (Go) if they belong to the target concept category (e.g. GM food) or the target attribute category (e.g. positive) and to not respond to stimuli (No-Go) if they belong to the opposing target attribute category (e.g. 'negative'). This procedure is then reversed so that the participants respond to stimuli if they belong to the target concept category (e.g. GM food) and the other attribute category (e.g. negative) and not to respond to stimuli if they belong to the opposing attribute category (e.g. positive). The GNAT score is calculated as the difference in responding between the two conditions. Condition differences can be evaluated in two ways, either using errors and signal detection theory or through differences in response latencies. Different contexts can be added to the GNAT by including other stimuli related to the particular context required as part of the background, which the participant is not required to respond to.

8.1.2.1. Benefits of the GNAT

The GNAT is a relatively new task with which implicit attitudes can be measured and related research is accordingly relatively sparse. Research so far however, has indicated that the GNAT is valid. Studies have found that expected differences between stimuli were obtained, for example, implicit attitudes were negative towards insects and positive towards flowers (Nosek and Banaji, 2001). Expected racial and gender differences have also been found (Nosek and Banaji, 2001; Blair et al., 2001).

The context-free version of the GNAT solves one of the main practical problems associated with the IAT. This is that the IAT can only examine evaluations of a concept in the context of some other opposing concept; the GNAT is able to evaluate a single concept in isolation. It is flexible though, in that other contexts are able to be introduced, facilitating comparisons. The IAT has been associated with other conceptual problems, e.g. familiarity problems, with regards to what the task actually measures, however it is unclear whether these will also be associated with the context-free GNAT. To date, these have not been investigated within the GNAT. It is suggested that at least some of these conceptual problems may be diminished due to the difference in procedure utilised within the GNAT. For example, familiarity effects that could pose a problem within the IAT are unlikely to be a problem within the context-free GNAT as there is only one target category used. Comparisons within the GNAT are made with the same words in each condition so there can be no differences in familiarity with words between conditions.

The GNAT has been associated with large effect sizes, similarly to the IAT, usually exhibiting Cohen's d of greater than one and often greater than two (Sedikides, 2005). Initial investigations of the GNAT indicate that split-half reliability measures average at around 0.20 which are low but acceptable; it is noted that these were calculated between blocks with different response windows which may artificially lower reliability (Nosek and Banaji, 2001). More recent evaluations of split-half reliability indicate an average correlation of around 0.75 (Sedikides, 2005). There are several ways in which internal reliability may be improved within the GNAT including increasing trials and using reaction time data rather than error data. The test-retest reliability of the GNAT has also been examined and these are found to be acceptable with an average correlation of around 0.53 (Sedikides, 2005).

8.1.2.2. Problems associated with the GNAT

Structurally, the GNAT is very similar to the IAT. Examining the GNAT with regard to De Houwer's (2003b) taxonomy of compatibility tasks reveals that as with the IAT, the GNAT exhibits relevant S-R compatibility and irrelevant S-R compatibility. Within the GNAT, the category to which target stimuli belong is the relevant task feature and the valence of individual stimuli is an irrelevant task feature. This means that, as with the IAT, effects can occur as a result of the valence of individual stimuli rather than as a result of associations with categories. Therefore, in such situations where there are neutral categories, the GNAT may exhibit response effects due to individual stimuli. This is problematic when the valence of a category is unknown because results may be due to associations with the category or to associations with individual stimuli.

It is noted that although the GNAT may overcome some of the conceptual problems associated with the IAT, e.g. familiarity effects, other effects may remain. The figure-ground problem (Rothermund and Wentura, 2001), for example, may have an impact on the context-free GNAT procedure. The format of the context-free GNAT requires that participants keep two pieces of information in mind when responding to the 'figure', however only one piece of information in mind when responding to the 'ground'. If participants realise this, they may keep just the information that they are not required to respond to (the ground) in mind which would compromise the basis of the task. This conceptual problem remains to be tested experimentally within the GNAT, however as with the IAT (Greenwald et al., 2005), any effects are likely to be minimal.

Concepts within the GNAT are examined at the level of the category as is done within the IAT and this may be criticised as lacking in ecological validity. Further to this, the possibility remains that environmental associations may be being measured by the task, rather than personal evaluative associations. However as with the IAT, it is possible these can be overcome, or at least diminished, by using a personalised version of the GNAT (Olson and Fazio, 2004) or by activating a participant's self-knowledge structure prior to task completion (Perugini and O'Gorman, 2005).

8.1.3. The Extrinsic Affective Simon Task (EAST)

The EAST was developed by De Houwer (2003a) and builds on both the IAT (Greenwald et al., 1998) and the AST (De Houwer and Eelen, 1998). The EAST, similarly to the AST, requires participants to respond to target concept stimuli on the basis of some non-affective feature of the stimulus, e.g. grammatical category. Rather than participants providing intrinsically valent responses however, as is done in the AST with participants verbally responding 'Good' or 'Bad', participants in the EAST provide responses that are extrinsically valent, in the same way as is done in the IAT. Within the EAST, participants are required to complete a series of evaluation trials in which obviously valent words are categorised according to their valence by pressing a particular response key. This results in those response keys acquiring the valence of the corresponding valent stimuli. These same response keys are used in order to respond to target concept stimuli on the basis of the non-affective feature and it is found that the acquired valence of the response key interferes with responses. For example, if a positive stimulus, e.g. 'flower', is required to be categorised as a noun using the same response key as is used to denote a positive valence, responses will be facilitated.

Structurally, the EAST is similar to the AST and exhibits only irrelevant S-R compatibility according to De Houwer's (2003b) taxonomy of compatibility tasks. The relevant task feature within the EAST is the non-affective feature of the stimuli, which participants are required to use as the basis for categorisation.

However as with the AST, it is found that the affective properties of stimuli (the irrelevant task feature) interferes with responding to the non-affective feature and interacts with the valence of the response.

8.1.3.1. Benefits of the EAST

As previously mentioned, the EAST is a relatively new task and for this reason research examining or using this task remains quite sparse. The small amount of research that exists on the EAST does indicate that this task is valid though. For example, initial uses of the EAST have demonstrated that data show expected differences between insects and flowers, whereby, insects provoke negative implicit attitudes and flowers provoke positive implicit attitudes (De Houwer, 2003a).

One of the main highlighted benefits of this task is that the researcher is able to examine single associations by themselves rather than in the context of something else (De Houwer, 2003a). Further to this, stimuli can be examined at the individual level which can be argued to make the task more ecologically valid. In addition, because stimuli are examined individually and the same words are used in each condition, familiarity effects should not be a problem. Salience asymmetries, i.e. the figure-ground problem (Rothermund and Wentura, 2001), are also unlikely to occur. Methodologically the EAST requires the categorisation of target stimuli by colour. As the colour that the stimulus is presented in is counterbalanced so that stimuli are presented an equal number of times in each colour, any potential effect of salience asymmetries between target stimuli is eliminated.

8.1.3.2. Problems associated with the EAST

One significant problem with the EAST is that, like the AST, it seems to produce fairly small effect sizes. Effect sizes noted within the EAST are greatly increased from that of the AST; however these are still smaller in size than those of the IAT and GNAT (De Houwer, 2003a). Research has indicated that the magnitude of effect sizes within the AST are dependent on the relevant (non-affective) stimulus feature utilised within the task (De Houwer and Eelen, 1998) and, therefore the use of a particular relevant feature may help to produce larger effect sizes.

There is little evidence as yet to the reliability of the EAST; however initial assessments of split-half reliabilities indicate that the EAST was unreliable in parts. Within reaction time data presented by De Houwer (2003a), positive words were reliable but negative words were only marginally so and within error data, negative words were reliable and positive words were unreliable. Further research has varied to the extent to which the EAST has been found to be internally consistent. One study found that the EAST had unacceptably low internal consistencies (Teige, Schanble, Banse and Asendorpf, 2004) whilst a more recent investigation of internal consistencies within the EAST has indicated that these were borderline acceptable (Perugini, O'Gormon and Conner, 2005). Further investigation of the reliability of the EAST is clearly required. Both effect sizes and internal reliabilities may potentially be improved through further procedural refinements.

In addition, as with many of these implicit tasks, the possibility that environmental associations are influencing results remains within the EAST. Although, again the personalisation of the task (Olson and Fazio, 2004), or the activation of a participant's self-knowledge structure prior to task completion (Perugini and O'Gorman, 2005), may help to diminish this effect.

8.1.4. Comparison of the GNAT and the EAST

As already noted, one of the main advantages of both the GNAT and the EAST is that these tasks can investigate implicit attitudes towards attitude objects in a context-free manner. Both tasks also seem to be valid measures of implicit attitudes. The GNAT has the advantages of being of being reliable, producing large effect sizes, and of potentially reducing some of the conceptual problems that have been associated with the IAT, e.g. familiarity effects. Other conceptual concerns, such as the figure-ground problem, may remain (at least within the context-free GNAT) but any associated influences on results are likely to be small. Further issues include the fact that the GNAT measures category level associations, which could be argued to have low ecological validity. It is also noted that individual exemplars used within target categories may influence effects noted.

The EAST has the advantage of reducing some of the conceptual problems that have been raised in association with the IAT, including familiarity effects and the figure-ground problem. Further to this, the EAST examines implicit attitudes towards individual stimuli rather than towards a category, which may be argued to be more ecologically valid. Unfortunately, the EAST does not seem to be a very powerful task resulting in the problem that Type II errors are likely to occur. In addition, reliability within the EAST may be a problem.

Both of these tasks suffer from the problem that research using these tasks is still fairly thin and further research is required to establish benefits and problems associated with using these tasks. It is possible that both the GNAT and the EAST may benefit through procedural refinements that will only become apparent through further investigation. As with the IAT, the possibility that environmental associations are influencing results remains an issue for both tasks. It is debatable whether this is a real problem or not but it is feasible that procedural refinements may help to reduce any environmental associations that do exist.

8.1.5. The relationship between implicit and explicit attitudes

Implicit attitudes are found to correlate with explicit attitudes in some domains and not in others (see chapter six, section 6.3 for a fuller discussion). Often implicit attitudes and explicit attitudes are found to differ within particularly controversial areas, e.g. racial attitudes (Kawakami and Dovidio, 2001), and therefore it is feasible that these will not correlate within the area of GM food.

There has also been some investigation into whether implicit attitudes might correlate with certain components of explicit attitude. Attitudes are thought to be divisible into three components, behavioural, affective and cognitive components (Fazio and Olson, 2003a). Leaving the behavioural component aside, as this is mainly theorised as a feedback mechanism, there has been some suggestion that the division of attitude into affective and cognitive components might have some parallels with the implicit/explicit distinction made with attitudes (see chapter six, section 6.2.4. for a review of related evidence).

A recent study by Giner-Sorolla and Wilson (2003) directly investigated the association between implicit attitudes and different components of explicit attitudes. They utilised two different implicit attitude measures, an affective priming task and an IAT, alongside an explicit attitude measure that divided attitude into four components of cognitive, hedonic affective, self-conscious affective and overall evaluative attitudes. Results indicated that contrary to previous suggestions that implicit attitudes may be particularly associated with affect, results from the affective priming task correlated best with overall evaluations and results from the IAT correlated best with the cognitive attitude component. In fact, neither the hedonic affective, nor the self-conscious affective components that were measured correlated with either implicit attitude measure. Giner-Sorolla and Wilson (2003) suggest that differences found between implicit attitude measures may be explained at an operational level as different processes are involved with the completion of the different tasks. To date, to this author's knowledge, correlations between the GNAT and the EAST and explicit attitude components have not been investigated.

8.2. Experiment one – current aims

Due to the relative novelty of the GNAT and the EAST, as well as the lack of data regarding the validity and reliability of these tasks, it was thought useful to examine these tasks in more detail experimentally. Within the first experiment in this chapter, the utility of both the GNAT and the EAST was examined within the domain of GM food. It was considered important to examine effect sizes, and internal consistencies of the tasks. Further to this, relationships between each task and explicit attitudes were examined as well as the relationship that the tasks have with each other.

A second aim of this study was to gather empirical data regarding implicit attitudes towards GM food. The GNAT was used to examine context-free implicit attitudes towards the category of GM food. The EAST was used in order to examine context-free implicit attitudes towards the concept of GM food as well as several other specific GM food products that are currently available, or are likely to become available in the future.

Recent investigations indicate that explicit attitudes towards GM food are ambivalent (Gaskell, Allum and Stares, 2004; Poortinga and Pidgeon, 2004). Consequently, it was hypothesized that explicit attitudes, measured here on bipolar evaluative scales, would be neutral overall. In addition, it was hypothesized that implicit attitudes towards GM food would be neutral overall within the GNAT and EAST tasks, as these are tasks that measure valence in a bipolar manner. Regarding individual GM food products, which were investigated within the EAST, it was hypothesized that implicit attitudes would vary between different products. It was thought likely that implicit attitudes would be most positive towards GM foods with health benefits (Bauer, 2002) and more positive towards GM foods that were plant based than those that are developed from animals (Frewer, Howard, Hedderley and Shepherd, 1997).

8.3. Method

8.3.1. Design

This experiment had a repeated measures design with each participant undergoing three tasks. The three tasks were a GNAT, an EAST and an explicit attitude questionnaire, all of which examined attitudes towards GM food. Task order was counterbalanced between participants. Within this two versions of the

GNAT were administered, one with positive attributes to be responded to first and one with negative attributes to be responded to first, to counteract overshadowing effects; this was also counterbalanced between participants.

8.3.2. Participants

In total, this task had 42 participants who were recruited during a study day in the psychology department at the University of Nottingham. All participants were students at the University of Nottingham. A topic-blind method of recruitment was used so that students did not self-select themselves for participation on the basis of an interest in GM foods.

8.3.3. Materials

The implicit attitude tasks were run using E-Studio (version 1.1) software. For the EAST task, stickers were used on the keyboard so that the letter Q was labelled the 'Good' key and the letter P was labelled the 'Bad' key.

Although the EAST and the GNAT were both used to examine attitudes towards GM foods, different word stimuli were used in the tasks (see Appendix eight). The structure of the GNAT means that it examines attitudes towards a category as a whole. However, although actual individual exemplars used have a lesser influence on attitudes, they may still exert an effect. Exemplars included in the GNAT were therefore chosen as being highly representative of the category. In contrast, the EAST examines attitudes towards individual words. The word 'GM food' was included so that a comparison could be made between this and attitudes found towards this word utilised as a category label in the GNAT. In addition, several other related specific GM food product titles were included as topical examples of GM food so that their individual associated valence could be examined. It has been suggested that previous low reliabilities found with the EAST may have been due to the lack of strong inter-individual differences between stimuli (De Houwer, 2003a). It was, therefore, considered that the use of topical stimuli may help to increase inter-individual differences and improve reliability.

The explicit attitude questionnaire divided explicit attitude into hypothesised components of hedonic, cognitive and overall evaluative components, taken from Crites, Fabrigar & Petty, (1994), see Appendix nine. These scales have been found to have good internal consistency and both discriminant and convergent validity. In addition, these questions were found to be useful for assessing the affective and cognitive properties of attitudes and in differentiating attitudes that are based primarily on affective or cognitive information. Responses were made on seven-point semantic differential scales and the presentation of items was counterbalanced in terms of whether the positive item appeared on the left, or the right, hand side of the page to ensure that participants attended to each question.

8.3.4. Procedure

Participants were presented with each task individually in turn. All tasks were provided with complete written instructions but participants were encouraged to ask the experimenter if anything was not clearly understood. On completion of all tasks, the aim of the experiment was explained to participants and any questions regarding the experiment were answered.

8.3.4.1. EAST

The procedure of the EAST was as described by De Houwer, (2003a). Participants were required to categorise words presented to them on a computer screen in one of two ways depending on the colour of the word; if the word was presented in white, it had to be categorised by meaning and if the word was presented in colour it had to be categorised by that colour. Words to be categorised by meaning were clearly valenced attributes, e.g. 'Excellent', whereas words to be categorised by colour were all GM food concepts, e.g. 'Pharm crops'. When required to categorise the word by meaning, participants were asked to indicate whether that meaning was good using the good key (key 'p' on the keyboard, labelled as 'Good') or bad using the bad key (key 'q' on the keyboard, labelled as 'Bad'). When required to categorise the word by colour, participants were asked to press the 'Good' key if the word colour was blue and the 'Bad' key if the word colour was green. Participants were reminded of what the keys meant after each section. Incorrect responses were indicated by a red cross, correct responses prompted the task to move on.

The EAST procedure began with two practice blocks; the first familiarised participants with categorising words (presented in white) according to valence and the second familiarised participants with categorising words (presented in colour) according to colour. Practice blocks contained 20 trials each. Following this, test blocks presented words in both white and colour at random. Four test blocks were completed altogether, consisting of 30 trials in each block; the first test block contained an additional four practice trials and the other three test blocks contained two practice trials. Valent attribute words were presented four times each and GM food concept words were presented four times in each colour.

8.3.4.2. GNAT

The context-free GNAT used here was procedurally the same as that described by Nosek and Banaji (2001). Participants were required to hit the space bar (Go) if a word presented on the computer screen belonged to certain key categories and not hit the space bar (No-Go) if the words presented did not belong to these key categories. The participants were told which key categories to respond to at the beginning of the test phase and they were reminded of these by labels that appeared on the computer screen throughout the task.

The GNAT procedure was divided into two sections. In one section participants were required to respond to exemplars belonging to the category of 'GM food' and to the attribute category of 'Pleasant' whilst ignoring all other words presented which as this was a context-free GNAT consisted solely of words relating to the opposing attribute category, 'Unpleasant'. In the other section participants were required to respond to 'GM food' words and 'Unpleasant' words whilst ignoring 'Pleasant' words. Which section participants were presented with first was counterbalanced between participants.

In total 20 practice trials and 120 target trials were used in comparison to 16 and 40 respectively used by Nosek and Banaji (2001). The number of trials utilised was increased in order to make the number of target trials comparable to that of the EAST. Each section consisted of a practice block followed by two trial blocks (consisting of 60 trials each). Within practice blocks each of the target words ('GM food' words and attribute words that were to be responded to) were presented once each and each of the attribute words, that were to be ignored, were presented twice each. As two categories were responded to and only one category ignored, this meant that participants responded and ignored words an equal number of times. Test blocks presented each of the target word exemplars ('GM food' words and attribute words to be responded to) three times and each of the attribute word exemplars, that were to be ignored, six times.

Each trial had a response window of 700ms within which participants were expected to respond. This was chosen as it is within the range (500ms – 1000ms) examined by Nosek and Banaji (2001); it is towards the lower end of the range as identifying GM food related words is likely to be quite easy. If the participant did not respond, or responded incorrectly within this response window, a red cross was presented on the computer screen; if the participant responded correctly within the time limit, a green star was presented on screen. Due to the short response window available for responding, the task moved extremely quickly and participants were warned of this and were encouraged to keep going, even if they made a lot of mistakes.

8.4. Results

8.4.1. Explicit attitude measure

GM food was rated on a scale from -3 to +3 for each of the items within each explicit component (scales were reversed as necessary for analysis so that -3 indicated a negative evaluation and +3 indicated a positive evaluation). The affective, the cognitive and the overall evaluative components of the explicit attitude measure all exhibited high reliability with Cronbach's alphas of 0.86, 0.80 and 0.92 respectively. One sample t-tests were conducted on each individual component to examine their significance, see Table 8.1. Means of individual attitude components measured were all non-significant. In addition, scores were summed across components for each participant in order to produce an overall explicit attitude score; mean levels of overall explicit attitudes were also found to be non-significant.

Table 8.1 – Explicit attitude means, the significance of the differences of means from scale mid-points, and effect sizes of differences

Explicit component	Mean (ms)	Standard deviation (ms)	t statistic	Cohen's d
Affective	-0.21	0.93	-1.43	-0.32
Cognitive	0.05	0.87	0.36	0.08
Overall evaluative	-0.19	1.36	-0.91	-0.20
Summed score	-0.12	0.98	-0.76	-0.17

* Significant after Bonferroni's adjustment of $p < 0.05 / 4 = 0.0125$

8.4.2. GNAT

The analysis of the GNAT was conducted using the signal detection sensitivity index of d' prime; this provides an index of the participants' ability to distinguish target stimuli from distracters. The assumption is that participants should be better able to distinguish targets from distracters when the target stimuli are more closely associated with each other than with distracters. As with other implicit tasks, strength of association between concepts and attributes are examined in order to discover implicit attitudes towards concept categories (Nosek and Banaji, 2001).

Calculation of d' prime was in accordance with Green and Swets (1966). The proportion of hits (correct 'go' responses for targets) and false alarms (incorrect 'go' responses for noise items) were calculated for each condition, i.e. when concept exemplars and pleasant attributes were targets and when concept exemplars and unpleasant attributes were targets. Proportions were then converted to z-scores and the difference between the z-score values for hits and false alarms provided a d'prime value. Consistency of the task was good and evidenced a split-half reliability of $r = 0.88$, $p < 0.001$ (after adjustment using Spearman-Brown correction).

Participants showed greater sensitivity in the task when 'GM food' exemplars and 'Pleasant' attributes were signal and 'Unpleasant' attributes were noise (mean d' = 1.92, sd = 1.08) rather than when 'GM food' exemplars and 'Unpleasant' attributes were signal and 'Pleasant' attributes were noise (mean d'= 1.57, sd = 0.86). A t-test showed this difference to be approaching significance, $t(41) = 1.88$, $p = 0.067$ and the associated effect size was Cohen's $d = 0.36$ which is small – medium.

It was also thought useful to examine reaction time data for the GNAT. Data was fairly normally distributed and was, therefore, left untransformed. Mean reaction time of participants responding to the category of 'GM food' when paired with the category of 'Pleasant' was 419.03ms (sd = 51.69ms) and when paired with the category of 'Unpleasant' was 442.85ms (sd = 46.33ms). A paired samples t-test indicated that reaction times were marginally significantly faster when 'GM food' words were paired with 'Pleasant' words than when paired with 'Unpleasant' words ($t(41) = -1.95$, $p = 0.058$). This difference has an effect size of Cohen's $d = -0.49$, which is a medium effect size. Consistencies of reaction time data were again high and evidenced an average split-half reliability of $r = 0.91$ (after Spearman-Brown correction).

8.4.3. EAST

Analysis was carried out on test trials on which coloured words were categorised; these were all words relating to GM food. All practice trials were removed and as recommended by De Houwer (2003a), response latencies that were below 300ms or above 3000ms were recoded to 300ms and 3000ms respectively and latencies were log-transformed. One participant was removed from analysis due to an excessively high error rate of almost 90% indicating that the task had not been completed correctly.

EAST data was examined for each concept by comparing the mean log-transformed reaction time on trials which had an extrinsically positive valence with trials which had an extrinsically negative valence (De Houwer, 2003a). For clarity these scores will be provided in untransformed reaction times, see Table 8.2. In addition, the percentage of errors made in trials which had an extrinsically positive valence were compared with the percentage of errors made in trials which had an extrinsically negative valence, see Table 8.3.

Paired sample t-tests indicated that reaction times were not significantly different between trials on which concepts had an extrinsically positive valence and those on which concepts had an extrinsically negative valence for any of the concepts used. In addition, all effect sizes noted were small. The percentage of errors made within extrinsically positive trials and extrinsically negative trials were not significantly different for 'GM foods', 'Engineered salmon', 'Flvr Svr tomatoes' or 'Pharm crops'. However, for 'Golden rice' the amount of errors made on trials with an extrinsically negative valence was significantly greater than the amount of errors made on trials with an extrinsically positive valence. Again, all effect sizes were small.

Table 8.2 – Mean reaction times, t-values of differences between reaction times and effect sizes, within the EAST by concept

Concept	Mean reaction time (ms) on extrinsically positive trials (sd)	Mean reaction time (ms) on extrinsically negative trials (sd)	t-value	Cohen's d
GM foods	607.92 (123.15)	594.97 (103.16)	-0.75	-0.18
Engineered salmon	596.84 (98.03)	618.08 (121.09)	1.27	0.19
Flvr Svr Tomatoes	621.32 (150.76)	600.78 (89.17)	-0.64	-0.17
Golden rice	599.08 (105.21)	611.74 (128.04)	0.61	0.09
Pharm crops	596.32 (120.54)	580.41 (131.29)	-1.15	-0.13

* Significant after Bonferroni's adjustment of $p < 0.05 / 5 = 0.01$

Table 8.3. – Mean percentage of errors, t-values of differences between percentages of errors and effect sizes, within the EAST by concept

Concept	Mean percentage of errors made on extrinsically positive trials (standard deviation)	Mean percentage of errors made on extrinsically positive trials (standard deviation)	t-value	Cohen's d
GM foods	0.07 (0.16)	0.09 (0.17)	-0.78	-0.003
Engineered salmon	0.08 (0.16)	0.08 (0.15)	-0.07	0
Flvr Svr Tomatoes	0.06 (0.17)	0.06 (0.15)	-0.53	0
Golden rice	0.06 (0.16)	0.11 (0.16)	-3.39*	-0.31
Pharm crops	0.07 (0.17)	0.08 (0.17)	-0.848	-0.06

* Significant after Bonferroni's adjustment of $p < 0.05 / 5 = 0.01$

Internal consistencies were found to be extremely low within the EAST, see Table 8.4. In fact, several split-half reliabilities were negative indicating that the different sections indicated different results. Responses for only one concept, Flvr Svr Tomato, reached an acceptable level of internal consistency (for both error and response latency data).

Table 8.4. – Split-half correlations for response latencies and errors by concept within the EAST (after Spearman-Brown correction)

Concept	**Response Latencies (Pearson's r)**	**Errors (Pearson's r)**
Engineered Salmon	-0.34	0.24
Flvr Svr Tomato	0.35	0.47
GM food	-0.24	0.13
Golden Rice	-0.32	-0.63
Pharm crops	-0.13	-0.53

8.4.4. Correlations between measures

Correlations between all explicit attitude components were positive, see Table 8.5. Implicit attitude measures did not correlate however. Correlations between implicit attitude measures and different components of explicit attitude were also all non-significant; neither the EAST or the GNAT correlated with the affective, cognitive or overall evaluative components of explicit attitude.

Table 8.5. Correlations (Pearson's r) between implicit attitude and explicit attitude measures

	EAST†	GNAT††	Affective (explicit)	Cognitive (explicit)	Evaluative (explicit)
EAST	-				
GNAT	0.01	-			
Affective (explicit)	0.14	-0.03	-		
Cognitive (explicit)	0.14	-0.52	0.75***	-	
Evaluative (explicit)	-0.04	-0.06	0.79***	0.84***	-

*Note: Sig of r *p<0.05, **p<0.01, ***p<0.001*

† *The EAST score for GM food was used and was calculated as the difference between reaction times for responses to GM foods when paired with extrinsically positive and extrinsically negative valence.*

†† *The GNAT score was calculated as the difference between reaction times of responses to GM foods when paired with pleasant and when paired with unpleasant.*

8.5. Discussion

8.5.1. Explicit attitudes

Explicit attitudes measured within this study were neutral and this supports previous research that indicates that explicit attitudes towards GM food in Britain were ambivalent (Gaskell, Allum and Stares, 2003; Poortinga and Pidgeon, 2004). On a bipolar scale such as was used here it is likely that ambivalence is expressed as neutral. Further to this, individual affective, cognitive and overall evaluative components of explicit attitudes were also neutral.

8.5.2. GNAT

Contrary to hypotheses, results from the GNAT indicated that implicit attitudes towards the category of GM foods were positive. This is particularly interesting as it differs from explicit attitudes, both those that were found here and those that were reported within surveys of explicit attitudes in Britain (Gaskell, Allum and Stares, 2003). In addition, correlations between implicit and explicit attitudes measured here were non-significant. It was suggested that implicit attitudes may correspond with a particular component of explicit attitudes as has previously been found (Giner-Sorolla and Wilson, 2003), however data shows that implicit attitudes did not correlate with any component of explicit attitude. It is noted that findings are likely to be highly dependent on the subject area.

Two main conclusions can be drawn from these results. One conclusion is that explicit and implicit attitudes towards GM food differ; the other is that the measurement of explicit or implicit attitudes is biased or invalid in some way. The first possible conclusion that explicit and implicit attitudes towards GM food were simply different is quite plausible. In fact, as was found here, correlations between implicit and explicit attitudes are often found to be non-significant; this seems to be particularly common in areas of high controversy (Kawakami and Dovidio, 2001; Devine, Plant, Amodio, Harmon-Jones and Vance, 2002) such as the topic of GM food.

From the view of the single attitude model, explicit attitudes may differ from implicit attitudes due to external influences such as self-presentation biases which impact upon explicit but not implicit attitudes. It is possible that participants may have provided neutral responses explicitly due to uncertainty regarding social norms regarding the issue of GM food, or may have provided less positive responses due to a perceived negative social norm regarding GM food. From the view of the dual attitude model (Wilson et al., 2000), explicit and implicit attitudes may differ due to differences in their formation which may have come about due to the controversial nature of the topic resulting in mixed information signals.

The alternative conclusion regarding differences between implicit and explicit attitudes, that the measurement of attitude constructs was at fault, is considered extremely unlikely. Semantic differentials used to assess explicit attitudes are psychometrically robust and have been used in much previous research (e.g. Townsend et al., 2004; Giner-Sorolla, 2004). Results obtained from the GNAT are also likely to be accurate. Internal reliabilities have previously been shown to be good (Nosek and Banaji, 2001; Sedikides, 2005) and here, they were also found to be very high. In addition, test-retest reliabilities have previously been found to be good (Sedikides, 2005). The GNAT is, therefore, considered to be reliable. The task is also thought to be valid; several previous studies have indicated that results predicted group membership (Nosek and Banaji, 2001; Mitchell, Nosek and Banaji, 2003; Sedikides, 2005) providing evidence of construct validity.

A potential criticism of the GNAT is that the particular exemplars used within the category of GM food may have influenced results. Exemplars used included some proposed benefits of GM food including 'increasing flavour' and 'increasing vitamins'. It might be argued that these exemplars are particularly positive and may have exerted a significant influence on the valence of participant's associations. It has been found that although results are primarily produced through responses to category labels, individual exemplars do exert a lesser influence on responses (De Houwer, 2001).

8.5.3. EAST

The examination of latency scores obtained from the EAST indicated that none of the concepts utilised in the task were viewed as significantly positive or negative. These results may reflect public ambivalence towards biotechnologies and indicate that attitudes towards these concepts are fairly neutral. Alternatively, the lack of significant results might be due to a lack of power within the EAST. The EAST's predecessor, the AST has previously been associated with weak effect sizes (Duscherer, Holender and Molenaar, 2002) and indeed associated effect sizes noted here within the EAST were extremely small.

Error scores obtained from the EAST, which have also been found to evidence EAST effects (De Houwer, 2003), were also non-significant for most of the concepts, except for the concept of 'Golden rice'; effect sizes were also low for all concepts. Error scores relating to participant's responses to 'Golden rice' indicated that implicit attitudes were positive towards this concept. The finding that 'Golden rice' is perceived more positively than the other examples of GM food used in the EAST is in keeping with previous research that has indicated that GM products produced using plants are viewed more positively than those produced using animals (Frewer, Howard, Hedderley and Shepherd, 1997). This does not, however, explain why 'Pharm crops' or the 'Flvr Svr tomato' are not also viewed positively. An alternative possibility is that participants did not know that 'Golden rice' is a GM product; they may have responded to the concept as if it were an ordinary type of food.

Correlations between EAST scores and explicit measures were non-significant; neither reaction time data nor error scores correlated with any of the components of explicit attitude measured. As noted previously it is common to find a non-significant relationship between explicit and implicit attitudes within areas of controversy such as GM food. In this case, it is also possible that the lack of a significant relationship may be attributable to the low reliability of several measures included in the task.

Before drawing conclusions from the findings of a task, the task must first be deemed reliable. This study found that within both response latency data and within error data internal consistencies of the task were unacceptable for most of the concepts used. The only concept that did display acceptable levels of internal consistencies was 'Flvr Svr Tomatoes' which was evaluated as neutral. These low reliabilities indicate that the results stemming from these measures should not be evaluated further and conclusions can not be drawn from these. The low reliability of this task is in keeping with previous research that has found the EAST to be unreliable in at least in some sections (De Houwer, 2003; Teige et al., 2004). The EAST may need to be further modified in order to increase its reliability before it can be utilised as a tool for examining attitudes.

8.5.4. Comparison of the GNAT and the EAST

Results obtained from the GNAT and the EAST did not correlate at all indicating that these tasks were not measuring the same thing. Indeed convergent validity between implicit tasks has so far been quite rare (Fazio and Olson, 2003) and this is partly attributed to measurement error inherent within implicit tasks (Cunningham, Preacher and Banaji, 2001) and partly attributed to the fact that the tasks measure implicit attitudes in slightly different ways. The GNAT measures evaluations made towards a concept category, whereas, the EAST examines evaluations of individual concepts. In this case, it is likely that the low internal reliabilities associated with the EAST may have also accounted for disparity between measures.

8.5.5. Conclusions

At present, the GNAT appears to be a more useful task than the EAST. For a task to be useful it must be reliable as otherwise results obtained may be meaningless. It is, therefore, concluded that the EAST, in its current form, is not a useful tool with which to examine implicit attitudes. The GNAT, however, not only proved to be reliable but also seems to be a more powerful task than the EAST as it displayed effects that were not evident within the EAST. Effect sizes were also larger within the GNAT than within the EAST. Results obtained here, in conjunction with previous research, indicate that the GNAT is an extremely useful tool with which many of the problems associated with its antecedent, the IAT, are solved including context effects and figure-ground salience effects.

The only reliable result obtained from the EAST was the data obtained regarding Flvr Svr Tomatoes. Results indicated that this item was not evaluated significantly differently between trials of different extrinsic valence indicating that these are associated with a neutral evaluation. Results from the GNAT indicate that participants examined here have positive implicit attitudes towards GM food. Further to this implicit attitudes did not correlate with explicit attitudes towards GM food, which were neutral. It is concluded that the most likely conclusion from this data is that implicit and explicit attitudes towards GM food differ. It is acknowledged, however, that this positive result could possibly be attributed to the particular exemplars used within the category of GM foods which may have influenced the category to be viewed positively.

Participants were recruited 'topic blind' and were all students from a British University which suggests that our results are reflective (to a limited degree) of general implicit attitudes towards GM food within students in Britain. However, the sample evaluated here is not a representative sample of the British population and, therefore, results cannot be generalised further than a student population. Interestingly, a number of studies have shown that those with higher socio-economic status and higher education levels are likely to be more negative towards GM than other groups (e.g. Noussair et. al., 2004). So, given that our sample was drawn from a highly educated and prosperous population, to some extent the finding that implicit attitudes towards GM foods are positive is quite surprising. It is possible that implicit attitudes towards GM food within Britain are generally more positive than was found here.

<u>8.5.6. Future research</u>

This study had two aims, one was to gather empirical data regarding implicit attitudes towards GM food and the other was to examine the usefulness of the GNAT and the EAST as tasks with which to examine implicit attitudes towards GM food. Different word stimuli were used within tasks in order to gather empirical data, and the only comparison that could be made was between the results obtained from the concept category of 'GM food' within the GNAT and results obtained from the individual word stimuli of 'GM food' within the EAST. It would have been useful, however, to have used the same word stimuli within the EAST as were used as category exemplars within the GNAT. This would have enabled a demonstration of the differences in task structure. As responses within the GNAT are made to the category label rather than the category exemplars, it would be predicted that these would differ from the mean of responses made to the same word stimuli used within the EAST.

This study did demonstrate the usefulness of the GNAT in this domain and it is recommended that further research should examine implicit attitudes towards GM food using the GNAT. It would be useful to utilise different exemplars within the concept category of GM foods than were used within this study in order to eliminate the possibility that the particular exemplars used here were responsible for the results found.

Future research should ideally examine implicit attitudes towards GM food in a larger statistically representative sample of the British population in order to examine the generality of this finding. It would also be useful to extend this finding by examining how implicit attitudes towards GM food may vary with context. It is possible that implicit attitudes towards GM food may differ according to the situation in which GM foods are encountered.

8.6. Experiment two – current aims

Experiment two again examined implicit attitudes towards GM food using the GNAT and compared these with explicit attitudes held towards GM food. This study altered the exemplars used within the category of GM food in order to rule out the possibility that these produced the positive implicit attitudes towards GM food noted within experiment one.

A second aim of experiment two was to examine how implicit attitudes towards GM foods, measured in a context-free manner, compare to implicit attitudes towards GM foods measured in the context of (a) ordinary food and (b) organic food, as ecologically valid comparison categories. It was hypothesised that the context-free version of the GNAT would reveal positive implicit attitudes towards GM food as was found within experiment one. We predicted that the inclusion of the contexts of organic and ordinary food would result in the elicitation of negative implicit attitudes towards GM food because it is thought that GM food is likely to be seen as negative in comparison to these food types. In addition, it was thought that explicit attitudes towards GM food would again be neutral, in keeping with previous research (Gaskell, Allum and Stares, 2003) and in keeping with data obtained within experiment one.

8.7. Method

8.7.1. Design

This study had a repeated measures design in which participants completed three different GNATs assessing implicit attitudes towards GM food in different contexts (GM alone vs. GM + ordinary food vs. GM + organic food). Each GNAT had two different versions, in one participants responded to GM food words and positive words first and in the other participants responded to GM food words and negative words first; these were counterbalanced between participants. Participants also completed an explicit attitude assessment of attitudes towards GM foods.

8.7.2. Participants

Sixty-two participants (25 males and 37 females) took part in the study; however the data of two females were lost due to a computer error. Participants were recruited in a topic blind manner and all were university students with British citizenship.

8.7.3. Materials

Materials used within experiment two included an explicit attitude questionnaire and three GNATs. The explicit attitude questionnaire was identical to the one used within experiment one described within this chapter and divided explicit attitude into affective, cognitive and overall evaluative components as per Crites, Fabrigar and Petty (1994), see Appendix nine.

GNATs were conducted using E-Studio (version 1.1) software. The three GNATs used all utilised the target category of GM food; one of these was a context-free GNAT, one used a context of ordinary food and one used a context of organic food. The procedure of the GNAT was identical to that within experiment one. The context-free version of the GNAT was exactly the same as that utilised within experiment one except that different word exemplars were used to represent the GM food category. Exemplars used within this study were all types of GM food or examples of GM food products, see Appendix eight. These were chosen as representing the range of GM food available and as being closely related to the category of GM food.

In the contextualised conditions, the different contexts were created by adding other stimuli, related to the particular context required (e.g. organic foods or ordinary foods). These then form the distracter stimuli which the participant is not required to respond to. Within GNATs that include a context, participants are again required to respond to exemplars of the 'GM food' category and one attribute category, e.g. 'Pleasant' in one condition but this time they also have to ignore exemplars of the context category, e.g. 'Ordinary food', as well as exemplars of the opposing attribute category, i.e. 'Unpleasant'. Five exemplars of each context category were used, see Appendix eight.

8.7.4. Procedure

All participants completed three GNATs and one explicit attitude questionnaire and completed each task individually in turn. Each task was provided with full instructions self-contained within the task but participants were encouraged to ask the experimenter if anything was not understood. The order of the three GNAT tasks and the explicit attitude questionnaire was counterbalanced between participants to prevent order effects. At the end of the experiment the aim of the study and the purpose of the methods were explained and any further questions were answered.

8.8. Results

8.8.1. Explicit attitudes

Again scales were reversed as necessary for analysis so that -3 indicated a negative evaluation and +3 indicated a positive evaluation. Internal consistencies were measured using Cronbach's alpha and the evaluative, cognitive and affective components displayed high consistencies of 0.95, 0.88 and 0.81 respectively. Means of individual explicit components were all neutral, see Table 8.3. An overall explicit rating was also calculated by combining the three components; this was also neutral.

Table 8.3. – Explicit attitude means, the significance of the differences of means from scale mid-points, and effect sizes of differences

Explicit component	Mean (ms)	Standard deviation (ms)	t statistic	Cohen's d
Affective	0.25	1.08	1.79	0.33
Cognitive	0.30	1.09	2.10	0.39
Overall evaluative	0.27	1.41	1.49	0.27
Summed score	0.27	1.11	1.90	0.34

* Significant after Bonferroni's adjustment of $p < 0.05 / 4 = 0.0125$

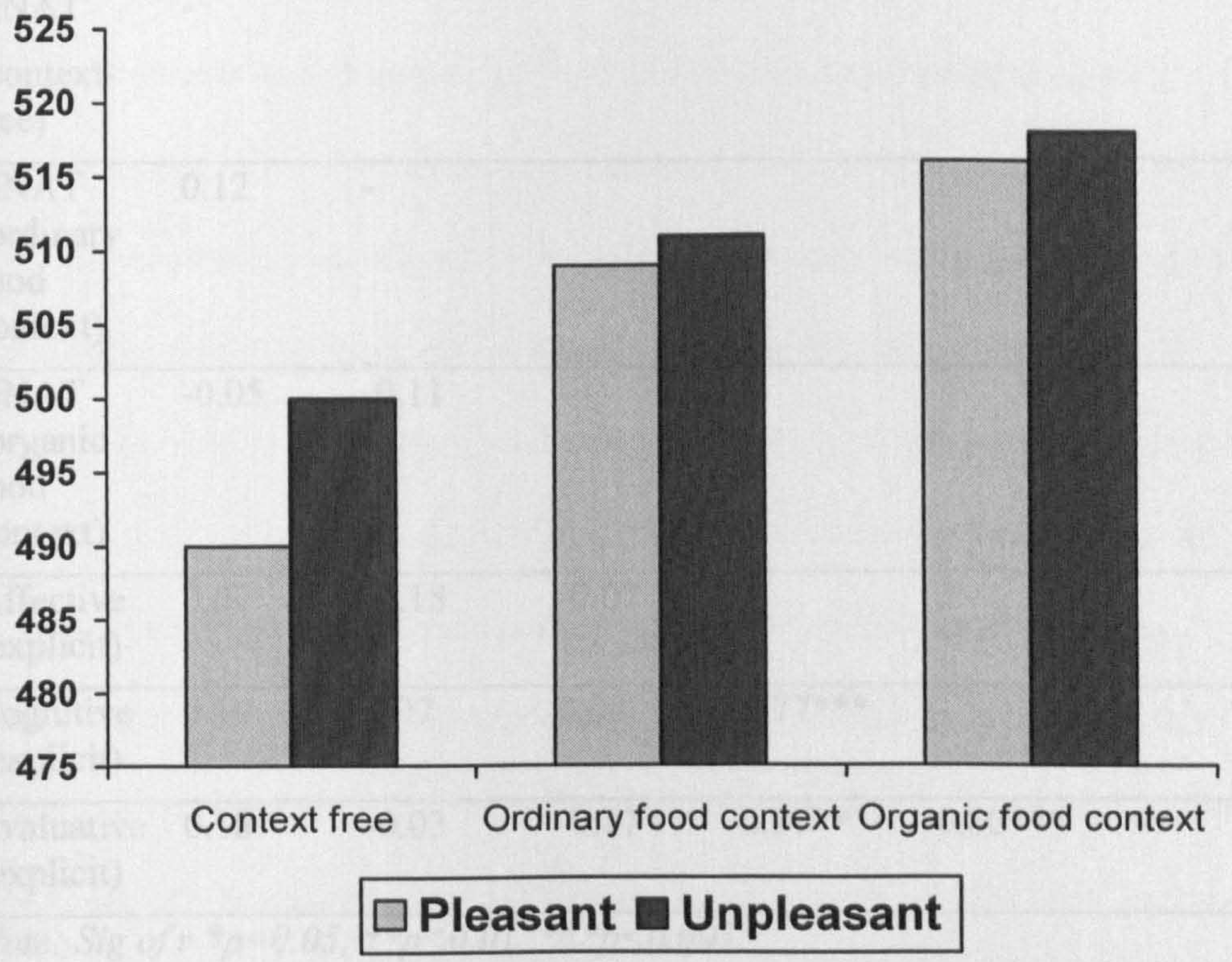
8.8.2. GNATs

GNATs were analysed by comparing reaction times made between the different conditions within the task, see Figure five, because reaction time analysis was found to be more consistent and to produce larger effect sizes than error rate analysis in the previous experiment. All GNATs used demonstrated good reliabilities; the context-free GNAT had a split-half reliability of $r = 0.92$, $p < 0.001$, the GNAT with a context of ordinary food had a split-half reliability of $r = 0.75$, $p < 0.001$, and the GNAT with a context of organic food had a split-half reliability of $r = 0.92$, $p < 0.001$ (after Spearman-Brown adjustments). Data for all three GNATs were fairly normally distributed and were, therefore, left untransformed for analysis.

In the context-free GNAT, it was found that responses made to the 'GM food' category when paired with the 'Pleasant' category were significantly faster, at a mean speed of 489.88ms (sd = 33.70ms) than when paired with the 'Unpleasant' category, when responses were at a mean speed of 500.28ms (sd = 29.67ms), ($t = -3.76$, $p < 0.001$). This difference had a small effect size (Cohen's $d = -0.32$).

The GNAT that used a context of 'ordinary food' showed a mean response time of 509.27ms (sd = 34.36ms) when the 'GM food' category was paired with the 'Pleasant' category and a mean response of 511.34ms (sd = 32.36ms) when it was paired with the 'Unpleasant' category. This difference was non-significant (t = -0.78, p = 0.44; Cohen's d = -0.06). In the GNAT that used a context of 'Organic food', mean response time when GM food was paired with the 'Pleasant' category was 516.06ms (sd = 34.16ms) and 517.92ms (sd = 37.80ms) when paired with the 'Unpleasant' category. This difference was also non-significant (t = 0.54, p = 0.59; Cohen's d = -0.05).

Figure 8.3. – Mean reaction times for each condition for each GNAT



8.8.3. Correlations

Correlations were conducted between the GNAT tasks used and the explicit attitude measurement, see Table 8.4. Correlations between the GNAT tasks and each of the explicit components, as well as the mean overall explicit rating, were all found to be non-significant. The different GNAT tasks were also found to be uncorrelated. Correlations between the affective, cognitive and evaluative components of the explicit attitude measure were significant though.

Table 8.4. Correlations (Pearson's r) between GNAT scores and explicit attitude measures

	GNAT (context free)	GNAT (ordinary food context)	GNAT (organic food context)	Affective (explicit)	Cognitive (explicit)	Evaluative (explicit)
GNAT (context-free)	-					
GNAT (ordinary food context)	0.12	-				
GNAT (organic food context)	-0.05	-0.11	-			
Affective (explicit)	0.07	-0.18	-0.07	-		
Cognitive (explicit)	0.19	0.07	0.00	0.77***	-	
Evaluative (explicit)	0.18	-0.03	-0.17	0.79***	0.80***	-

*Note: Sig of r *p<0.05, **p<0.01, ***p<0.001*

8.9. Discussion

8.9.1. Implicit attitudes towards GM food

Data indicates that implicit attitudes towards GM food are positive when evaluated in a context-free manner. This supports data from experiment one reported within this chapter, indicating that this is a reliable finding, and reduces the possibility that a positive implicit attitude could be attributed to the particular exemplars utilised within the GNAT used within experiment one. Again, although participants were all students and, therefore not representative of the British population, participants were recruited 'topic blind' which means that they could not have not self-selected themselves to take part in the study.

It was also found that implicit attitudes towards GM food were neutral when evaluated in the context of ordinary food or organic food. This indicates that implicit attitudes towards GM food may not be any different from implicit attitudes towards any other type of food and that participants were equally positive towards GM food as towards ordinary food and organic food. It is noted that it is possible that participant's responses were made to the general category of food, rather than GM food, due to a lack of knowledge about GM food. Participants may not have very well developed cognitive structures regarding GM food and may not have developed direct valent associations with this concept. Spontaneous responses, as measured using implicit attitude measures, may therefore measure valent associations towards the general category of food, or any other category related to GM food. Further to this, it is noted that the use of the categories of 'Organic food' and 'Ordinary food' alongside 'GM food', within this experiment, may have primed GM food to be viewed as a food.

No matter what the reason, GM food seems to provoke a positive implicit attitude, when measured in a context-free manner, which has important implications for behaviour. As previously discussed (see chapter six, section 6.4), implicit attitudes have important predictive value, particularly for spontaneous behaviour (Poehlman et al., 2005). Results here, therefore indicate that when behaviour is driven by implicit attitudes, individuals who encounter GM foods in a neutral context are likely to engage in approach behaviour.

8.9.2. Explicit attitudes and their relationship with implicit attitudes

Explicit attitudes towards GM food were again found to be neutral. This supports results from experiment one reported within this chapter as well as previous research that indicates that the British population is ambivalent towards GM food (Gaskell, Allum and Stares, 2003; Poortinga and Pidgeon, 2004). As was found within experiment one within this chapter, explicit and implicit attitudes towards GM food did not correlate significantly. This corresponds with previous research that has found that explicit and implicit attitudes often do not correspond within controversial topic areas (Kawakami and Dovidio, 2001; Devine, Plant, Amodio, Harmon-Hones and Vance, 2002), see section 8.5.2. for a further discussion of why this might be.

The low correlations between explicit and implicit attitudes towards GM food found here have implications for the predictive value of these measures. A recent meta-analyses of the predictive value of the IAT found that low correlations between explicit and implicit attitudes lowers the predictive value of both constructs and in particular that of explicit attitudes (Poehlman et al, 2005). Diverging explicit and implicit attitudes may drive behaviour in different directions and this may particularly effect explicit attitudes as these are more susceptible to change. A low correlation between explicit and implicit attitudes, therefore, reinforces the importance of examining implicit attitudes, as well as explicit attitudes, when predicting potential behaviour towards GM food.

8.9.3. Conclusions

The experiments contained within this chapter are (to this author's knowledge) the first ever investigations of implicit attitudes towards GM food. Interestingly, implicit attitudes towards GM food were found to be positive and this finding has important implications for behaviour. Further to this, implicit attitudes were found to diverge from explicit attitudes which lowers the predictive validity of both constructs but particularly that of explicit attitudes indicating that the examination of implicit attitudes is particularly important here. This data suggests that more people than expected may purchase GM food if it becomes available in the UK. Implicit attitudes are likely to encourage approach behaviour towards GM food when encountered in a context-free or context neutral environment. This behaviour may be moderated by explicit attitudes if the individual has the time and cognitive capacity with which to consider these attitudes, however given that explicit attitudes are generally neutral, approach behaviour is still likely to occur. Behaviour may differ if GM food is encountered in the context of other foods, and in this situation our results suggest that approach and avoidance behaviour are equally likely to occur.

The data obtained by the two experiments reported within this chapter indicate that the finding that implicit attitudes towards GM food are positive is reliable. The GNAT used to obtain data was found to be internally reliable and the same results were within both studies. These results, combined with previous research that has indicated that the GNAT has good test-retest reliability, indicate that the results obtained here are dependable.

It is noted, however, that the samples examined within the two studies described within this chapter consist of students and are not representative of the British population. Future studies would benefit from recruiting a statistically representative sample of the British population.

8.9.4. Future research

Further research into implicit attitudes towards GM food should consider utilising unipolar tasks. The British population have been found to be ambivalent in their explicit attitudes towards GM food but it is difficult to measure ambivalence using bipolar evaluative tasks. Unipolar tasks would be able to detect whether, at an implicit level, people hold both positive and negative associations with GM food.

Further research in this area should also examine the cause of the positive implicit attitudes noted towards GM food here. It is suggested that these may have stemmed from associations with better known categories, e.g. food, which are linked to the concept of GM food. It is possible that this finding may have stemmed from the methodology employed within this task. The presentation of GM food alongside other categories of food may have primed participants to consider GM food as a food. It would be useful to further examine the impact of priming and context on the measurement of implicit attitudes. Implicit attitudes towards GM food may be found to differ if participants consider GM food as a biotechnology rather than a food for example.

Chapter Nine – The Impact of Context and Salience Manipulations on Implicit Attitudes Towards GM Foods

9.1. Introduction

In real life, attitudes are dependent on the situational context and on the differential salience of environmental cues and this is found to be true of both explicit and implicit attitudes. Implicit attitudes towards GM food were found to be positive when measured in a context-free manner in the previous chapter (chapter eight). However, these were neutral when measured in the contexts of ordinary or organic food. It was suggested that the positive implicit attitude noted towards GM food may stem from a positive implicit attitude held towards all food types. It is possible that attitudes towards GM food may differ substantially if it is viewed as a biotechnology rather than as a food.

This chapter will review previous literature that has examined the effect of context on both explicit and implicit attitudes. Consideration will also be given to the extent to which context effects have influenced previous evaluations of explicit attitudes towards GM food. A study that examined the influence of context and priming on implicit attitudes towards GM food will then be described. This investigated the possibility that related categories of food and of biotechnology may have differential effects on the way that GM food is perceived. Due to interesting findings from this study, a further follow up study, that was conducted in order to clarify the influence of priming on implicit attitudes towards GM food, is also described.

9.1.1. Context effects

The particular situation in which a judgment is made or in which an attitude object is perceived can have an enormous impact on evaluations. In fact, Schwarz, Groves and Schuman (1998) found that measures of participants' explicit attitudinal judgements were influenced by contextual factors including question order, references to social norms and question formatting. So, seemingly trivial characteristics of questionnaires, can potentially lead researchers examining the same questions to different conclusions. These findings have frequently been made use of within marketing techniques. If a particular product is presented in a positive context, or alongside another product or brand that has known positive connotations, that product is also more likely to be perceived positively (De Pelsmacker, Geuens, and Anckaert, 2002). For example, advertisers frequently use product placement techniques where their product appears within a television show or film in order to increase liking for their products, e.g. the BMW Z3 car appearance within the James Bond film 'Goldeneye'.

9.1.2. Situational influences on measurements of implicit attitudes

Measurements of implicit attitudes have also been found to be susceptible to context effects. In fact the Implicit Association Test (IAT; Greenwald et al., 1998), which is one of the most commonly used implicit attitude measures, by its very nature measures implicit attitudes in the context of some other category and the category it is contrasted with has a significant impact on how the target category is perceived. For example, it was demonstrated that non-smokers displayed more negative implicit attitudes towards smoking than smokers on an IAT when smoking was contrasted with non-smoking, however, when smoking was contrasted with stealing, non-smokers and smokers displayed similar results (Robinson, Meier, Zetocha and McCaul, 2005).

In addition, it seems that measurements of implicit attitudes may differ as a result of external influences. For example, measurements of implicit attitudes may differ depending on who is assessing the attitude. Lowery, Hardin and Sinclair (2001) found that the presence of an African-American experimenter produced more positive implicit evaluations, as measured by the IAT, towards African-Americans as a group than the presence of a European-American experimenter. Lowery et al. (2001) interpreted this effect as evidence of social tuning in which participants modify their perspective in an attempt to achieve common ground with the experimenter. In this way, it seems that measurements of implicit attitudes can be modified by social motives. Other factors have also been found to influence the assessment of implicit attitudes and in fact Blair (2002) conducted a review of influences that have been found to impact upon measures of automatic stereotypes and prejudice. Although this review was domain specific, it does serve to illustrate a range of ways in which implicit attitude measures can be altered. In addition to social motives, Blair (2002) noted that assessments of implicit attitudes can be influenced using specific strategies, by the perceiver's focus of attention, by the configuration of stimulus cues and by characteristics of individual stimuli within the target group.

9.1.3. Conceptual underpinnings of context effects

There are evidently a variety of ways in which contextual information can influence measures of attitudes and there are several different interpretations of why this may occur. It is possible that attitudes are temporarily shifted in direction according to situational cues, or current information, and that this change will gradually diminish over time (Wegner and Bargh, 1998). Another view is that attitudes are not stable entities but are constructed afresh as they are retrieved, in accordance with the situation (Smith, 1996). From this point of view, attitudes are likely to incorporate different information depending on the context, potentially resulting in different measurements of attitudes depending on the situation. Yet another stance is that of the model of dual attitudes. This theoretical stance holds that multiple attitudes exist towards the same attitude object (Wilson et al., 2000) and which is activated will depend on the situation. No matter which theoretical stance is subscribed to, it seems that measurements of attitudes are quite susceptible to changes in context.

9.1.4. Categorising attitude objects

Attitude objects differ in the number of ways in which they can be categorised. If an attitude object has only a small number of ways by which it can be categorised and is often categorised in a similar fashion, the way in which it is evaluated is likely to remain similar over time. If an attitude object can be categorised in multiple ways, on the other hand, each of these categories may contribute to the way it is evaluated and therefore as these categories become more or less salient in different situations, the evaluation of the attitude object is more likely to fluctuate over time (Ferguson and Bargh, 2003).

Smith and Zárate (1992) outlined a general theory of social judgement that brought together social and cognitive dimensions in organising and explaining associated exemplar-based effects relating to which category is likely to be attended to and used during judgment. Factors considered to be important in influencing social judgement include perceiver self-schemata, social context and in-group/out-group dynamics (Smith and Zárate, 1992). (This theory specifically referred to person perception; however, multiple categorisations are applicable to objects as well as to people and similar factors are likely to influence the judgment of objects.) One important factor that has been found to influence categorisation of objects is the accessibility of attitudes that are attached to related categories (Smith, Fazio and Cejka, 1996). A category with a highly accessible attitude will attract more attention than other related categories and is more likely to be used during judgement tasks. The act of priming an attitude held towards a particular category will, therefore, prime both the accessibility of that category and of its related attitude which will draw further attention to that category and increase its salience during subsequent tasks (Smith, Fazio and Cejka, 1996).

It is of further interest as to when an attitude object will be assimilated with a particular category and when it will be contrasted with a particular category. Information pertaining to a relevant context category may have opposing effects depending on whether the attitude object is assimilated or contrasted with that context category. Bless and Schwartz (1998) demonstrated that the act of thinking about a particular well-known German politician resulted in significantly different evaluations of his associated political party depending on whether participants were primed to think of him as part of that party or whether they were primed to think of him as part of a neutral political organisation to which he also belonged. In fact, Schwartz and Bless (1992) proposed a framework for conceptualising assimilation and contrast effects known as the inclusion/exclusion model. This model assumes that judging a particular attitude object requires the retrieval of the cognitive representation of that object and also the determination of some standard of comparison for evaluation. Assimilation effects are postulated to occur when contextual information is included in the representation of an attitude object and contrast effects are postulated to occur when contextual information is excluded in the representation of an attitude object. Furthermore it was asserted that the default operation is that of including information (and of assimilation) unless there are specific circumstances or methodological details that encourage the exclusion of information (Schwartz and Bless, 1992).

9.1.5. The perception of GM foods in different contexts

GM food is a multiply categorisable attitude object and, therefore, it is likely that attitude judgments may differ depending on situational cues and how GM food is categorised. Two closely associated categories with GM food are the super-ordinate categories of food and of biotechnology. The category of food is associated with positive attitudes as food is not only necessary to live but is also seen as pleasurable by the majority of people (Conner and Armitage, 2002). The category of biotechnology, in contrast, is likely to be neutral as public opinion surveys have indicated that most people are ambivalent towards biotechnologies in general (Gaskell, Allum and Stares, 2003) and feelings of ambivalence are likely to be expressed as neutral when an individual is forced to make a bipolar evaluative judgement. Whether GM food is placed in the context of food or in the context of biotechnology is, therefore, likely to have an impact on how it is perceived. Furthermore, whether GM food is contrasted or assimilated with these super-ordinate categories is likely to influence evaluations of GM food.

Indeed, Fife-Schaw and Rowe (2000) noted that methodological details of order effects and anchoring effects can have large effects on ratings of food-related hazards. In relation to this, Townsend et al., (2004) noted that the majority of previous surveys of attitudes towards GM food (Gaskell et al., 2000; Frewer, Howard and Shepherd, 1997; Siegrist, 2000) have placed GM food in the context of other biotechnologies. This is likely to prime participants to assimilate GM food with the category of other biotechnologies which may have an important impact on responses. Townsend et al., (2004) examined perceptions of GM food in the context of other current issues, e.g. terrorism, poverty, train crashes, instead of in the context of other biotechnologies. It was found that GM food was actually rated as relatively quite controllable, dull, not dreaded and as the least risky issue presented. These results contrast with previous surveys evaluating attitudes toward GM food which have found people to be quite worried about GM food (Gaskell et al., 2000; Frewer, Howard and Shepherd, 1997), indicating that the context that GM food is presented in is important in influencing perceptions.

Context effects can also arise when implicit attitudes towards GM food are examined. As previously noted within chapter eight (experiment two) contrast effects were noted within the measurement of implicit attitudes towards GM food. It was found that implicit attitudes held towards GM food were positive when evaluated in a context-free manner but were neutral when evaluated in the contexts of ordinary or organic foods.

9.2. Current aims

This study was conducted in order to examine how measures of implicit attitudes towards GM food may differ depending on the situation in which these are encountered. Two main reference categories for GM food are the category of food and the category of biotechnology and it was of interest to examine how implicit attitudes towards GM food would differ depending on whether it was viewed in relation to the category of food or the category of biotechnology.

More specifically this study examined how implicit attitudes towards GM food differed when:

a/ contrasted with evaluations of categories of food or biotechnology and

b/ primed by activating evaluations of related categories of food or biotechnology

It was hypothesised that altering the context in which GM food was contrasted with would have a significant effect on measurements of implicit attitudes towards GM food. It was expected that GM food would be evaluated as negative in comparison to the category of food, which is thought to have positive associations (Conner and Armitage, 2002), and as neutral in comparison to the category of biotechnologies, which is thought to have neutral associations (Gaskell, Allum and Stares, 2003).

Priming participants with the evaluations of different categories relating to GM food was expected to have a different effect on measurements of implicit attitudes. Priming GM food with evaluations of the category of food is thought to increase the accessibility of the category of food. In addition, this increases the accessibility of attitudes towards food which increases the attention given to this category. It was predicted that this would result in evaluations of GM food being assimilated with evaluations of the category of food and that this would result in measurements of implicit attitudes towards GM food being positive when examined in a context-free manner. Similarly, it was predicted that priming GM food with evaluations of the category of biotechnologies would increase the accessibility of the category of biotechnologies as well as attitudes towards biotechnologies which would increase attention given to this category. This was hypothesised to influence GM food to be perceived as a biotechnology and thus be implicitly evaluated as neutral when measured in a context-free manner.

9.3. Experiment one - Method

9.3.1. Design

This experiment had a within subjects design. IATs were used to examine implicit attitudes towards GM food when contrasted with two different contexts - food and biotechnologies. Explicit attitude questions regarding the category of GM food and the categories of food or biotechnologies were used to prime associations with, and attitudes held towards, either the category of food or the category of biotechnologies. Immediately following the prime, GNATs were used to examine implicit attitudes towards GM food in a context-free manner.

9.3.2. Materials

All IATs and GNATs were conducted using E-Studio (version 1.1) software. Each participant was presented with two IATs, one that used contrasting target categories of 'GM foods' and 'Other foods' (IATf) and one that used contrasting target categories of 'GM foods' and 'Other biotechnologies' (IATb). Exemplars were chosen as being concepts that were familiar, and closely related to the target categories, and were pretested to ensure that this was the case. Five exemplars were used for each target category, see Appendix nine for details.

The procedure of the IAT was exactly the same as that of Greenwald et al., (1998) except that in this study 40 practice trials and 120 critical trials were used; number of trials used was increased to ensure reliability. In addition, the procedure was modified in order to reduce extrapersonal associations as presented by Olson and Fazio (2004; Han, Olson and Fazio, in press). This involved changing the attribute titles from 'Pleasant' to 'I like' and 'Unpleasant' to 'I dislike' although exemplars were kept the same (see Appendix nine). In addition, because clearly pleasant and unpleasant exemplars were used rather than idiosyncratic liked or disliked items, feedback was included so that errors were minimised.

Participants were also presented with two GNATs; these were identical as they were designed to assess the impact of the salience manipulation presented just beforehand. Both GNATs used GM food as the target category and because these were context-free GNATs these utilised only attributes as the background context. Participants were therefore required to respond to 'GM food' words and 'I like' words in one condition (against a background consisting only of 'I don't like' words) and to respond to 'GM food' words and 'I don't like' in the other condition (against a background consisting only of 'I like' words). The procedure was identical to that used within chapter eight except 20 practice trials and 80 critical trials were used, in comparison to 20 and 120 used within chapter eight. Numbers of trials used were reduced in order to make the task slightly faster, and less tedious to complete, but the amount used remained higher than that utilised by Nosek and Banaji (2001) of 16 practice trials and 40 critical trials, in order to ensure reliability. As reaction times were to be used for analysis, a response deadline of 1000ms was used for target words and a response deadline of 500ms was used for distracter items; a shorter time is recommended for distracter items in order to maintain the speed of responses. The procedure was slightly modified in order to reduce extrapersonal associations in a similar way to the IAT (Olson and Fazio, 2004). This involved changing attribute titles from 'Pleasant' to 'I like' and 'Unpleasant' to 'I dislike' although exemplars were kept the same.

Two sets of explicit attitude questions were used, see Appendix ten. One set of questions examined participant's attitudes towards GM food amongst questions about their attitudes towards other foods. A second set of questions examined participant's attitudes towards GM food amongst questions about their attitudes towards other biotechnologies. These questions were used not only to assess explicit attitudes but also to act as a prime, in order to induce participants to assimilate GM foods with the super-ordinate categories of food or biotechnologies respectively. The types of food and biotechnologies assessed within these questions were the same as those used in the context categories within the IATs used here, see Appendix nine.

9.3.3. Participants

Forty participants (nine male and 31 female) were recruited using convenience sampling in a topic blind manner (Campbell and Townsend, 2003). Participants were all students at the University of Nottingham recruited through posters displayed around campus and through e-mails to a database of students who had previously indicated that they would be willing to take part in psychology experiments.

9.3.4. Procedure

Participants were provided with an information sheet about the study and a consent form to complete prior to beginning the study to ensure that they understood what they were required to do. All participants completed six tasks comprising two sets of explicit questions that were also used as priming manipulations, two GNATs that were used to assess implicit attitudes in a context-free manner and two IATs that were used to assess implicit attitudes in different contexts. Presentation order was designed so that the questions acting as a priming manipulation always preceded the GNAT; GNATs in turn preceded IATs. Which priming and context category was presented first was counterbalanced between participants. Participants, therefore, were first presented with explicit questions assessing attitudes towards GM food and either food or biotechnology. This was followed by the presentation of a context-free GNAT and then by an IAT which assessed implicit attitudes towards GM food relative to the super-ordinate category of either food or biotechnologies, in accordance with whichever had previously been used as a prime. This process was then repeated for explicit questions, the context-free GNAT and the IAT using the opposing super-ordinate category of either food or biotechnologies as the prime and the context.

Further to this, two versions of the GNAT were administered, one with positive attributes to be responded to first and one with negative attributes to be responded to first, to counteract overshadowing effects. These were also counterbalanced between participants. The two GNAT versions presented within individuals were identical though as it would not make sense to compare a GNAT that presented positive target attributes first with one that presented negative target attributes first.

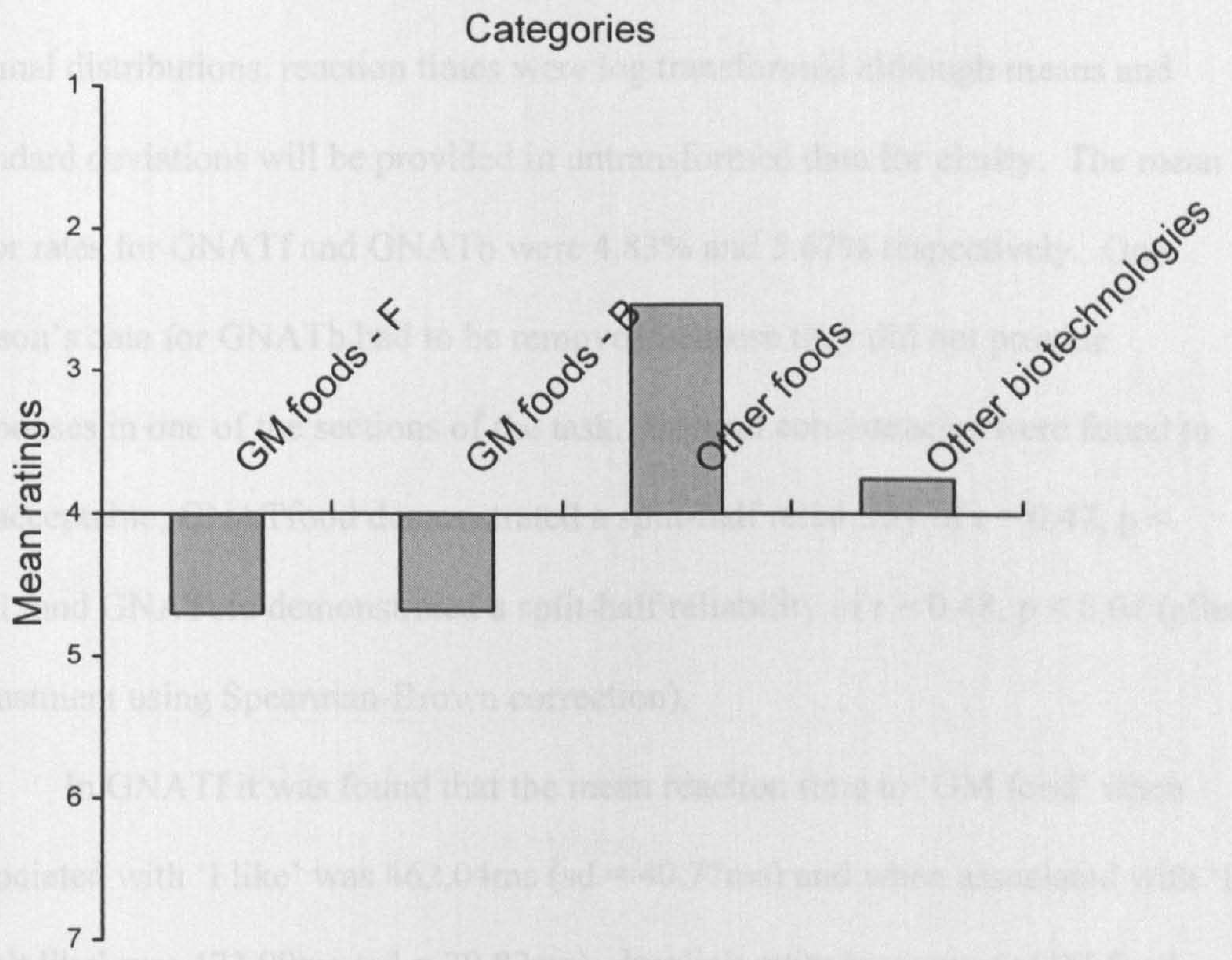
Similarly, two different versions of each IAT were used between participants, one which presented the target category of GM food with positive words first and one which presented GM food with negative words first. Again within participants, the same versions of IATs were used for comparison purposes. It is noted that at the beginning of each implicit attitude measure, the categories that were to be responded to and the exemplars within each category were provided to participants to ensure that they understood which category each exemplar belonged to.

9.4. Results

9.4.1. Explicit measures

Explicit attitude ratings of GM food (on a scale of one to seven, one indicating strong like and seven indicating strong dislike) were performed twice by participants, once in the context of other foods and once in the context of biotechnologies. GM food had a mean rating of 4.70 (sd = 0.80) when evaluated in the context of food and a mean rating of 4.69 (sd = 0.82) when evaluated in the context of biotechnologies, see Figure 9.1. These ratings were both found to be significantly negative, $t(39) = 5.52$, $p < 0.001$ (Cohen's $d = 1.24$) and $t(39) = 5.53$, $p < 0.001$ (Cohen's $d = 1.16$) respectively. Ratings of GM food in the different contexts of food and biotechnology were not significantly different from one another ($t(39) = -0.158$, $p = 0.875$) and the effect size of the difference was very small (Cohen's $d = 0.01$). Participants provided a mean rating of 3.76 (sd = 0.72) to the other biotechnologies questioned about and a mean rating of 2.53 (sd = 0.72) to the other foods questioned about, both of which were significantly positive ratings $t(39) = -2.10$, $p < 0.05$ (Cohen's $d = -0.47$) and $t(39) = -12.83$, $p < 0.001$ (Cohen's $d = -2.89$) respectively. Mean ratings of other biotechnologies were significantly more negative than mean ratings of other foods ($t(39) = 8.04$, $p < 0.001$; Cohen's $d = 1.71$). The difference between ratings of GM food (provided in the context of other foods) and ratings of other foods was found to be significant ($t(39) = 12.729$, $p < 0.001$; Cohen's $d = 2.85$) as were differences between ratings of GM food (provided in the context of other biotechnologies) when compared with ratings of other biotechnologies ($t(39) = 6.640$, $p < 0.001$; Cohen's $d = 1.21$).

<u>Figure 9.1. Mean explicit ratings of categories evaluated.</u>



GM foods - F = Ratings of GM foods when presented in a context of other foods

GM foods - B = Ratings of GM foods when presented in a context of other biotechnologies

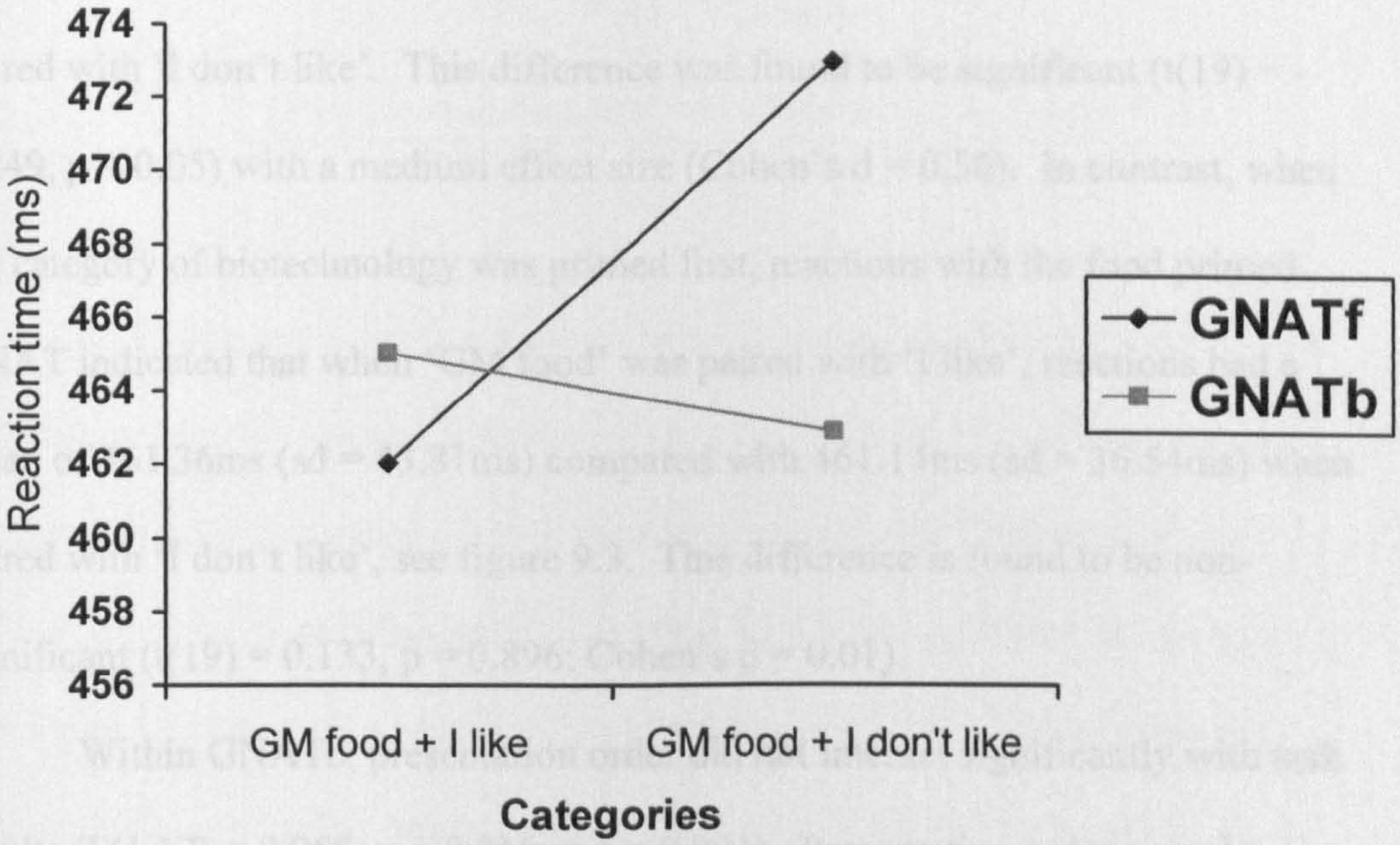
9.4.2. GNATs

In a similar way to the duplicated explicit questions regarding GM food, the GNATs evaluating context-free implicit attitudes towards GM food were also administered twice in different frames. One GNAT was administered immediately after the explicit questions that framed GM food in the context of foods (this task will be referred to as GNATf) and one GNAT was administered after the explicit questions framing GM food in the context of biotechnologies (this task will be referred to as GNATb).

GNATs used here were evaluated using reaction times. Due to non-normal distributions, reaction times were log transformed although means and standard deviations will be provided in untransformed data for clarity. The mean error rates for GNATf and GNATb were 4.83% and 5.67% respectively. One person's data for GNATb had to be removed because they did not provide responses in one of the sections of the task. Internal consistencies were found to be acceptable; GNATfood demonstrated a split-half reliability of $r = 0.47$, $p < 0.01$, and GNATbio demonstrated a split-half reliability of $r = 0.48$, $p < 0.01$ (after adjustment using Spearman-Brown correction).

In GNATf it was found that the mean reaction time to 'GM food' when associated with 'I like' was 462.04ms (sd = 40.77ms) and when associated with 'I don't like' was 472.99ms (sd = 39.82ms). Implicit attitudes towards GM food were, therefore, positive when previously primed as a food but this effect is only approaching significance ($t(39) = -1.818$, $p = 0.077$). The size of this effect was classed as small with a Cohen's d of -0.27. Mean reaction times in GNATb were found to be 465.02ms (29.93ms) when 'GM food' was associated with 'I like' and 462.88ms (31.93ms) when 'GM food' was associated with 'I don't like'. There was no significant difference between these conditions ($t(38) = 0.415$, $p = 0.680$) and the size of the effect was classed as very small with a Cohen's d of 0.07. GNAT effects were also compared between priming conditions and it was found that the food prime utilised, prior to GNAT completion, resulted in GM food being perceived more positively than when a biotechnology prime was used. However, differences were only approaching significance ($F(1,38) = 3.365$, $p = 0.071$; $\eta_p^2 = 0.083$), see Figure 9.2.

Figure 9.2. Mean reaction times within GNATf and GNATb

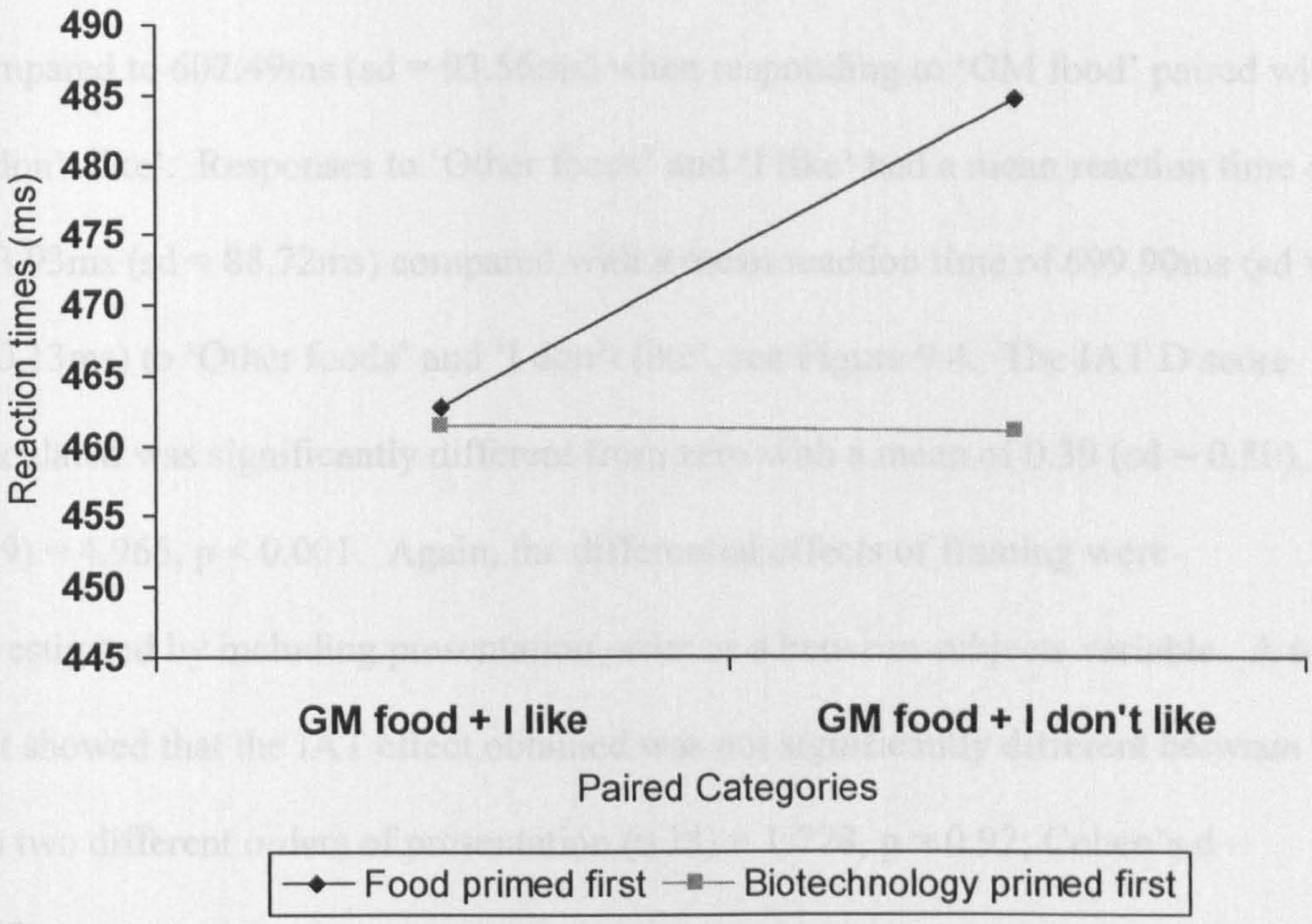


It is possible that the lack of framing effects found on task performance may have been due to overshadowing effects of the previous frame. In other words, due to the counterbalancing procedures that meant that half of the participants were provided with a food frame first and half provided with a biotechnology frame first, the second framing effect may not have been enough to counteract the first frame. To investigate this, presentation order was included in the analyses as a between subjects variable.

Within GNATf, the interaction of presentation order and task results was found to be approaching significance ($F(1,38) = 3.251$, $p = 0.079$; $\eta_p^2 = 0.079$). This interaction was examined further by splitting data by presentation order. The difference between reactions to the 'GM food' category when associated with 'I like' or 'I don't like' was much greater when the food prime was presented first. When the category of food was primed first, reactions within the food primed GNAT indicated that when 'GM food' was paired with 'I like', reactions had a mean of 462.72ms (sd = 38.61ms) compared to 484.84ms (sd = 40.30ms) when paired with 'I don't like'. This difference was found to be significant ($t(19) = -2.249$, $p < 0.05$) with a medium effect size (Cohen's d = 0.56). In contrast, when the category of biotechnology was primed first, reactions with the food primed GNAT indicated that when 'GM food' was paired with 'I like', reactions had a mean of 461.36ms (sd = 43.81ms) compared with 461.14ms (sd = 36.54ms) when paired with 'I don't like', see figure 9.3. This difference is found to be non-significant ($t(19) = 0.133$, $p = 0.896$; Cohen's d = 0.01).

Within GNATb, presentation order did not interact significantly with task results ($F(1,37) = 0.055$, $p = 0.816$; $\eta_p^2 = 0.001$). Presentation order was also found to have a non-significant influence on the differences between GNATf and GNATb ($F(1,37) = 1.459$, $p = 0.235$; $\eta_p^2 = 0.038$).

Figure 9.3. Reactions within GNATf split by presentation order

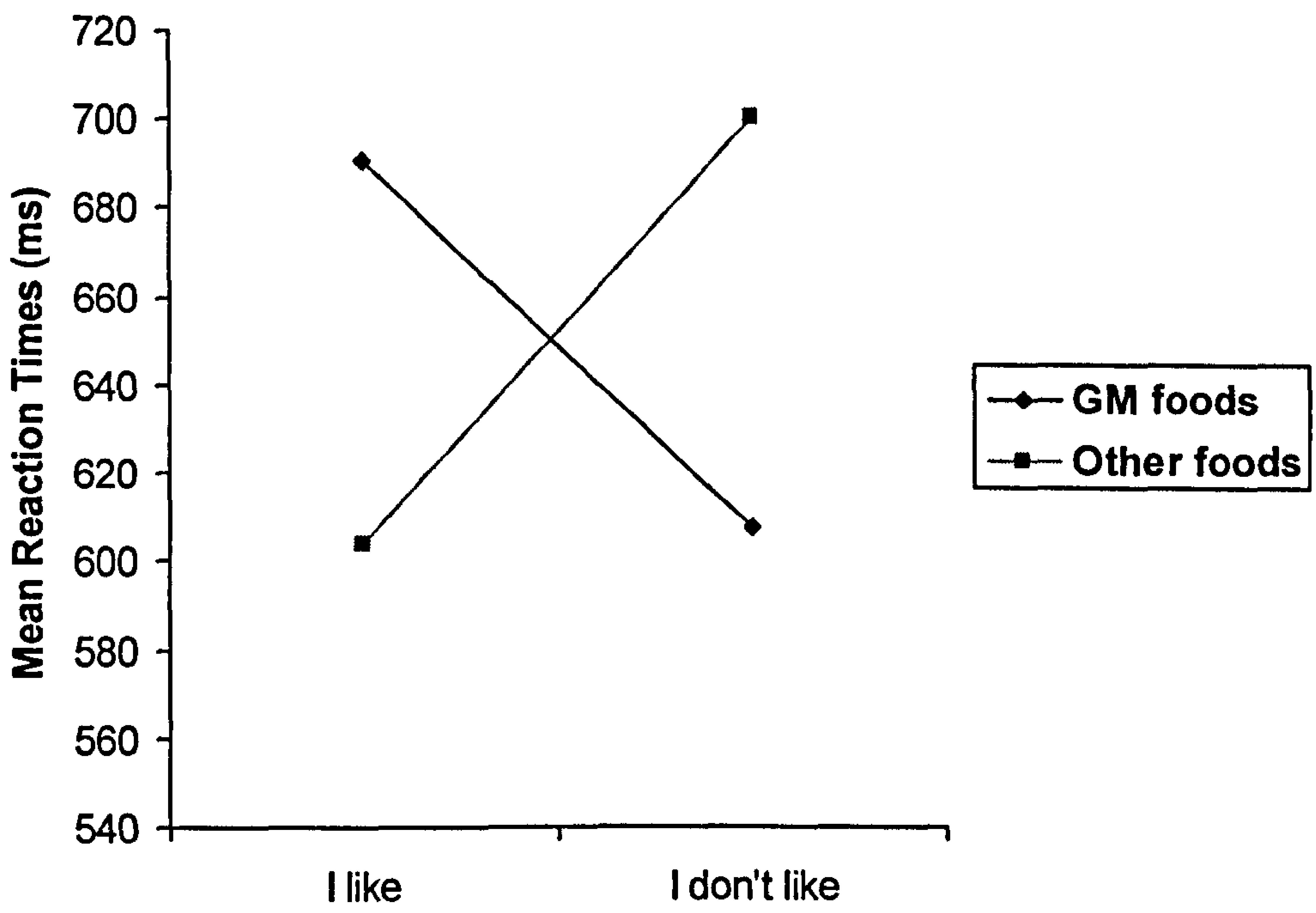


9.4.3. IATs

IATs that participants completed were analysed using Greenwald, Nosek and Banaji's (2003) improved scoring algorithm. This involved removing any participants who responded to more than 10% of trials with latencies of under 300ms (zero cases) and eliminating any trials which had response latencies of more than 10,000ms (zero cases). Error data was replaced with the mean of correct responses for the same response block plus 600ms. The resulting block means obtained from concept-attribute pairings were then subtracted from block means with opposing concept-attribute pairings and divided by the pooled standard deviation calculated for both blocks. Participants made an average of 10.99% errors during IATf and an average of 10.86% errors during IATb. Internal consistencies were found to be good; IATf demonstrated a split-half reliability of $r = 0.84$, $p < 0.001$, and IATb demonstrated a split-half reliability of $r = 0.81$, $p < 0.001$ (after adjustment using the Spearman – Brown correction).

Within IATf, participants evidenced a mean reaction time of 690.31ms (sd = 137.24ms) when responding to 'GM food' paired with the category 'I like' compared to 607.49ms (sd = 93.56ms) when responding to 'GM food' paired with 'I don't like'. Responses to 'Other foods' and 'I like' had a mean reaction time of 603.93ms (sd = 88.72ms) compared with a mean reaction time of 699.90ms (sd = 140.13ms) to 'Other foods' and 'I don't like', see Figure 9.4. The IAT D score calculated was significantly different from zero with a mean of 0.39 (sd = 0.50), $t(39) = 4.965$, $p < 0.001$. Again, the differential effects of framing were investigated by including presentation order as a between subjects variable. A t-test showed that the IAT effect obtained was not significantly different between the two different orders of presentation ($t(38) = 1.728$, $p = 0.92$; Cohen's $d = 0.55$).

Figure 9.4. Mean reaction times in IATF



Performance in IATb produced a mean reaction time of 669.08ms (sd = 115.21ms) when 'GM food' was paired with 'I like' and of 682.93ms (sd = 117.69) when paired with 'I don't like'. The target category of 'Other Biotechnologies' produced a mean reaction time of 688.03ms (sd = 123.29ms) when paired with 'I like' and a mean reaction time of 666.21ms (sd = 107.95ms) when paired with 'I don't like'. The IAT D score demonstrated a mean of -0.06 (sd = 0.49) which was not significantly different from zero, $t(39) = -0.747$, $p = 0.460$. Including presentation order as a between subjects variable within an independent samples t-test indicated that order did not have a significant influence on IATb effects ($t(38) = 0.583$, $p = 0.563$; Cohen's $d = -0.04$).

9.4.4. Correlations

Correlations between implicit attitude tasks (the GNAT and the IAT) were all non-significant as were correlations between implicit attitude tasks and explicit attitude measures (see Figure 9.6). However, explicit attitudes held towards GM food when measured in the context of food were significantly correlated with explicit attitudes towards GM food when this was measured in the context of biotechnologies.

Figure 9.6. Correlations between explicit attitude measures, implicit attitude measures and knowledge measures (Pearson's r)

	Explicit GM foods rating (food context)	Explicit GM foods rating (biotech. context)	IATf - GM foods	IATb - GM foods	GNATf
Explicit GM foods rating (food context)	-				
Explicit GM foods rating (biotech. context)	0.916**	-			
IATf - GM foods	0.192	0.224	-		
IATb - GM foods)	0.052	0.029	0.212	-	
GNATf	0.013	-0.058	0.255	-0.226	-
GNATb	-0.098	-0.140	0.099	-0.198	0.191

* = significant to $p < 0.005$

** = significant to $p < 0.001$

9.5. Discussion

9.5.1. Explicit attitudes

Explicit ratings of GM food were negative in both contexts that they were presented in and were rated as significantly more negative than other biotechnology and other food contexts. This contrasts with previous findings that indicated that people were overall ambivalent towards GM food (Gaskell, Allum, and Stares, 2003; Poortinga and Pidgeon, 2004). It is possible that the difference noted between this study and previous studies may be due to the context in which explicit attitudes were obtained. Both contexts used (of other biotechnologies and of other foods) were rated positively and, therefore, it is possible that GM food was rated as negative in comparison to these positive context categories. This explanation is supported by previous research that has found that perceptions of GM food were influenced by the context in which questions are presented (Fife-Schaw and Rowe, 2000; Townsend et al., 2004). Another explanation for the difference between findings of the current study and previous findings may be due to the characteristics of the population examined within this study. The participant sample used within this study was made up of undergraduate students and, therefore, did not constitute a representative sample of the British population. Previous research conducted by Noussair et al., (2004) has indicated that people with a higher level of education are more negative towards GM food and, therefore, the high education level of the participant sample used here may help to explain findings.

Positive reactions to the category of food were expected and this is in line with previous research (Conner and Armitage, 2002), however positive reactions to other biotechnologies were not expected and this contrasts with previous research that indicated that people were ambivalent towards biotechnologies (Gaskell, Allum and Stares, 2003). This may be reflective of the increasing optimism noted towards biotechnologies across Europe (Gaskell, Allum and Stares, 2003). Explicit ratings of food were significantly more positive than biotechnologies indicating that the use of these categories as primes was likely to provoke significantly different reactions.

Interestingly, there was no significant difference found in the explicit ratings of GM food when these were presented in the differing contexts of food and of biotechnologies. It is likely that in addition to being primed as a member of each of these categories, GM food was contrasted with other members of these categories included within the explicit questions; a combination of processes may therefore be impacting on the measurement of explicit attitudes here

9.5.2. Implicit attitudes

The impact of context on implicit attitudes was found to be significant when GM food was contrasted with related categories, in line with hypotheses, but only marginally significant when GM food was primed as a member of these related categories. Contrast effects of context, as measured by IATs, showed clearly that evaluations of GM food were significantly more negative than evaluations of other foods but were not significantly different than evaluations of other biotechnologies.

The effects of priming different contexts on implicit attitudes were less clear. The priming manipulation was theorised to increase the salience of the super-ordinate category primed and also draw attention to that category by asking participants to consider their evaluations of that category. However, participants who were primed to consider their evaluations of the super-ordinate category of food resulted in only marginally positive measurements of implicit attitudes towards GM food when measured in a context-free manner, whereas, participants who were primed to consider their evaluations of biotechnologies resulted in neutral measurements of implicit attitudes towards GM food. In addition, the differences between the results of the GNAT between the two priming conditions were only marginally significant.

Results may, therefore, be interpreted in (at least) two different ways. It may be that measurements of implicit attitudes towards GM food were not affected when primed by attitudinal judgments of related super-ordinate categories. This implies that either implicit attitudes towards the super-ordinate category of food were not positive or that information regarding the food prime was not assimilated into the representation of GM food as was intended. On the other hand, it is possible that the lack of significant effects noted was because the size of the effect under examination was quite small. One possible reason for this may have been that the priming technique was not as effective as it could have been. The possibility that the within subjects design of this task may have resulted in overshadowing effects between the primes has also been considered. This was investigated by including presentation order within analyses; however, results were only marginally significant. Examining effects within this marginally significant result closer did indicate that some overshadowing may have occurred though. When data was split by presentation order, hypothesised effects emerged clearly with GM foods being evaluated positively when primed as a food and neutral when primed as a biotechnology.

It is concluded that context is an important influence on implicit attitudes towards GM food particularly when GM food is contrasted with other products or categories. Results with regards to the effects of priming on implicit attitudes towards GM food are as yet inconclusive and further research would be useful to clarify this finding.

9.5.3. Correlations

Correlations between explicit measures and both of the implicit measures (the GNAT and the IAT) were non-significant, which is in accordance with much research, particularly that which has examined the relationship between implicit and explicit attitudes within controversial topics (e.g. Kawakami and Dovidio, 2001). There are a variety of potential moderators of the relationship between implicit and explicit attitudes (Nosek, 2005) including self-presentation effects and attitude strength. Another possible reason for discordance between implicit and explicit attitudes is that the tasks used are simply measuring different things. From the viewpoint of the dual attitude model (Wilson et al., 2000) it would be suggested that the tasks may be measuring two distinct attitudes that an individual holds towards the same attitude object.

Correlations between implicit attitude measures were also non-significant. The contextual manipulations employed were likely to have significantly altered the way that GM food was categorised between tasks. The inclusion/exclusion model (Schwartz and Bless, 1992) would suggest that within the IATs, GM food was contrasted with the super-ordinate categories of food and of biotechnologies. In this way, the IAT in which GM food was contrasted with food is likely to have influenced participants to exclude information regarding food from their representation of GM food. Similarly, the IAT in which GM food was contrasted with biotechnologies is likely to have influenced participants to exclude information regarding biotechnologies from their representation of GM food. With regards to completion of the context-free GNATs which were primed with evaluations of the categories of food and biotechnologies, the inclusion/exclusion model would suggest that these tasks will have influenced participants to assimilate primed information with their representations of GM food. The GNAT that was primed with evaluations of the category of food would have influenced participants to include food information in their representations of GM food. In contrast, participants who completed the GNAT that was primed with evaluations of the category of biotechnology were likely to include information regarding biotechnologies in their representations of GM food. It was, therefore, expected that implicit attitudes would differ between tasks and measurement contexts.

9.6. Experiment two: The comparison of priming effects on implicit attitudes towards GM foods using a between subjects design

A second experiment was conducted in order to clarify hypothesised assimilation effects of priming within implicit attitudes towards GM food, measured by the GNAT. The marginal significance of the effects noted within the previous study may be due either to random error, or to a small effect size. A further experiment was considered necessary in order to examine this effect in a more sensitive manner.

Experiment two was a much shortened version of experiment one that concentrated solely on priming effects on implicit attitudes towards GM food, as measured by the GNAT. Several alterations were made in order to increase the sensitivity of the experiment. A between subjects design was used to reduce overshadowing effects of participants receiving two different primes. The salience of the prime was increased and the sensitivity of the GNAT was increased by shortening the response window within which participants were required to make responses.

9.7. Method

9.7.1. Design

This experiment had a between subjects design with one factor: this was the category of the prime used and it had two levels, food or biotechnology prime. The design was similar to experiment one within this chapter but shorter, containing only explicit attitude questions and a GNAT which examined implicit attitudes towards GM food in a context-free manner. Again, explicit attitude questions regarding GM food and either the categories of food or biotechnology were used in order to prime GM food as part of the category of food or as part of the category of biotechnology. These primes were used to increase the accessibility of these super-ordinate categories and also the attitudes held towards these categories which would increase the attention given to these categories. Following this, a GNAT was used to examine implicit attitudes towards GM food in a context-free manner.

9.7.2. Participants

Forty participants (seven males and 33 females) were recruited using convenience sampling. Participants were recruited topic blind and were simply told that the experiment was being conducted to investigate attitudes. Seventeen participants were recruited and tested during a practical class held at the University of Nottingham and the remaining 23 participants were approached in computer rooms on the campus at the University of Nottingham and asked if they would participate in the experiment. Participants were all undergraduate students at the University of Nottingham.

9.7.3. Materials

Materials used were similar to those used in experiment one presented in this chapter. Again, two sets of direct explicit questions were used and again these examined attitudes towards GM food amongst either other food types or amongst other biotechnologies. The questions were slightly adjusted for this experiment though. The number of questions was reduced from 12 to eight to reduce time needed for participation, see Appendix ten. The title of the question paper was altered to read either 'Attitudes towards foods' or 'Attitudes towards biotechnologies' for food questions and biotechnology questions respectively in order to increase the salience of the categories with the aim of increasing the priming effect.

The GNATs used within this experiment were almost identical to those used in the previous experiment and again examined implicit attitudes towards GM foods in a context-free manner. The only difference between the GNATs used here and the GNATs used in the previous experiment was that the response deadline was altered for this experiment. It has previously been noted that effect sizes increase as response deadlines decrease (Nosek and Banaji, 2001), therefore, it was considered useful to decrease the response deadline used in order to increase the likelihood of detecting any effects present. In this experiment, a response deadline of 800ms was used for target words and a response deadline of 400ms was used for distracter items.

9.7.4. Procedure

Participants were asked to firstly complete explicit questions and then complete a GNAT. The type of explicit questions that participants received (regarding foods or regarding biotechnologies) was counterbalanced between participants. Again two versions of the GNAT was used; one in which 'GM food' was paired with the category of 'I like' first and one in which 'GM food' was paired with the category of 'I don't like' first in order to counteract overshadowing effects. The version of the GNAT that was completed first was counterbalanced between participants.

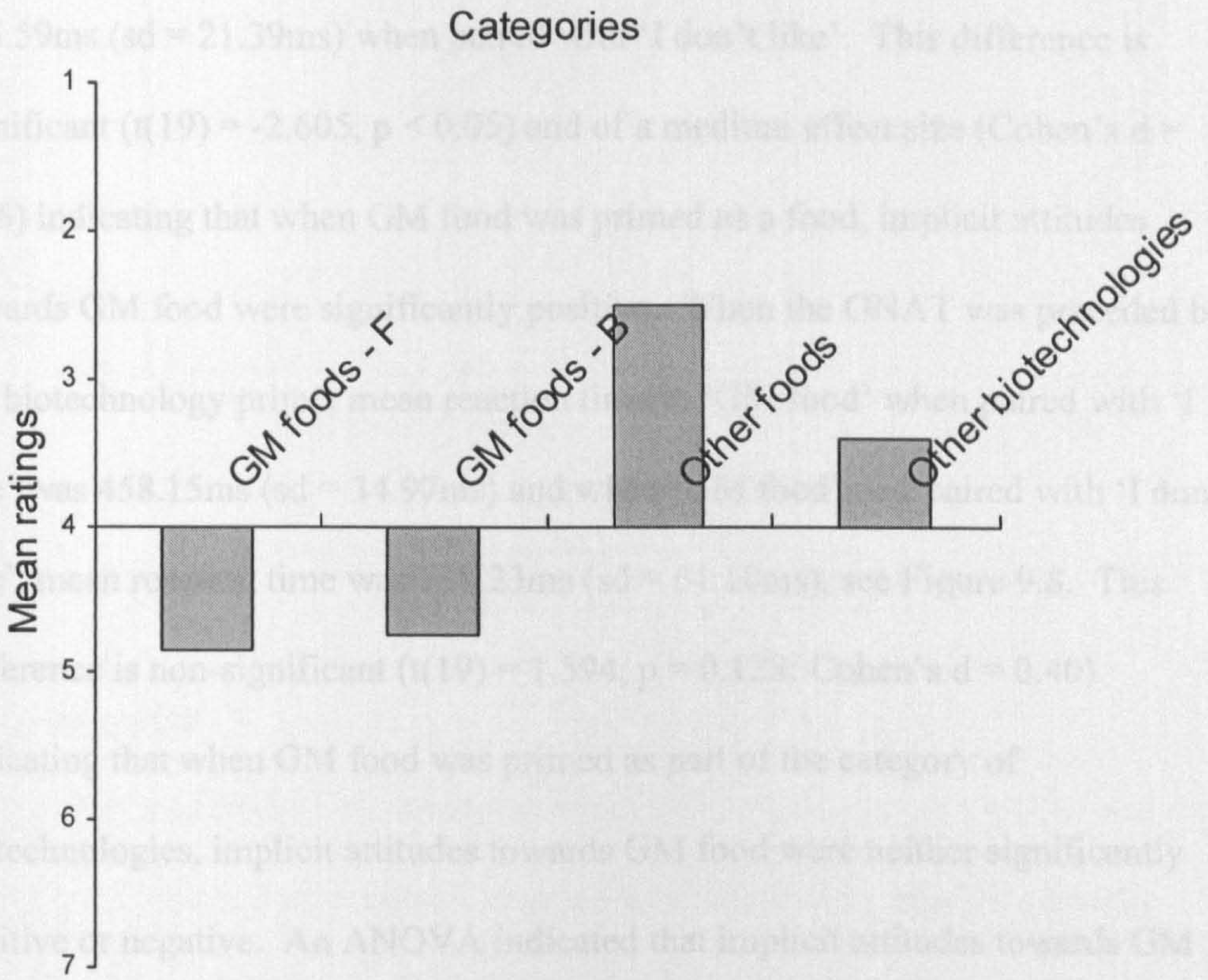
9.8. Results

9.8.1. Explicit measures

Explicit attitude ratings of GM food were made on a scale of one to seven, where one indicated strong like and seven indicated strong dislike, see Figure 9.7. Half of all participants rated GM food amongst other foods and half rated GM food amongst other biotechnologies. GM food had a mean rating of 4.85 (sd = 0.93) when rated amongst other foods and of 4.75 (sd = 1.52) when rated amongst other biotechnologies. Both of these ratings are found to be significantly negative $t(19) = 2.210$, $p < 0.05$ (Cohen's $d = 1.29$) and $t(19) = 4.073$, $p < 0.05$ (Cohen's $d = 0.70$) respectively. Participants' ratings of GM foods, in the different contexts of food and biotechnology, were not significantly different from one another ($t(38) = 0.251$, $p = 0.803$; Cohen's $d = 0.13$).

Ratings of other food types had a mean of 2.50 (sd = 1.32) which was found to be significantly positive ($t(19) = -5.09$, $p < 0.001$; Cohen's $d = -1.61$) and ratings of other biotechnologies had a mean of 3.40 (sd = 1.23) which was also significantly positive ($t(19) = -2.179$, $p < 0.05$; Cohen's $d = -0.69$). Other food types were rated as significantly more positive than other biotechnologies ($t(38) = -2.232$, $p < 0.05$; Cohen's $d = -0.71$). Ratings of GM food obtained amongst ratings of other food types were found to be rated as significantly more negative than these other food types ($t(19) = 7.513$, $p < 0.001$; Cohen's $d = -2.06$). Similarly, ratings of GM food that were obtained amongst questions regarding attitudes towards other biotechnologies were found to be rated as significantly more negative than these other biotechnologies ($t(19) = 4.620$, $p < 0.001$; Cohen's $d = 0.98$).

Figure 9.7. Mean explicit ratings of categories evaluated



GM foods - F = Ratings of GM foods when presented in a context of other foods

GM foods - B = Ratings of GM foods when presented in a context of other biotechnologies

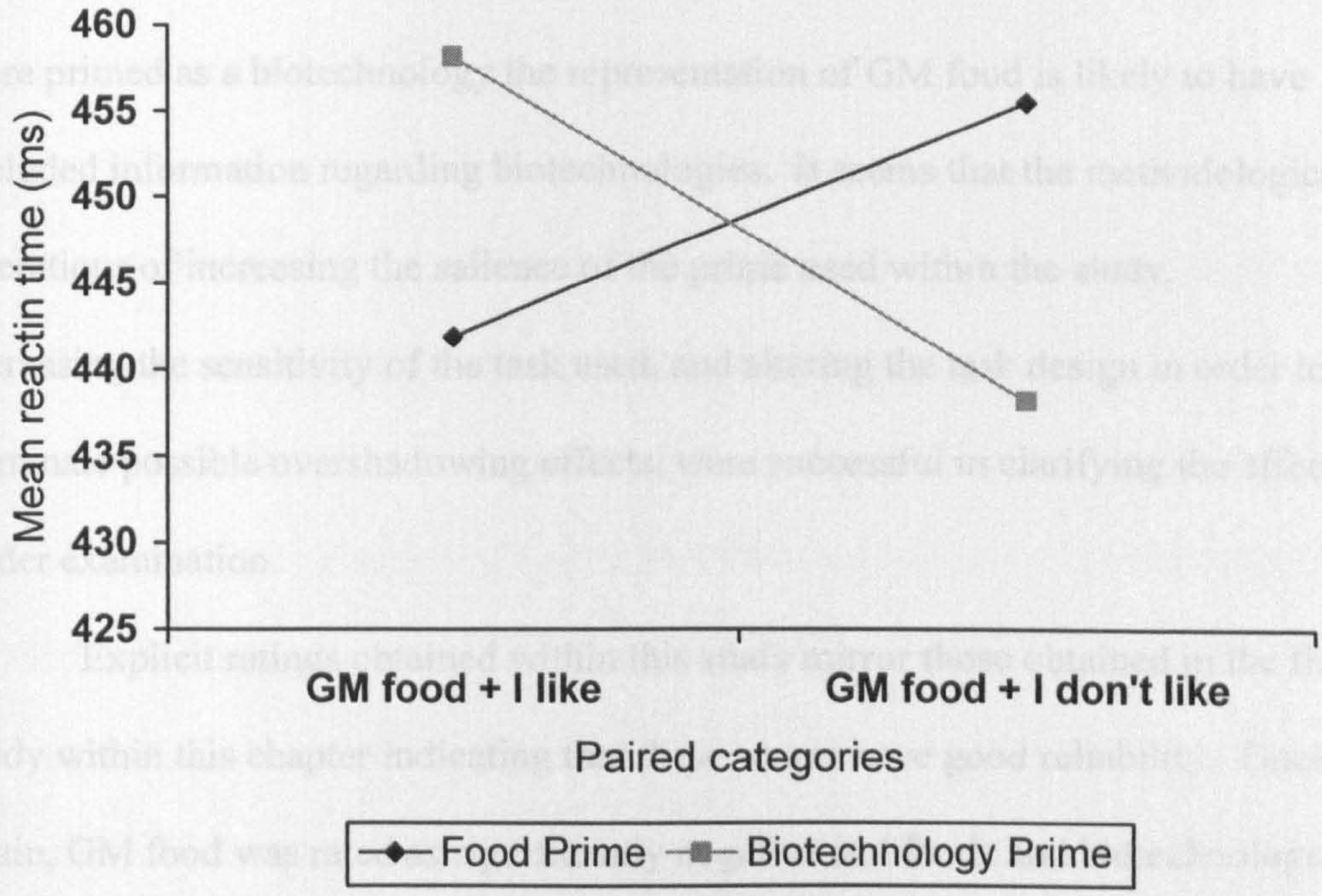
9.8.2. GNATs

The GNATs used here were evaluated using reaction times and results were log transformed to meet normality assumptions although means and standard deviations are provided in untransformed data for clarity. The mean error rate for GNATs completed was 3.47%. Internal consistencies were good with a split half reliability of $r = 0.47$ ($p < 0.05$) for the GNAT that was preceded by the food prime and a split half reliability of $r = 0.39$ ($p < 0.05$) for the GNAT that was preceded by the biotechnology prime (after adjustment using the Spearman-Brown correction).

In the GNAT that was preceded by the food prime, mean reaction time to 'GM food' when paired with 'I like' was 441.89ms (sd = 27.39ms) compared to 455.59ms (sd = 21.39ms) when paired with 'I don't like'. This difference is significant ($t(19) = -2.605$, $p < 0.05$) and of a medium effect size (Cohen's d = 0.56) indicating that when GM food was primed as a food, implicit attitudes towards GM food were significantly positive. When the GNAT was preceded by the biotechnology prime, mean reaction time to 'GM food' when paired with 'I like' was 458.15ms (sd = 34.97ms) and when 'GM food' was paired with 'I don't like', mean reaction time was 438.23ms (sd = 61.10ms), see Figure 9.8. This difference is non-significant ($t(19) = 1.594$, $p = 0.128$; Cohen's d = 0.40) indicating that when GM food was primed as part of the category of biotechnologies, implicit attitudes towards GM food were neither significantly positive or negative. An ANOVA indicated that implicit attitudes towards GM food, as measured by the GNAT, were significantly more positive when GM food was primed as part of the food category than when primed as part of the category of biotechnologies ($F(1, 38) = 5.658$, $p < 0.05$; $\eta_p^2 = 0.130$).

Correlations between implicit attitudes towards GM food, as measured by the context-free GNAT, and between explicit attitudes towards GM food were non-significant ($r = -0.183$, $p = 0.259$).

Figure 9.8. Mean reaction times to GNATs evaluating implicit attitudes towards GM foods when primed with foods or biotechnologies



9.9. Discussion

Findings clearly indicated that when participants were primed so that the category of food and its related evaluation were accessible, implicit attitudes towards GM food were positive when measured in a context-free manner. When participants were primed so that the category of biotechnologies and its related evaluation were accessible, implicit attitudes towards GM food were neutral when measured in a context-free manner. Implicit attitudes towards GM food were significantly more positive when GM food was primed as a food than when primed as a biotechnology.

This builds on effects noted in experiment one reported in this chapter and indicates that priming participants to consider GM food in different ways will have an important effect on implicit attitudes towards GM food. Differences are attributed to the way in which priming encouraged participants to categorise GM food. According to the inclusion/exclusion model (Schwarz and Bless, 1992) when GM foods were primed as a food the representation of GM food is likely to have included information regarding food in general, whereas when GM foods were primed as a biotechnology the representation of GM food is likely to have included information regarding biotechnologies. It seems that the methodological alterations of increasing the salience of the prime used within the study, increasing the sensitivity of the task used, and altering the task design in order to eliminate possible overshadowing effects, were successful in clarifying the effect under examination.

Explicit ratings obtained within this study mirror those obtained in the first study within this chapter indicating that these scores have good reliability. Once again, GM food was rated as significantly negative and foods and biotechnologies were rated as significantly positive. Additionally, GM food was rated as significantly more negative than foods and biotechnologies. GM food was again not rated significantly differently when this was presented amongst food compared with when this was presented amongst biotechnologies. It is likely that this is because a variety of processes impacted upon the reporting of explicit attitudes including both priming and contrast effects. Further to this, correlations between explicit and implicit attitudes towards GM food were again non-significant. It is likely that extraneous factors, e.g. self-presentation, attitude strength, impacted upon the implicit-explicit attitude relationship.

One shortcoming of the research contained within this chapter is that implicit attitudes towards the super-ordinate categories of food and of biotechnologies were not measured. Although previous research has indicated that explicit attitudes towards food are positive and explicit attitudes towards biotechnologies are neutral, there is no known research that has examined implicit attitudes towards these categories. It would have been more thorough to establish what implicit attitudes are towards these categories prior to completing the experiments contained within this chapter.

The results of this study help to further understand the results obtained in the study conducted within chapter eight of this thesis which found that implicit attitudes towards GM foods were evaluated positively when evaluated in a context-free manner. One possible explanation proposed for this was that the positive associations discovered were actually towards the more general category of food rather than towards GM food itself. Although the findings from the current study do not conclusively prove this explanation, they do add support to this possibility because positive implicit attitudes were found towards GM food when this was primed as a food. Participants within the study reported in chapter eight were likely to consider GM food as part of the category of food as other food categories of organic foods and ordinary foods were also examined within this study and these may have acted as an inadvertent prime.

It is interesting to compare results obtained within the current chapter to results obtained within the previous chapter, chapter eight, in which a GNAT with a context of ordinary food was utilised. This task could in some sense be thought of as similar to the IAT which contrasted GM food with other food used in experiment one within this chapter and also the GNATs that examined GM food in a context-free manner after participants had been primed to consider GM food as a food. It is proposed that each of these tasks is slightly different though. The IAT in which GM food was contrasted with other food (reported in experiment one within this chapter) required that participants consider their evaluations of other food alongside their evaluations of GM food and the IAT effect was, therefore, made up of a combination of these evaluations. Within the GNAT that utilised a context of ordinary food (reported within chapter eight), participants would have concentrated on the evaluation of GM food and the context of ordinary food would have served to have made GM food salient as a food but also would have made the quality of 'GM' the nominal feature for the basis of evaluation (Mitchell et al., 2003). In a different way, the context-free GNAT that utilised a food prime prior to completion (reported within experiments one and two within this chapter) made GM food salient as a food without highlighting its 'GM' quality. The differences between these three tasks are upheld by the differences in results that they displayed. The IAT that compared GM food and other food indicated that GM food was perceived more negatively than other food. The GNAT that utilised a context of ordinary food found that GM food was evaluated as neutral in that context. The context-free GNAT that utilised a food prime prior to completion indicated that GM foods were evaluated as positive. Thus, subtle differences in task methodology and the influence that this has on context and the salience of different features of the target concept are important in determining results.

Although our studies demonstrated that context effects were important influences on implicit attitudes towards GM food they did not add to the understanding of why these effects exist. Results could equally be explained by the view that attitudes were temporarily shifted in light of primes or context, of the view that attitudes are constructed afresh in the light of each situation, or the dual attitude view that multiple attitudes exist and which one is activated will depend on the situation and context.

9.9.1. Conclusions

It is apparent that although research within chapter eight demonstrated that measures of implicit attitudes towards GM food were positive, the situation in which evaluation occurs is a key determinant of this attitude. Here, when GM food was viewed as a food, implicit attitudes were positive and when these were viewed as a biotechnology, implicit attitudes were negative. Additionally, when GM food was contrasted with other foods, implicit attitudes towards GM food were negative. When GM food was contrasted with biotechnologies, however, implicit attitudes towards GM food were neutral.

Findings have important implications for the presentation of GM food to consumers as well as for methodological implications in evaluating attitudes towards GM food. Clearly contextual cues are extremely important in both situations and can significantly manipulate the outcome of interactions with GM food. It seems that if there is a distinct choice between GM food and other foods, people are likely to choose other foods. However, if there were a choice between GM food and some other biotechnology (albeit most probably a hypothetical choice), people would be equally likely to choose GM food as that other biotechnology. It would be beneficial for those marketing GM food to highlight its membership of the category of food and downplay its membership of the category of biotechnologies.

9.9.2. Future research

Further research into the associations between contextual influences and attitudes should also examine the related construct of attitude strength. It is suggested that stronger attitudes may be more resistant to contextual influences than weaker attitudes. In relation to this, it is possible that those with a higher level of knowledge about an attitude object, who are likely to hold stronger attitudes, may be less susceptible to context effects that those with a lower level of knowledge. It would be interesting to examine this possibility by examining attitude strength and knowledge alongside context effects on implicit attitudes.

Results obtained from the current study added support to the theory that positive implicit attitudes held towards GM food may stem from a positive implicit attitude held towards all food types. It would be useful to directly examine this hypothesis. This could be done by examining correlations between implicit attitudes towards GM food and implicit attitudes towards the general category of food. Alternatively, the extent to which participants view GM food as a food or as a biotechnology could be measured and examined to see if this is predictive of implicit attitudes towards GM food.

It would also be useful for future research to examine the predictive validity of implicit attitudes towards GM food. To date, there has been no examination of whether implicit attitudes are useful predictors of behaviour within this domain. It is noted that unless implicit attitudes predict significant amounts of variance in behaviour above and beyond that predicted by explicit attitudes, the usefulness of the construct is limited. The predictive validity of implicit attitudes will be examined within the following chapter, chapter ten. Chapter ten will examine how implicit and explicit attitudes towards GM food may best be combined to predict behaviour towards GM food.

Chapter Ten - Predicting GM Food Behaviour with Implicit and Explicit Attitudes

10.1 Introduction

Ultimately, one of the main reasons for examining attitudes towards GM food is in order to predict future behaviour with regards to this technology. As previously noted, there has been a dearth of research examining actual behaviour towards GM food and this is partly due to practical reasons in that it is not widely available in Britain yet. The availability of GM food in Britain is likely to increase in the future though and, therefore, it is of increasing importance to gain an insight into potential behaviour towards GM food. Further to this, it is theoretically interesting to examine how implicit and explicit attitudes relate to behaviour in novel domains and how these relations may differ depending on the situation.

This chapter will briefly recap evidence regarding empirical research into behaviour towards GM food and extend this by examining research into the way that specific attributes of GM food have an impact upon peoples' behavioural reactions. The predictive validity of explicit attitudes and implicit attitudes will also be examined in some depth. Consideration will be given to previous research regarding the best way that explicit and implicit attitude constructs may be combined, or dissociated, in order to predict behaviour. The final experiment of this thesis will then be described. This experiment examined how implicit and explicit measures of attitude towards GM food could best be utilised in order to predict behaviour towards GM food.

Of course, behaviour differs depending on the situation and, therefore, some thought will be given to how the predictive validity of explicit and implicit attitudes may vary depending on the situation.

10.2. Behaviour towards GM food

To date, there has been little research investigating behaviour towards GM food, and even less that has examined behaviour towards GM food in Britain. This is mainly due to the fact that GM food is not widely available within Britain. Chapter five (section 5.3.1.) examined the methodologies that have been used in order to examine behaviour towards GM food, as well as actual research that has previously been conducted with this aim, both in Britain and abroad. Overall, it is evident that most research indicates that a significant amount of people are likely to purchase and try GM food. However, results differ a great deal between different studies and this is attributed to differences in methods and the context of the task. For example, some tasks utilise self-report questions, whereas others use real choice situations and some tasks offer participants GM food to try for free, whereas others utilise a context of money. It is apparent that both within Britain and abroad, studies find that behavioural results regarding the amount of people who are willing to try GM food are much higher than has been indicated by surveys of explicit attitudes within the same countries.

Behaviour towards GM food is likely to differ in relation to the particular features of the specific GM product encountered. Michael Burton and colleagues have examined characteristics of GM produce using conjoint analysis (see chapter five, section 5.3.1.2. for a review) in both Australia and Britain and found that GM food produced from plants was more likely to be accepted than GM food produced from animals (Burton et al., 2001; James and Burton, 2003). In addition, GM food was found to be more widely accepted when it was associated with the reduced use of chemicals, was locally produced, had less environmental risk and was safer than alternatives. Another study, which used a willingness-to-pay contingent valuation task to examine acceptance of GM food, found that consumers were more likely to pay a higher premium to avoid GM food if they associated GM food with risks to health or the environment or if they thought these were morally wrong (Moon and Balasubramanian, 2003). In addition, participants were more likely to try and avoid GM food if they associated GM food with the growing control of multinational corporations and if they saw multinational corporations as being the primary beneficiaries of biotechnology. On the other hand, if participants associated GM food with benefits such as, the reduction of chemical use in crop production, improved nutritional content, and potential increase in yields, they were more likely to accept GM food.

The features highlighted in these studies of behaviour accord with some of the perceptual features highlighted as positive and negative in studies of attitudes towards GM food (Frewer, Howard and Shepherd, 1998a; 1998b) as well as some of the personal constructs highlighted in relation to biotechnologies within chapter three. Overall, features seem to broadly relate to health, the environment, economics and morals. There is also evidence that some of these benefits may be more important to consumers than others, for example it has been found that health benefits were more important to consumers than economic benefits (Magnusson and Hursti, 2002; Frewer et al., 1996).

One of the main features that has been associated with the acceptance of GM food is cost. Several studies have shown that the acceptance of GM food increased as cost of the food decreased (Burton et al., 2001; Moon and Balasubramanian, 2003; James and Burton, 2003). Moon and Balasubramanian (2003) found that consumers were willing to pay a mean of approximately £0.44 to purchase non-GM breakfast cereal rather than GM breakfast cereal (see chapter five, section 5.3.23 for a full review). However, evidence from chapter five of this thesis found a higher difference in valuations of GM and non-GM food of £1.20. Differences between studies may be attributable to differences in methodology as well as due to the differences in the goods examined; a greater cost difference may be required in order to induce consumers to purchase luxury GM food, such as chocolate, than is required for more staple GM food, such as breakfast cereal.

10.3. Predictive value of implicit and explicit attitudes

The predictive validity of explicit and implicit attitudes is extremely important because if implicit attitudes do not differ significantly from explicit attitudes, and if they do not provide additional information to the end of predicting behaviour, then the usefulness of measuring implicit attitudes is limited.

Explicit attitudes have often been used to predict behaviour and have generally been found to predict a significant amount of variance in behaviour (Armitage and Conner, 2001). However, the predictive value of explicit attitudes can vary widely between different behaviours and in some cases research indicates that explicit attitudes have not predicted behaviour well (Dovidio et al., 1997; Dovidio et al., 2002). The examination of the predictive power of implicit attitudes has also produced mixed results with some studies indicating that implicit attitudes predicted behaviour well (e.g. Frings and Wentura, 2003) and some indicating that implicit attitudes did not predict behaviour well (e.g. Bosson et al., 2000). One meta-analysis that examined the predictive validity of the IAT found that the average correlation between implicit attitudes as measured by the IAT and behaviour measures was low, but noteworthy, at $r = 0.27$ (Poehlman et al., 2005).

Generally, it has been found that implicit attitudes predict spontaneous behaviour and explicit attitudes predict deliberative behaviour, as was described within Fazio's MODE model (see Chapter six, section 6.4 for a review). A recent meta-analysis of the predictive validity of the IAT, and explicit attitude measures, found that explicit attitude measures were significantly better predictors of deliberate behaviour than spontaneous behaviour (Poehlman et al., 2005). However, it has been found that the IAT was effective in predicting certain behaviours that are controllable, such as brand related choices (Maison et al., 2004). Other authors have similarly stated that a double dissociation pattern, in which implicit and explicit attitudes predict spontaneous and deliberate behaviours respectively, may be over simplistic (Rudman, 2004).

It should be acknowledged, however, that the evidence does not necessarily contradict the double dissociation pattern of prediction. It has been argued that in many studies the variance, accounted for in deliberate behaviour by implicit attitudes, was shared with explicit attitudes (Poehlman et al., 2005). Unfortunately, most studies that have examined the predictive validity of attitudes have not included both implicit and explicit measures of attitude together in the same analysis (and of those that have many included additional variables) so it is unclear whether separate behavioural variance was predicted by the two attitude measures.

Within the few studies that do include both explicit and implicit attitudes in predictive analysis, evidence regarding whether implicit attitudes have predictive validity over and above explicit attitudes appears mixed. Several studies have found that implicit and explicit attitude measures do predict separate variance in behaviour, e.g. in the prediction of math SAT scores (Nosek et al., 2002) and alcohol consumption (Wiers, Woerden, Smulders and de Jong, 2002).

Further evidence suggests that implicit and explicit attitudes may interact together to explain additional variance in behaviour. A recent study found that individuals who had the combination of both high self-esteem on explicit attitude measures and low self-esteem on implicit attitude measures were relatively high in narcissism and defensiveness (Jordan, Spencer, Zanna, Hoshino-Browne and Correll (2003). So in this case, behaviour (defensive behaviours including in-group bias and dissonance reduction were measured) was found to be best predicted by combining measures of implicit and explicit attitudes in a multiplicative fashion.

The degree to which implicit and explicit attitude measures correspond seems to be an important factor influencing predictive validity. When correspondence between implicit and explicit attitude measures was low, both measures were associated with worse predictive validity than when correspondence was high (Poehlman et al., 2005). This finding is consistent with previous suggestions that individuals holding discrepant automatic and controlled evaluations may experience some internal conflict (Nosek, 2005; Wilson et al., 2000). When attitudes are discrepant, explicit attitudes may be less predictive of behaviour because these have to override an automatically evoked response and equally, implicit attitudes may be less predictive of behaviour as these are pulling against opposing explicit attitudes. It was found that inconsistencies between implicit and explicit attitude measures have a significantly greater detrimental effect on the predictive validity of explicit attitude measures compared to implicit attitude measures. Poehlman et al., (2005) suggest that this is because people may be less aware of their automatic associations and consequently less able to override these.

10.3.1. Testing predictive models

Different theoretical stances regarding the relationship between implicit and explicit attitudes correspond loosely to different postulated patterns of combining implicit and explicit attitudes to predict behaviour (Perugini, 2005). Altogether, three main predictive models of combining implicit and explicit attitudes to predict behaviour have been suggested: an additive model, a double dissociation model and an interactive model. Traditional dual process theories (e.g. Fazio, 1990; Bohner, Moskowitz, and Chaiken, 1995) imply an additive pattern indicating that implicit and explicit attitudes predict separate variance in behaviour and that both will predict all behaviours, to a greater or lesser extent. The dual attitude model (Wilson et al., 2000) implies a double dissociation pattern, which predicts that implicit attitudes will predict spontaneous behaviour and explicit attitudes will predict deliberate behaviour. (The extent to which implicit attitudes may predict deliberate behaviour or explicit attitudes may predict spontaneous behaviour is explained as shared variance between the two attitude measures.) The integrative approach of the reflexive-impulsive model (Strack and Deutsch, 2004) implies an interactive combination pattern in which implicit and explicit attitudes combine to predict behaviour in a synergistic fashion. It is emphasised, however, that the confirmation of one particular pattern does not confirm or deny the validity of the associated theoretical approach as each theoretical approach could in fact explain each of the predictive patterns.

Asendorpf et al., (2002) tested two potential predictive models (the additive model and the double dissociation model) within the domain of shy behaviour. Results showed that even though implicit self-concepts and explicit self-concepts correlated with both spontaneous and deliberate measures of behaviour, the double dissociation model was found to fit the data better than the additive model.

A further examination of predictive models was carried out by Perugini (2005) who examined two different behaviours, smoking and eating snacks versus fruits. Within the study of smoking behaviour an interactive, rather than an additive model was supported (it was not possible to examine the double dissociation model because only one behaviour was examined). It was found that for neutral explicit attitudes the likelihood of smoking increased with an increasingly positive implicit attitude. For positive explicit attitudes, the likelihood of smoking increased sharply with an increasingly positive implicit attitude, however for negative explicit attitudes the likelihood actually decreased with an increasingly positive implicit attitude. Within the study of eating snacks versus fruits (Perugini, 2005), two behaviours were examined. The deliberate behaviour was a self-report of the frequency of which the individual ate snacks versus fruits, and the spontaneous behaviour was the choice made by the participant when offered the choice of either fruit, or a snack, at the end of the experiment. All three of the predictive models were examined and of these, it was found that the double dissociation model was supported. Here, implicit attitudes clearly predicted spontaneous behaviour but not deliberate behaviour and explicit attitudes predicted deliberate behaviour but not spontaneous behaviour. The conclusion was that different patterns of combining implicit and explicit attitudes may account for different behaviours across domains (Perugini, 2005).

10.4. Measuring spontaneous behaviour

Behaviour can be thought of as deliberate or as spontaneous and, in fact, different types of behaviour may fall along a continuum between being completely deliberate and being completely spontaneous (Møller, 2003; Schneider and Shriffrin, 1977; Fazio, 1990; Beach and Mitchell, 1978). It was theorised that deliberate behaviour is distinguished from spontaneous behaviour with respect to the amount of cognitive effort used in making the decision to carry out the particular behaviour. Fazio's (1990) MODE model (see chapter six, section 6.4. for a review) suggests that behaviour will be deliberate when the individual has the motivation and the opportunity to carry out the behaviour. Motivation is thought to increase with involvement as well as with the perceived risk connected with the decision and with the costs involved with making the wrong decision. Opportunity is decreased by time pressure and with ability, which can be affected by cognitive capacity available with which to make the behavioural decision. Following this reasoning, behaviour can be forced to become more spontaneous by decreasing motivation, by increasing time pressure or by decreasing the individual's cognitive capacity available (Beach and Mitchell, 1978).

10.5. Current aims

The aim of this study was to examine the three main predictive models of implicit and explicit attitudes within the domain of behaviour towards GM food.

Previous research has indicated a disparity between measures of explicit attitude towards GM food and measures of implicit attitude towards GM food. Both types of attitude measure are thought to be important in predicting behaviour. Explicit and implicit attitudes were included in this study in order to examine the relationship between these constructs and also to examine the predictive validity of these measures and how these may combine, or dissociate, in order to best predict behaviour in different situations.

Three different behaviours were examined, one spontaneous behaviour, one deliberate behaviour and one intermediate behaviour (henceforth referred to as combined behaviour) that was partly spontaneous, and partly deliberate. As implicit and explicit attitudes have been differentially associated with spontaneous and deliberate behaviour it was thought appropriate to examine behaviours that were characterised by a range of spontaneity. As noted earlier, there has been little previous research into actual behaviour towards GM food and those studies that have been carried out have used quite different methods. This study, therefore, also allowed the examination of differences between several different measures of behaviour towards GM food.

It was hypothesised that implicit attitudes would predict spontaneous behaviour and that explicit attitudes would predict deliberate behaviour. With regards to intermediate behaviour, it was postulated that both implicit attitudes and explicit attitudes would predict behaviour. Behaviour measures were hypothesised to show that a majority of participants would try GM food (Sparks et al., 1995; Townsend and Campbell, 2004) although it is thought that there would be some differences in results obtained between measures due to differences in context as well as differences in the amount of deliberation the methods require from the individual.

10.6. Method

10.6.1. Design

A repeated measures design was used in which all participants completed five tasks. Two tasks examined attitudes: a Go No-Go Association Task (GNAT) examined implicit attitudes towards GM food and direct questions were used to examine explicit attitudes towards GM food. Three tasks examined behaviour: a vignette task, a real choice task and an equivalent gain lottery task. The vignette task was designed to assess deliberate behaviour, the real choice behavioural task was designed to assess combined behaviour and the equivalent gain lottery task (which utilised a time limit) was designed to assess spontaneous behaviour.

10.6.2. Participants

Two hundred people took part in this study altogether. Recruitment was carried out in a topic blind fashion, to avoid self-selection on the basis of an interest in biotechnology (Campbell and Townsend, 2003). Participants were recruited through posters advertising the study around the University campus as well as through e-mail advertising to undergraduate university students.

10.6.3. Materials

10.6.3.1. GNAT (implicit attitudes)

A GNAT (Nosek and Banaji, 2001) was used to examine implicit attitudes towards GM food. This was conducted using E-Studio (version 1.1) software.

The GNAT used was procedurally identical to the context-free GNAT used within chapter nine and the same categories of 'GM foods', 'I like' and 'I don't like' were used. Further to this, the same stimuli were used to represent each category, see Appendix nine for details. Reaction times were used for analysis due to the finding, noted within chapter eight, that the internal consistency of the GNAT was higher when using reaction times than when using error rates. A response window of 1,000ms was used for target concepts and a window of 500ms was used for distracter concepts.

10.6.3.2. Explicit attitude questions

Questions assessing explicit attitudes towards GM food utilised eleven semantic differential seven-point scales ranging from minus three to plus three. Adjectives used were bipolar pairs (bad-good, harmful-harmless, foolish-wise, unpleasant-pleasant, boring-exciting, unenjoyable-enjoyable, sexy-unsexy, healthy-unhealthy, sociable-unsociable, glamorous-ugly, calming-stressful) and were the same as those used in previous studies that have examined the relationship between implicit and explicit attitudes (Swanson et al., 2001; Perugini, 2005).

10.6.3.3. Vignettes (deliberate behaviour)

In total, nine vignettes were constructed, see Appendix 11. These were developed by determining real possible future benefits of GM food. Three different types of situation were developed:

A. A basic situation in which GM food is offered to the participant.

B. A situation in which GM food may provide health benefits to the participant.

C. A situation in which GM food is cheaper than alternative food stuffs.

Within these situation types, three potential situations were developed and participants had to decide what they would do in each situation. To make this easier, multiple choice options for potential behaviour were provided. These options were, (a) Eat the GM food, (b) Do not eat the GM food, or (c) Don't know. Each question also included space for participants to write further comments if they desired. A pre-test involving 13 participants was used in order to evaluate the consistency of the questions used. Cronbach's alphas were medium to high at 0.70, 0.59, and 0.72 for question types (a), (b) and (c) respectively, indicating that the questions' consistencies were good. It is noted that vignettes measure intentions to perform behaviour, rather than actual behaviour itself, but these will be used as a measure of potential deliberate behaviour.

10.5.3.4. Real choice task (combined behaviour)

The real choice task utilised, purportedly GM, chocolate chip cookies that were individually wrapped and presented on a serving plate. The ingredients labels of each cookie was removed so as to disguise the fact that ingredients were not GM which left each cookie in a sealed, see-through, plastic wrapper. This task also made use of a voice recorder that was hidden from view within an open drawer in order to record the time taken to make the decision.

10.6.3.5. Equivalent gain lottery task (spontaneous behaviour)

The equivalent gain lottery task that was used within this study is a type of contingent valuation task (see Venkatachalam, 2004, for a review) that avoids potential biases associated with willingness-to-pay and willingness-to-accept tasks. This task was identical to the equivalent gain lottery task used within chapter five and asked participants to choose between chocolates or a monetary amount, e.g., 'We give you £0.60 or a box of eight chocolates'. As within the task utilised within chapter five, two pages of 20 options were used that increased in monetary amount offered from zero to £5.70 (increasing in increments of £0.30). One page offered a box of eight GM chocolates, as an alternative to the monetary options, and one page offered a box of eight non-GM chocolates as an alternative; which version was presented first was counterbalanced between participants. As an incentive to be truthful in the choices that they made, it was emphasised to participants that they would receive one of these options drawn from one of the lotteries. A stopwatch was also used for this task in order to measure one minute which was the time limit allowed for the participants to complete the task. As noted earlier, the use of time pressure is established as a standard method of encouraging spontaneous behaviour (Beach and Mitchell, 1978).

10.6.4. Procedure

Participants were firstly provided with an information sheet and a consent form which explained that they could withdraw from the study at any time without having to give a reason, and that their data could be withdrawn from analysis on request. The procedure of the study was then described. Participants completed four tasks within the study with full knowledge of participation and completed one further task that was purportedly not part of the experiment. The four tasks that participants completed with knowledge of participation were a GNAT examining implicit attitudes towards GM food, direct questions examining attitudes towards GM food, a series of vignette questions examining deliberate behaviour and an equivalent gain lottery task examining spontaneous behaviour towards GM food. All tasks were completed without time restrictions, apart from the GNAT which utilised a response window inherent to the task design, and the equivalent gain task in which participants were given one minute to complete the task in order to increase spontaneity of responses. All participants completed the equivalent gain task within the time limit set. Presentation order of these tasks was counterbalanced, although it was ensured that attitude tasks were presented first and behavioural tasks second. In other words, whether participants completed the GNAT or the direct attitude questions first was counterbalanced and whether participants completed vignettes or the lottery task first was counterbalanced but the attitude questions always preceded the vignettes and the lottery task. In addition, the different versions of the GNAT and the equivalent gain task were counterbalanced between participants.

After completing the four tasks with full knowledge of participation, participants were told that the study was over. Participants then received their prize from the equivalent gain lottery task. This was chosen by the participants themselves by drawing a number (from a selection of 1 – 20) from a bag without being able to see the numbers. The corresponding prize option was then consulted and the participants were provided with whatever they chose for that option. For example, if a participant drew the number nine, option nine within the task was consulted and if the participant had chosen the monetary amount on that option, they were provided with this amount of money, if they had chosen chocolates, they were provided with the chocolates. Although participants were originally told that they could receive their prize from either the GM or the non-GM options, in reality all participants received their prize from the non-GM options. This was done for practical reasons as it was not feasible to obtain GM food samples for use in the study.

The final fifth section of the study was, ostensibly, not part of the study as participants had already been told that the experiment was over. This section involved offering participants a chocolate chip cookie that was purportedly made using GM ingredients. Participants were told that these cookies were samples provided from a biotechnology company. However, practical reasons meant that non-GM chocolate chip cookies were actually used. Participants had the choice of whether to accept the cookie or not. In addition, the amount of time that participants took to make the choice of whether to accept the cookie or not was recorded. To ensure that this was standardised across participants, the time taken was recorded discretely using a voice recorder. The recorder was started as soon as the experimenter had finished explaining that the participant was allowed to take a cookie and stopped as soon as participants indicated that either they would or would not like to have the cookie. The participant's choice was measured as either when they actually picked up a cookie or as when they verbally accepted or rejected the cookie.

Finally, the purpose of the experiment was explained to the participant. The deceptions involved in the experiment were fully explained, both in terms of what these were, and why these were used. Several follow up questions were also asked of participants. These were (a) whether they realised that the offer of a chocolate chip cookie, at the end of the experiment, was part of the actual study and (b) if they believed that the chocolates, and the chocolate chip cookie, that they had been offered contained genetically modified ingredients. In addition, if participants had refused the cookie, they were asked to give a reason for refusing the cookie. If they had accepted the cookie, they were asked if they had accepted the cookie for themselves, and whether they had intended to eat the cookie.

10.7. Results

10.7.1. Explicit attitudes

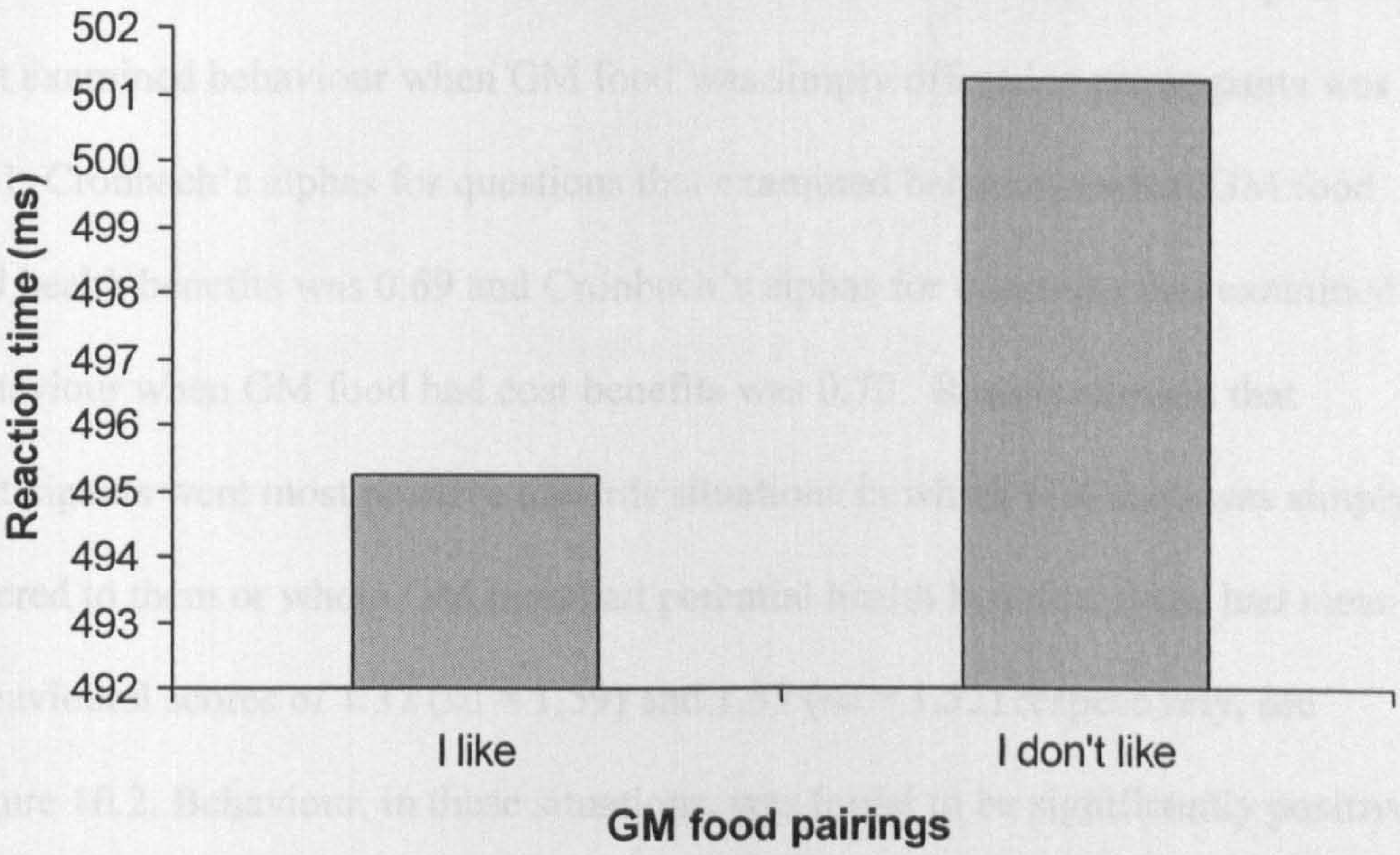
The measurement of explicit attitudes displayed good consistency as measured by Cronbach's alpha (0.80). The data for the explicit attitudes for two participants were lost, leaving the data from 198 participants for analysis. Across participants, explicit attitudes towards GM food had a mean of -0.12 ($sd = 0.73$) which was found to be significantly negative ($t(197) = -2.329$, $p < 0.05$; Cohen's $d = -0.23$).

10.6.2. Implicit attitudes

GNATs were analysed using reaction time data. Due to non-normal distributions reaction times were log transformed, however means and standard deviations are provided for untransformed data for clarity. The mean percentage of errors made by participants within the GNAT was 5.30%. Internal consistencies were examined using split-half reliabilities and these were found to be acceptable with a value of $r = 0.67$, $p < 0.001$ (after adjustment using the Spearman – Brown correction)

Across participants, it was found that when responding to 'GM food' words, mean reaction time was 495.24ms ($sd = 44.44$ms) when paired with 'I like' words and was 501.25ms ($sd = 44.98$ms) when paired with 'I don't like' words, see Figure 10.1. Reactions to the pairing of 'GM food' and 'I like' were significantly faster than to the pairing of 'GM food' and 'I don't like' ($t(199) = -2.329$, $p < 0.05$; Cohen's $d = -0.13$).

Figure 10.1. – Mean reaction times when GM food was paired with I like and I don't like



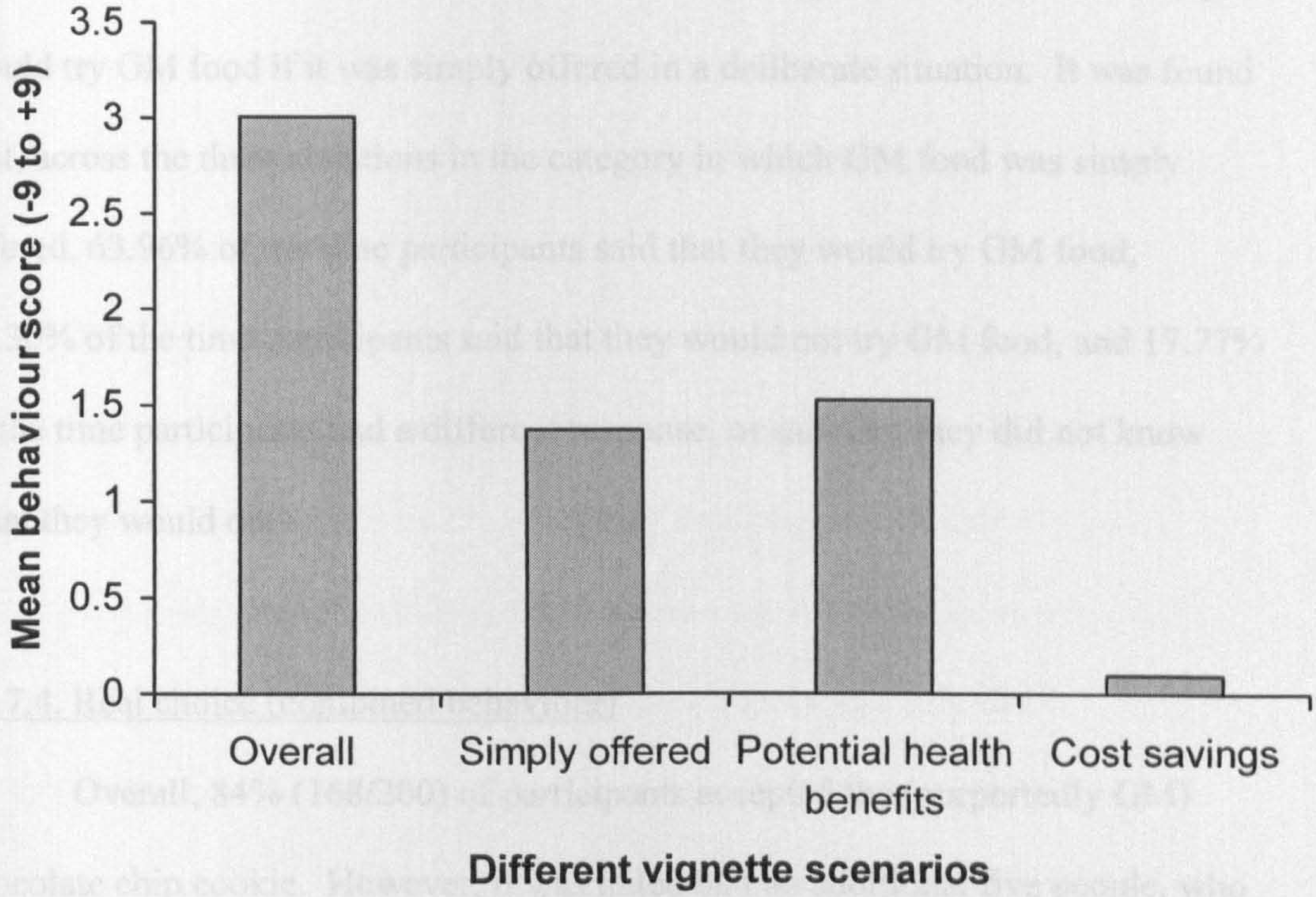
10.7.3. Vignettes (deliberate behaviour)

Behaviour, as measured by the vignette questions, was coded as plus one if the participant indicated that they would eat GM food, zero if the participant was not sure if they would eat GM food and minus one if the participant would not eat GM food. Scores were added for all the vignettes to provide a total deliberate behaviour score for each individual, therefore, a higher score indicates that a participant is more likely to eat GM food (Scores could vary between minus nine and plus nine as there were nine vignettes in total).

Internal consistency was good with Cronbach's alpha of 0.77. The overall deliberate behaviour score found was 3.01 (sd = 4.11) indicating that the majority of people would eat GM food in most of the situations provided. A one sample t-test indicated that this was significantly positive ($t(196) = 10.256$, $p < 0.001$; Cohen's $d = 1.04$).

Within the vignettes, three different types of situations were developed and internal consistencies were good for each. Cronbach's alpha for the questions that examined behaviour when GM food was simply offered to participants was 0.61, Cronbach's alphas for questions that examined behaviour when GM food had health benefits was 0.69 and Cronbach's alphas for questions that examined behaviour when GM food had cost benefits was 0.70. Results showed that participants were most positive towards situations in which GM food was simply offered to them or where GM food had potential health benefits; these had mean behavioural scores of 1.37 (sd = 1.59) and 1.53 (sd = 1.52) respectively, see Figure 10.2. Behaviour, in these situations, was found to be significantly positive across participants $t(196) = 12.045$, $p < 0.001$ (Cohen's $d = 1.22$) and $t(196) = 14.121$, $p < 0.001$ (Cohen's $d = 1.42$) respectively, indicating that the majority of participants would try GM food. In situations in which GM food was cheaper than alternatives, a mean behavioural score of 0.10 (sd = 2.03) was found which was non-significant ($t(196) = 0.701$, $p = 0.484$; Cohen's $d = 0.07$) indicating people were equally likely to buy GM, or non-GM, food.

Figure 10.2. – Behavioural scores overall and split across different situations



Behaviour scores differed significantly between the three types of situations distinguished ($F(2,195) = 68.769$, $p < 0.001$, $\eta_p^2 = 0.414$). A comparison of means of the individual situations, using a Bonferroni adjustment, indicated that behavioural scores differed significantly between situations in which participants were simply offered GM food and where GM food was cheaper than alternatives ($p < 0.001$). In addition, behaviour scores differed significantly between situations in which GM food carried potential health benefits and where GM food was cheaper than alternatives ($p < 0.001$). However, behaviour scores did not differ significantly between situations in which GM food was simply offered to participants and situations in which GM food carried potential health benefits ($p = 0.609$).

In order that results could be compared across behaviour measures, it was considered useful to calculate the mean percentage of people who said that they would try GM food if it was simply offered in a deliberate situation. It was found that, across the three situations in the category in which GM food was simply offered, 63.96% of the time participants said that they would try GM food, 18.30% of the time participants said that they would not try GM food, and 17.77% of the time participants had a different response, or said that they did not know what they would do.

10.7.4. Real choice (combined behaviour)

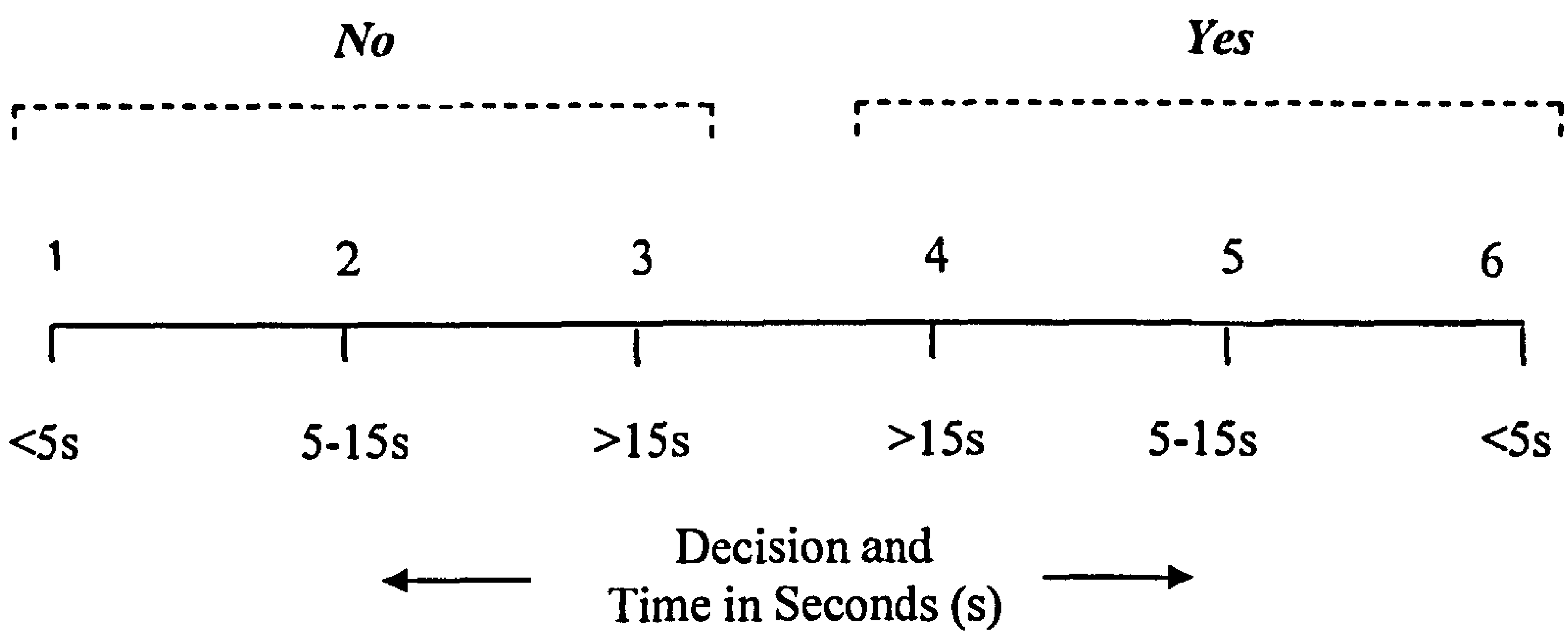
Overall, 84% (168/200) of participants accepted the (purportedly GM) chocolate chip cookie. However, it was noted that an additional five people, who did not take the cookie, said that they would have accepted an alternative GM product. In addition, five people who did accept the cookie said that they would not have tried the cookie but accepted it in order to give it to a friend. A further two participants, who took the cookie, said that they were not sure whether they were actually going to eat it or not.

The time taken, for participants to make the choice whether to accept the (purportedly GM) cookie or not, was also measured. This was used in conjunction with the participant's decision of whether or not to accept the cookie so as to order participants' preferences for the cookie. In this way, the length of time participants took to make their decision was taken as a measure of the certainty of their choice and this was supported by qualitative responses. Those that took longer to decide, whether they wanted to take the (purportedly GM) cookie, generally filled the decision time with questions regarding the safety of

GM food, e.g., 'Does it have any side effects?', questions regarding the ingredients in the cookie, e.g., 'What's GM about it?', or regarding the taste, e.g., 'What do they taste like?'. Others simply paused for a length of time before making their decision or expressed uncertainty over their decision, e.g., 'I'm not sure whether to try it or not'.

Participant's preference was measured on a scale which had six discrete points, with three points representing the decision to accept the cookie at varying lengths of time and three points representing the decision to refuse the cookie at varying time lengths. The scale ran from one to six in which one represented a certain refusal and six represented a certain acceptance, see Figure 10.5. Scores on this scale were used as an indication of the participant's decision in further analyses.

Figure 10.5. – Ordinal scale used in which to classify time taken to make combined choice



The majority of participants made the choice whether to accept the cookie or not quite quickly (under five seconds). Fewer people took between five seconds and 15 seconds to make the decision and only a small amount of people took over 15 seconds to make the decision, see Table 10.1.

Table 10.1. – Time taken to make combined choice

Decision and Time taken	Frequency	Percent
No – less than 5s	21	10.5
No – between 5 and 15s	10	5
No – over 15s	1	0.5
Yes – over 15s	3	1.5
Yes – between 5 and 15s	21	10.5
Yes – less than 5s	144	72

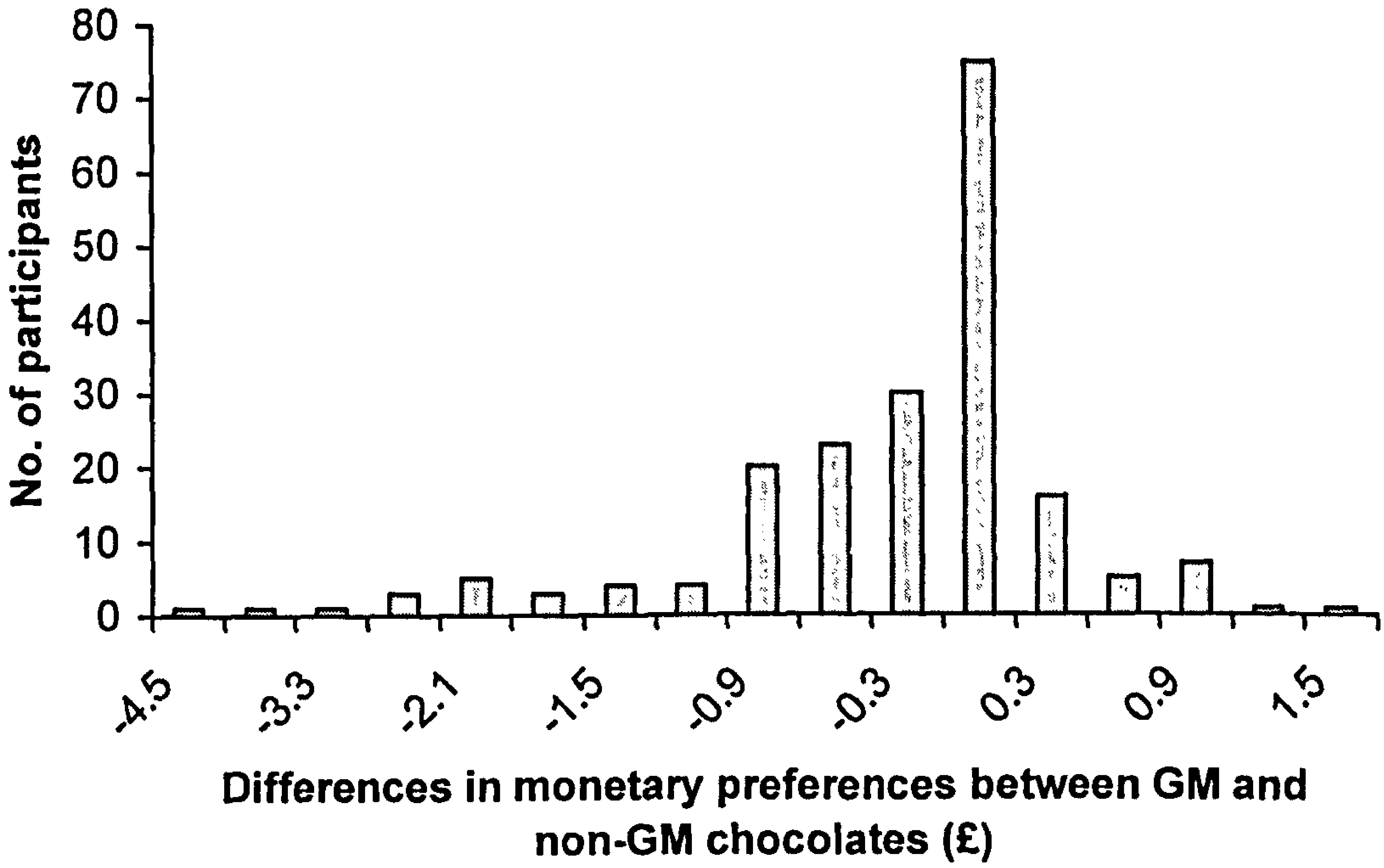
Regarding the effectiveness of the deception used within this study, it was found that the majority of participants did not realise that the real choice required at the end of the experiment was part of the actual experiment. Altogether, 145 participants did not realise that the real choice made was part of the actual experiment, 51 people did realise that this was part of the experiment and four people were uncertain whether they realised this or not.

In addition, six people did not believe that the chocolate and cookies offered to them were really GM and a further nine people were suspicious that the food offered to them was not really GM. The vast majority of people, who participated in the experiment (185/200), did believe the deception and were surprised (and at times disappointed) when it was revealed that the food did not contain any GM ingredients.

10.7.5. Equivalent gain lottery task (spontaneous behaviour)

Overall, the amounts of money that participants were willing to accept in preference to a box of GM chocolates were positively skewed, with a median of £1.20 and a full range of £5.70. The amounts of money participants were willing to accept in preference to a box of non-GM chocolates were also positively skewed and had a median of £2.10, and a full range of £5.70. A Wilcoxon signed ranks test showed that amounts of money accepted in preference to a box of GM chocolates were significantly lower than those accepted in preference to a box of non-GM chocolates ($z = -6.041$, $p < 0.001$). The difference between the median amounts of money accepted in preference to a box of GM chocolates and a box of non-GM chocolates was £0.90.

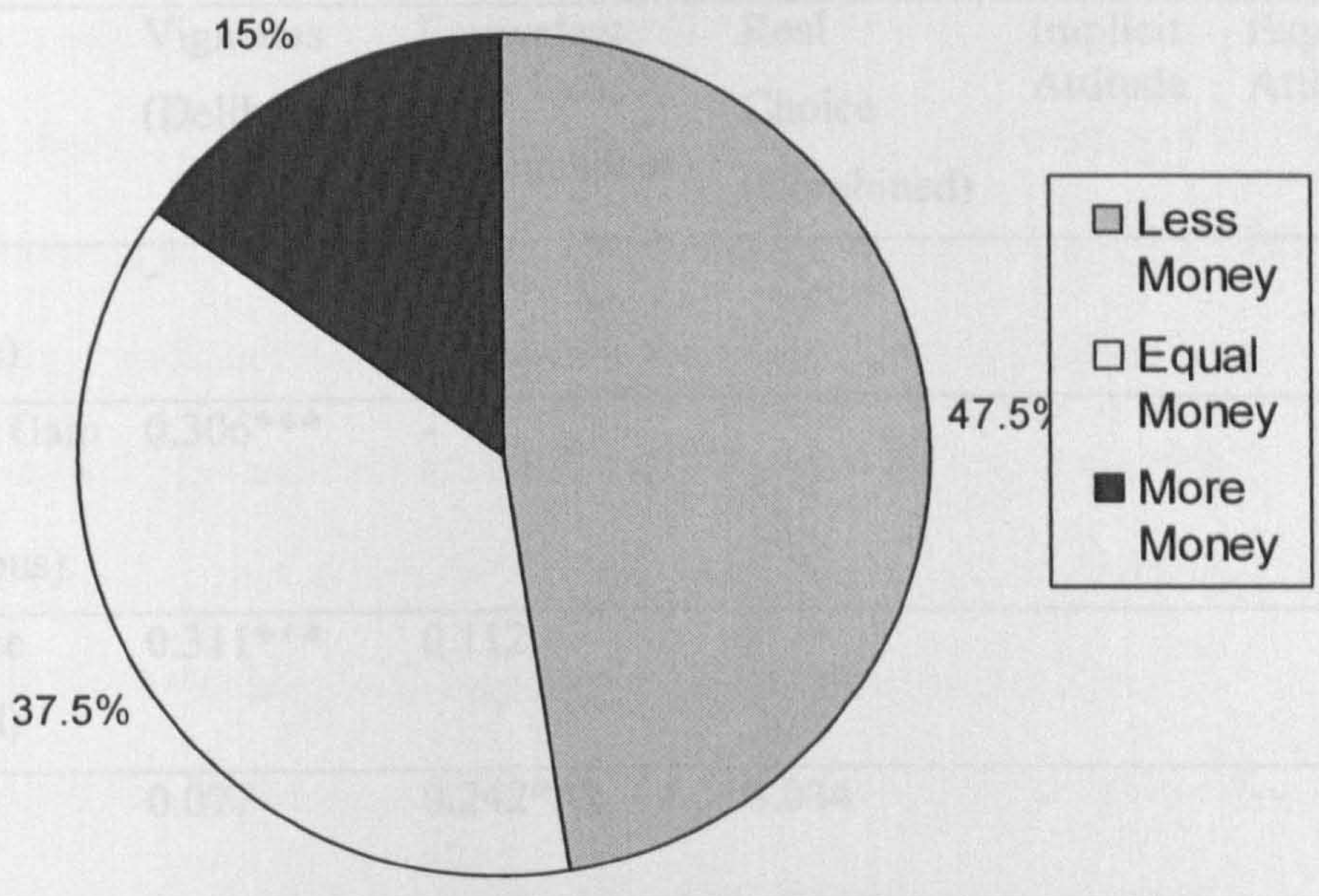
Figure 10.3. – Range of differences in monetary preferences between non-GM and GM chocolates



In order to control for individual preferences for chocolate, and so as to examine the value of the attribute of GM exclusively, behaviour towards GM food was calculated as the difference between the monetary amounts participants were willing to accept in preference for GM, and the non-GM, chocolates. Again, this measure was positively skewed, and extremely kurtotic, with an almost unimodal distribution at zero, see Figure 10.3.

Altogether, 47.50% (95/200) of participants would accept less money instead of GM chocolates as compared to non-GM chocolates. 37.50% (75/200) of participants would accept the same amount of money in preference to GM, or non-GM, chocolates and 15.00% (30/200) would accept more money instead of GM chocolates than non-GM chocolates, see Figure 10.4. It was also found that, of those who would accept either kind of chocolates (99%), 96.96% of participants (192/198) would prefer GM chocolates over money at some level and only 3.03% (6/198) would not.

<u>Figure 10.4. – Percentage of participants prepared to accept more, equal or less amounts of money instead of GM chocolates compared with non-GM foods</u>



10.7.6. Correlations

Pearson's product moment correlations were carried out between all variables apart from between real choice task data and other variables for which polyserial correlations were used because this variable has an ordinal level metric, see Table 10.2. Correlations between factors measured indicated that explicit attitudes were not significantly correlated with implicit attitudes. Explicit attitudes were significantly correlated with all three behavioural measures of the vignettes, the lottery task, and the final real choice decision. Implicit attitudes were found to correlate with just one behavioural measure which was the lottery task (spontaneous behaviour). The vignette behaviour measure demonstrated significant correlations with the real choice task and the equivalent gain lottery task.

Table 10.2. – Correlations between factors measured (Pearson's product moment and Polyserial correlations)

	Vignettes (Deliberate)	Equivalent Gain Task (Spontaneous)	Real Choice (Combined)	Implicit Attitude	Explicit Attitude
Vignettes (Deliberate)	-				
Equivalent Gain Task (Spontaneous)	0.306***	-			
Real Choice (Combined)	0.311***	0.112	-		
Implicit Attitude	0.077	0.242***	0.034	-	
Explicit Attitude	0.507***	0.205**	0.154*	0.135	-

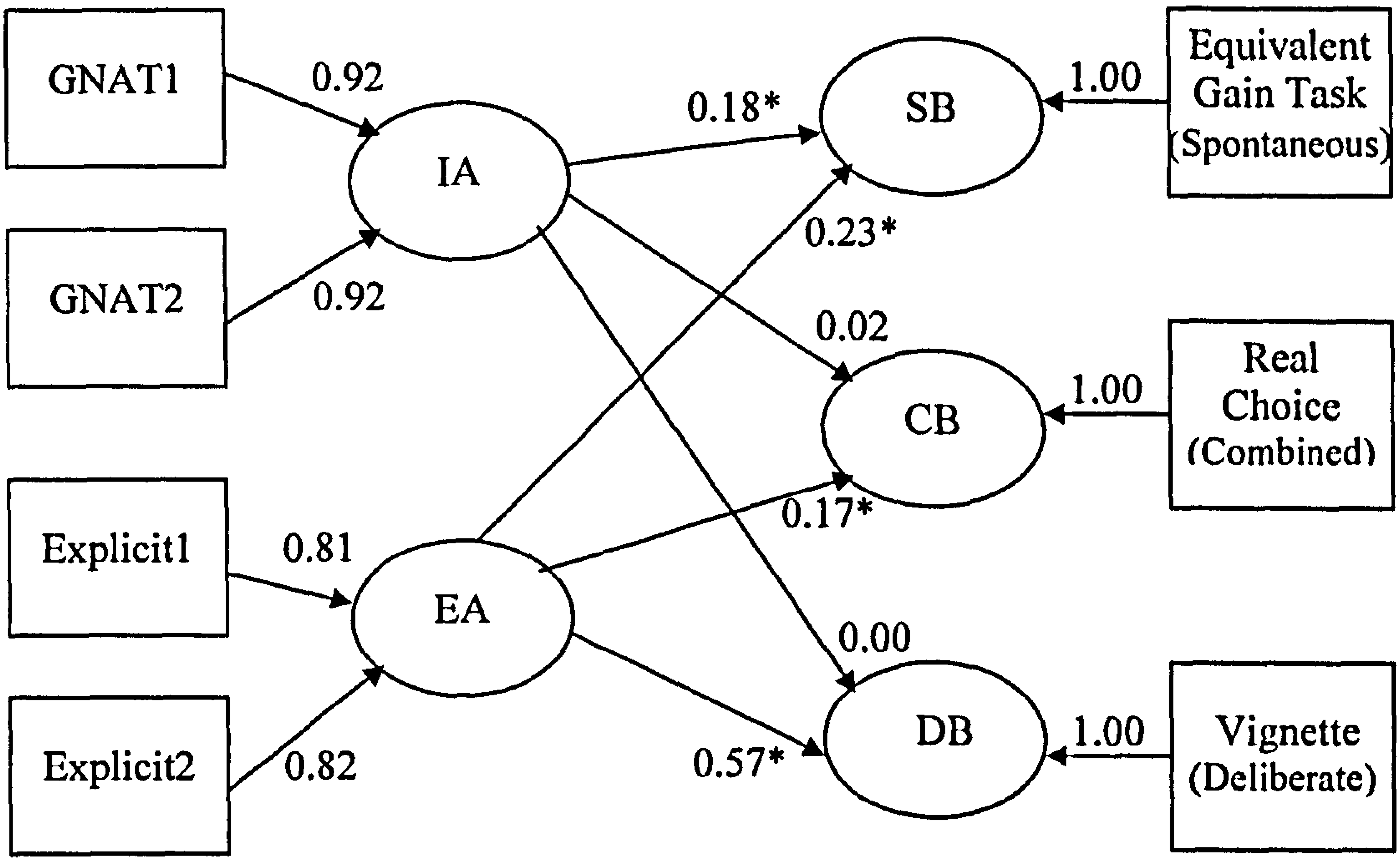
*Note: *p<0.05, **p<0.01, ***p<0.001.*

A structural equation model was used to further investigate the relationships between attitudes and behaviours and to test the three different theoretical models discussed earlier. All three models (additive, double dissociation and interactive) were tested using structural equation modelling with LISREL software. All data was measured on interval or ratio scales apart from data from the real choice task which was measured on an ordinal scale. Additionally, data from the real choice task and from the equivalent gain lottery task was severely negatively skewed and was therefore transformed by reflecting and inversing scores in order to obtain more normally distributed samples (Tabachnik and Fidell, 1996)

The explicit attitude latent factor was loaded by two halves of the semantic differential scales utilised (because there were an odd number of semantic differentials used, the first six were used as one indicator and the second five were used as a second indicator). The implicit attitude latent factor was loaded by two GNAT scores which were calculated as the difference between the first and third critical trial blocks of the task, and the difference between the second and fourth critical trial blocks of the task; the critical trial blocks compared were those that paired the target attribute of GM foods with opposing attributes. Behavioural measures were all used as direct indicators of their latent counterparts. See Appendix 13 for the input matrix for LISREL, again this contains Pearson's product moment correlations and polyserial correlations as appropriate.

The path model for the additive pattern is reported in Figure 10.6. The fit was good ($\chi^2 = 5.30$, $p = 0.81$) and the additive model is clearly supported. Implicit attitudes did not significantly predict deliberate behaviour or combination behaviour but did significantly predict spontaneous behaviour. Explicit attitudes, on the other hand, significantly predicted deliberate behaviour, combination behaviour and spontaneous behaviour.

Figure 10.6. – Path Diagram for Additive model

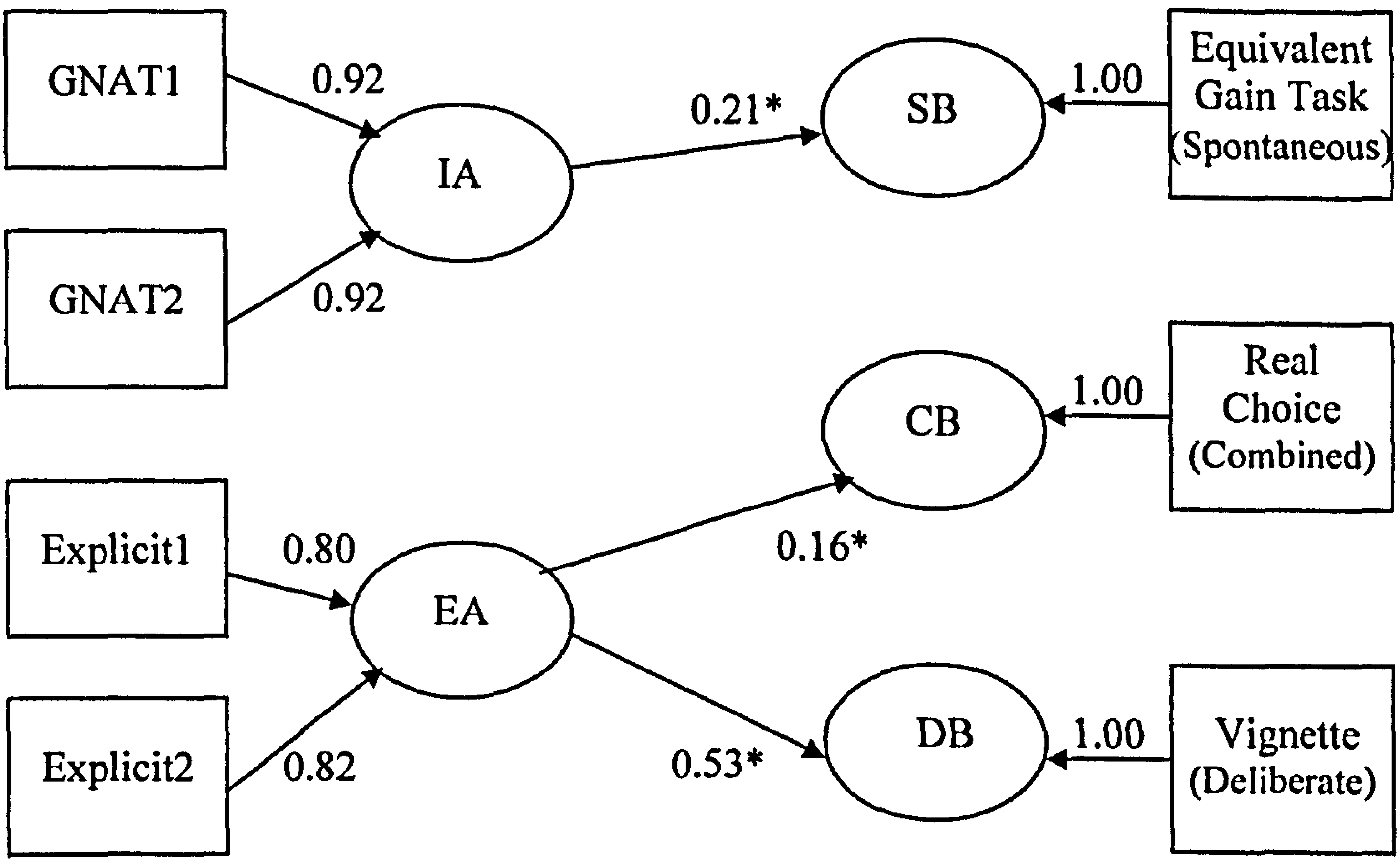


N.B. Delta path values are displayed

KEY: IA = Implicit Attitude; EA = Explicit Attitudes; SB = Spontaneous Behaviour; DB = Deliberate Behaviour; CB = Combination Behaviour; (G1+G2)*(E1+E2) = multiplication of the sum of implicit attitude indicators (GNAT1 and GNAT2) and of explicit attitude indicators (Explicit1 and Explicit2)

To test the double dissociation pattern, a modified nested model without the additive crossed paths was run, see Figure 10.7. This model was restricted so that implicit attitudes only predicted spontaneous behaviour and explicit attitudes only predicted deliberate behaviour. In addition, for the double dissociation model, only one attitude measurement could be allowed to predict combination behaviour and as gamma (γ) values were higher for the path from explicit attitudes to combination behaviour, this path was kept free and the path from implicit attitudes to combination behaviour was restricted[1]. The fit was again very good ($\chi^2 = 13.76$, $p = 0.32$). As the double dissociation model was nested within the additive model, a formal test of the need for the additive paths was possible. In fact, the difference between model chi-squares was significant ($\chi^2_{d(2)} = 8.46$, $p < 0.05$) indicating that the fit of the model was significantly improved by the additional paths included within the additive model (see Table 10.3. for a comparison of model fit indices).

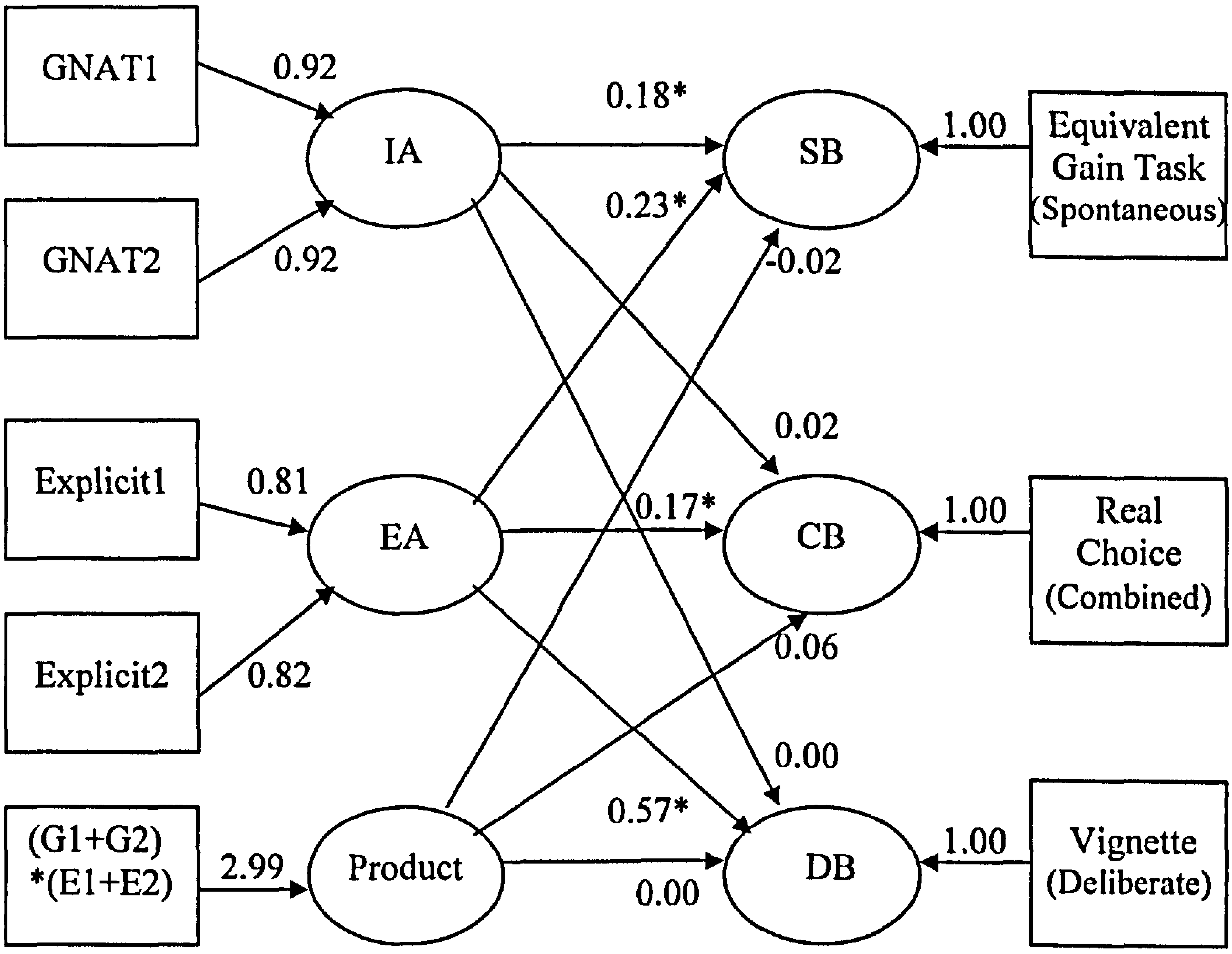
Figure 10.7. – Double Dissociation Model



KEY: As Figure 10.6.

[1] The alternative double dissociation model, in which implicit attitudes are allowed to predict combination behaviour and the path from explicit attitudes to combination behaviour is restricted, was also tested. This model did not fit the data as well as the original double dissociation model tested and again the additive model proved to fit the data better than this alternative double dissociation model.

Figure 10.8. – Interactive Model



KEY: As Figure 10.6.

The interactive pattern (see Figure 10.8) was tested according to the approach suggested by Ping (1995). Ping (1995) recommends using the product of the sums of the indicators of the component variables as the sole indicator of the latent product. In other words, the recommendation is to sum the indicators of the latent variable, implicit attitude, and to sum the indicators of the latent variable, explicit attitude, and multiply these summed totals together to obtain the indicator for the latent product variable. It is then suggested that the additive model is established first and the relevant values from this analysis be used in order to fix the paths associated with the latent product in the interactive model.

The fit of the interactive model was good ($\chi^2 = 5.30$, $p = 0.81$). The model fit statistics were very similar to the additive model indicating that the extra product variable included did not significantly improve the fit of the model. Comparing the model AIC (Akaikes information criterion) and NNFI (non-normed fit index) for these models (both criteria which penalise for model complexity) demonstrates that the additive model is the model of best fit, see Table 10.3. It was therefore concluded that the additive model was supported; the double dissociation model and the interactive models did fit the data well but the additive model fitted the data better than the double dissociation model and was more parsimonious than the interactive model.

Table 10.3. - Comparison of model fit indices

	Chi - square	**df**	**Model AIC**	**CFI**	**NNFI**
Additive model	5.30	9	43.30	1.00	1.03
Double dissociation model	13.76	12	45.76	0.99	0.99
Interactive model	5.30	9	59.30	1.00	1.04

10.8. Discussion

10.8.1. Empirical levels of attitudes

Explicit attitudes towards GM food were found to be negative within this experiment which contrasts with previous research that indicated that the British public were ambivalent towards GM food (Gaskell, Allum and Stares, 2003). This may be due to the characteristics of the sample examined. Participants within this study were all students at the University of Nottingham and were, therefore, not representative of the British population. Previous research conducted by Noussair et al., (2004) indicated that people with a higher level of education were more negative towards GM food and, therefore, the advanced level of education within our sample may explain our findings.

Data regarding implicit attitudes indicated that the sample examined here had positive implicit attitudes towards GM food. This supports previous research (reported within chapter eight) that found positive implicit attitudes towards GM food. It was suggested that the positive implicit attitudes towards GM food may have been due to an inadvertent priming effect within the study which primed GM food to be considered as a food. As there was no such priming effects within this study, this does not support this explanation. This is not to suggest that the reasoning for why implicit attitudes are positive is not correct as it is perfectly feasible that people consider GM food as a food, without any priming.

Explicit and implicit attitudes towards GM food did not correlate significantly within this study and this supports findings from the study reported within chapter eight. It is possible that other factors moderate the relationship between explicit and implicit attitudes (single attitude view) or indeed that explicit and implicit attitudes are completely different constructs that have been developed in different ways (dual attitude view).

10.8.2. Predicting behaviour

This study found that the additive model, in which explicit attitudes and implicit attitudes both predicted separate variance in behaviour, provided the best and most parsimonious fit to the data. This finding is consistent with several previous studies (Brunel, Collins, Greenwald and Tietje, 1999; Hugenberg, and Bodenhausen, 2003) and is in line with the recent meta-analysis conducted by Poehlman et al. (2005) that assessed the predictive validity of the IAT and found that implicit attitudes (as measured by the IAT) predicted significant independent variance, over and above explicit attitudes, in some behaviour measures.

These results do differ from many previous studies though which have supported a double dissociation pattern in which implicit attitudes predict spontaneous behaviour and explicit attitudes predict deliberate behaviour (Spalding and Hardin, 1999; Fazio, et al., 1995; Dovidio, et al., 1997; Dovidio, Kawakami and Gaertner, 2002). Findings also differ from previous comparisons of predictive models which have supported the double dissociation model (Asendorpf et al., 2002; Perugini, 2005) and the interactive model (Perugini, 2005). It is noted that the current study examined a wide range of behaviours that were specifically designed to vary with regards to their level of spontaneity and this may be the cause of differences noted. It is possible that had the equivalent gain task not been included in this study, the additive model may not have been the best fitting model because this was the only behaviour measure to be significantly predicted by both explicit and implicit attitudes. As Perugini (2005) suggests, it is likely that different behaviours may be better predicted by different patterns of combining implicit and explicit attitude measures. However, our study does indicate that a double dissociation pattern alone is not always sufficient to account for behaviour. Therefore, when predicting behaviour it is insufficient to consider just one attitude measure; it is important to consider both explicit and implicit attitudes as each may predict separate variance.

It would also be advisable to consider the possibility that implicit and explicit measures may interact to explain further variance in behaviour. The interactive model of predicting behaviour was not found to be optimal for this research and receives only limited support in the literature (Poehlman et al., 2005). This indicates that only in certain specific circumstances will behaviour best be predicted by an interaction between implicit and explicit attitudes[2]. Further research is required across a variety of different domains in order to delineate specific cases, and possibly types of cases, in which behaviour is best predicted by additive or interactive patterns of combining implicit and explicit attitudes.

It is noted that results from this study, although loosely associated with traditional dual process theories (e.g. Bohner, et al., 1995; Fazio, 1990) should not be taken as support for this theory. It is feasible that either the model of dual attitudes (Wilson, Lindsay, and Schooler 2000) or the Reflective-Impulsive model (Strack and Deutsch, 2004) could also account for results found here.

Explicit attitudes were found to significantly predict all three behaviours measured, spontaneous behaviour (as measured by the equivalent gain lottery task), deliberate behaviour (as measured by vignettes) and combination behaviour (as measured by the real choice task). Implicit attitudes were found to be useful in predicting only one behaviour measure of those examined, which was the equivalent gain lottery task (spontaneous). This is in line with previous research that finds that implicit attitudes are most useful for predicting spontaneous behaviours (Poehlman et al., 2005).

It is perhaps surprising that implicit attitudes were not found to be predictive of the real choice task that was utilised as a combined behaviour with the aim of being partly spontaneous and partly deliberate. However, due to the nature of the deception involved with this task, the real choice task was included at the end of the experiment once participants had been thoroughly questioned

[2] Of course this study only examined multiplicative ways in which implicit and explicit attitude measures may interact, it is feasible that these may combine in other ways.

about what they would do if they encountered GM food in different situations and this is likely to have reduced the spontaneity of the decisions made within the task. Comments made during debriefings suggested that participants viewed the real choice as being similar to decisions made during the vignette task. The reason that the real choice behaviour was measured at the end of the experiment was in order to validate the deception that this was not part of the actual experiment and so as to decrease any associated demand characteristics. It would be useful in future similar experimental research to include real choice measures at the beginning of experiments so that these are not influenced by other measures.

This is the first study that has confirmed the predictive validity of implicit attitudes in the domain of behaviour towards GM food. It is evident that the accurate prediction of behaviour towards GM food requires the examination of implicit, as well as explicit, attitudes towards GM food. Data from this study also provides one of the first rigorous tests of the predictive validity of the context-free GNAT and demonstrates that the GNAT does have the ability to predict variance in behaviour.

10.8.3. Behaviour towards GM food

All behaviour measures utilised within this study indicated that the majority of participants would engage in approach behaviour towards GM food. This has important implications for any possible future introductions of GM food to Britain. Individuals may be more likely to accept, and purchase, GM food than has previously been indicated by surveys examining only explicit attitudes towards GM food. It is acknowledged that the generalisation of results obtained within this study must be limited because a representative sample of the British public was not obtained. It is also of note however that the sample recruited here was found to be more negative than previous surveys have found of the British population. This might, therefore, indicate that the positive behaviour noted in this sample may actually be less positive than might be expected from a representative sample of the British population. However, of course it is acknowledged that variation in other factors that influence behaviour may also differ between samples.

The real choice task utilised here indicated that a vast majority of individuals (84%) would accept a GM cookie when offered. This supports previous research that has found that in real choice situations involving purportedly GM apples, the majority of individuals would accept the GM apple (Townsend and Campbell, 2004). Similar results have also been found with respect to GM cheese (Lahteenmaki et al., 2002).

Results obtained within the equivalent gain task used within this study found that the mean difference in valuation of GM and non-GM chocolate was £0.90. As noted within chapter five (section 5.7.1), this difference in valuations of GM and non-GM versions of chocolate is more than was obtained by Moon and Balasubramanian (2003) for breakfast cereal (around £0.44) and it is possible that this is due to the perceived necessity of the good. Luxury items such as chocolate may require a greater price difference between GM and non-GM options in order to persuade consumers to purchase GM. Interestingly, results obtained for the equivalent gain task used within this study were extremely similar to results obtained within the same task that was used within chapter five in conjunction with an examination of the TPB. In fact, the medians found within the GM and the non-GM versions of the task were identical between studies, as were the ranges of data that were obtained. This provides confidence in the reliability of the task because similar data was found at different time points as well as in the generalisability of the findings as the sample examined here consisted of students, whereas, the sample examined within chapter five were call centre employees which are a quite different population sample in terms of socio-economic status and education.

The likelihood of responding positively towards GM food varied significantly between vignettes, and the different types of situations involving GM food that were proposed. Situations in which GM foods were simply offered to participants or in which they were described as conferring potential health benefits were more positively responded to than situations in which GM food conferred cost savings. This supports previous research that found that health benefits were viewed more positively than economic benefits associated with GM food (Magnusson and Hursti, 2002; Frewer et al., 1996). Interestingly, GM food that was just offered to participants was viewed more positively than that which conferred cost savings. Participants may have responded more negatively to GM food when cost savings were offered because they felt coerced into trying the food or because they felt that a lower price may have been an indication of lower quality.

10.8.4. Differences between behaviour measures

Behaviour towards GM food was found to be most positive in the equivalent gain task (spontaneous behaviour) in which 97%, of those participants who would accept any chocolates, would accept GM chocolates at some cost. The real choice task (combined behaviour) exhibited the second most positive behaviour towards GM food with 84% of participants accepting a GM cookie when offered and the vignette task (deliberate behaviour) displayed the least positive behaviour towards GM food with 64% of situations presented eliciting positive intentions with respect to trying GM food.

The differences between results obtained from behaviour measures are attributed to differences within the tasks. The box of chocolates, offered within the equivalent gain task, may have been viewed as a higher quality option than the chocolate chip cookie, offered within the spontaneous choice task, which may partly account for differences. In addition, the fact that the equivalent gain task had an alternative monetary option is likely to have forced participants to value the GM food offered and influenced responses in some way. The vignette task displayed the least positive behaviour towards GM food and this may be due, to some extent, to the fact that this task allowed participants to choose an alternative 'don't know / other' option as a response. The vignette task was also the only hypothetical behaviour task utilised within this study, which may also account for differences between the tasks.

Differences between behavioural tasks may also be explained by examining the differential influence of underlying behavioural influences. Interestingly implicit attitudes, which were found to be positive, were found to predict just one measure of behaviour, the equivalent gain task (spontaneous behaviour), which was found to produce the most positive results towards GM food. In addition, the least positive behavioural measure, vignettes (deliberate behaviour), were found to be the measure most strongly predicted by explicit attitudes, which were negative. It is possible, therefore, that differences in results obtained from tasks may be due to differences in the spontaneity of the decisions that they elicited from participants. It is acknowledged that the third variable problem exists here though, in that there may be other influences on behaviour, which were not measured here, that may also account for differences in behaviour.

10.8.5. Conclusions

Within this study, explicit attitudes were found to be negative towards GM food and implicit attitudes were found to be positive towards GM food. In addition, three different measures of behaviour towards GM food indicated that the majority of people were likely to engage in approach behaviour towards GM food. Differences between these tasks were attributed to methodological differences between tasks as well as to differences in the extent to which implicit and explicit attitudes were driving behaviour. Implicit and explicit attitudes were both found to be important in predicting behaviour towards GM food. Implicit attitudes predicted spontaneous behaviour best and explicit attitudes predicted combined and deliberate behaviour best. The comparison of different ways of combining explicit and implicit attitudes in order to predict behaviour indicated that the double dissociation pattern of data best fits results obtained here.

10.8.6. Future research

Future research should attempt to delineate conditions in which the different patterns of combining implicit and explicit attitude measures may apply. In this respect, it would be useful to methodically examine behaviours within different domains and of varying levels of spontaneity. It would also be useful to find some external means of validating behaviour in terms of its level of spontaneity.

It is also acknowledged that the use of only one implicit task here limits the latent variable of implicit attitude. The well documented low convergent validity of implicit attitude tasks indicates that it is possible that results might vary if different implicit attitude measures were used. Further research should, therefore, utilise several different implicit attitude measures, in the same way as was done here, in order to examine this point.

Behaviour towards GM food was examined quite rigorously within this study using three different measures of behaviour. Further research should examine how behaviour may differ towards different types of GM food in a more in-depth manner. For example, the price differential between GM food and non-GM food required to induce participants to purchase GM should be investigated for different types of food. In addition, it would be useful to examine behaviour towards GM food in a stratified sample of the UK population in order to examine the extent to which current findings can be generalised.

Chapter Eleven – General Discussion and Conclusions

The main aim of this PhD was to further the understanding of attitudes and behaviour towards biotechnologies, and in particular GM food. Relevant literature was explored and a variety of studies and experiments were conducted resulting in advances within this field of both an empirical and theoretical nature. This chapter will begin by examining these advances. The practical implications of results obtained will then be explored to examine the potential impact of findings. Shortcomings of the research will also be described and in association with this, the extent to which results can be generalised will be considered. Suggested directions for future research within this field will then be discussed before conclusions about the overall meaning and importance of the research contained within this thesis are drawn.

11.1. Empirical achievements

A variety of empirical data relating to the domain of attitudes and behaviour towards biotechnologies, and in particular GM food, has been produced within this thesis. This research has increased our understanding of how people perceive biotechnologies and GM food and how people behave towards GM food. The nature of behavioural influences, in particular attitudes, within this domain has also been clarified. This section will summarise the most important empirical findings and explain their significance.

11.1.1. Perceptions of biotechnologies (Chapter three)

An in-depth qualitative investigation of biotechnologies, including GM food, provided a useful insight into personal constructs associated with biotechnologies. Personal constructs are ways in which people organise the world around them (Kelly, 1955). The most common personal constructs used to organise biotechnologies were 'Research object', 'Genetic modification', 'General Application', ' Type' (product/process), 'Medical', 'Personal preference', 'Knowledge', 'Beneficiaries', 'Time', 'Social acceptance', 'Effects' and 'Risk'. These dimensions provided an insight into the most significant features of biotechnologies that are attended to and which are likely to provide the basis for attitude formation.

This study also indicated that, generally, biotechnology concepts that were associated with animals and plants were perceived as genetically modified, non-medical and as less liked or disliked. Biotechnology concepts that were associated with humans, on the other hand, were perceived as not being genetically modified, medical and were liked. These divisions align well with perceptual groupings that have been identified from previous research which divide biotechnologies into medical (red) biotechnologies and agricultural (green) biotechnologies (Bauer, 2002).

11.1.2. Emotions and imagery associated with biotechnologies (Chapter three)

Emotions and imagery associated with biotechnologies were also examined. The emotions that were identified in relation to biotechnologies were grouped into different categories of emotion. The most common types of emotion generated were simple evaluative descriptions ('Positive', 'Negative', 'Neutral'), however other more complex emotions were also generated ('Anger', 'Disgust', 'Interest', 'Risky', 'Fear', 'Hopeful', 'Unsure'). The imagery that was associated with biotechnologies was grouped into categories that were direct descriptions of the technologies themselves ('Positive', 'Neutral', 'Negative'), and those that were indirectly associated with the technologies ('Artificial', 'Side effects', 'Humorous', 'Scientific', 'Medical', 'Media', 'Economics' and 'Power'). Associations between emotions and imagery linked with different types of biotechnology displayed a main divide between food and medical biotechnologies (Bauer, 2002). Emotions relating to food biotechnologies were mixed and imagery was quite varied, whereas emotions relating to medical biotechnologies were positive and imagery mostly related to medicine and science.

It has been theorised that emotions play a large role in decision making, particularly when decision making is made under time pressure or under a heavy cognitive load (Finucane et al., 2000; Loewenstein et al., 2001; Damasio, 1994). Emotions associated with biotechnologies may, therefore, provide a direct insight into the type of behaviour that is likely to be produced when a particular biotechnology is encountered. Previous research has made some progress in identifying the type of behaviours that are most commonly elicited when individuals experience different emotions. For example, the emotion of anger has been associated with risky choices whilst the emotion of fear has been associated with risk averse choices (Lerner and Keltner, 2000).

Theory suggests that images have a close relationship with emotions and decision-making (Damasio, 1994) and empirical evidence has found that imagination has a significant impact on behaviour (Strack et al., 1985; Pham and Taylor, 1999; Blair et al., 2001). It was concluded that imagery associated with biotechnologies may relate to the most influential factors that predict behaviour towards the biotechnologies. Imagery may also provide evidence of further factors, perhaps those that are difficult to verbalise, that may influence behaviour.

11.1.3. Cognitive constructs explicitly associated with GM food (Chapters four and five)

A variety of cognitive constructs relating to GM food were examined within this thesis. Explicit attitudes were measured several times in different experiments and on the whole were found to be neutral across participants. This supports previous research that has found the British population to be quite ambivalent towards GM food (Gaskell, Allum and Stares, 2003; Poortinga and Pidgeon, 2004); ambivalence is likely to be expressed as neutral when bipolar scales are used to examine evaluative valence.

Several other socio-cognitive constructs relating to GM food have also been examined. Subjective norms and moral norms were repeatedly found to be significantly positive towards GM food. This indicates that most participants tested felt that their friends and family would be positive towards eating GM food and also that they felt that eating GM food was morally acceptable. Data regarding self-identity indicated that the majority of individuals identified themselves as a person who would eat GM food (although this was not significant in all samples tested). Perceived behavioural control (PBC) over the behaviour of trying GM food has also been examined. On the whole, PBC was found to be neutral indicating that the majority of individuals do not feel significantly either in control or not in control over eating GM food.

Further to this, the cognitive construct of emotional involvement was examined within this thesis. Emotional involvement was conceptualised as the degree to which an individual feels engaged with the topic of GM food. Interestingly, measures of emotional involvement differed quite greatly between samples of participants tested. Within the student population tested (consisting of psychology and biology students), levels of emotional involvement were significantly positive, whereas within the call centre population tested, levels of emotional involvement were significantly negative. Differences are likely to be due to differences in the characteristics of the population samples tested.

Behavioural intentions towards GM food were neutral in all samples apart from biology students. This is considered to be an artefact of participant selection; those who choose to study biology are likely to be more positive towards related technologies. Overall, other samples examined seem to be neutral with regards to whether they would try GM food.

11.1.4. Implicit attitudes towards biotechnologies (Chapter seven)

An examination of implicit attitudes towards different types of biotechnologies indicated that evaluative differences existed at an implicit level between animal, human and plant biotechnologies. Results indicated that implicit attitudes towards human biotechnologies and towards plant biotechnologies were significantly more positive than implicit attitudes towards animal biotechnologies. Implicit attitudes did not differ significantly between human and plant biotechnologies.

These results align, to some extent, with explicit attitudes towards biotechnologies. Explicit attitudes have indicated that the public were more positive towards medical biotechnologies than towards food biotechnologies (Bauer, 2002) which supports the finding that implicit attitudes towards human biotechnologies (which are generally related to medicine) were more positive than towards animal biotechnologies (which are generally related to food). Explicit attitudes have also indicated that the public was more positive towards biotechnologies that were developed using plants than towards biotechnologies that were developed using animals (Frewer, Howard, Hedderley and Shepherd, 1997). This supports the finding that implicit attitudes towards plant biotechnologies were more positive than towards animal biotechnologies. The finding that human biotechnologies were not evaluated significantly more positively than plant biotechnologies was not anticipated because medical biotechnologies have previously been found to be evaluated significantly more positively than food biotechnologies (Bauer, 2002). This might be explained by the fact that the category of food biotechnologies encompasses animal biotechnologies (as well as plant biotechnologies) which have been found to be perceived more negatively than plant biotechnologies (Frewer, Howard, Hedderley and Shepherd, 1997).

11.1.5. Implicit attitudes towards GM foods (Chapters eight and nine)

The first ever investigation of implicit attitudes towards GM foods, conducted as part of this PhD, found that implicit attitudes were positive toward GM food. As implicit attitudes have been shown to be important predictors of behaviour (see Poehlman et al., 2005, for a review), these results indicate that behaviour driven by implicit attitudes is likely to be positive.

Interestingly, implicit attitudes did not correlate with explicit attitudes. Depending on the theoretical stance taken this has differing implications. From the view of the model of dual attitudes (Wilson et al., 2000), which states that explicit and implicit attitudes are different constructs, it would be assumed that these different attitudes were developed in different ways. From the view of the single attitude model (e.g. Chaiken, 1980; Fazio, 1990; Devine, 1989), which states that explicit and implicit attitudes are different measures of the same construct, it would be assumed that other factors, e.g. self-presentation effects, moderate the relationship between explicit and implicit attitudes causing these to differ.

The divergence noted between explicit and implicit attitudes has important implications for the predictive validity of these constructs. Research has shown that the extent to which implicit and explicit attitudes predict behaviour is lowered when these constructs do not correlate, particularly for explicit attitudes (Poehlman et al., 2005). Implicit attitudes may, therefore, be a particularly useful source of information in predicting behaviour when implicit and explicit attitudes diverge.

Implicit attitudes towards GM food were found to differ depending on the context in which they were presented. Results showed that implicit attitudes towards GM food were neutral if examined in the context of ordinary food or in the context of organic food. This implies that implicit attitudes towards GM food may not differ significantly from implicit attitudes towards any other food types.

Implicit attitudes towards GM food also varied depending on what GM food was contrasted with and what super-ordinate category GM food was associated with. When GM food was contrasted with other food types, implicit attitudes towards GM food were negative, whereas when GM food was contrasted with other biotechnologies implicit attitudes towards GM food were neutral. On the other hand, when GM food was considered as part of the super-ordinate category of food, implicit attitudes towards GM food were positive but when GM food was considered as part of the super-ordinate category of biotechnologies, implicit attitudes were neutral. These results show that implicit attitudes towards

GM food will differ depending on the situation in which GM food is encountered and the way in which GM food is perceived.

11.1.6. Behaviour towards GM food (Chapters five and ten)

Behaviour towards GM food has been measured several times within this thesis using a variety of different methods and all examinations have indicated that the majority of participants would try GM food, or would purchase GM food. Vignettes examining self-predicted behaviour towards GM food indicated that participants were likely to try GM food in the majority of scenarios specified. Participants predicted that they were significantly likely to try GM food when just offered or when GM food had potential health benefits. However, participants predicted that they were significantly less likely to try GM food when it had potential cost savings. This is likely to be due to the economic association with the food; this may cultivate feelings of being coerced to try the food or perhaps that the food is associated with a poorer quality due to its cheapness. It is noted that this result may be due to demand characteristics of the questions, which were hypothetical, and that in a real situation behaviour may be different.

A real choice task that was used to examine behaviour towards GM food found that the vast majority of participants were willing to accept a purportedly GM chocolate chip cookie when offered. Further to this, an equivalent gain valuation task found that the majority of participants would try GM chocolate at some cost. It was also found however, that GM chocolate was valued significantly less than non-GM chocolate.

Altogether, findings indicate that people are likely to try GM food when offered. However, in order to persuade people to actually purchase GM food in preference to non-GM food, some extra incentive, e.g. health benefits, may be required.

11.2. Theoretical and methodological achievements

In addition to the various empirical findings of this thesis, a number of contributions have been made to the theoretical understanding of attitudes and behaviour in the domain of biotechnologies and GM food.

11.2.1. The single criterion card sorting task (Chapter three)

Research demonstrated that the single criterion card sorting task was a useful tool with which to examine personal constructs within the domain of biotechnologies. In fact, this method may be more useful within areas in which participants may have relatively low knowledge, e.g. GM food, than other related tasks that have previously been used, such as the repertory grid technique, because this method seems better able to identify more basic personal constructs.

Research also provided information with regards to the relationships between personal constructs, emotions and imagery. Data unfortunately does not conclusively prove or disprove relationships between these constructs. Findings did demonstrate that personal constructs, emotions, and imagery do not directly mirror one another but this does not rule out the possibility that these may be related.

11.2.2. Important cognitive factors relating to behaviour towards GM food and the TPB (Chapters four and five)

This thesis has also provided data regarding the predictive value of various cognitive constructs within the domain of GM food. Within original components of the TPB model, results indicated that attitudes and subjective norms were significant predictors of behavioural intentions. This supports findings from previous research (Cook et al., 2002; Saba and Vasallo, 2002; Sparks et al., 1995; Sparks and Shepherd, 2002). Both attitudes and subjective norms were found to have a positive influence on behavioural intentions, so as levels of these factors increase, behavioural intentions are also likely to increase.

PBC was also a significant predictor of behavioural intentions, but only in one of the population samples that were tested here. PBC was found to predict behavioural intentions of the call centre population sample (reported within chapter five) but did not predict behavioural intentions of the psychology and biology students that were examined (reported within chapter four). Differences in results are likely to be due to the characteristics of the different populations. Previous research has suggested that issues of control may be particularly important for individuals of low socio-economic status (Frewer, 2000) and findings may reflect this. In all samples, PBC had a negative influence on behavioural intentions indicating that as control increases, the likelihood of trying GM food will decrease.

Results indicated that the factor of moral norms did not significantly predict variance in behaviour intentions in any of our samples. This adds to previously mixed research with regards to the usefulness of moral norms within the domain of GM foods, although the majority of studies have found this factor to be non-significant (Saba and Vasallo, 2002; Sparks et al., 1995). Moral norms are concluded to be of little importance with respect to behaviour towards GM food, although this concept might be useful in certain specific situations or population samples.

A further influence on behaviour that had not been examined before in conjunction with the TPB is emotional involvement. This factor emerged from previous research that examined attitudes towards GM food and has been found to be an important determinant of support of GM food (Gaskell, Allum and Bauer et al., 2003; Campbell and Townsend, 2003). The inclusion of this factor alongside TPB components received mixed results in our studies; it was found to predict a significant amount of variance in behavioural intentions within the call centre population sample that was tested but not within university students. These samples also differed significantly in terms of the levels of emotional involvement displayed. The call centre sample displayed significantly low levels of emotional involvement whilst university students displayed significantly high levels of emotional involvement. It is possible that emotional involvement may only predict significant amounts of behavioural intentions within populations that feel significantly disengaged with the topic of GM food. In conclusion, the construct of emotional involvement is important within the domain of GM foods but may also be usefully added to the TPB when applied to other domains. It should therefore be further investigated.

<u>11.2.3. The impact of learning on cognitive factors relating to the behaviour of trying GM food (Chapter four)</u>

Interestingly, learning was found to have very little impact on behavioural intentions, and cognitive antecedents of behavioural intentions examined. With regard to the pattern of cognitive influences that were found to impact on behavioural intentions, no significant differences were found over time after the learning intervention was experienced by biologists. With regard to empirical levels of TPB components, the only construct that differed significantly over time with learning was the construct of PBC. Biologists who received the learning intervention displayed a significant increase in levels of PBC over time, whereas psychologists, who did not receive a learning intervention, did not show any significant differences in PBC. This finding is in line with hypotheses and previous research that suggested that higher levels of knowledge are associated with higher levels of PBC (Frewer et al., 1994a).

Interestingly, expected changes in levels of attitude as a result of learning were not found within the study. This contrasts with previous research that has indicated that, within the area of GM food, higher knowledge is associated with more positive levels of attitude (Gaskell et al., 2000; Allum et al., 2002). Further research has, in fact, demonstrated that the relationship between knowledge and attitudes is likely to be more complex that a simple positive linear association. Findings have indicated that within the domain of science, an increase in knowledge is actually associated with stronger attitudes, no matter what the direction (Evans and Durant, 1995). Results from our research indicated that an increase in knowledge did not result in a simple positive increase in attitudes. However, results also indicated that an increase in attitudes did not alter the influence of attitudes on behaviour which would be an expected result of attitude strengthening (Davidson et al., 1985). Attitude strength was not directly measured within this study though, and as a consequence it is difficult to draw reliable conclusions about the impact of knowledge on this aspect of attitudes. It is possible that attitudes were not strengthened with knowledge, possibly due to the controversial nature of the domain and the non-selective, balanced way in which participants received information. It is noted that the learning undergone by students was not intended to be persuasive. It is also possible that knowledge may only increase attitude strength within certain domains. This data has added to current information regarding knowledge and attitudes and may help to focus future studies that examine the relationship between these constructs.

11.2.4. Implicit attitudes towards GM food (Chapters eight and ten)

This thesis examined the concept of implicit attitudes in some depth along with the different tasks that are used to measure implicit attitudes. Two of the newest tasks that have been developed to examine implicit attitudes, the EAST (Extrinsic Affective Simon Task) and the GNAT (Go No-Go Association Task) were examined and compared within this research. Altogether the GNAT was found to be a more useful task than the EAST. The GNAT was more powerful than the EAST and it was internally consistent, whereas the EAST was internally inconsistent for most of the concepts examined. Further research conducted therefore made use of the GNAT rather than the EAST.

Research conducted within this thesis adds to previously sparse evidence (Nosek and Banaji, 2001) regarding the predictive validity of the GNAT. The GNAT was found to be useful in predicting behaviour towards GM food. In fact, this research was the first to examine the predictive validity of implicit attitudes within the domain of behaviour towards GM food. Data indicated that implicit attitudes should be considered alongside explicit attitudes when making predictions about behaviour towards GM food.

11.2.5. Predicting behaviour using implicit and explicit attitudes (Chapter ten)

The potential ways in which explicit attitudes and implicit attitudes may be combined to predict behaviour towards GM food were examined within this thesis. Potential patterns of combination included: additive (in which implicit attitudes and explicit attitudes both predict variance in behaviour), double dissociation (in which implicit attitudes predict spontaneous behaviour and explicit attitudes predict deliberate behaviour separately), and interactive (in which implicit attitudes and explicit attitudes combine interactively to predict behaviour). This research examined the predictive power of each potential pattern of combination in a particularly rigorous manner using three different behaviour measures and a structural equation modelling approach. Results indicated that the additive pattern of combination was the best fitting and most parsimonious model tested. This adds to previously mixed results (Asendorpf et al., 2002; Perugini, 2005) and indicates that different patterns of combination may be more or less useful in different domains of behaviour and for different types of behaviour.

11.3 Practical implications

11.3.1 Implications for biotechnology companies

Data obtained within this thesis indicated that if GM food does become available in Britain, it is likely that the consumption of GM food will be greater than surveys of explicit attitudes have indicated (Gaskell, Allum and Bauer et al., 2003). Results show that the majority of consumers would buy GM products if the price is right. Non-GM food is generally preferred to GM food however, and therefore additional benefits such as lower cost are likely to be required in order to persuade consumers to buy GM.

In fact, the data presented here showed that even some consumers who are purportedly anti-GM will try GM food in certain situations. As implicit attitudes are generally more positive than explicit attitudes, it is likely that spontaneous behaviour, which is thought to be primarily driven by implicit attitudes, is more likely to be positive towards GM food than deliberate behaviour. Therefore, promotions that encourage spontaneous food choice, such as free sample offers in public places, are likely to be successful in increasing the uptake of GM food. As previous behaviour is an extremely good predictor of subsequent behaviour (Rhodes and Courneya, 2003), an initial positive behaviour towards GM food is likely to promote positive subsequent behaviour towards GM food.

This research has highlighted the most influential cognitive constructs on behaviour. Attitudes and self-identity are the most important influences on behaviour followed by subjective norms and to a lesser extent PBC and emotional involvement. Therefore any advertising campaigns would be advised to focus on influencing attitudes, self-identity and subjective norms.

Overall, with other factors remaining constant, GM food is likely to have a viable market within the UK. A major concern for biotechnology companies is likely to be the reactions of key related interest groups, such as consumer groups, scientists and anti-GM groups. Campaign messages by these key groups, who are the most trusted by consumers on the issue of GM food, could possibly alter the attitudes and behaviour of many people. However if the fears of these key groups can be appeased, then sales of GM food in the UK are likely to be good.

11.3.2 Implications for government and policy making

The findings of this thesis are relevant to policy makers as it is important for policy makers to understand how people are likely to react towards GM food when formulating policy on this issue. The government has a duty to protect consumer interests as well as in supporting the British economy. Economically, the government should encourage the proliferation of GM food if it encourages trade and growth within Britain's markets. Socially, the government must ensure the safety of GM food before it becomes widely available for consumption.

Consumer interests should be protected by government policy, and consequently it is of question what consumer interests are. Arguably, explicit attitudes are the real opinions of individuals, as these attitudes are produced when people have time to think carefully about a topic and produce a deliberate response. Data within this thesis indicates that there is a need for government to protect consumers in this case as implicit attitudes, and behaviour, often seem to differ from explicit attitudes. Consumers may eat GM food in certain situations, particularly spontaneous situations, when implicit attitudes may override explicit attitudes towards GM food. In other situations where the consumer has more time to think about the situation, they may not eat GM food. This implies a need for the government to exert further caution in allowing the distribution of GM food.

Attitude strength is found to moderate the relationship between implicit and explicit attitudes; the stronger the attitude, the more likely that implicit and explicit attitudes will be similar (Nosek, 2005). It is, therefore, also recommended that the government encourages the strengthening of attitudes towards GM food. This will enable consumers to develop implicit and explicit attitudes that are more in line with one another and facilitate informed decision making. Attitude strengthening may be achieved through media campaigns and the provision of further information about GM food with the aim of promoting further discussion on the topic.

11.4 Shortcomings

Alongside the achievements of this thesis, acknowledgement must be given to the shortcomings of the research. With hindsight, and through the benefit of the accumulation of knowledge that occurred during the course of the research, certain aspects of the research conducted would be done differently if it could be redone.

More specifically, the initial qualitative study that was carried out which examined different biotechnologies within a card sort task (chapter three) may have been more informative had it been conducted in a slightly different way. Had participants been asked to provide imagery and emotions that they associated with the different card sorts that they had produced, rather than simply to the biotechnologies themselves, this may have provided a greater insight into the most important cognitive appraisal dimensions relating to biotechnologies. As it stands, the card sort task described was informative albeit in a slightly different way. If these changes had been made, information relating to the imagery and emotions that participants associate with different biotechnologies would have not been gained.

Two different studies (reported within chapters four and five) made use of the TPB in order to examine cognitive constructs associated with behavioural intentions and their usefulness in predicting intentions and behaviour. Unfortunately questions used to assess cognitive constructs did not all correspond precisely with one another which may have diminished relationships measured somewhat. Specifically, questions used to measure attitudes and one of the questions used to measure subjective norms assessed cognitions relating to GM food in general, whereas all other questions related to the behaviour of trying GM food. The likely consequences of this are that the impact of attitude and subjective norms on behavioural intentions may have been underestimated. Both of these constructs were found to have significant positive effects on behavioural intentions but it is possible that these may have had a larger effect had correspondence been specified more accurately. It is noted, however, that only one question assessing subjective norms related to GM food itself and other questions did relate to GM food behaviour. In addition, Cronbach's alpha levels indicated that this construct was internally consistent, which indicates that any consequences resulting from a lack of correspondence were minimal.

With hindsight, changes would be made to the study that utilised IATs (reported within chapter seven) in order to examine implicit attitudes towards plant, animal and human biotechnologies. Firstly, this study would ensure that exemplars contained within the categories utilised did not confound food and medical biotechnologies. This meant that implicit attitudes gained were a result of considering both process and product attributes and, therefore, it is difficult to distinguish the cause of the attitude. It would have been more valid to examine each main process category (i.e. plant, animal and human biotechnologies) within each product category (i.e. food and medical biotechnologies) separately. Further to this, it would have been useful to have also examined the explicit attitudes of participants towards each category of biotechnology used so that implicit and explicit attitudes could have been compared directly.

The study that compared the Go No-Go Association Task (GNAT) and the Extrinsic Affective Simon Task (EAST), contained within chapter six, would have been enhanced had the same word stimuli been used by both tasks. The study, as it stands, was useful and achieved its purpose. However, it could have also operated to examine the structural differences between the tasks if the same word stimuli had been used by both. Theoretically, the GNAT assesses implicit attitudes towards the overall category that participants are asked to respond to, whereas within the EAST participants respond to individual word stimuli. It would be hypothesised that responses to the category utilised within the GNAT would differ from the averaged response to the same category exemplar words utilised within the EAST. As it stands, it was demonstrated that responses to the GM food category utilised within the GNAT differed from responses made to the category title 'GM food' as utilised as word stimuli within the EAST.

Improvements could have been made to the experiments contained within chapter nine of this thesis that investigated context effects relating to the measurement of implicit attitudes towards GM food. It would have been more rigorous to have included a pre-test that measured implicit attitudes towards the related super-ordinate categories of food and biotechnologies that were made use of within this chapter. This would have facilitated predictions and demonstrated more conclusively why effects were occurring.

A general shortcoming of the research conducted within this thesis is that experiments were not carried out on a representative sample of the British population. This problem relates to several experiments carried out, including the card sorting task (chapter three), the TPB study carried out in conjunction with an experimental behavioural task (chapter five), the IATs that examined animal, plant and human biotechnologies (chapter seven), the GNATs that examined GM food in different contexts (chapter nine) and the final large experiment that assessed implicit attitudes, explicit attitudes and behaviour (chapter ten). The use of a stratified sample of residents within Britain was considered, however for practical reasons, and particularly monetary reasons, this possibility was not feasible.

11.5 Future research

As much as the completion of this PhD has satisfied initial questions that were raised in the meeting of aims with regards to examining attitudes and behaviour towards GM food, it has also resulted in the initiation of further questions relating to this topic.

11.5.1. Cognitive appraisal dimensions, imagery and emotions

The examination of personal constructs relating to biotechnologies revealed that there is great variation between perceptions of different biotechnologies and, therefore, more in-depth research is recommended into individual biotechnologies. It would be interesting to examine cognitive appraisal dimensions further within each of the main groups that were emergent within the study described within chapter three that applied the card sorting task to biotechnologies, for example, the category of food biotechnologies could be examined on its own. This would allow the investigation of cognitive appraisal dimensions that distinguish different food biotechnologies from each other.

It would also be interesting to examine the relationship between cognitive appraisal dimensions, imagery and emotions in more depth. Chapter three of this thesis examined each of these types of constructs in relation to different biotechnologies, however it would be useful to examine these in relation to one another. More specifically, participants could be asked to provide images and emotions that they associate with each cognitive appraisal dimension generated. If cognitive appraisal dimensions are regressed against behavioural intentions or actual behaviour in order to examine how influential these are, the hypothesis that images are associated with the most influential cognitive appraisal dimensions could be tested. Further to this, associated emotions could be related to the direction in which cognitive appraisal dimensions relate to intentions and/or behaviour. In addition, it would be useful to examine behaviour under different conditions, which vary with regards to spontaneity, alongside cognitive appraisal dimensions, emotion and imagery in order to examine how the importance of these may vary in different situations. This research would go further in testing Damasio's (1994) somatic marker hypothesis.

11.5.2. Cognitive constructs relating to behavioural intentions and behaviour

The use of the TPB in examining cognitive constructs relating to behavioural intentions and behaviour proved useful within the domain of GM food (see chapters four and five). Constructs examined explained a significant amount of variance in behavioural intentions and behaviour but a large amount of variance was left unexplained. It would be useful to examine how further constructs, which have been identified as important within the domain of GM food, e.g. trust, may help to predict intentions and behaviour.

It would also be interesting to examine the construct of explicit attitudes in more detail. Aspects of attitude such as attitude strength and attitude dimensionality, as well as attitude ambivalence, may impact on relationships observed within constructs investigated here. The relationship between learning and attitude and related attitudinal constructs would also be a useful direction for future research.

The TPB model proved to be a useful framework with which to examine behaviour towards GM food, however an alternative model that also deserves consideration is the Model of Goal Directed Action (Perugini and Bagozzi, 2001). The Model of Goal Directed Action adds affective, motivational and automatic processes to the TPB in order to provide a more complete analysis of behaviour. This may be a useful tool within which to integrate research and provide a clearer examination of behavioural processes.

11.5.3. Implicit attitudes towards GM food

The finding that implicit attitudes are positive towards GM food (reported within chapter eight) has important ramifications but requires further exploration. Most importantly, implicit attitudes towards GM food should be investigated within a large stratified sample of the British population in order to examine the generality of this finding. The most feasible way of doing this is probably by making use of the internet and using some way to direct and entice specific people to a particular web site to complete implicit attitude tasks online. The use of internet technology would also facilitate cross-cultural comparisons of implicit attitudes towards GM food. It would also be useful to measure implicit attitudes towards GM food using unipolar tasks. This would enable the examination of the possibility that people hold both positive and negative associations towards GM food.

Chapter eight also demonstrated that implicit and explicit attitudes towards GM food did not correlate. The relationship between implicit and explicit attitudes is not fully understood, and therefore it would be both empirically and theoretically useful in order to examine potential moderators of the relationship between these constructs in this domain. Again, it may be possible to do this online.

There is more than one plausible reason why implicit associations with GM foods are positive. It is possible that these have been learnt through evaluative conditioning as with any other implicit attitude. Alternatively, it is possible that cognitive structures regarding GM food that implicit attitude tasks are measuring are not very well developed, and therefore associations that are measured are actually associations relating to a better developed, super-ordinate category that GM food belongs to, i.e. food or biotechnologies. This hypothesis could be tested by studying which category participants most associate with GM food, by examining the implicit association that the participant has towards that category, and by examining whether this is predictive of a participant's implicit attitude towards GM food. It would also be useful to examine how knowledge relates to implicit associations held towards GM foods. An individual who has a high level of knowledge about GM food is likely to have developed direct associations with the concept of GM food and may, therefore, be less likely to rely on associations with related cognitive categories.

An interesting extension of the examination of implicit attitudes towards GM food would be to examine other implicit associations that people have with GM food. Implicit associations with cognitive constructs, such as risk or control, which have been explicitly related to GM food, could be examined for example.

This would enable a more in-depth exploration of the cognitive structure surrounding the concept of GM food.

11.6. Conclusions

This thesis has demonstrated that cognitions, emotions and imagery vary greatly between different biotechnologies. An examination of these constructs provided an insight into similarities and differences between biotechnologies as well as an indication of likely behaviour towards different biotechnologies. Food biotechnologies were perceived as more genetically modified than medical biotechnologies and were less liked. In addition, food biotechnologies were associated with a mixture of emotions and imagery that were both positive and negative in valence, whereas medical biotechnologies were generally associated with positive emotions and scientific and medical imagery.

An expanded version of the TPB that includes the constructs of emotional involvement and self-identity, alongside original constructs of attitude, subjective norms and PBC, was found to be a useful tool in examining an individual's likely intentions and behaviour towards GM food. The effects of learning about GM food were also examined and this had little impact on cognitive constructs relating to GM food behaviour or on behavioural intentions.

Implicit attitudes were found to be useful in predicting behaviour towards GM food alongside the construct of explicit attitudes. In fact, the best fitting model of behaviour prediction was achieved when both implicit and explicit attitude measures were allowed to predict behaviour. It is noted, therefore, that it is insufficient to consider just one measure of attitude when making behavioural predictions with respect to GM food. Investigations indicated that implicit attitudes were significantly less positive towards animal biotechnologies than towards plant biotechnologies and human biotechnologies. Implicit attitudes towards GM foods themselves were found to be positive but it was also demonstrated that these would vary depending on context and the way in which GM foods were perceived.

11.7. Summary

Whether GM food is a good idea or not is a matter for societal debate, however this thesis has shown that the British public are likely to behave more positively towards GM food than large survey data has indicated. The examination of explicit attitudes on its own ignores other important influences on behaviour, including other socio-cognitive factors, e.g. subjective norms, and associative processes as measured by implicit attitudes. The consideration of these factors, alongside the direct examination of behaviour towards GM food, has resulted in a transformation of the understanding of potential reactions to the likely future increase of GM food in Britain. The data within this thesis has enormously important implications for biotechnology companies, policy makers and consumers within Britain and data obtained will be disseminated as widely as possible.

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Appendix One - The mapping of concepts across average criterion groupings

Sorting dimension	Research Object	Genetically modified	Medical	Personal preference
Groups within sort	*Animal and Plant*	*Genetically manipulated*	*Non-medical*	*Personally disliked and less liked*
Stimuli	GM strawberries	GM strawberries	GM strawberries	GM strawberries
	GM fruit and vegetables	GM fruit and vegetables	GM fruit and vegetables	GM fruit and vegetables
	Golden rice	Golden rice	Golden rice	Golden rice
	Herbicide resistant crops	Herbicide resistant crops	Herbicide resistant crops	Herbicide resistant crops
	Pest resistant crops	Pest resistant crops	Pest resistant crops	Pest resistant crops
	Animal cloning	Animal cloning	Animal cloning	Animal cloning
	Faster growing animals	Faster growing animals	Faster growing animals	Faster growing animals
		Human cloning	Human cloning	Human cloning
			Eugenics	Gene therapy
			DNA fingerprinting	
Groups within sort	*Human*	*Not genetically manipulated*	*Medical*	*Personally liked*
Stimuli	Human cloning			
	Human insulin	Human insulin	Human insulin	Human insulin
	Blood substitutes	Blood substitutes	Blood substitutes	Blood substitutes
	Pharmocogenetics	Pharmocogenetics	Pharmocogenetics	Pharmocogenetics
	Gene sequencing	Gene sequencing	Gene sequencing	Gene sequencing
	Tissue culture	Tissue culture	Tissue culture	Tissue culture
	DNA fingerprinting	DNA fingerprinting		DNA fingerprinting
	Xenotransplantation	Xenotransplantation	Xenotransplantation	Xenotransplantation
	Stem cell research	Stem cell research	Stem cell research	Stem cell research
	Biosensors	Biosensors	Biosensors	Biosensors
	Bioremediation	Bioremediation	Bioremediation	Bioremediation
	Eugenics	Eugenics		Eugenics
	Gene therapy	Gene therapy	Gene therapy	

Appendix Two – Questions used to assess TPB components within chapter four

Construct	Items	Scale
Subjective norms	• "In general, what do you think your family and friends would think of you eating GM food?"	• "Pleasant – Unpleasant"
	• "The people in my life whose opinions I value would not mind if the food they eat was GM."	• "True - False"
	• "Most people who are important to me consider GM food to be:"	• "Pleasant - Unpleasant"
	• "The people in my life who are important to me would not mind if I ate GM food."	• "Agree - Disagree"
PBC	• "How much control do you feel you have over eating a GM free diet?"	• "Complete control - No control"
	• "How confident are you that it is possible to avoid eating GM food?"	• "Very confident - Not very confident"
	• "I could easily avoid GM food if I wanted to."	• "True – False"
	• "I do not have control over whether my diet includes GM food or not:"	• "True – False"
	• "Personally, I would find it easy to keep to a GM free diet."	• "True – False"
	• "Do you consider yourself able to monitor your diet and avoid GM foods?"	• "Not at all able - Very able"
	• "Do you think that you are personally able to exclude GM food from your diet?"	• "Definitely – Definitely not"
Attitude	• "In general I believe that the use of gene technology in food production is:"	• "Good - Bad"
		• "Positive - Negative"
		• "Selfish – Unselfish"
		• "Safe - Dangerous"
		• "Beneficial - Harmful"
		• "Useless – Useful"
		• "Right - Wrong"
		• "Wise - Foolish"
Self-identity	• "I am the type of person that would eat GM food."	• "True - False"

	• "I consider myself as a person who would be open to trying GM food."	• "True – False"
	• "I am the kind of person who will only eat food that has been grown naturally without genetic modification."	• "True - False"
Moral norms	• "It would be wrong of me to eat genetically modified food."	• "True – False"
	• "I shouldn't really eat GM foods for moral reasons."	• "Strongly agree - Strongly disagree"
	• "Morally, I have no problem with GM food stuffs."	• "Agree - Disagree"
	• "I do not consider the production of GM foods morally wrong."	• "Agree - Disagree"
Emotional involve-ment	• "The continued production of GM foods does not upset me at all."	• "True – False"
	• "Do you feel that decisions about GM food are largely irrelevant to you?"	• "Definitely - Definitely not"
	• "Might decisions taken by governing bodies about the future of GM foods upset you?"	• "Not at all - Very much"
	• "To what extent do you feel like you're emotionally involved in whether GM food should be produced or not?"	• "Very much - Not at all"
	• "How emotional do you feel about the decisions taken to produce GM food?"	• "Not very emotional - Emotional"
Intention	• "I always intend to avoid eating GM food	• "True – False"
	• "When eating, I intend to make sure that my food does not contain GM ingredients."	• "True - False"
	• "I intend to try new foods prepared by gene technology."	• "True - False"

Appendix Three – Effect sizes (Cohen's d) of differences between TPB mean component levels and the scale mid-point

Component	Psychologists		Biologists	
	Time 1	**Time 2**	**Time 1**	**Time 2**
Intention	0.18	0.32	0.67	0.80
Attitude	0.17	0.19	1.00	0.94
Subjective Norms	0.50	0.52	0.38	0.62
PBC	-0.28	-0.13	-0.59	-0.12
Moral Norms	0.99	0.93	1.50	1.61
Self-Identity	0.80	0.80	1.27	1.51
Emotional involvement	0.80	0.92	0.56	0.42

Appendix Four – Correlations between TPB components measured within chapter four

4a - Correlations between TPB components measured within Psychology students at time 1 (Pearson's r)

	Intentions	Attitude	Subjective norms	PBC	Self identity	Emotional involvement	Moral norms
Intentions	-						
Attitude	0.687***	-					
Subjective norms	0.533***	0.485***	-				
PBC	0.061	0.122	-0.68	-			
Self identity	0.771***	0.711***	0.543***	0.054	-		
Emotional involvement	0.550***	0.431***	0.435***	0.196	0.610***	-	
Moral norms	0.739***	0.745***	0.469***	0.103	0.764***	0.622***	-

*Note: Sig of r *p<0.05, **p<0.01, ***p<0.001*

4b – Correlations between TPB components measured within Psychology students at time 2 (Pearson's r)

	Intentions	Attitude	Subjective norms	PBC	Self identity	Emotional involvement	Moral norms
Intentions	-						
Attitude	0.663***	-					
Subjective norms	0.478***	0.466***	-				
PBC	0.132	0.280**	0.160	-			
Self identity	0.839***	0.738***	0.535***	0.159	-		
Emotional involvement	0.583***	0.525***	0.404***	0.210*	0.609***	-	
Moral norms	0.718***	0.742***	0.468***	0.266*	0.770***	0.697***	-

*Note: Sig of r *p<0.05, **p<0.01, ***p<0.001*

4c - Correlations between TPB components measured within Biology students at time 1 (Pearson's r)

	Intentions	Attitude	Subjective norms	PBC	Self identity	Emotional involvement	Moral norms
Intentions	-						
Attitude	0.772***	-					
Subjective norms	0.627***	0.444***	-				
PBC	-0.213	-0.259*	-0.242*	-			
Self identity	0.846***	0.778***	0.556***	-0.357**	-		
Emotional involvement	0.677***	0.549***	0.574***	-0.194	0.583***	-	
Moral norms	0.627***	0.658***	0.447***	-0.174	0.658***	0.633***	-

*Note: Sig of r *p<0.05, **p<0.01, ***p<0.001*

4d- Correlations between TPB components measured within Biology students at time 2 (Pearson's r)

	Intentions	Attitude	Subjective norms	PBC	Self identity	Emotional involvement	Moral norms
Intentions	-						
Attitude	0.823***	-					
Subjective norms	0.539***	0.541***	-				
PBC	-0.178	-0.007	-0.40	-			
Self identity	0.783***	0.846***	0.530***	-0.069	-		
Emotional involvement	0.428***	0.529***	0.507***	-0.031	0.540***	-	
Moral norms	0.702***	0.707***	0.604***	-0.115	0.686***	0.548***	-

*Note: Sig of r *p<0.05, **p<0.01, ***p<0.001*

Appendix Five – Questions used to assess TPB components within chapter five

Construct	Items	Scale
Subjective norms	• "The people in my life whose opinions I value would not mind if the food they eat was GM." • "Most people who are important to me consider GM food to be:" • "The people in my life who are important to me would not mind if I ate GM food."	• "True - False" • "Pleasant - Unpleasant" • "Agree - Disagree"
PBC	• "How confident are you that it is possible to avoid eating GM food?" • "Do you consider yourself able to monitor your diet and avoid GM foods?" • "How much control do you feel you have over eating a GM free diet?"	• "Very confident - Not very confident" • "Not at all able - Very able" • "Complete control - No control"
Attitude	• "In general I believe that the use of gene technology in food production is:"	• "Good - Bad" • "Positive - Negative" • "Safe - Dangerous" • "Beneficial - Harmful" • "Right - Wrong" • "Wise - Foolish"
Self-identity	• "I am the type of person that would eat GM food." • "I am the kind of person who will only eat food that has been grown naturally without genetic *modification.*"	• "True - False" • "True - False"
Moral norms	• "I shouldn't really eat GM foods for moral reasons." • "Morally, I have no problem with GM food stuffs." • "I do not consider the production of GM foods morally wrong."	• "Strongly agree - Strongly disagree" • "Agree - Disagree" • "Agree - Disagree"
Emotional involvement	• "Do you feel that decisions about GM food are largely irrelevant to you?" • "Might decisions taken by governing bodies about the future of GM foods upset you?"	• "Definitely - Definitely not" • "Not at all - Very much"

	• "To what extent do you feel like you're emotionally involved in whether GM food should be produced or not?" • "How emotional do you feel about the decisions taken to produce GM food?"	• "Very much - Not at all" • "Not very emotional - Emotional"
Intention	• "When eating, I intend to make sure that my food does not contain GM ingredients." • "I intend to try new foods prepared by gene technology."	• "True - False" • "True - False"

Appendix Six – Correlations between TPB components measured within chapter five (Pearson's r)

	Intentions	Attitude	Subjective norms	PBC	Self identity	Emotional involvement	Moral norms
Intentions	-						
Attitude	0.666***	-					
Subjective norms	0.525***	0.535***	-				
PBC	-0.267**	0-0.117	-0.168	-			
Self identity	0.740***	0.636***	0.541***	-0.209*	-		
Emotional involvement	0.606***	0.525***	0.479***	-0.061	0.565***	-	
Moral norms	0.574***	0.620***	0.472***	-0.205*	0.551***	0.511***	-

*Note: Sig of r *p<0.05, **p<0.01, ***p<0.001*

Appendix Seven – Exemplars used within IATs within chapter seven

Exemplars used within IAT comparing biotechnologies and other technologies

'biotechnologies'	**'other technologies'**	**'pleasant'**	**'unpleasant**
Biosensors	Digital	Diamond	Abuse
Blood substitutes	Internet	Heaven	Bomb
Cloning	Lasers	Honour	Cancer
DNA fingerprinting	MP3s	Loyal	Disease
Eugenics	Microchips	Rainbow	Sickness
GM foods	Minidiscs	Freedom	Rotten
Pharmocogenetics	Satellite	Honest	Evil
Stem cell research	Virtual reality	Love	Murder
Xenotransplantation	Voice recognition	Lucky	Poverty
Gene sequencing	Wireless technology	Peace	Vomit

Exemplars used within IATs comparing plant, animal and human biotechnologies

'plant biotechnologies'	**'animal biotechnologies'**	**'human biotechnologies'**	**'pleasant'**	**'unpleasant**
GM strawberries	Disease resistant cows	Blood Substitutes	Freedom	Abuse
Fruit with increased flavour	Faster growing pigs	Synthetic Insulin	Honest	Evil
Golden rice	Fish farming	Eugenics	Love	Murder
Herbicide resistant crops	Sheep cloning	Gene Therapy	Lucky	Poverty
Pest resistant crops	Transgenic mice	DNA fingerprinting	Peace	Vomit

Appendix Eight – Exemplars used within GNATs and the EAST within chapter eight

Exemplars used within the GNAT utilised during experiment one

'GM food'	'Pleasant'	'Unpleasant'
Pest resistant crops	Excellent	Bad
GM plants	Good	Horrible
GM animals	Happy	Nasty
Increasing vitamins	Likeable	Dislike
Improving flavour	Wonderful	Terrible

Exemplars used within the EAST

Exemplars	'Pleasant'	'Unpleasant'
GM foods	Excellent	Bad
Pharm crops	Good	Horrible
Flvr savr tomato	Happy	Nasty
Golden rice	Likeable	Dislike
Engineered salmon	Wonderful	Terrible

Exemplars used within GNATs utilised during experiment two

'GM foods'	'Ordinary foods'	'Organic foods'	'Pleasant'	'Unpleasant'
Transgenic crops	Vegetables	Organic carrots	Excellent	Bad
GE livestock	Sheep farming	Free range	Good	Horrible
GM plants	Fruit farming	Unprocessed fruit	Happy	Nasty
Engineered salmon	Haddock	Organic fish	Likeable	Dislike
Modified tomatoes	Potatoes	Natural ingredients	Wonderful	Terrible

Appendix Nine – Explicit attitude questions examining affective, cognitive and overall evaluative components of explicit attitude towards GM food used within chapter eight

These questions are designed to investigate attitudes towards genetically modified (GM) foods. The questions that follow are required to be answered on a scale from -3 to +3, if you agree with the description at one end of the scale circle that number and if you agree with the description at the other end circle that number. The numbers in between should be used if you are less certain about the description and the central number 0 can be used to indicate neutrality.

How do you feel about GM food?

Love	-3	-2	-1	0	1	2	3	Hateful
Delighted	-3	-2	-1	0	1	2	3	Sad
Annoyed	-3	-2	-1	0	1	2	3	Happy
Calm	-3	-2	-1	0	1	2	3	Tense
Excited	-3	-2	-1	0	1	2	3	Bored
Angry	-3	-2	-1	0	1	2	3	Relaxed
Acceptance	-3	-2	-1	0	1	2	3	Disgusted
Joy	-3	-2	-1	0	1	2	3	Sorrow

Please indicate the traits or characteristics that you think best describe GM food.

Useful	-3	-2	-1	0	1	2	3	Useless
Foolish	-3	-2	-1	0	1	2	3	Wise
Unsafe	-3	-2	-1	0	1	2	3	Safe
Harmful	-3	-2	-1	0	1	2	3	Beneficial
Valuable	-3	-2	-1	0	1	2	3	Worthless
Perfect	-3	-2	-1	0	1	2	3	Imperfect
Unhealthy	-3	-2	-1	0	1	2	3	Wholesome

Generally how would you evaluate GM food?

Positive	-3	-2	-1	0	1	2	3	Negative
Desirable	-3	-2	-1	0	1	2	3	Undesirable
Bad	-3	-2	-1	0	1	2	3	Good
Dislike	-3	-2	-1	0	1	2	3	Like

Appendix Ten – Exemplars used within IATs and GNATs within chapter nine

Exemplars used within Target Categories

Target Categories	GM foods	Other foods	Other Biotechnologies
Exemplars	Transgenic crops	Vegetables	Tissue culture
	GE livestock	Potatoes	Cloning
	GM plants	Red Meat	Stem cell research
	Modified tomatoes	Bread	Gene sequencing
	GM Maize	Dairy Farming	Gene therapy

Exemplars used within Attribute Categories

Attribute Categories	I Like	I Don't Like
Exemplars	Good	Bad
	Excellent	Horrible
	Happy	Nasty
	Pleasant	Unpleasant
	Wonderful	Terrible

Appendix Eleven – Explicit questions regarding GM foods

Use	Food Questions	Biotechnology Questions
Used in both Experiments 1 and 2	How do you feel about the category of food?	How do you feel about the category of biotechnology?
	How do you feel about dairy farming?	How do you feel about gene sequencing?
	How do you feel about Genetically Modified (GM) foods?	How do you feel about Genetically Modified (GM) foods?
	How do you feel about vegetables?	How do you feel about stem cell research?
	How do you feel about red meat?	How do you feel about gene therapy?
	How do you feel about potatoes?	How do you feel about tissue culture?
	How do you feel about bread?	How do you feel about cloning?
Used in Experiment 1 only	How do you feel about GM plants?	How do you feel about GM plants?
	How do you feel about GE livestock?	How do you feel about GE livestock?
	How do you feel about modified tomatoes?	How do you feel about modified tomatoes?
	How do you feel about GM maize?	How do you feel about GM maize?
	How do you feel about transgenic crops?	How do you feel about transgenic crops?

N.B. Assessed on a scale of 1-7 (extreme like – extreme dislike)

Appendix Twelve – Vignettes used in each category and responses made (%)

Scenario	Category	Results	Responses (%)
You attend a dinner party where the host announces that he has prepared the food only using GM ingredients.	Simply Offered	Eat GM food Do not eat GM food Don't know / Other	70.1 4.1 25.9
You attend a restaurant with friends for dinner and notice that at the bottom of the menu there is a notice stating that some of the food served may contain GM ingredients.	Simply Offered	Eat GM food Do not eat GM food Don't know / Other	72.6 6.1 21.3
You are shopping at your local supermarket and notice that there are people giving away free samples of GM wine.	Simply Offered	Eat GM food Do not eat GM food Don't know / Other	49.2 44.7 6.1
Researchers have developed a GM version of your favourite kind of fatty food that reduces the fat content without altering the taste.	Potential Health Benefits	Eat GM food Do not eat GM food Don't know / Other	51.3 17.3 31.5
You run a high risk of coronary heart disease and, although there are other treatments available, the doctor has advised you that the consumption of a certain type of genetically modified food may greatly reduce the chances of you actually developing this.	Potential Health Benefits	Eat GM food Do not eat GM food Don't know / Other	80.7 6.1 13.2
You are allergic to a wide variety of foodstuffs which means it is very difficult to maintain a healthy diet. GM foods are available in non-allergic varieties of some of the foodstuffs that you can not eat.	Potential Health Benefits	Eat GM food Do not eat GM food Don't know / Other	69.5 10.7 19.8
Money is a particular problem for you at the moment and whilst you are at the supermarket you notice a new range of cut price GM food.	Cost Savings	Eat GM food Do not eat GM food Don't know / Other	47.2 29.4 23.4
Your favourite kind of food is unfortunately very expensive however a new GM version has been developed that tastes just the same but is significantly cheaper. Do you purchase the GM version?	Cost Savings	Eat GM food Do not eat GM food Don't know / Other	39.1 35.5 25.4

Valentines day is coming up and your partner is expecting you to organise and pay for a meal but you're really short of money. A friend offers you a free voucher for a new restaurant that serves only GM food.	Cost Savings	Eat GM food	30.5
		Do not eat GM food	41.6
		Don't know / Other	27.9

Appendix Thirteen – Correlation matrix entered into LISREL (Pearson's product moment and polyserial correlations)

	Vignettes	Equivalent Gain Task	Real Choice	GNAT1	GNAT2	Explicit1	Explicit2	Product
Vignettes	1.000							
Equivalent Gain Task	0.289	1.000						
Real Choice	0.310	0.112	1.000					
GNAT1	0.050	0.174	0.071	1.000				
GNAT2	0.096	0.213	0.011	0.500	1.000			
Explicit1	0.459	0.246	0.158	0.069	0.136	1.000		
Explicit2	0.471	0.165	0.129	0.081	0.138	0.674	1.000	
Product	-0.003	-0.006	-0.051	-0.144	-0.132	-0.007	0.049	1.000