Intuitive and explicit reactions towards "new" food technologies: attitude strength and familiarity

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Attitude strength and familiarity

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Abstract

Purpose – New food technologies are of increasing importance but not a lot of research into how people react to these technologies has been conducted. The purpose of this paper is to provide insight into how implicit measurements in addition to explicit measurements give insight into how well an attitude towards a food concept, in relation to its familiarity, is predictive for behaviour.

Design/methodology/approach – An implicit measurement (EAST) and an explicit questionnaire were used to investigate people's attitudes and attitude strength towards two food technologies (genetic modification and organic production). Correlations between the two measurements were calculated to determine whether familiar food technologies are more predictive for behaviour than relatively unfamiliar food technologies.

Findings – Implicit measurements showed negative associations with genetic modification. Explicit measurements showed neutral associations with genetic modification. In contrast, implicit and explicit measurements showed positive associations with organic production. When a food technology is well known (e.g. organic production), significant correlations between the two measurements were present suggesting that attitudes were predictive for behaviour. In contrast, when a food technology is not well known (e.g. genetic modification), significant correlations were not present suggesting that attitudes were not predictive for behaviour.

Originality/value – This is the first study to examine the relation between intuitive and explicit reactions in relation with the novelty of food technologies.

Keywords Attitudes, Explicit knowledge, Genetic modification, Organic foods, Brand awareness

Paper type Research paper

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While shopping or watching commercials on television, we keep seeing advertisements for new brands of peanut butter, new kinds of candy bars or for better tasting types of soy. Many of these food innovations are distinctive because of the way they are produced (e.g. organically grown vegetables and meats, genetically modified food). One way of investigating people's attitude towards new food technologies would be to just ask people what they think about the technologies in question, i.e. measuring their attitude on a cognitive and conscious level. Another way is relying more on gut reactions: measuring people's attitudes on a more affective and unconscious level. Despite the fact that new food technologies are of increasing importance, not a lot of

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research into how people react implicitly to these technologies has been conducted (Spence and Townsend, 2006).

Explicit attitudes are believed to predict deliberate, well-contemplated behaviour, whereas implicit attitudes are believed to predict spontaneous behaviour (Perugini, 2005). Therefore, behaviour is better predicted by both explicit and implicit attitudes than by explicit attitudes alone. When correlations between explicit and implicit attitudes are high, they are believed to be highly predictive of behaviour. In contrast, when correlations between explicit and implicit attitudes are low or none existing, they are believed to be less predictive of actual behaviour (Spence and Townsend, 2006).

The study of Spence and Townsend (2006) was the first ever study to examine implicit attitudes toward GM food. The study showed neutral implicit attitudes (in the context of organic food) and neutral explicit attitudes towards GM foods. The authors found no significant correlation between people's implicit and explicit attitude towards GM food. According to Hoffmann *et al.* (2005) such a non-existing correlation between explicit and implicit attitudes is due to a lack of introspective access to implicitly assessed representations.

We argue that such lack of introspective access is present when people have no experience with a new object or concept. Therefore the current study investigated whether the absence of a relation between implicit and explicit attitudes towards food technologies can be explained by the novelty of the food technology in question. This could provide further insight into whether attitudes towards food technologies are predictive of behaviour. First we will explain what attitudes are and how they can be explicitly and implicitly measured.

Attitudes

In the definition of Eagly and Chaiken (1993, p. 1) an attitude is: "the psychological tendency to evaluate a particular entity with some degree of favour or disfavour". Attitudes help us to make decisions and to understand and interact with our environment. The extent to which attitudes predict behaviour varies and depends among other factors on the strength of the attitude. People's attitudes become stronger when people are frequently exposed or are highly involved with an attitude-object, or when they have frequently expressed their attitude. Strong attitudes are highly embedded into people's inter- and intra-attitudinal structure. The inter-attitudinal structure encompasses a larger number of attitudes to which a certain attitude is related. For example, someone's attitude towards "genetic engineering" can be related to someone's attitude toward "cloning" and "recycling". Thus, a supporter of genetically modified foods may for example have a positive attitude towards cloning and a neutral or negative attitude towards recycling. On the other hand, attitudes are also embedded into a larger set of related concepts like for example beliefs and values. Someone's attitude toward genetic engineering can for example be influenced by beliefs like "genetic engineering can help cure diseases" or by values like "power" (Dreezens, 2006). The structure that contains these interrelated beliefs, values and attitudes is called the intra-attitudinal structure. Well-embedded attitudes are strong over time and are less susceptible to context effects (and have more impact on behaviour), whereas weak attitudes are constructed on the spot and are assumed to be easily changed (Holland *et al.*, 2002). Attitude strength is conceived to consist of two important dimensions; centrality and commitment. Centrality refers to the strength of

the link between an attitude and characteristics of the self ("how important is this for me"). Centrality is an aspect of the inter-attitudinal structure of an attitude because it has associations with other elements in the cognitive structure (e.g. values, personality traits, goals). Commitment refers to the accessibility of the link between an attitude object and its evaluation ("how certain am I about my opinion"). It is an aspect of the intra-attitudinal structure of an attitude because it is related to structural properties of the attitude itself (e.g. behavioural, cognitive or affective evaluations). Although centrality and commitment are moderately correlated, they are conceptually distinct. People can find for example certain issues (e.g. death penalty, nuclear power) very important, but are uncertain of whether they are in favour or against (Holland, 2003).

Holland (2003) showed that highly central attitudes are strongly embedded in the cognitive structure of the personal self. When people have highly committed attitudes, they can make decisions without much deliberation (automatically). These attitudes can easily be retrieved from memory and are held with great confidence and are therefore not easily affected by context. When commitment is low, attitudes are not strong and, due to on-line construction, are inferred from behaviour. By measuring people's attitude centrality and commitment, one can investigate whether attitudes are well embedded in their inter- and intra-attitudinal structure, or in other words how strong the attitudes are.

Implicit measurement

A problem with measuring explicit attitudes is that verbal reports depend on conscious introspection, by eliciting verbal responses to statements about feelings, beliefs and behaviour (Fazio and Olson, 2003; Ottaway *et al.*, 2001). Not all attitudes can be validly measured with explicit measurements, for example when attitudes are not readily accessible or when it concerns issues that are relatively unknown. Some food technologies, like genetic engineering, are relatively new and consumer knowledge about this technology is limited (House *et al.*, 2004; Cuite *et al.*, 2005). When people are asked to report how they feel about for example genetic modification (GM), it is possible that their response is affected due to a lack of knowledge. To avoid response biases and other problems associated with introspective verbal responses, indirect or "implicit" measures have emerged (Fazio and Olson, 2003; Hermans *et al.*, 2003). With the use of these indirect measures it is possible to investigate consumers' first, intuitive or even implicit evaluative impressions when they are confronted with a new food technology.

One of the most common methods to measure implicit attitudes is the Implicit Association Test (IAT), developed by Greenwald *et al.* (1998). The IAT is based on the assumption that task performance is better when responses are made to a pair of items that are strongly associated, than when a pair of items are weakly associated (Spence and Townsend, 2006). The original IAT involves a relative comparison of attitudes towards two target concepts that are in some way each other's opposite (e.g. a positive or negative attitude towards white people compared to a positive or negative attitude towards black people) (De Houwer, 2003). Therefore, this technique is not suitable for measuring implicit reactions to concepts that are not each other's opposite. After the initial IAT, many additional implicit measurement techniques have been developed (For an overview, see Fazio and Olson, 2003). The Extrinsic Affective Simon Task (EAST) was first developed by De Houwer (2003) and is a modified version of the IAT.

The EAST solves the earlier mentioned problem of the IAT: it can also be applied to single concepts. Although concepts like GM and organic production (OP) are seemingly opposite issues (e.g. in familiarity or in extent of human interference), it could be argued that the opposite of GM is in fact the absence of use of genetic engineering. OP and for example functional food production are both technologies that do not make use of genetic engineering. Because it is not clear whether GM and OP are opposite issues, we believe that the EAST is a suitable method to measure implicit evaluative associations towards concepts like food technologies because the EAST can be applied to both opposite and single concepts.

In the EAST, the task of the participant is to categorize words as they appear on a computer screen. Participants have to classify words on the basis of either stimulus valence when the word is printed in white (e.g. "positive" or "negative") or on the basis of colour when the word is printed in a colour (e.g. the colour "purple" and the colour "blue"), by pressing one of two response keys. This is practiced, so that each response key becomes associated with one specific valence and one specific colour, e.g. "positive" and "blue" on the first response key and "negative" and "purple" on the second response key. After practice each stimulus word (e.g. the word "school") is presented once in purple and once in blue. When a participant has a negative association with the word "school," the response time for determining that the word is shown in blue (which is on the same response key as "negative") is faster than the response time in determining that that same word is printed in purple (which is on the same response key as "positive"). Trials in which stimulus words are presented in white serve as control trials only (De Houwer, 2003).

Current research

As mentioned before, behaviour is better predicted by both explicit and implicit attitudes than by explicit attitudes alone. When correlations between explicit and implicit attitudes are high, they are believed to be highly predictive of behaviour (Spence and Townsend, 2006). When correlations between explicit and implicit attitudes are low, they are believed to be less predictive of actual behaviour and are believed to be due to a lack of introspective access to implicitly assessed representations (Hofmann *et al.*, 2005). We also mentioned that non strong attitudes are not well embedded in people's inter- and intra-attitudinal structure and are therefore not easily accessible. This might indicate that the strength of an attitude moderates the relationship between implicit and explicit attitudes. If so, it would hold that people's implicit and explicit attitudes towards an (novel) issue (e.g. GM), to which they have no strong attitude, will not correlate (or correlate modestly). In contrast, when people have a strong attitude towards an (familiar) issue, their implicit and explicit attitude towards this issue would highly correlate.

The present study aimed to investigate both explicit attitudes and implicit associations towards different food technologies. We hypothesised that food technologies differ in familiarity. We also hypothesised that attitudes towards familiar food technologies are strong (i.e. highly central and highly committed). Likewise, we hypothesised that attitudes towards novel food technologies are not strong. Besides this, we hypothesised that familiarity of a food technology moderated the relation between implicit and explicit attitudes. More specific, we hypothesised that implicit and explicit attitudes correlated when the attitude object was a familiar food

technology. In contrast, we hypothesised that implicit and explicit attitudes did not correlate when the attitude object was a novel food technology. Additionally, this study will serve as a replication of the finding of the study of Spence and Townsend (2006), by showing that no correlation between the implicit and explicit attitude towards GM is present.

Method

In order to select two food technologies for our sample of production methods, we conducted a pilot study in which several food production technologies were compared with each other in terms of familiarity and embeddedness.

Pilot study

In a pilot study with 45 undergraduate students (33 females, 12 males) of Universiteit Maastricht with a mean age of 20.16 years (SD = 4.36, ranging from 18 to 24), we investigated people's explicit attitude, attitude centrality and attitude commitment towards different processing technologies like functional food production, genetic modification (GM), organic production (OP), vegetarian production and food supplements.

Two questions concerned the extent to which their first impression was positive and desirable (e.g. What is your first impression when you think of genetic modification), four questions were asked about their attitude towards the technology in question (e.g. How do you feel about genetic modification) and three questions were to rate the ambivalence of their attitude (e.g. I have doubts about my opinion towards genetic modification). Three questions assessed attitude centrality (e.g. How important is genetic modification to you?) and three questions assessed attitude commitment (e.g. How convinced are you that your opinion about genetic modification is correct?). A study of House *et al.* (2004) investigated the subjective and objective knowledge towards the acceptance of GM foods. The authors showed that subjective knowledge was a significant determinant of how willing consumers were to eat GM food products, whereas objective knowledge was not related to acceptance. The authors tested subjective knowledge with one single self-report item about how knowledgeable the participant believed he or she was about GM. Therefore we included one question that measured the perceived level of subjective knowledge (e.g. How knowledgeable do you believe you are about genetic modification?).

The pilot study showed that people had the most positive first impression and the most positive attitude towards OP, which was well embedded (highly central) and easy accessible (highly committed). Further, people had the most ambivalence towards GM and had the most negative attitude towards GM, which was not well embedded and not very accessible. The attitudes towards the other technologies was slightly positive, was central but was not very committed in our sample of production methods. Since GM and OP represented the two extremes in terms of embeddedness, we chose these two technologies as stimuli in our sample of production methods. The pilot study further showed that people perceived to have more subjective knowledge about OP than about GM. It can be concluded that OP is a relatively more familiar technology than GM. Besides this, it can be hypothesised that the correlation between implicit and explicit attitudes towards OP is relatively stronger than towards GM.

Sample

A total of 47 undergraduate students (40 females, seven males) of Universiteit Maastricht participated in the main study. The mean age of the participants was 21.72 years (SD = 4.87, ranging from 18 to 50). All participants were undergraduates of the health sciences department and all participants signed an informed consent form and received course credit for their participation.

Materials

Implicit measurement. An EAST contains white and coloured words. For the white (control) trials, in which words are categorized on the basis of valence, we used the same five positive and five negative nouns, (evaluative words) as De Houwer (2003), see Table I. For the coloured trials (where the left key has to be pressed for one colour, and the right for the other colour) we chose five nouns related to GM and five nouns related to OP (stimulus description words) (see Table I). These nouns were selected in an unrelated pilot test among ten employees of Universiteit Maastricht. The participants of this pilot test had to mention words that were associated to either GM or OP. We chose the five most frequently listed words for each category. The stimulus description words were presented in either the colour blue or purple. The colours were picked in such a way that they were quite similar in order to make sure that the participants would pay enough attention to the presented words. The EAST was presented on a 5320 Macintosh Performa computer.

Explicit measurement. We used an electronic questionnaire that consisted of two parts. In the first part (14 questions), the participants were asked to rate on a five-point Likert-scale the extent to which they felt positive or negative about genetically modified food products in general. Four questions were asked about their attitude towards GM (e.g. How do you feel about genetic modification) and three questions were to rate the ambivalence of their attitude (e.g. I have doubts about my opinion towards genetic modification). Three questions assessed attitude centrality (e.g. How important is genetic modification to you?) and three questions assessed attitude commitment (e.g. How convinced are you that your opinion about genetic modification is correct?). One question measured the perceived level of subjective knowledge (e.g. How knowledgeable do you believe you are about genetic modification?).

Procedure

The participants completed the experiment on an individual basis. The experimenter welcomed the participants and told them that the experiment consisted of two separate tasks, a computer task and a questionnaire. Each would take about ten minutes. All participants first completed the computer task, followed by the questionnaire. For

Positive attribute words	Negative attribute words	Genetic modification related words	Organic production related words
Love	Hate	Genetic modification	Organic production
Fortune	War	Cloning	Natural
Fun	Murder	Genetic manipulation	Organic food
Flower	Pain	Genetic technology	Organic cattle breeding
Peace	Death	Genetic change	Environmentally conscious

Table I. Stimulus words used in the EAST (translated from Dutch)

technical reasons, the two tasks were done in two separate, research cubicles. The participants were seated in the first research cubicle containing only a computer on a desk and a chair.

EAST

The EAST consisted of two practice blocks and a test block. The instructions were presented on the computer screen. These instructions informed the participants that they had to classify words, depending on the valence of the word when the word was presented in white or depending on the colour of the word when the word was printed in a colour, by pressing the keys "a" or "6" (on the numerical pad), labelled respectively as "L" (left) and "R" (right), of the (QWERTY) keyboard. When exposed to either a positive or blue word the participants were asked to press the "L" key. When exposed to either a negative or purple the participants were asked to press the "R" key. The instructions about which key to press were repeated before each practice and each test block. The words were presented in the center of the screen and appeared after a red fixation cross which was visible for 500 ms. Participants were asked to respond as quickly and accurately as possible by classifying the target word as either positive or negative or by the colour of the word. The target word remained on the screen until the participants responded. Participants received no error message when they gave an incorrect response (e.g. classifying a positive word as negative or vice versa). In the first practice block, each of the five positive (e.g. love, fortune, flower) and five negative evaluative words (e.g. hate, war, pain) were presented twice in white letters in a random order. The second practice block consisted of ten trials with the word "nutrition" presented in either the colour blue or purple. The test block, containing a total of 60 trials, started with ten warm up trials (presenting the ten evaluative words randomly in white), followed by 50 random test trials in which the ten evaluative words were presented twice in white, the ten stimulus description words (target words related to GM or OP) once in each colour and the word "nutrition" five times in each colour.

Explicit attitude measurement

After completing the computer task, the participants moved to the other research cubicle that also contained a chair and a computer on a desk. The participants were seated and were asked to answer some questions. Instructions were presented on the screen of the computer and the questions were presented in random order.

Results

Method of analysis

In this study we investigated both explicit attitudes and implicit associations towards different food technologies. We hypothesised that implicit and explicit measures correlated when people had a strong attitude towards an (familiar) issue. In contrast, we hypothesised that implicit and explicit measures would not (or less strongly) correlate when people had no strong attitude towards an (novel) issue because their attitude was not (yet) well embedded.

First the implicit and explicit attitude of both GM and OP were measured. Paired samples tests were conducted to test whether people are more familiar (i.e. have more subjective knowledge) with OP than with GM. Correlations between subjective

knowledge and attitude centrality and commitment of both GM and OP were conducted to test whether subjective knowledge increased attitude centrality and commitment. Paired samples tests were conducted to test whether attitudes towards a familiar food technology were more central, more committed and less ambivalent than towards a novel food technology. Then, correlations between the implicit measurement and explicit measurement were computed to test whether the implicit and explicit attitudes correlated when it involved a familiar food technology and to test whether the implicit and explicit attitudes did not correlate when it involved a novel food technology. To test whether significant correlations between the implicit and explicit measurements were only present when people had high attitude centrality and/or high attitude commitment, we correlated implicit and explicit attitudes towards both technologies, separately for high and low attitude centrality and for high and low attitude commitment. Likewise, we tested whether significant correlations between the implicit and explicit measurements were only present when people had high subjective knowledge about a technology, by correlating implicit and explicit attitude towards both technologies, separately for high and low subjective knowledge.

EAST

Data of four participants were removed from the analysis. These participants reported to be dyslectic or their responses were too slow (more than three SDs from the mean response time). Only the trials in the test block in which coloured words were presented and a correct response was given were analysed. Trials on which an incorrect response was given were discarded. Following Greenwald *et al.* (1998), the reaction times below 300 ms were recoded to 300 ms and reaction times above 3000 ms were recoded to 3000 ms and all latencies were log-transformed before analysis. These procedures are all standard. The means of these latencies and the percentages of errors were calculated separately for the trials that required a positive extrinsic response (i.e. printed in the colour that is associated to the key that in white trials corresponds to a positive valence) towards organic-related words, trials that acquired a positive extrinsic response towards GM-related words, trials that acquired a negative extrinsic response towards organic-related words and trials that acquired a negative extrinsic response towards GM-related words. A 2 (stimulus valence: organic versus GM) $\times$ 2 (extrinsic response valence: positive versus negative) ANOVA with repeated measures was used to analyse the mean log-transformed reaction times and the percentage of errors.

The analysis of the log-transformed reaction times showed no main effect of stimulus valence, $F < 1$, and no main effect of extrinsic response valence, $F < 1$. Apparently participants were not faster in giving a positive or a negative extrinsic response, and the reaction times were not influenced by whether the words were related to GM or organic. The important interaction between stimulus valence (GM versus organic) and extrinsic response valence (positive versus negative) was significant, $F(1, 35) = 5.67$, $p < 0.05$. The untransformed means are displayed in Table II; participants were faster in responding to trials in which a positive response was given to organic-related words and a negative response to GM-related words compared to trials in which a positive response was given to GM-related words and a negative response to organic-related words. We conclude that the trials in which a positive response was given to organic-related words and a negative response to

GM-related words are congruent trials and the trials in which a positive response was given to GM-related words and a negative response to organic-related words are incongruent trials. We suggest that a positive association exists with OP and a negative association with GM.

The general EAST effect is the difference between the untransformed mean reaction times of the congruent (stimulus and response are similar) and the incongruent trials (stimulus and response differ). The EAST effect had a mean value of 59.8 ms, a standard deviation of 155, and an effect size of $d = 0.39$. The mean untransformed reaction times and error percentages are displayed in Table II.

The analysis of the percentage of errors showed no main or interaction effects (all Fs < 1).

Explicit attitude

The 14 questions of each part of the questionnaire were divided into five categories. These categories were attitude, attitude centrality, attitude commitment, ambivalence and subjective knowledge. The four questions about attitude, the three questions about attitude centrality, the three questions about attitude commitment and the three questions about ambivalence had acceptable internal consistency (all alpha's > 0.61). Therefore the means of these questions can be calculated to measure attitude, attitude centrality, attitude commitment and ambivalence. The items for subjective knowledge were analysed separately (for means see Table III).

The means on the explicit measure for attitude and ambivalence towards GM did not significantly differ from the midpoint on the five-point Likert-scale (Attitude; $t(46) = -0.15$, $p = 0.88$; Ambivalence: $t(46) = -0.59$, $p = 0.56$). This measure showed that the participants are neutral towards GM on a conscious level. On the other hand, the explicit measure for attitude and ambivalence towards OP did significantly differ from the midpoint on the five-point Likert-scale (Attitude: $t(46) = 13.70$, $p < 0.01$; Ambivalence: $t(46) = -7.55$, $p < 0.01$). It appeared that participants have a positive explicit attitude towards OP and are not very ambivalent about their attitude (For means see Table III). Moreover, paired samples tests showed that participants perceive OP explicitly as more positive than GM.

Paired samples tests were also conducted to test whether people are more familiar (i.e. have more subjective knowledge) with OP than with GM. Data showed that people had significantly more subjective knowledge about OP than about GM (see Table III). This finding is in coherence with our hypothesis that food technologies differ in familiarity.

Correlations between subjective knowledge and attitude centrality and commitment of both GM and OP were conducted to test whether subjective knowledge increased attitude centrality and commitment (i.e. attitude stability). Correlations showed that

Table II.
Mean untransformed reaction times in milliseconds and percentage of errors on target stimulus trials as a function of stimulus valence and extrinsic response valence

	Reaction time				Percentage of errors			
	Positive stimulus	SD	Negative stimulus	SD	Positive stimulus	SD	Negative stimulus	SD
Extrinsic positive response	691	166	749	231	3.83	10.74	4.68	11.20
Extrinsic negative response	738	215	701	163	4.26	9.27	3.40	9.63

subjective knowledge about GM is positively correlated with attitude centrality ($r(47) = 0.48$, $p < 0.001$) and commitment ($r(47) = 0.37$, $p < 0.05$) of GM. Subjective knowledge about OP is also positively correlated with attitude centrality and commitment of OP (respectively $r(47) = 0.44$, $p < 0.05$ and $r(47) = 0.61$, $p < 0.001$). This shows that when people have more subjective knowledge about GM or OP, their attitude towards these technologies became more central and more committed.

Paired samples tests were conducted to test whether attitudes towards a familiar food technology (OP) were more central, more committed and less ambivalent than towards a novel food technology (GM). Data showed that people's attitude towards OP was more positive and less ambivalent compared to GM. Besides this, participants' attitude toward OP was more central and more committed than their attitude toward GM. The attitude centrality and commitment of OP was slightly below midpoint on a five-point Likert scale, whereas attitude centrality and commitment of GM were below midpoint on a five-point Likert scale. This result showed that although the attitude towards OP was not highly central or highly committed, the attitude was more central and more committed than the attitude towards GM.

Note that tests for the explicit measures contain 46 degrees of freedom, for the implicit measurement only 35 degrees of freedom. The difference in number of participants is due to the removal of 11 participants that made mistakes in the implicit measurement. When the explicit measures were re-analysed with the 36 participants that remained in the analysis of implicit variables, identical results were obtained.

Implicit measures versus explicit measures

To test whether the implicit and explicit attitudes correlated when it involved a familiar food technology and to test whether the implicit and explicit attitudes did not correlate when it involved a novel food technology, we computed the difference between the untransformed mean reaction times on positive and negative trials for both the GM related words and the OP related words. Correlations between these effects and the explicitly measured attitude, attitude centrality and attitude commitment of GM and OP related words were computed.

	GM		OP	
	M	SD	M	SD
EAST	−0.06a	0.25	−0.04[b]	0.19
Attitude[1]	2.98[a]	0.71	4.15[b]	0.57
Ambivalence[1]	3.06[a]	0.74	2.09[b]	0.82
Attitude centrality[1]	1.88[a]	0.51	2.95[b]	0.83
Attitude commitment[1]	2.37[a]	0.53	2.85[b]	0.70
Subjective knowledge[2]	2.38[a]	0.80	2.72[b]	0.71
Attitude low centrality	1.42	0.26	2.17	0.24
Attitude high centrality	2.22	0.35	3.44	0.67
Attitude low commitment	1.82	0.28	2.16	0.27
Attitude high commitment	2.68	0.37	3.30	0.63

Notes: [1] Scale: 1 "very low" to 5 "very high". [2] Scale: 1 "I totally do not agree" to 5 "I totally agree". Means within rows with different superscripts differ, $p < 0.05$; $n = 47$

Table III. Means and standard deviations of EAST effects (difference between the untransformed mean reaction times on positive and negative trials) and explicit measurements

The data showed significant positive correlations between the EAST effect of organic related words and the explicitly measured attitude ($r(26) = -0.37$, $p < 0.05$) towards organic related words (for means see Table III). No significant correlations were found between GM variables.

To test whether significant correlations between the implicit and explicit measurements were only present when people had high attitude centrality and/or high attitude commitment, we performed a median split on attitude centrality and attitude commitment for both GM and OP. Attitude centrality was divided into the subsets "high attitude centrality" and "low attitude centrality". Likewise, attitude commitment was divided into the subsets "high attitude commitment" and "low attitude commitment". We performed the same analysis as mentioned above, separately for high and low attitude centrality and for high and low attitude commitment (for both GM and OP). Data showed that the correlations between the EAST effect of organic related words and the explicit attitude towards OP is only present when people had high attitude centrality ($r(26) = 0.38$, $p < 0.05$) or high attitude commitment ($r(26) = 0.39$, $p < 0.05$) towards OP. As expected, we did not find correlations between the OP variables when people had low attitude centrality or low attitude commitment towards OP and again no correlations were observed between GM variables. These results showed that attitude stability (attitude centrality and attitude commitment) appeared to moderate the correlation between the implicit and explicit measurements related to OP.

To test whether significant correlations between the implicit and explicit measurements were only present when people were familiar with a technology, we performed a median split on the reported level of subjective knowledge for both GM and OP. Subjective knowledge was divided into the subsets "high subjective knowledge" and "low subjective knowledge" (for both GM and OP). Paired samples tests showed that the amount of subjective knowledge about OP was indeed higher for the subset "high subjective knowledge" than for "low subjective knowledge" ($M = 3.21$ vs $M = 2.00$), $t(47) = 10.58$, $p < 0.001$). We performed the same analysis as mentioned above, separately for high and low subjective knowledge (for both GM and OP). Data showed that the correlation between the implicit and explicit attitudes toward OP was only present when people had a high level of subjective knowledge towards OP ($r(28) = 0.49$, $p < 0.01$). This result showed that the reported level of subjective knowledge appeared to be a factor that moderates the correlation between implicit and explicit measurements related to OP.

Discussion

The present research aimed to investigate both explicit attitudes and implicit evaluative associations with different food technologies. The main finding of this study is the presence of a significant correlation between the implicit and explicit attitude towards OP and the absence of a significant correlation between the implicit and explicit attitude towards GM. This main finding could provide insight into how attitudes towards new technologies are formed. It suggests that the attitude towards OP is highly predictive of behaviour, whereas the attitude towards GM is not predictive and open to change.

The current study showed that the participants perceive GM implicitly as more negative and OP as more positive. The explicit measure showed that the participants

are neutral towards GM on a conscious level. This latter finding is in contradiction with our finding in the pilot test. The participants in the pilot test reported a slightly negative explicit attitude towards GM. On the other hand, participants appeared to have a positive explicit attitude towards OP. Moreover, the results showed that participants perceive OP explicitly as more positive than GM; at the same time the participants are less ambivalent, have a more committed and more central attitude towards OP compared to GM. Besides this, people have more subjective knowledge about OP than about GM. These latter results replicated the findings of the pilot test.

The centrality of attitudes reflects how well attitudes are embedded, whereas commitment to attitudes reflects the accessibility of an attitude. The results of the current study suggested that people's evaluation of OP has been often accessed, maybe because people are more familiar with this technology, with the result that people's attitude towards OP is well embedded, easy accessible and therefore more strong. Because a significant correlation between the implicit and explicit attitude towards OP was found, we suggest that the attitude towards OP is strong. Because of this relatively strong attitude, we believe that people can infer their opinion towards OP more automatically than towards GM.

Although we found a clearly negative implicit evaluation towards GM in general, this seems, however, based on ambivalent and not on very strong convictions, probably related to the lack of subjective knowledge. People do not have an articulated opinion about GM and attitudes towards GM are therefore relatively open to change. We found no significant correlation between the implicit and explicit attitude towards GM. This latter result is in accordance with the finding of Spence and Townsend (2006) that no correlation between implicit and explicit measurements towards GM is present. We believe that this finding can be explained because people's attitude towards this relatively novel food technology is not well embedded and not easy accessible and therefore people's attitude towards GM is not (yet) strong. This result is in line with the suggestion of Hoffmann *et al.* (2005) that such non existing correlations between explicit and implicit attitudes are due to a lack of introspective access to implicitly assessed representations.

Within OP, attitude centrality, attitude commitment and people's amount of subjective knowledge appear to moderate the correlation between the implicit and explicit measurements, which is absent within GM. It appears that this significant correlation between implicit and explicit measurement is only present in case of high attitude centrality, high attitude commitment and high amount of subjective knowledge towards OP. This latter finding suggested that the implicit and explicit attitude are similar when an attitude is well embedded and easy accessible, which is the case when the food technology is well known.

One of the criticisms of this study could be the possible influence of the fixed order of the measurements. An implicit priming effect could have impacted on responses to the explicit measurement. We judged that it was better to administer the implicit measurement first because carryover effects of explicit measures on implicit measures appear to be larger than vice versa (Bosson *et al.*, 2000).

Furthermore, there are some issues with our sample. It could be argued that the relatively small sample size could have biased the results. On the other hand, the study of Spence and Townsend (2006) was executed with a sample size of 60 participants and they found similar results. It could also be argued that the overrepresentation of female

participants could have biased the results. A study of Cuite *et al.* (2005) showed that women were less likely to approve of GM foods. Thus, when the sample would be more representative for the population, a more positive explicit attitude towards GM could be expected. On the other hand, the sample used in the study of Spence and Townsend was more representative for the population (58 per cent females versus 42 per cent males) and this study also showed a neutral explicit attitude towards GM. It could also be argued that the education level and age of the participants in our sample may have biased the results. Cuite *et al.* (2005) showed that people who have a higher education level and people who are younger are more likely to approve of GM foods. In contrast, Noussair *et al.* (2004) showed that people with higher education levels are likely to be more negative towards GM. Apparently there is no consensus about the influence of gender, age and education level towards GM acceptance. Future research could focus on the effect of gender, age and education level towards explicit measurements and implicit measurements.

Another limitation of this study could be that we only studied two food technologies. Future research might focus on other food technologies and specific food products.

The current research suggests that the implicit measurement next to the explicit measurement provides insight into how well a concept is embedded in people's cognitive structure and whether the attitude is predictive for behaviour. By investigating implicit and explicit measurement one could determine the extent in which food technologies can be influenced and changed. More research is needed into how explicit and implicit attitudes relate to each other and how their combination might predict behaviour. This research validates the use of implicit measurements but at the same time it shows that there can be discrepancies between intuitive and explicit reactions that indicate that attitudes towards novel food technologies are not (yet) strong structures.

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Further reading

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