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Optimising the delivery of food allergy information. An assessment of food allergic consumer preferences for different information delivery formats

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ABSTRACT

In this study, the preferences of food allergic consumers for different prototype information delivery tools was examined, with the aim of improving informed product choices. Sixty-two self-reported food allergic participants from the Netherlands and Germany were included in the study. Each tested three prototype information delivery tools (a food label, a handheld electronic scanner, and an information booklet) to access allergy information. Participants rated each tool in terms of perceived convenience, usefulness and confidence. Principal Component Analysis indicated that convenience and usefulness loaded on one construct, namely functionality. The impact of information delivery tool and country on functionality and confidence was analysed with two repeated measures generalised linear models. The highest perceived functionality was found for the label. The electronic scanner was rated as the next most functional method to deliver information, followed by the booklet. Food allergic consumers were equally confident about using all three information delivery tools. The results have implications for developing new policies and legislation concerning information provision to food allergic consumers.

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1. Introduction

Adverse reactions to food, such as food allergy, can trigger the body's immune system such that it responds to harmless proteins (Buttriss, 2002). This response, can result in a range of symptoms, from uncomfortable skin reactions to anaphylactic shock, which can be potentially fatal. At the present time, the only effective risk management strategy involves removing problematic food allergens from the diet of those experiencing allergic responses (Dutau & Rance, 2006; Eigenmann, 2001; Munoz-Furlong, 2003). Avoiding the consumption of potentially problematic foods and ingredients has the potential to negatively affect the quality of life of food allergic consumers and their families (Blok de et al., 2007; Sicherer, Noone, & Munoz-Furlong, 2001), as well as the economic functioning of individuals and their families (Fox et al., 2009; Voordouw et al., in press), health services and all actors involved in the agri-food sector (for example the food industry) (Miles, Fordham, Mills, Valovirta, & Mugford, 2005).

The prevalence of clinically diagnosed food allergy is estimated to be 1–2% in adults and 5–8% in children (Mills et al., 2007; Pereira

et al., 2005). However, the prevalence of self-reported *undiagnosed* food allergy is much higher in adults, with an estimated 3–35% of the population reporting allergic responses to foods (Rona et al., 2007). There is some evidence to suggest that the prevalence of some food allergies may be increasing, although the evidence is equivocal (Grundy, Matthews, Bateman, Dean, & Arshad, 2002; Rona et al., 2007). However, combining the diagnosed and perceived food allergy rates imply that a substantial percentage of the population may be affected by the issue of food allergy, and in some way restrict their behaviour in concordance with this.

The EU directive 2003/89/EC, which came into operation in November 2005, requires that the food industry lists 14 potential food allergens on pre-packed food labels regardless of the quantity in the finished product. The aim of the directive was to facilitate consumer identification of food allergens in food products. It is important to note that, in addition to the obligatory declaration of food allergens on the label, many food manufacturers also provide voluntary allergen advisory statements, which provide information about possible unintended cross-contamination between the food product and a food allergen ("precautionary labelling"). The purpose of the advisory statements is to alert food allergic consumers to the possible food allergens in the food product. However, these advisory statements may result in confusion on the part of the food allergic consumer (Simons, Weiss, Furlong, & Sicherer, 2005).

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Cornelisse-Vermaat et al. (2008a) conducted a stakeholder analysis to identify the different technical possibilities for information delivery regarding the presence of food allergens in food products. Stakeholders (drawn from the all sectors of food industry, patient groups, retailers and relevant regulatory bodies in Germany, Greece, the Netherlands, Poland and Spain) were asked to prioritise different approaches to delivering allergy information to consumers. These included existing approaches (for example, information on labels, information booklets), as well as novel approaches (for example, ICT delivery systems which enabled delivery of personalised allergen information, “allergen” free foods in a single location in the supermarket, or improved training of retail staff regarding allergen information). The standardised label was chosen as a first preferred scenario, although participants were also positive about the feasibility of introducing novel ICT approaches to traceability and information delivery. An important conclusion was that the information available for use by food allergic consumers might be improved if new Information and Communication Technologies (ICT) were developed specifically with the aim of improving information delivery, (for example, through the provision of information about specific allergens and the food products in which they were contained), although such methods of communication were unlikely to replace product labelling. In addition, stakeholders indicated that the use of ICT approaches might provide an additional information “stream,” which would convey additional information focused on facilitating safe food choices on the part of food allergic consumers, assuming consumers were comfortable in operating such novel ICT tools. Three “candidate” types of information scenarios were identified in the stakeholder analysis as being the preferred method of information delivery which both addressed consumer needs and were technically feasible, at least in the opinion of stakeholders. These were, firstly, a Label¹ (in the format of a standardised label with food allergy symbols). The second generic information scenario consisted of an information Booklet with allergen information about specific products, which could be made available in the retail environment. The third scenario consisted of a handheld electronic “scanner”—in this case a small information terminal with bar-code scanner—which could be used to identify potential allergens through scanning the ingredient traceability information provided by the bar code. The different information delivery scenarios were assessed by (self-reported) food allergic consumers, including those from the Netherlands, and Germany, using an web-based online survey to identify preferences for the different characteristics within each type of information delivery tool (Voordouw et al., 2011). The use of conjoint analysis enabled identification of the most preferred approach to information provision within each generic information delivery scenario. Overall, participants in all countries preferred, on average, the adjusted label. Dutch participants rated ICT as the second most preferred solution, and the booklet as the least preferred solution. German participants preferred the booklet more than the ICT solution. The research also identified an “ideal format” for information delivery for each of the information tools developed.

However, the conjoint analysis survey did not allow consumers to assess the actual use of “prototypes” of each of the three most preferred information delivery tools (Cornelisse-Vermaat, Voordouw, Yiakoumaki, Theodoridis, & Frewer, 2008b; Voordouw et al., 2011).

Various factors need to be addressed if information provided about food allergens is to be effective as a communication tool. These include the extent to which consumers are confident about the information provided, as well as the extent to which it is perceived

to be useful, convenient and functional. The current academic literature focused on allergen labelling is somewhat sparse, and offers little theoretical grounding for research of this type (Cornelisse-Vermaat et al., 2008a,b). However, these factors may be identifiable from the broader consumer literature, which will also be relevant to the needs of food allergic consumers.

Confidence in the accuracy of information is extremely important (for example, see Frewer, Howard, Hedderley, & Shepherd, 1996). It is relevant to distinguish the concept of “confidence”, as used in the research presented here, from that of “self-efficacy”. The latter to an individuals perceived ability to act in such a way as to affect their life (for example, see, *inter alia*, Bandura, 1977; 2001; Lippke, Wiedemann, Ziegelmann, Reuter, & Schwarzer, 2009). This differs from the concept of “confidence” as used in the present study, which refers to the extent to which an individual consumer trusts the safety of food products, (De Jonge, Van Trijp, van der Lans, Renes, & Frewer, 2008), in particular if credence factors (i.e., consumer perceptions of product qualities which are not directly verifiable, but are indicated by information or claims) are utilised in decision-making regarding consumption. There is also evidence to suggest that the extent to which an individual perceives an ICT application to be personally useful (Broos, 2005; Horst, Kuttschreuter, & Gutteling, 2007; Schaper & Pervan, 2007), convenient to use (Ferrell, 2005; Mokhtarian, 2004) and functional in terms of delivering relevant information determine their likelihood of using it (Best, 2009).

“Ideal” profiles of information included for each tool have already been identified in previous research, although presented as a series of scenarios rather than as actual prototype information devices (Voordouw et al., 2011). The aim of the research presented here was to compare the preferences of food allergic consumers for the different “ideal” information strategies, once the results of the previous research had been translated into prototypes which could actually be tried and tested against actual “products”. The comparison is therefore constrained to comparisons of three idealised but implementable information delivery prototypes tested against simulated products. The results will contribute to the development of the optimal strategy for conveying information about food allergens to food allergic consumers and other end-users.

2. Method and materials

2.1. Study sample

The participant sample consisted of food allergic adults or their spouses, or the parents of food allergic children. Participants were recruited through advertisements published in national newspapers, on patient organisation websites and via nutritionists. In total, 62 participants (24 in Germany, and 38 in the Netherlands) were included in the sample on the basis of their self-reported perceived or diagnosed food allergy or intolerance to at least one of the following foods: milk, egg, tree nuts, peanuts, and/or gluten.² The food allergies were selected on the basis of their relatively high prevalence in the Netherlands and Germany (Mills et al., 2007; Pereira et al., 2005; Rona et al., 2007). Fifty participants in the study reported suffering from food allergy themselves, 6 participants had a partner with self-reported or diagnosed food allergy and 18 participants had a child suffering from self-reported or diagnosed food allergy. Some participants fell into two or more of these categories. The participants each were given a voucher worth 25 Euros, and

¹ Including specific food allergens in the list of ingredients is legally required in the EU but there was no legislation or advice concerning the use of symbols at the time of data collection.

² In Voordouw et al. (2011), the average preference difference between the ideal types of booklet, label and ICT were at least 0.3 on the 7-point scale. A preliminary power analysis indicated that the sample size should be about 60 in order to find significant differences.

their travel expenses to the site where data were collected were refunded. Eighty-five per cent of the sample was female. Time Budget Research (TBO) data from the Netherlands showed that women are mostly responsible for the grocery shopping for the household (Sociaal Cultureel Planbureau, 2006). This is in line with the findings of a study conducted in 22 countries which has suggested that women engage in more domestic tasks than men (Batalova & Cohen, 2002). From this it could be argued that the high numbers of women included in the sample reflect responsibility for food shopping and preparation between men and women, but the very high bias towards women's participation (85%) suggests that this cannot be the only explanation. Alternative explanations may relate to the possibilities that women have more free or more flexible time, which would allow them to participate in the study, or having lower incomes, which results in the payment of 25 euros representing a good incentive to participate in the study. Twenty-one percent were aged between 18 and 35, 29% between 36 and 45, 21% between 46 and 55, 15% between 56 and 65, and 11% were older than 66 years. Age data were missing for 2 participants. Ninety-eight percent of the sample had completed at least a primary education, 92% secondary education, 19% a commercial or technical education, and 24% a university degree (at Bachelors, masters or higher level).

2.2. New information delivery tools

The attributes of the new information tools are provided in Table 1. In addition to the standard information which, at time of data collection, was required by the existing European food regulations, the “ideal format” of the label, as indicated by consumers, included allergen percentages being indicated between brackets as part of the ingredient list. In addition, allergy information was provided in an eye-catching box below the ingredient list. Below this box, specific details concerning allergy management in the factory was provided (e.g., “Processed in a facility that also processes [allergen], or “Processed in a factory which was [allergen] free”). In addition, allergen symbols were provided on both the front and the back of the package. These included a symbolic representation of an egg, peanut, walnut, udder, and a wheatear, indicating the presence of hen's egg, peanuts, tree nuts, cow's milk, and gluten respectively. Below the allergen information, a customer service telephone number was provided for additional information requests.

To develop the “ideal format” for the ICT scanner, in order that this might be used as a proptype by study participants, a database was created containing the ingredient list, the allergen information, and information about allergen management in the factory. The data base was linked to the ICT device via wireless Internet access. The data base could be activated by scanning the barcode of the product, after which the information appeared on the screen. This information consisted of an information field providing details of the ingredient list. Participants had the option to click on underlined terms, (i.e., E-numbers, herbs or spices, chemical names, and aromas), and were subsequently provided with more information

about these issues. For example, if the participant clicked on “starch” or “oil” a new field opened providing information about the origin of the starch, for example corn starch or sunflower oil. If an ingredient in the food was derived from, or contained ingredients derived from, allergenic sources, they needed to be included with specific names in the list of ingredients by the manufacturer according to current legislation. In addition, food allergic consumers surveyed in the previous study (Voordouw et al., 2011) expressed a preference for information on all ingredient sources, as lack of knowledge about the ingredients gives food allergic consumers a feeling of insecurity. Allergenic ingredient contents, expressed as a percentage, were again provided between brackets in the ingredient list. Allergen information was provided in a different field below the ingredient list. The latter field indicated whether the allergens which required labelling according to the EU directive were present in the product. The field remained empty if the product was free from these allergens. When an allergen containing product was scanned using the ICT scanner, an audio warning sound was produced. The last field contained information about allergen management used in the factory in which the product was produced (i.e., “processed in a facility that also processes [allergen]”).

The “ideal format” of the booklet provided the percentages of the allergen content in the ingredient list between brackets, and specific details concerning allergen management in the factory. The booklet included a glossary explaining “difficult” terminology (e.g., chemical names, E-numbers). The innovative aspect of the information booklet was that it showed allergen-containing products by product category. For example, the booklet listed all allergen-containing food products in the category “biscuit.” If a particular product was not listed, the implication was that the product was allergen free and safe to eat. For each food containing allergens a special form for the booklet was filled. The booklet had the advantage of the same information structure irrespective of the type or size of the food product.

The study was conducted in either German or Dutch. The materials, ICT scanner, booklet and Labels, as well as the questionnaire were all translated into the appropriate language for each country.

2.3. Food products

To assess consumer preferences for the new information delivery tools, fictitious food products were developed by using empty packages with labels manipulated to provide information according to the ‘ideal format’ resulting from the previous research. Three different categories of food products were included, namely, ready-made meals, snacks, and pre-prepared salads. For each product category, two fictitious food products were provided, one containing an allergen, and one allergy free. The “allergenic” food products (lasagne Bolognese, milk biscuits, and American coleslaw) contained all of the following allergens: milk, egg, peanuts, tree nuts, and gluten. The “allergen free” products (lasagne Verdi, biscuits, and vegetable salad) did not contain any of the 14 allergens legally

Table 1

Attributes of the prototype information delivery tools (developed according to the most preferred attributes identified in Voordouw et al., in press). Total sample size $N = 62$.

Attribute	Label	ICT scanner	Booklet
Percentage of allergen content	x	x	x
Specific details on allergen management in the factory	x	x	x
Eye-catching “box” on the packaging with standardised allergy information format	x		
Allergen symbol provided on the back and front of the package	x		
Telephone number for consumer service hotline	x		
Glossary of technical terms		x	x
Audio and visual warnings		x	
Allergen containing products by food category			x

required to be specified in the list of ingredients. The products were chosen after consulting the Dutch Nutrition Centre³ as these products could all potentially contain the food allergens included in this study, increasing the “realism” of the study.

2.4. Study design

Participants were asked to use each of the three information delivery tools to assess whether the different food products (two food products of one category per information delivery tool) were safe for them, or their family members, to consume. To randomize the interaction effect of the food product and the information delivery tool, a Latin Square Design was used. Three versions of the assignment were developed, each differing in the tool–product combination (e.g., “label” either with lasagne, biscuits or salads). To randomize the order effect of the tools in each version of the questionnaire, the tools were rated in different orders. A Latin square design was used to allocate information delivery tools to the different fictitious food products. In version A, study participants were asked to rate the *label* in combination with the cookies, the *ICT scanner* in combination with the lasagne, and the *information booklet* in combination with salad. In version B, the *ICT scanner* was rated in combination with the salad, the *information booklet* in combination with the cookies, and the *label* in combination with the lasagne. In version C, the *information booklet* was rated in combination with the lasagne, the *label* in combination with the salad, and the *ICT scanner* in combination with the cookies. Participants were asked to evaluate both the allergen containing and allergen free version of each type of food product.

After this assignment, questionnaires were used to collect participants ratings regarding each of the three information delivery tools on seven-point scales concerning ‘convenience’ (anchored by “very inconvenient” and “very convenient”), ‘usefulness’ (anchored by “very useless” and “very useful”), and ‘confidence’ (anchored by “low confidence” and “high confidence”). Finally, the participants completed a five-item 7-point ICT self-efficacy scale to estimate their experience with ICT, adapted from Eastin and Larose (2000).

Participants were also able to fill out their comments on the questionnaire about each of the information tools. These written comments were analysed qualitatively by coding all quotes and assigning them into categories. A code was developed if at least two participants mentioned the topic.

The questionnaire was piloted in the Netherlands with three respondents. They suffered from (self-reported) peanut, nut and sesame seed allergies. These respondents provided feedback leading to the re-phrasing of a few questions in the final questionnaire.

3. Results

Data analysis comprised three parts, to be described below: the quantitative analysis concerned data reduction and analysis of variance, and qualitative analysis of the participants’ written comments.

3.1. Quantitative analysis

All analysis was conducted using SPSS, version 18. A principal components analysis was performed on the three ratings concerning ‘convenience,’ ‘usefulness,’ and ‘confidence.’ A one-component solution yielded loadings of, respectively, .87, .82, and .62, with a cumulative explained variance of 60.1%. To investigate further whether the items formed a single construct a reliability test was

performed, resulting in an alpha of 0.67. To improve reliability, item deletion was applied. The scales of ‘convenience’ and ‘usefulness’ were taken together as one construct named ‘functionality’ with an alpha of 0.73. ‘Confidence’ was treated as a single-item construct.

The mean distribution of the ICT self-efficacy scales were as follows. The mean value for the item “confidence with terms concerning computer hardware was 4.9 (SD 1.7). For the item “confidence with terms concerning computer software, the mean score was 4.4 (SD 1.7). For the item “confidence with computer problems”, the mean score was 4.2 (SD 1.9). For the item “confidence in explaining why a task will not run” a mean score of 4.1 (SD 1.8) was observed. “Confidence in learning advanced skills within specific computer program” was associated with a mean score of 4.9 (SD 1.8). The mean value of the combined items was used to assess overall confidence self-efficacy in using ICT technology. A factor analysis was performed on the ICT experience scale. One factor was identified in this analysis, explaining 84% of the variance (Cronbach α = .95). The factor score was used as a co-variate in a Generalised Linear Model (GENLIN) with repeated measures.

All respondents were able to select the food product in the experiment they could safely eat (taking their food allergy into account). The main effects of the model are shown in Table 2. The main effects of the new information tools on functionality ($p < .01$) and the effect of ICT self-efficacy on functionality ($p < .05$) were significant. The main effects on confidence were not significant.

The post-hoc analysis showed that there were no significant differences between the countries on the ‘functionality’ and ‘confidence’ scales. The data was therefore pooled in subsequent analyses.

Table 3 shows the ratings for the information tools on the two scales. Perceived functionality was rated significantly higher for the label when compared to the booklet ($p < .01$) and ICT scanner ($p < .05$). The ICT scanner was rated as significantly more functional compared to the booklet ($p < .05$). The mean functionality score for the booklet was relatively low compared to label and ICT scanner. Overall, the participants reported (similar) high levels of confidence for all three information delivery tools.

3.2. Qualitative analysis

The participants were given the opportunity to provide commentary and feedback on the different tools if they wished. Thirty-two Dutch (NL) and 17 German (D) participants provided written feedback.

3.3. The label

Some participants indicated their appreciation of the symbols, with the caveat that the symbols needed explanation before they were able to use them correctly.

P24 NL (female): “The symbols are very useful. Although, explanation of the symbols is necessary. Symbols are fast to read.”

Table 2

Model effects with Wald chi-square of main effects of tools and co-variants country and ICT experience (χ^2 , degrees of freedom in parentheses).

	Tools	Country	ICT self-efficacy scale
Functionality	41.120 (2)**	0.121 (1)	3.950 (1)*
Confidence	1.450 (2)	.005 (1)	0.450 (1)

* $p < .05$.

** $p < .01$.

³ In Dutch “Voedingscentrum”.

Table 3Preferences for the new information tools (mean (SE)). Total sample size $N = 62$.

	Book	Label	ICT scanner
Functionality	4.9 ^a (.21)	6.3 ^b (.10)	5.7 ^c (.16)
Confidence	5.9 ^a (.18)	6.0 ^a (.16)	6.1 ^a (.16)

^{abc} For each row different superscripts indicate that the respective estimates were significantly different at the 5% level. Same superscripts in each row indicate that the respective estimates were not significantly different.

P38 NL (female): “I am very pleased with the symbols.”

However, some participants indicated that the symbols could lead to confusion as to whether or not the allergen was contained in the product.

P1 D (female): “For me the symbols are a bit confusing however after getting used to the symbols it will be very informative.”

Many participants expressed appreciation of the new label design.

P25 NL (female): “Once I know that all information is on the label, the font size is readable and the symbols are included, my personal preference would be the label because of its consumer friendly design.”

P6 D (female): “I do not buy a product before consulting the label. I feel insecure if it states “modified starch” Because I always want to know what kind of starch it is. On this label the allergen reference takes away this insecure feeling. Furthermore, the allergen management information is fantastic!”

There was some evidence to suggest that the provision of details regarding the conditions in the factory was very informative.

P8 D (female): “The allergy management information is very useful; it gives me more trust in the brand.”

P4 NL (female): “...also very useful the difference between produced in an allergen free environment or possible presence of allergens in the products.”

3.4. ICT scanner

In general, participants indicated that the information provided by the ICT scanner was detailed enough to make a safe food choice. Furthermore, the glossary function was reported to be informative and enhanced the participants’ trust in the product. Against this, some German participants reported that the scanner was not “user friendly” enough. In particular, they reported that the menu system was too complex, and the speed of information provision was too slow. Additional concerns were raised about the costs of the scanner.

P12 NL (female): “I believe when I am used to this device it will be very helpful...”

P6 D (female): “...If the screen turns red there are allergens in the product. For a reasonable price I would consider buying this device, but than it needs to be made more practical.”

Additional concerns were raised about the potential for social exclusion of particular groups in the population, who are less comfortable about using modern ICT technologies.

P4 NL (female): “This is not appropriate device for technophobic people like my mother.”

Other concerns were voiced about practical difficulties in using the scanner (for example, in terms of its pragmatic use in the shopping environment, or the extra time needed to use it when shopping). Safety concerns were related to the accuracy of the ingredient traceability data base rather than the scanner itself.

3.5. Information booklet

Some participants reported that the booklet was too laborious, time consuming and impractical to use in a retail environment. Furthermore, concerns were raised about the reliability of the booklet, given the need to frequently update the information it contained.

P27 NL (female): “The information in the booklet is good although this is not practical in the store [...] If a product is not in the booklet, meaning it is allergen free, I would not trust the information and I will still look at the ingredient list on the label.”

However, some participants reported that the information in the booklet was adequate for making safe food choices.

P33 NL (female): “Looks very complete and clearly ordered with valuable information. More and completer information than the label. If I would want more information I would use the scanner.”

Generally, the comments served to further understand consumer preferences identified in the quantitative part of the research.

4. Discussion

The aim of this study was to investigate whether the prototype information delivery tools, based on the preferences of food allergic consumers identified in previous research (Voordouw et al., 2011), enabled food allergic consumers to make safe food choices when applied in an experimental shopping environment. Consumer assessments of the functionality of the different information delivery tools, together with ratings of their confidence in using them to make safe food purchases from the perspective of allergy avoidance, were also assessed.

The perceived functionality of information delivery devices is important and enables food allergic consumers to utilise them in a retail environment. This study showed that the label and ICT scanner scored relatively high in terms of functionality. The booklet was judged to be less functional. Since food allergic consumers were equally highly confident in the information provided by the different tools (scoring around 6 on the 7-point scale), one might conclude that preferences were determined more by the functionality of the tools than the reliability of the information about allergens they provided. These findings confirm the results of the earlier study, as the highest preference was for the label, and secondly the second highest for the ICT scanner.

Most respondents indicated that the product label was the most functional source of allergen information. In part, this may reflect the potential lack of availability of the electronic scanner, or the fact that the use of the ICT scanner and the booklet was time consuming. Participants also expressed the view that the meaning of “symbolic” allergen labelling should be explained before food allergic consumers can optimally use them. This is in line with previous research indicating the need for clear, unambiguous and uniform symbols (Voordouw et al., 2009). Communication and education strategies about symbols and product information on packages might solve these issues. Previous research indicated that the ingredient list was not always understood because of the terminology used (Voordouw et al., 2009). The labels included in this study tried to address this issue by placing the lay explanation of

difficult (chemical) terminology between brackets, an addition viewed positively by the participants.

Although labelling was found to be the preferred information strategy by food allergic consumers, the use of ICT devices such as the electronic scanner merits further exploration. For example, ICT has the advantage of being able to deliver up-to-date allergen information relatively quickly (for example, should accidental contamination of a specific product line occur, or when product recipes change). Indeed, the electronic scanner utilised in the current research, when connected to an online data base, can provide far more information than can be indicated by a label with limited space. The scanner can make use of a “layered menu”⁴, such that consumers can choose whether they want or need specific food-related information (for example, about a specific range of potential allergens, or combinations of allergen and other food-related information, such as production methods, sustainability, or nutritional issues, or even product alternatives). It is suggested here that the use of an electronic scanner may be used in addition to food allergy labelling. Given the flexibility of the consumer information provided, the approach may also be useful in developing competitive advantage in the retail sector.

In line with the health channels communications literature, the results of the research suggest that information which has been tailored to individual needs (for example, with a high level of specificity regarding allergen needs) is preferred over and above generic information targeting a larger group, in particular for population groups where recognition of what information is required is high (see, *inter alia*, Kreter & Wray, 2003). The advantage of the ICT scanner is that it acts as a message strategy which can be applied under circumstances where the type of information required can be specifically matched to the needs of the target or end-user population (Kreuter, Farrell, Olevitch, et al., 1999). For example, allergen information can be matched to consumer requirements regarding specific allergen content. A second potential advantage (although this was not measured in the study explicitly) is that the adoption of the ICT approach may be used to alert consumers quickly if cross-contamination or accidental inclusion of allergens in foods has occurred – in other words, the ICT scanner can rapidly deliver health information in a “crisis” context, perhaps utilising information delivery developed from the principles of risk communication (Rudd, Comings, & Hyde, 2003). Despite the potential advantages of the ICT scanner in tailoring information in this way, the use of the label information was still the information channel most preferred, although preference for the ICT scanner increased with ICT experience. The results suggest that, first, food allergic consumers tend to shop in a habitual way, relying on repurchase of “safe” brands. Inspection of the label is a cross-check of what has been learnt from experience, but is also an activity which has been applied before and in which consumers have high levels of confidence (Cornelisse-Vermaat et al., 2008b). The use of the scanner may introduce novel behaviours into routine shopping activities. Second, consumers who are less familiar with ICT in general may have less confidence in both their ability to use the ICT scanners to identify allergen information, and the credibility of the information provided. A further issue relates to the potential exclusion of specific population groups if ICT technology replaced labelling. This may result because consumers do not trust, or do not have confidence in their ability to apply the technology, or because some food retailers may not have the resources to introduce such technology into the retail environment (for example, smaller shops may have reduced investment resources). This suggests that the continuation of an optimised allergen labelling strategy, applied in combination with personalised information delivered via an ICT

scanner, might best serve all members of the food allergic population.

The qualitative analysis was an useful source of information regarding the information preferences of food allergic consumers. Many consumers expressed appreciation of the use of symbolic labelling on the label. However, there was some evidence to suggest that the inclusion of additional forms of allergen information appeared to increase, rather than decrease, confusion about the presence of food allergens for some consumers in the products tested. The interpretation of symbolic labelling needs to be well understood by allergic consumers and other end-users before it can be implemented (possibly harmonised at an international level, where the use of multiple languages may become a problem which can be managed through the use of allergen symbols). Concerns about the usability ICT scanner were expressed by German participants, perhaps suggesting that a more usable menu system be incorporated into the device before it could be used as an information tool, and that the final versions of the scan should deliver information more quickly. Concerns were also voiced about how practical it would be to use the information booklet in a retail environment. This may explain, in part, consumer preference for the ICT scanner, which delivered more “automated” results. Unsurprisingly, study participants demanded reliable allergen information. The reliability of the information booklet was questioned in this regard, as study participants perceived that it would be difficult to maintain constant revisions of allergen information if needed. In contrast, reliability concerns about the ICT scanner related to the accuracy of the associated data base, and food and ingredient traceability systems, rather than the scanner technology *per se*.

One potential issue relates to the severity of symptoms an individual may experience following exposure to potentially problematic proteins. For example, an individual who may suffer anaphylactic shock following ingestion of peanut protein may be more concerned about the accuracy of allergen labelling, than a consumer who experiences mild symptoms following allergen ingestion (Schenk et al., 2011). The severity of symptoms may influence communication preferences, and should be investigated in future research. In addition, having responsibility for the care of another dependent family member (for example, small children) may also influence the extent to which consumers require highly accurate food allergen information. Given the relatively small number of parents of food allergic children who responded, compared to food allergic adults, statistical analysis was not possible in this study. A further important limitation of the research reported here relates to the very small sample of participants included. The generalisability of results may be limited unless replicated in a larger sample. For the same reason, comparison between German and Dutch consumers is not appropriate (Fig. 1). Future research is again indicated which could enable further investigation of demographical and country differences. In addition, extending the research to include more countries would allow further assessment of consumer preferences under conditions where cultural differences in dietary preferences or food allergy prevalences exist.

In conclusion, the results suggest that the food allergic consumers in this study preferred clear and unambiguous labelling on product packaging, although the functionality of the electronic scanner was appreciated. Whilst the use of allergen labelling of food products remains an important consumer priority, additional information provision through the application of novel ICT technologies seems highly relevant (not the least from the retailer perspective of potentially delivering competitive advantages in terms of facilitating consumer choice). Replicating the study using a larger sample drawn from a greater range of countries would allow increased generalisability of the conclusions, as well as facilitate cross-cultural comparisons in preferences.

⁴ Layered menu means that with each additional click on the screen the study participant received more detailed information.



Fig. 1. Illustrative example of experimental packaging (in this example, developed for Dutch consumers). Circled is the symbol which indicates that the product contains milk proteins.

The results of this study are important for developing new policies and legislation concerning information provision to food allergic consumers, for example developing and implementing a harmonised international symbolic allergen strategy, associated with effective communication about how such labels should be interpreted. These results could also directly be used by manufacturers to develop new labelling or ICT scanners to improve their service to clients in the store and thereby their market position.

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