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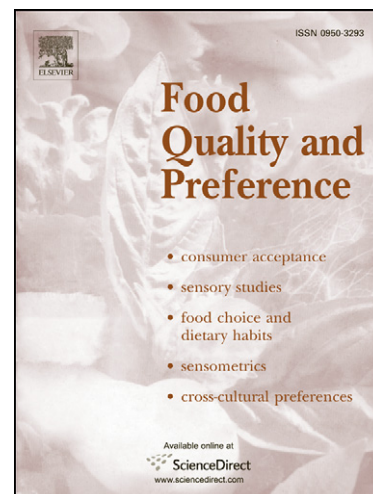
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**Preferred Information Strategies for Food Allergic Consumers.
A Study in Germany, Greece, and The Netherlands.**

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Abstract

Information provided on food packaging is currently the most important method enabling food allergic consumers to eliminate allergens from their diet. This study aimed to identify the preferences of food allergic consumers regarding different information provision scenarios. Respondents (N=287) filled out a web-based questionnaire on their preferences regarding a food label, an in-store booklet, and an ICT-solution. ICT methods will not replace effective food labelling, but may be used to supplement information provided by labels. Recommendations for information delivery to food allergic patients in the form of labels and booklets, as well as personalised (novel ICT) approaches, are provided.

1 Introduction

2 There is evidence to suggest that the incidence of some food related allergies may be increasing in
3 Europe and elsewhere (Jarvis et al, 2005), for example, in the case of peanut allergy in children (Grundy et al,
4 2002). Differences in methodological approaches to data collection and study designs make systematic
5 comparisons across different populations, at different times, make systematic comparisons of populations
6 difficult (Rona et al., 2007). None-the-less, an 18% increase in childhood food allergy from 1997 to 2007, with
7 an estimated 3.9% of children overall affected at the end of this period, has been reported (Branum and
8 Lukacs, 2008, Decker et al., 2008, Sicherer and Sampson, 2007). Systematic comparison of incidence
9 between different European Countries represents work in progress (Mills et al, 2007¹), although self-reported
10 food allergy incidence has been as high as 35% (Rona et al, 2007). Given that avoidance of allergens is the
11 only way to prevent an allergic reaction (Munoz-Furlong, 2003), the provision of effective information about
12 potentially allergenic foods and ingredients is a priority, particularly when contextualised by the potential
13 severity associated with a reaction (Buttriss, 2002).

14 At the time of data collection, EU directive 2003/89/EC amending 2000/13/EC), effective from
15 November 2005, made it mandatory for the food industry to list all 12 potential food allergens on product
16 labels regardless of the quantity in the finished product (Cheftel, 2005; Hefle & Taylor, 2004; Hignett, 2002).
17 These were cereals containing gluten, crustaceans, eggs, fish, peanuts, nuts, soybeans, milk, celery,
18 mustard, sesame, and sulphur dioxide at levels above 10mg/kg , The directive is clear about the need to label
19 potentially problematic ingredients, but there is no clarity regarding precautionary labelling, which an allergen
20 might be in the food, even though it is not listed as an ingredient. For example, a food product might contain
21 the warning statement "may contain peanuts," even though peanuts have been added as an ingredient, but
22 are potentially the result of cross-contamination in the factory where the foods are manufactured.

23 One effect of legislative change is that manufacturers are adopting *precautionary labelling*, rather than
24 face possible legal action in the event of small amounts of undeclared allergens being discovered in their
25 products. Rather than helping the allergic consumer cope with their condition, such labelling restricts food
26 choices further. There is also evidence that food allergic consumers may regularly ignore precautionary
27 labels, putting themselves at risk and further devaluing food label information (Cornelisse-Vermaat et al.,

¹ www.euoprevall.org

2008; Hefle et al., 2007; van Hengel, 2007). Joshi et al. (2002) report that only 10% of those avoiding milk in processed foods were able to spot the “milk words” in a label-reading task. Similarly 54% of those avoiding peanuts correctly identified peanuts on labels (in other words, were able to specify which of a range of products contained peanut protein when reading the ingredients list), and 22% correctly identified soy (Joshi, Mofidi, & Sicherer, 2002). Consumers are wary of using lists of commercially prepared “safe” foods, because manufacturers may change the ingredients contributing to specific products without warning (Mofidi, 2003). As a consequence, food allergic consumers, or those responsible for their care, must read the ingredient statements for all products each time they shop, which is time consuming and has a detrimental effect on quality of life and welfare (Blok de et al., 2007; Knibb et al., 2000; Primeau et al., 2000).

Recent research has suggested that current food allergy coping strategies adopted by consumers are inadequate. To some extent, allergic reactions were attributed to *misunderstanding label terms* and to inclusion of *non-specific terms* in the ingredients list (Elinor, Weiss, & Furlong, 2005). The requirement for more information is at odds with providing food labels with clarity and is compounded by many labels appearing in multiple languages and in very small type, making them difficult to read which, in addition to incomplete allergen detection, may lead to unnecessary restrictions on dietary choices. (Joshi, Mofidi, & Sicherer, 2002)

Consumers frequently call manufacturers to assess the safety of the products, despite changes in labelling legislation, because of lack of trust in the accuracy of existing labels, as well as difficulty in interpreting them (Mofidi, 2003). Whilst most large manufacturers willingly provide this information (Munoz-Furlong, A. 2003), the additional burden in terms of time and inconvenience this places on the consumer is unacceptable.

Information delivery via the product label is not the only feasible approach. The improvement of information supply for food allergic consumers might be strengthened if new Information and communication technologies (ICT) were used (Cornelisse-Vermaat, Voordouw, Yiakoumaki, Theodoridis, & Frewer, 2008). For example, ICT could deliver personalized information about allergens and other product related information to consumers in a form which they prefer, assuming adequate food and ingredient traceability systems can be put into place. New ICT-technologies like Radio Frequency Identification (RFID), bar-coding on foods sold loose could be used to provide information which is more complete and easier to understand. Information can

be linked the bar code on a product, and “read” using a scanner in the retail environment, (with the information being personalised using a smart card) or a handheld scanner. Alternatively, information could be provided at the checkout, again in combination with a smartcard.

Improved information delivery to food allergic consumers is a policy priority within the EU. The aim of the study reported here was to identify the usefulness of specific characteristics and means of information provision for allergic consumers through different information delivery scenarios.

Method

Adult food allergic consumers, and the parents of food allergic children, were recruited through advertisements in national newspaper or e-letters from national patient groups (all related to food allergy) in Germany, Greece, and the Netherlands. Participants were also recruited through advertisements published in newspapers and trade magazines. Two hundred and eighty seven participants were included on the basis of self-reported perceived or actual allergies to three possible foods. i.e., milk, egg and/or tree nuts or peanuts. These food allergies were selected from the EU list of 14 potential food allergens, and were included because milk allergy is very common among children, and egg and/or tree nuts or peanuts are common adult allergies. A number of possible information scenarios were developed based on previous research (Cornelisse-Vermaat et al., 2008a; Cornelisse-Vermaat, Voordouw, Yiakoumaki, Theodoridis, & Frewer, 2008b; Voordouw et al., 2009). The scenarios were identified through a combination of a stakeholder analysis of what was possible given existing and emerging possibilities regarding traceability, bar code labelling, and information delivery systems (Cornelisse-Vermaat et al, 2008a) and ethnographic research to elicit the preferences of consumers for the type of information they required, together with their preferred method of delivery (Cornelisse-Vermaat et al, 2008b; Voordouw et al, 2009). Data were collected using a web-based questionnaire in the spring of 2007. The scenarios were presented as future possibilities as the various combinations of options included are not all currently available in the retail environment.

Effective labelling on packages, ICT approaches including a “Personal Shopping Assistant” (where the bar code of individual products could be scanned and a warning signal was provided if the product contained the allergenic ingredients to which the consumer was allergic), and an information terminal (providing similar information to the “personal shopping assistant”, but not requiring the consumer to purchase

or borrow a hand-held scanner) were identified as potentially effective information sources for consumers, together with more traditional media such as information booklets.

Three main information scenarios were selected as the preferred candidates for delivering allergen information: a) Label - standardised label with symbols; b) Booklet - with allergen information; c) Information Communication Technologies (ICT) - such as a small personal shopping assistant, an information terminal, a handheld scanner, or an internet shop.

The most important attributes of each of the different information scenarios were also identified. Five different attributes of food labels, 5 for ICT tools, and 4 for the booklet were selected (see Table 1).

[Table 1 about here]

Participants were initially presented with images of the information delivery systems, as well as brief explanations regarding each information “attribute”. Respondents were then asked to rate the information scenarios using a seven-point Likert scale. An example of an information scenario profile is shown in Figure 1. Conjoint analysis of the ratings was employed to evaluate the relative preference for each information attribute for the three information types. Separate analyses were conducted for the Label, Booklet, and ICT information delivery approaches.

[Figure 1 about here]

There were many possible combinations of attribute levels for each information delivery approach (288 for Label + 72 for Booklet + 72 for ICT). A fractional factorial design was employed to minimize the number of profiles presented to respondents. Orthogonal designs of attribute level combinations were generated by SPSS 15.0 for each information approach, which resulted in sixteen profiles for each of the three conjoint experiments. To reduce experimenter concerns regarding participant fatigue, each participant rated half of the profiles, involving 8 questions per information scenario (Label, Booklet, ICT) or a total of 24 different profiles. Additionally, two holdout profiles were included for each information scenario (one for each set of 8 questions), which was excluded from the conjoint analysis and later used to evaluate the model

reliability. After the rating task, several questions concerning demographics were asked (gender, age category, educational level, specific allergy, allergy severity), together with items about previous experience with ICT tools.

The questionnaire was piloted in English with students from the three participating countries. Feedback regarding the questionnaire explanations, content and structure was incorporated into the design. The final English questionnaire was translated and back translated into German, Dutch, and Greek. Any remaining inconsistencies were resolved. The final online survey took approximately twenty minutes to complete.

Data from Germany (N=55), Greece (N=65), and the Netherlands (N=167) were pooled for each conjoint analysis. A generalised linear model with repeated measures for subjects was estimated. The relevant attributes and a country variable were included as fixed variables. For the ICT conjoint analysis, an additional covariate was included based on a factor analysis of five questions related to previous experience with ICT tools (the factor explained 83% of the item variance). For all of the conjoint analyses, pairwise comparisons were conducted which were adjusted for multiple comparisons using Fisher's least significant difference. Overall model fit was assessed by calculating χ^2 from the log-likelihoods of the specified model and of the model including a constant term only. The normality of the residuals was assessed using normal probability plots. Summaries of the results are presented in Tables 2–4. For each conjoint analysis, if four or more of the responses were missing then the data for that respondent was excluded from the analysis. For the ICT conjoint analysis, any respondents that did not complete the five experience questions were excluded from the analysis. This procedure resulted in 287 observations for Labels, 287 for Booklets, and 255 for ICT.

Results

Label

A summary of the demographic characteristics of the sample is provided in figure 2.

[Figure 2 about here]

Results from the conjoint analysis for the label ratings indicated that significant differences were observed between levels of each attribute ($p < .05$). Cross-country differences were detected, such that the Dutch ratings were significantly more positive about all label attributes compared to the Greek and German responses. The χ^2 indicated a highly significant improvement of the likelihood of the specified model as compared with the likelihood of the model including a constant term only.

In terms of the optimal strategy to present the ingredients on the label for food-allergic consumers, the pairwise tests indicated that the option to *show the percentage of allergens* was rated significantly higher than either showing percentages of all ingredients, and not showing percentages. Similarly, the pairwise tests revealed significant differences between the type of precautionary information that was favoured for the label, where *specific details on allergy management* was rated significantly higher than providing notification that a food product *may contain traces of allergens*. Both of these options were preferred compared to providing *no precautionary information*. The results also supported the use of an *eye-catching box with standardised allergy information* versus *no box*.

Moreover, a standardised symbol representing allergy information at the *front and back* of the food product was preferred. Beyond the information provided directly on the package, the results indicated that services to provide additional allergy information should be offered through a *hotline*, which was rated significantly higher than through a *website*, *hotline and website*, or not at all. However, there was no significant difference between the *website* or combined option of a *hotline and website*, while providing *no information service* was only significantly lower compared to the *hotline* and combined *hotline and website* alternative and did not differ significantly from the *website* option. Apparently receiving information from a real person about the food products was preferred to finding information on a website.

[Table 2 about here]

Booklet

The results of the booklet conjoint analysis indicated significant differences between levels of each attribute (see Table 3). The use of a glossary in the food allergy booklet was supported by the results. The only

exception was the country variable, showing no significant differences between the ratings across countries. The χ^2 indicated a highly significant model as compared with the model including a constant term only.

In terms of the remaining attributes with multiple levels, the pairwise tests suggested several significant differences. Providing *no* percentage breakdown of allergens or ingredients resulted in significantly lower ratings compared to both of the alternatives, although there was no significant difference between *showing the percentage of allergens* versus *showing the percentage of ingredients*. Furthermore, there was no significant difference between specifying the food product *may contain traces allergens* versus providing *specific details about allergy management*. Nonetheless, in terms of the format of the booklet, there was a clear preference for information to be *specified according to products containing allergens and divided into categories per food category*, which was rated significantly higher compared to all the other options. However, this information is not currently supplied in retail outlets. Booklets are often ordered by allergen-free products.

[Table 3 about here]

Information Communication Technologies

At least some levels of each attribute in the ICT conjoint analysis were significantly different from one another at the five percent level (see Table 4), although the variables representing country and respondent experience with ICT were not significant. Since ratings for glossary were significantly higher than without glossary, this result supported the inclusion of a food allergy glossary in any ICT approach to information delivery.

The pairwise tests indicated many of the levels for each attribute were not significantly different from each other. For the percentage breakdown options in the ICT conjoint, there was no significant difference between the options to *show the percentages of allergens* versus *the percentage of ingredients*, although both of the options were rated significantly higher compared to providing no percentage breakdowns. Likewise, in terms of food allergy warnings provided through ICT, *no warning* was significantly lower than the other options, although there was no significant difference between the other 3 options: visual warning, audio warning, or audio and visual warning. Lastly, in terms of the kind of precautionary information provided, there

was no significant difference between ICT that advises that a food product *may contain traces of allergens* versus one which specifies *details regarding allergy management*.

The χ^2 indicated a highly significant model as compared with the model including a constant term only.

[Table 4 about here]

In the analysis of the holdout profiles, we compared the ratings predicted by the estimated model with the actual ratings of the holdout profiles by the participants. For 5 holdout profiles, the predicted ratings were less than 7% off the actual ratings, and the differences were not significant in a t-test. For one Booklet holdout profile, the difference was 16% ($t=2.41$, $p<.05$).

On the basis of the overall ratings of the respective profiles, an indication regarding participant preferences for label versus booklet versus ICT could be obtained. All three conjoint analyses were repeated, including interaction effects between the attributes and country. Using the results from these analyses, the overall ratings for each device was calculated for each country. Participants in all countries gave the highest average preference ratings to an adjusted label on the 7-point scale (Netherlands: 6.13, $s.e.=0.27$; Greece: 5.88, $s.e.=0.28$; Germany: 5.75, $s.e.=0.22$). Participants in the Netherlands (5.48, $s.e.=0.29$) and Greece (5.40, $s.e.=0.29$) rated ICT as the second best solution and the booklet as the least preferred solution on average (Greece: 5.30, $s.e.=.29$; Netherlands: (5.19, $s.e.=.32$). German participants preferred the booklet (5.25, $s.e.=0.25$) more than the ICT solution (5.20, $s.e.=0.24$).

Discussion and Conclusion

Adults from three different EU countries were surveyed regarding the allergy management of the most severely food-allergic member of their family (themselves or another family member).

Most respondents preferred a label containing a box with standardized food allergy information. Respondents preferred a standardised symbol (indicating the allergens) both at the back and the front of food packages.

The results suggested that the label should show the percentages of the allergens in the food product, as well

as provide specific details about allergy management in the food chain, displayed in an eye-catching box with standardised information, and located in a standard place on the label. The respondents preferred to have a hotline (telephone number), rather than a website address placed on the label.

One improvement could be mandatory safety warnings for major allergenic food ingredients, as defined by Directive 2000/13/EC, on every foodstuff package. No exceptions (for example, based on the size of the product or the presence of secondary packages) would be permitted (see also Hendrick, Frewer & van de Meulen, submitted). Due to space limitations on small packages and the large number of European languages, a safety warning could in the form of a (European) symbol could be used to warn and inform food-allergic individuals (Buhl, Kampmann, Martinez, & Fuchs, 2008). Given the need for detailed information to be available to consumers to enable an effective avoidance strategy to be implemented as part of food allergen risk management, such symbolic labelling is likely to be valuable as a warning to consumers regarding the presence of potential allergens in food products, but will not, in itself, replace this information. The adoption of ICT approaches which can deliver information in the language preferred by a particular consumer may be solve the problem of language, but pan-European application will incur significant costs to the food industry, in terms of traceability implementation and ICT infrastructure across the retail sector,

It is notable that particular groups within the population (in this case food allergic adolescents) have been reported to be five times more likely to use the front label/nutrient claims than nutrient labels on the back of the packaging (McCullum & Achterberg, 1997) and so if a choice needs to be made between labelling on the front of packaging, and the back, the front should be prioritised.

The results of the study show that the participants preferred a glossary in the *booklet* that explains complicated terms. The booklet should also show the percentages of the allergens and contain a “may contain” warning. Contrary to the Netherlands and Greece, in Germany the booklet was preferred above an ICT-solution.

The analyses of the results focused on the *ICT-solution* showed that a device was preferred that would show the percentages of all ingredients (or at least those of the allergens), have audio and visual warnings, a “may-contain” warning (if applicable), and a glossary explaining complicated terms. One advantage of using ICT approaches is the flexibility which they confer in terms of personalising information, which is a common requirement for food allergic consumers or their care givers (Hu, Grbich, & Kemp, 2007).

In general, consumer preferences for allergen information delivery did not differ profoundly between the three countries. Participants in all countries gave the highest average preference ratings to an adjusted label on the 7-point scale, possibly because this approach to information delivery was the least cumbersome and most familiar. In other words, respondents had experience of using the approach. It is of interest that Dutch respondents rated all of the label attributes more highly compared to respondents from other countries, possibly because of a cultural difference in label use, but further research would be need to confirm this. One difference between countries related to preference for ICT and booklet information delivery approaches. Participants in the Netherlands and Greece rated ICT as the second best solution and the booklet as the least preferred solution, whereas German participants preferred the booklet more than the ICT solution. One may speculate that this is a consequence of consumer familiarity of use, but further research is required to explain this result.

Although Dutch consumers were more positive than other respondents about the attributes of the label, cross-national preferences for presentation and informational content did not vary. As a consequence, it the appearance of the food label can be adopted throughout Europe. General guidelines could be set out (for example, including a symbol on the package), which could then be adapted to linguistic needs in specific countries. The participants in the three countries included in the study did not differ in their preferences regarding the information which should be included in a booklet. The same was true for the proposed ICT-solutions. Within the constraints of the study (in particular the limited number of European countries involved), the results suggest that a harmonised information delivery strategy is feasible, at least regarding label format and the type of information delivered.

Effective implementation of systems is contingent not only on consumer preferences for information delivery, but also whether such systems can be effectively and safely implemented throughout the food chain (for example in terms of ingredient traceability and information delivery in the retail environment, such as the may contain labelling). Whilst new developments in ingredient traceability, such as RFID tagging, improve identification of particular ingredients in a given food chain, other factors such as the efficiency and reliability of traceability systems, or the cost of implementation, may make their adoption unfeasible (Davies, van Rijswijk, Frewer, Luijckx, & Ward, 2008).

It is of interest to speculate why preferences for different information formats and delivery systems vary. For example, consumers may prefer a hot-line over a website because direct contact with an individual via the telephone generates more trust in the individual, whereas trust in a website is lower because it is perceived to represent an institution. Generally, consumers tend to state that they prefer to more, rather than less information provided on labels about different attributes and qualities of food products (for example, see Miles et al, 2005, Roosen et al, 2003), assuming such information is presented in a form which is interpretable by consumers (Cowburn and Stockley, 2005). This is confirmed by the results of the current study. For example, consumers expressed a preference for showing the percentage of allergens in labels, and providing additional information regarding specific details about allergy management during the manufacturing process, both of which add to the current information available. A similar requirement for increased information was observed in terms of the information booklet (for example, in terms of the inclusion of a glossary to define difficult or ambiguous terminology), but not for all of the attributes included in the study (for example, regarding percentages of allergens *versus* percentages of ingredients, or information about production risk management). This may be related to the characteristics of the information delivery system, inasmuch as information booklets are perceived as cumbersome to use compared to labels, in particular when shopping. Consumer preferences for attributes included in the ICT approach were similar to that in the glossary. One attribute, the inclusion of visual and/or auditory warnings were appreciated by consumers, but these could not be included in the other information delivery options. The inclusion of such warnings, in particular if personalised to the particular needs of food allergic consumers, appears to provide a benefit which may increase acceptance of ICT approaches to information delivery, as well as reduce the time burden associated with shopping.

One important limitation of the study was that the demographic data did not allow for accurate separation of self and physician diagnosed food allergy, and identification of families where multiple members suffered (or were perceived to suffer) from food allergies. It is essential that future research address this issue. For example, parents of food allergic children may be more concerned about accurate labelling because of their responsibilities in terms of protection. This merits investigation in future research. In addition, the participants were not nationally representative in terms of age, gender and socio-economic class. In the absence of valid epidemiological data it cannot be judged whether the responses are representative of the

food allergic consumers in specific countries. In addition, data were not collected regarding the severity of food allergies across family members- again a topic worthy of future research with regard to food allergy labelling.

Another potential limitation of the research relates to how participants were recruited, through advertisements in the press or allergy patient group newsletters. It is possible that participants who were “self-selected” may have a greater interest in food allergy labelling than food allergic participants more generally, which may have influenced the level of detail they required relating to allergen information. Differences in information preferences may also exist between participants with *medically diagnosed* and *perceived* food allergies, in particular as medical diagnosis may be associated with more severe reactions. These individuals may have received such a formal diagnosis– and may require more certainty in terms of information in order to make a decision about consumption, given the potential severity of their response to food allergens. Finally, participants were included on the basis of self-reported perceived or actual allergies to three possible foods, i.e., milk, egg and/or tree nuts or peanuts. Information preferences in relation to other food allergies, (for example, those less likely to be used as a difficult to identify ingredient in composite products, such as shrimp, or which tend to have very mild symptoms, such as apple) may be associated with less complex information preferences.

One question not addressed by this research is whether symbolic labelling should indicate whether the product actually contains this allergen or is free of this allergen. Further research is required to clarify this issue. A further problem in terms of public health relates to the fact that children and adolescents in unfamiliar surroundings do not always have access to the outer packages of foodstuffs, or the types of information delivery utilised at point of sale, to assess the safety of foodstuffs. Finally, the non-declaration of individually wrapped foodstuffs with outer packages and the general exclusion of the labelling of products whose largest single surface area falls below 10 cm² are legally allowed in the EU and elsewhere. As a consequence, small-sized foodstuffs may represent a potentially fatal hazard to vulnerable consumers, but nonetheless remain unlabelled under current legislative frameworks. Further refinement of existing legislation is required, contextualised by parallel research to determine optimal information delivery strategies for these consumers.

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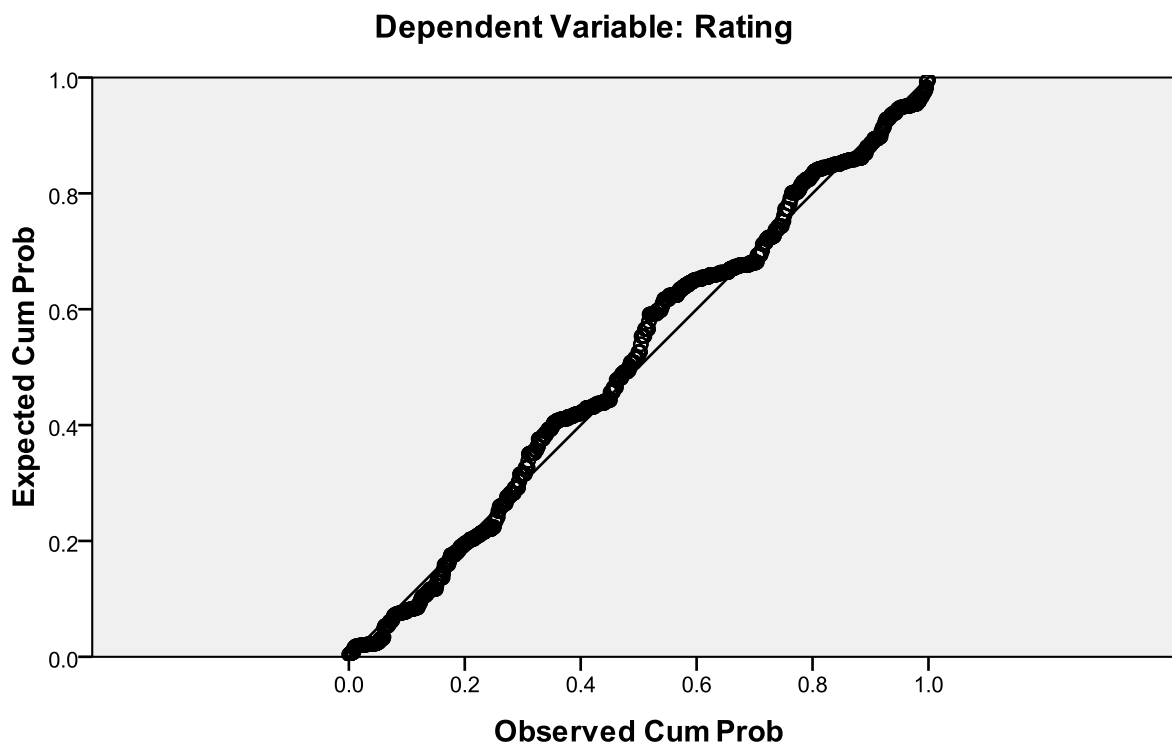
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407 **Acknowledgements**

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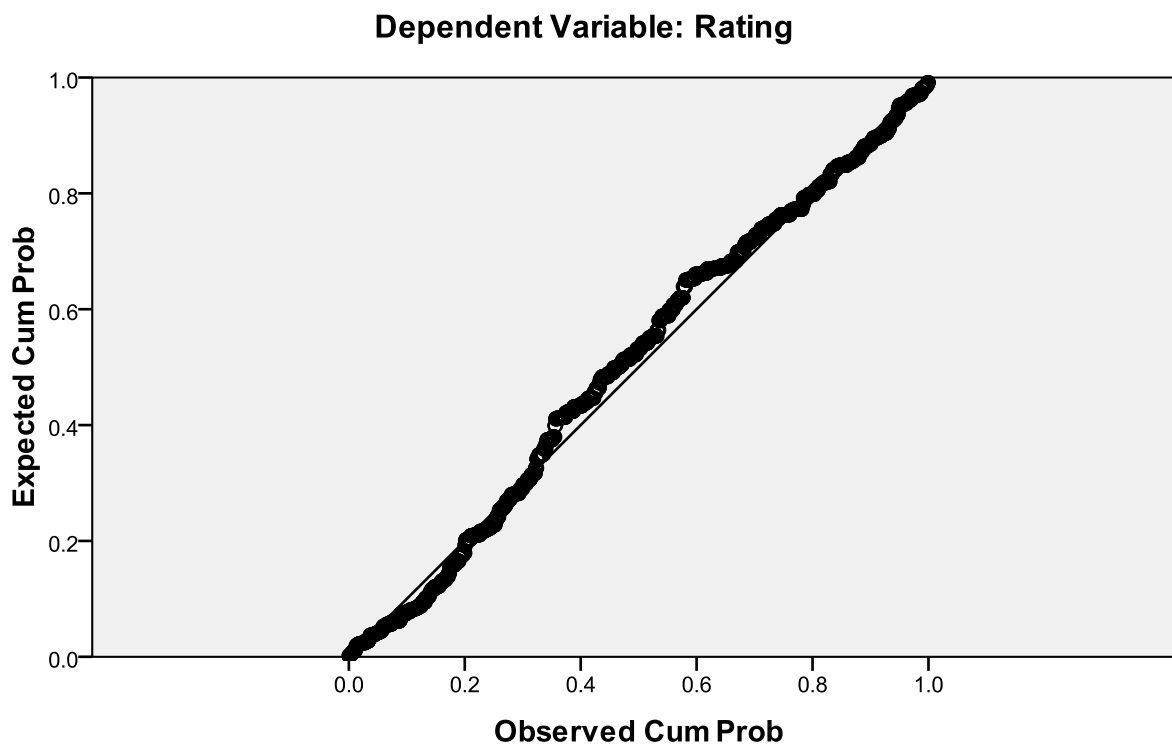
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ACCEPTED MANUSCRIPT

Normal P-P Plot of Regression Standardized Residual

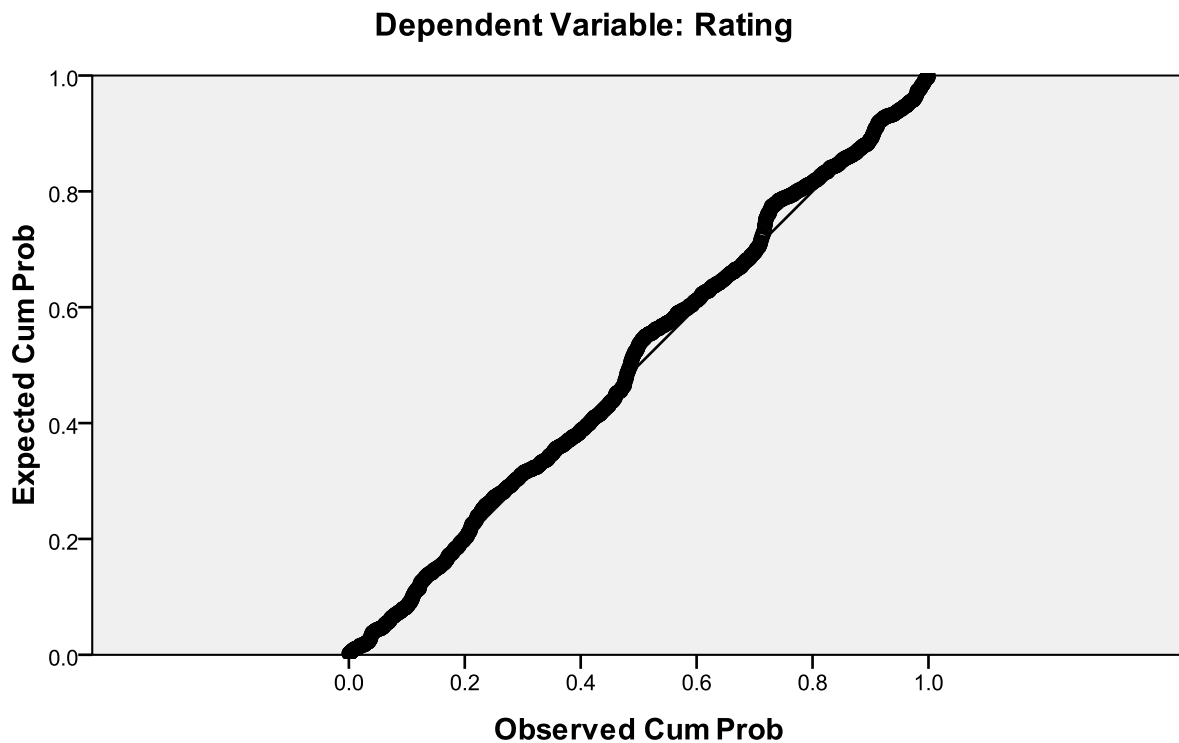
Probability plot for booklet

Normal P-P Plot of Regression Standardized Residual



Probability plot for label

Normal P-P Plot of Regression Standardized Residual



Probability plot for ICT

Results

Reviewers comment: *Eliminate sentences like the one pointed out in line 116, "Both of these options were preferred compared to providing no precautionary information", (also in line 139) as it is an obvious result given in the sample that was worked with (Adult food-allergic consumers, and the parents of food-allergic children).*

Authors response: The following sentences have been deleted from the results section. Both of these options were preferred compared to providing *no precautionary information*. Similarly, although participants expressed a preference for precautionary information compared to providing *none*. although both of these options were rated significantly higher compared to providing *no* precautionary information.

Reviewers comment * *The results of the study should be expanded upon using a comparison of the results, not just by country but also according to "adult food-allergic consumers or the parents of food-allergic children". Significant differences may be detected in the case of "the parents of food-allergic children", particularly in Europe, which has a low birth rate.*

Information about the demographic breakdown of the sample is provided figure 1.

An example of a scenario for the food labelling approach.

In addition to the current food labelling requirements this label will provide:

Glossary	Ingredients information	Personal warning systems	Additional information	Standardized format	Standardized allergen symbols	Information Service	Booklet Format
<i>Not applicable</i>	2. Percentage s of allergens contained in the product	<i>Not applicable</i>	3. Specific production details about how allergens are managed within a factory	1. Eye-catching box with standardised allergy information	4. At the back and the front	4. Both hotline and website	<i>Not applicable</i>

An example of a scenario for the information booklet approach.

In addition to the current food labelling requirements this booklet will provide:

Glossary	Ingredients information	Personal warning systems	Additional information	Standardized format	Standardized allergen symbols	Information Service	Booklet Format
2. Ability to look up explanations for difficult terms or ingredients	1. Does not show percentages at all.	<i>Not applicable</i>	2. Precautionary labelling to indicate that a product "may contain traces of the allergen".	<i>Not applicable</i>	<i>Not applicable</i>	<i>Not applicable</i>	4. Allergen free products

An example of a scenario for the information booklet approach.

In addition to the current food labelling requirements *ICT information delivery* will provide:

Glossary	Ingredients information	Personal warning systems	Additional information	Standardized format	Standardized allergen symbols	Information Service	Booklet Format
2. None	1. Percentage s of ingredients contained in the product	4. Visual and Auditory	1. No additional information	<i>Not applicable</i>	<i>Not applicable</i>	<i>Not applicable</i>	<i>Not applicable</i>

Figure 1. Examples of the type of information combination provided for each information approach.

The full range of options is provided in Table 1. Not applicable indicates that the type of information was not relevant to the delivery system under consideration, and this was not included. Participants were asked to rate each "combined information option" on a 7 point scale, anchored by 1="dislike very much" and 7="like very much".

	Germany	Greece	The Netherlands
Gender respondent	%	%	%
female	81	49	91
male	15	40	9
missing	3	11	0
Total number	55	65	167
Age respondent	%	%	%
<20 years	7	20	2
20-30 yrs	27	29	9
40-50yrs	22	20	28
50-60yrs	8	6	18
60-70yrs	5	3	10
70-100yrs	2	1	1
Missing	29	17	32
Total number	55	65	167
Education level respondent	%	%	%
primary	2	0	0
secondary	15	5	47
bachelor	29	40	18
master	49	50	35
Missing	5	5	0
Total number	55	65	167

Figure 2. Breakdown of sample demographics. Demographic breakdown of the sample.

Note that sample sizes were not appropriate to conduct further analyse preferences for information according to food allergic family member composition.

Table 1. Attributes for the Label, Booklet, and ICT scenarios

Attribute	Attribute levels	Option evaluated		
		Food label	Booklet	ICT
Glossary	1. None 2. Ability to look up explanations for difficult terms or ingredients	<i>n.i.</i>	√	√
Ingredients information (Percentages)	1. Does not show percentages at all 2. Show percentage of allergens in product 3. Show percentages of all ingredients in product	√	√	√
Personal warning systems	1. None 2. Visual 3. Audio 4. Visual and audio warning	<i>n.i.</i>	<i>n.i.</i>	√
Additional information	1. No additional information 2. Precautionary labelling to indicate that a product 'may contain traces of the allergen' 3. Specific production details about how allergens are managed within a factory	√	√	√
Standardized format	1. No box 2. Eye-catching box with standardized allergy information	√	<i>n.i.</i>	<i>n.i.</i>
Standardized allergen symbols	1. None 2. At the front 3. At the back 4. At the back and the front	√	<i>n.i.</i>	<i>n.i.</i>
Information Service	1. None 2. Telephone hotline 3. Website address 4. Both hotline and website	√	<i>n.i.</i>	<i>n.i.</i>
Booklet Format	1. Allergen free products- per food category 2. Allergen containing products - per food category 3. Allergen containing products 4. Allergen free products	<i>n.i.</i>	√	<i>n.i.</i>

Note. √ attribute included in the option evaluated.
n.i. not included in the option evaluated

Table 2. Results of label conjoint analysis

Label	Attribute levels	Mean	SEM
Percentages**	None	3.89 ^A	0.08
	Show percentage of ingredients	4.36 ^B	0.08
	Show percentage of allergens	4.60 ^C	0.07
Precaution**	None	3.85 ^A	0.08
	May contain traces allergens	4.41 ^B	0.08
	Specific details on allergy management	4.59 ^C	0.08
Allergy info**	No box	3.87 ^A	0.07
	Eye-catching box with standardized Information	4.69 ^B	0.07
Symbols**	No symbol	3.80 ^A	0.08
	Symbol at back	4.23 ^B	0.08
	Symbol at front	4.47 ^C	0.08
	Symbol at back and front	4.64 ^D	0.08
Info service**	None	4.09 ^A	0.09
	Website	4.24 ^{AB}	0.08
	Hotline and website	4.27 ^B	0.08
	Hotline	4.54 ^C	0.09
Country**	Germany (n= 55)	4.12 ^A	0.14
	Greece (n=65)	4.24 ^A	0.10
	Netherlands (n=167)	4.49 ^B	0.08

Note. * $p < .10$, ** $p < .05$, ^{ABC} Different superscripts within a cell mean that the respective estimates were significantly different at the 5% level (within a cell). Same superscripts within a cell mean that the respective estimates were not significantly different.

Table 3. Results of booklet conjoint analysis

Booklet (n=292)	Attribute levels	Mean	SEM
Percentages**	None	3.68 ^A	0.09
	Show percentage of ingredients	4.43 ^B	0.10
	Show percentage of allergens	4.48 ^B	0.08
Precaution**	None	3.75 ^A	0.08
	Specific details on allergy mgt	4.36 ^B	0.10
	May contain traces allergens	4.48 ^B	0.09
Glossary**	No glossary	3.85	0.08
	Glossary	4.54	0.08
Format**	Allergen free products per food category	4.09 ^A	0.09
	Allergen free products	4.18 ^A	0.09
	Allergen containing products	4.19 ^A	0.09
	Allergen containing products per food category	4.33 ^B	0.08
Country	Netherlands (n=164)	4.14 ^A	0.10
	Germany (n=58)	4.20 ^A	0.17
	Greece (n=70)	4.25 ^A	0.10
Model fit: $\chi^2 = 900$, df = 10, p < .0001			

Note. * p < .10, ** p < .05, ^{ABC} Different superscripts within a cell mean that the respective estimates were significantly different at the 5% level (within a cell). The same superscripts within a cell mean that the respective estimates were not significantly different.

Table 4. Results of ICT conjoint analysis

ICT (n=217)	Attribute levels	Mean	SEM
Percentages**	None	3.33 ^A	0.09
	Show percentages of all allergens	4.43 ^B	0.08
	Show percentages of all ingredients	4.46 ^B	0.08
Warning**	None	3.49 ^A	0.09
	Audio	4.22 ^B	0.09
	Visual	4.24 ^B	0.08
	Audio and visual	4.34 ^B	0.09
Glossary**	No glossary	3.75	0.08
	Glossary	4.40	0.07
Precaution**	None	3.47 ^A	0.07
	Specific details on allergy mgt	4.36 ^B	0.09
	May contain traces of allergens	4.39 ^B	0.09
Country	Germany (n=50)	3.89 ^A	0.15
	Greece (n=62)	4.13 ^A	0.10
	Netherlands (n=143)	4.21 ^A	0.09
Experience Factor	Co-variate coefficient	0.11	0.07
Model fit: $\chi^2 = 3728$, df = 11, p < .0001			

Note. * p < .10, ** p < .05, ^{ABC} Different superscripts within a cell mean that the respective estimates were significantly different at the 5% level (within a cell). Same superscripts within a cell mean that the respective estimates were not significantly different.

- Information delivery to consumers regarding food allergy information must be improved if consumer protection is to be optimised
- Effective ingredient labelling on packaging was the most preferred information strategy but improvements (for example in terms of increased font size or standardised information format) is needed. This was found in all countries included in the study (Germany, Greece, and The Netherlands).
- The label should show the percentages of the allergens in the food product, as well as provide specific details about allergy management in the food chain, displayed in an eye-catching box with standardised information, and located in a standard place on the label.
- Changes in European (and international) legislation might reflect these consumer preferences for an effective labelling strategy, and be used as the basis of a harmonised labelling policy.
- “Personalised” information about allergens, delivered using ICT technology, was also identified as a second source of information about food allergens, which could also deliver additional information (for example, about nutritional composition or production method) in line with consumer preferences.