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Change detection for new food labels

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ABSTRACT

The amount of information on food packages (e.g., environment- and health-related) has increased in Europe and other regions in recent years. It is therefore important to understand to what extent this information attracts the attention of and is processed by consumers, considering characteristics of the product information as well as person-specific variables such as age. In two studies we tested whether the change detection task is a useful paradigm for studying how individuals attend to and process recently introduced formats and contents of food labels. In the change detection tasks presented here, 133 participants were shown two photographs of a food package that differed in one label and were asked to identify as quickly as possible which information was constantly changing. We found systematic differences in change detection times for different types of product label content and format, representing the amount of attention habitually paid to the specific labels. Interestingly, the detection times for each label did not correlate with participants' self-report measures of how much attention they give to this specific label during typical grocery shopping. In both studies we also found a positive correlation between age and time needed to detect change in label format and content, but only for labels that were introduced on packages in recent years (such as the 'organic' label) not on longer established information (such as the 'best-before' date).

1. Introduction

The amount of information on food packages (e.g., environment- and health-related) has increased in Europe and other regions in recent years. Although consumers are constantly being exposed to more labels and specifications, relatively little is known about the information that consumers attend to and process. To learn which information consumers process in a supermarket setting, a number of different techniques have been used, including questionnaires (for a review see Cowburn and Stockley (2005)), verbal protocol techniques (e.g., Higginson, Kirk, Rayner, & Draper, 2002), or eye tracking (e.g., Goldberg, Probart, & Zak, 1999).

Self-report instruments seem to be the method of choice in the vast majority of studies on how consumers seek environment- and health-related information (e.g., De Boer, Hoogland, & Boersema, 2007; Grankvist & Biel, 2007; Napolitano, Caporale, Carlucci, & Monteleone, 2007; Poelman, Mojet, Lyon, & Sefa-Dedeh, 2008; Verbeke & Ward, 2004). The central question in these studies is what kind of information consumers seek and how. For instance, the "animal-friendly attitude" scale in the study by De Boer and colleagues consists exclusively of items that frame what participants *want to know* about aspects of sustainable animal production. Additionally to volitional factors, food information processing might be determined by habitual allocation of attention. For instance, based on self-report data Verbeke and Ward suggested that it might be entirely different to perceive a label as important or to actually pay attention to it.

The present work demonstrates the usefulness of the flicker task, adopted from the research on change blindness (e.g., Rensink, O'Regan, & Clark, 1997), as a new, simple, and inexpensive behavioral paradigm for measuring which particular information in the form of food labels consumers usually process. In the studies reported here, we use the change detection method to investigate how people attend to consumer information on packaged food.

The change detection task potentially captures unconscious, habitual allocation of attention to food packages and can thus help to investigate aspects of information processing that are not accessible with self-report and verbal protocol. We adopted the flicker task (Rensink, O'Regan, & Clark, 1997; Simons & Rensink, 2005) to specifically measure which package information consumers attend to. In the paradigm used in this study, naturalistic photographs of food packages that differ in one aspect of information labelling are repeatedly shown in a sequence interrupted by blank screens. In a trial, for instance, a photo of a milk package can be used in which two versions, A and A′ alternate, that are produced

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by substituting the fat content label with the surrounding background in the A′ version. The pictures are repeatedly shown in an A–A′–A–A′ – sequence with a short gray blank shown between the pictures. The latter creates the impression of flickering. The sequence continues until the participant spots and indicates by means of a mouse click what had been constantly changing from picture to picture (see Fig. 1, left panel). The observers usually believe that they can perceive the entire structure of a scene in great detail and would notice any changes immediately (e.g., Levin, Momen, Drivdahl, & Simons, 2000). Often in the change detection task, they experience to their surprise and delight that the latter is an illusion. Rather large changes can pass by unnoticed for a long time, as long as the observer does not pay attention to the specific part of the picture that is changing.

Change detection in the flicker paradigm has been shown to be driven by habitual allocation of attention (or "interests", e.g., Rensink, O'Regan, & Clark, 1997; Scholl, 2000; Turatto, Bettella, Umiltà, & Bridgeman, 2003). Attention is always required to perceive change. There are two mechanisms guiding attention. One of them (the bottom-up guidance) directs attention automatically to changes in a scene as they produce a motion signal that involuntarily draws attention. This mechanism is effectively disabled in the flicker paradigm. Therefore the effects of the second mechanism (top-down guidance) can be studied in isolation in this task, showing how observers actively direct attention based on their interests and habits. Masks (e.g., the blank display in our paradigm; see also O'Regan, Rensink, & Clark, 1999) create a global change signal, which conveys change in the whole picture. This global change signal masks the local change (e.g., that a food label is constantly appearing and disappearing). Without the masking by the blank, the local change would be detected by the visual system with minimal effort. With masking, however, attention is not automatically directed to the local change. Therefore, observers have to take time to scan the picture part-by-part. The scan-path is heavily influenced by the observer's interests and attention allocation habits (Rensink, O'Regan, & Clark, 1997; Scholl, 2000; Turatto et al., 2003) allowing researchers to use the detection latencies to infer specifically on them. Therefore this paradigm is well suited for research projects on habitual allocation of attention in a consumer context, such as label detection on food packaging.

There is evidence that change detection in the flicker paradigm can measure attention towards information elements on pictures of packages (e.g., Jones, Bruce, Livingstone, & Reed, 2006). This has not yet been demonstrated with *food* package information processing. Still, our approach can build on other work employing change detection as a measure of attention to real-life stimuli. For instance, Jones et al. used the flicker task to measure the alcohol-related attentional bias in problem drinkers. Problem drinkers detected a change applied to an alcohol-related object more quickly than to a neutral object, whereas social drinkers showed no such difference. Furthermore, a correlation was observed between change detection time and the treatment progress of problem drinkers: Change detection time was shorter if problem behavior had been treated more often. The study by Jones and colleagues is one example of using the change detection paradigm to study information processing differences among individuals. In another study using the change detection paradigm, Marchetti, Biello, Broomfield, MacMahon, and Espie (2006; see also Field et al., 2007; Jones, Macphee, Broomfield, Jones, & Espie, 2005) found a stronger attention bias to sleep-related than to neutral stimuli in individuals with psycho-physiological insomnia as compared to good sleepers.

To explore the flicker paradigm's potential for providing information relevant for food consumer research, we examined the allocation of attention to different types of food product information. We used naturalistic stimuli of both food labels that have been recently introduced to the food market, such as the 'organic' label, and already established food information such as fat content and

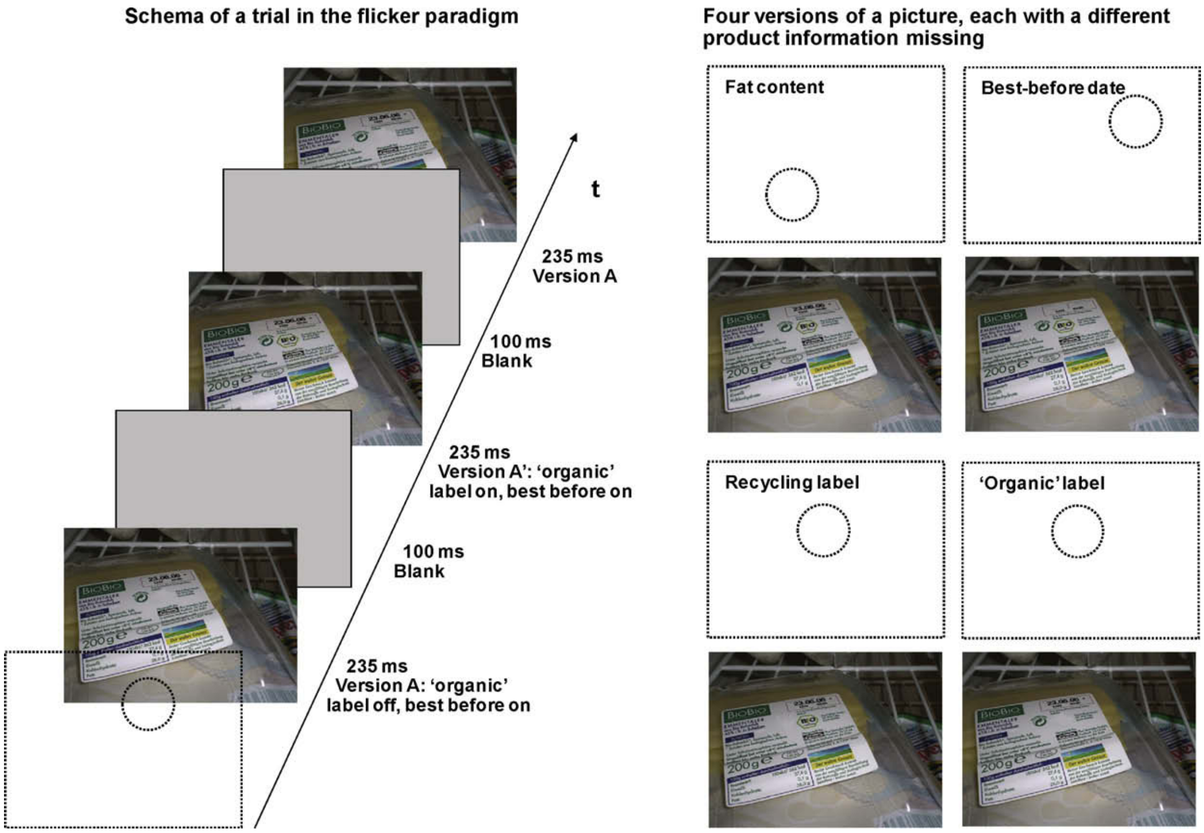

Fig. 1. Schema of a trial in the flicker paradigm (left panel) and example for the set of changes applied to one picture (right panel).

best-before date. We hypothesized that there would be systematic differences concerning the attention paid to different types of product information. Attention to specific types of food product information was measured as change detection latency in the flicker paradigm. Study 1 assessed detection latencies for four different types of product information employing six different pictures of food products each. Additionally, we assessed self-reported attention to the types of product information. As Study 1 did not allow conclusions about whether systematic differences in change detection of consumer information are linked to content properties (new vs. old labels) vs. form (textual vs. graphical), we systematically varied these two factors in Study 2.

Based on the literature on change detection in other contexts we assumed that the differences in change detection times between types of product information would reflect interest or habitual allocation of attention. To back up this interpretation further we computed a control measure and furthermore ran a control study testing whether bottom-up saliency (i.e., some product information standing out relative to others due to color or form) could explain the results. For instance, the 'organic' label might have been detected quickly because of its hexagonal shape, rather than because people generally search for 'organic' information in whatever form it might be represented. Accordingly, in the control study, the food product information employed as change detection target in Studies 1 and 2 had to be searched for explicitly. As people were told upfront what to search for, interests and habitual allocation of attention should have played a less important role compared to the free search in the flicker task. By obtaining the search times for our material, we could estimate the bottom-up saliency of the different types of product information.

We were interested in investigating not only which package information people attend to in general, but also the person-variables associated with lower change detection latencies for specific food-related information; specifically age of participants. Whereas other studies have investigated how product information is understood and mirrored in decisions made by persons of different age (e.g., Burton & Andrews, 1996; Cole & Balasubramanian, 1993) our focus is to investigate which information is actually being perceived after all. We hypothesized that older consumers show higher detection latencies and especially so for recently introduced food labels. The assumption underlying this hypothesis is that incorporating a new type of information (i.e., recently to the market introduced food label) into the set of to-be-attended-to product information might be harder for older consumers who are most likely not only more experienced but are also likely to have more (and possibly stronger) habits.

2. Study 1

2.1. Method

2.1.1. Participants

Thirty-one participants (age: $M = 29$ years, range 15–58 years, $SD = 12.8$ years; 18 women) participated at an open house hosted by the Humboldt-Universität zu Berlin, Germany. Participants agreed to take part in the study prior to starting the experiment; parental consent was obtained for participants under age 18. The study had the approval of the ethics committee of the Psychology Department.

2.1.2. Stimuli

2.1.2.1. Change detection. We obtained the software for running the change detection task from the freely available open source Java library www.pxlab.de (Irtel, 2007). Stimuli consisted of color photographs of everyday products (milk, butter, cheese, noodles, sweets, and cream). Products stemming from different supermarkets and carrying the 'organic' label of the European Union were used. The products either completely filled the photographs or were displayed on a uniform light background. We produced five different versions of each photograph by manipulating the pictures in a pixel graphics program. One picture included all four labels; the fat content, best-before date, recycling, and 'organic'; in each of the other four versions, one of these labels was missing (Fig. 1, right panel for an example). The change detection task was constructed by combining the *all-labels-present* version of each of the six photographs with the four *one-label-absent* versions of the same photographed object. To obtain the missing-label versions of the photographs we replaced the specific label with the background surrounding it. The amount of pixels changed ranged from .03% to .88% between the different pairs of pictures (90–2700 pixels, $M = 0.36\%$, see Table 1 for the means per category). The color photographs were presented in the center of a 17″ CRT computer screen at a resolution of 1024×768 pixels with an image size of 640×480 pixels. Participants were seated 50 cm away from the monitor. In each trial, the participants were shown the all-labels-present version and a specific one-label-absent version of the photograph in alternating order. A blank (light gray) screen of 0.1 s duration was shown between the two photographs that differed in a single feature. The blank had the approximate duration of an eye-blink. The photographs were presented for 0.235 s each (see Fig. 1). The alternating pattern of the original and the changed version of a photograph, and the blank in between, continued until participants had indicated their response with a mouse click.

2.1.2.2. Self-report. To explore whether change detection performance can be predicted by self-reports about the amount of attention participants pay to each label, we administered rating scales that matched the contents of the change detection task. Specifically, after the change detection task was completed, we asked participants how much attention they generally pay to fat content, best-before date, recycling, and 'organic' labels. The 5-point response scale ranged from never to always. In addition we asked participants how much attention they pay to layout and material of the packaging, appearance of the product, bread units, carbohydrates, protein content, calories, weight or amount, country of origin, brand, price, additives, and ingredients.

2.1.3. Procedure

Introducing the task, participants were asked how easily they thought they could detect a change that happened in front of their

Table 1
Summary of change detection results of Study 1 together with self-report data and control measures.

Food label	New		Established	
	'Organic'	Recycling	Best-before	Fat content
Change detection latency (s)	5.4	7.6	6.1	10.3
Self-report importance	2.6	1.9	4.1	2.8
Age correlation (R)	.57	.54	.03	.08
Pixels changed in %	.47	.33	.29	.37
Instructed search latency (in s, from control study)	1.7	1.8	2.0	2.9

eyes within the blink of an eye. They were instructed that one element in the picture would be repeatedly appearing and disappearing with the flickering of the photograph. Their task was to specify the location of the alteration as fast as possible by positioning the mouse pointer at that location on the photograph and clicking. They were also told that the response time and the *X–Y* coordinates of the mouse click would be recorded. The coordinates made it possible to verify whether the location of the change had been identified correctly. A response deadline of 1 min was used. Participants performed 24 change detection trials (six different product photographs by four changed versions) presented in an individually randomized order. Testing took 10–15 min per participant, including the questionnaire administered at the end. Participants were assessed individually.

2.1.4. Control study

In order to control Studies 1 and 2 for influences of bottom-up saliency we tested an additional sample of participants. For change detection in the flicker task a major influence of such habitual allocation of attention or interests has been suggested. However, habits and interests should only play a minor role if participants are told upfront what product information to search for. Differences between types of product information in the latter task should mirror bottom-up saliency. Measuring how easily the different types of product information could be found, the control study can be used to estimate the impact of saliency on change detection. Our control study on the search properties of the pictures in Studies 1 and 2 was run at Humboldt-Universität zu Berlin with an undergraduate student sample ($N = 39$; 6 males; mean age = 22 years, $SD = 3.4$ years). The students received course-credit for participating and were informed about the task beforehand. We wanted to obtain data on how fast the students could locate the different types of product information when they were directly asked to search for it. In contrast to the change detection task, participants saw a written instruction at the beginning of each trial telling them which food product information label they should locate and click on with the mouse. Then the picture containing the target product information appeared and remained visible until the participants responded.

2.1.5. Pre-analysis

We discarded 7.5% of the trials because participants had not clicked on the location of change. To detect this, we compared the *X–Y* coordinates of the clicks to normative coordinates, using a cut-off value of 100 pixels distance. This procedure was double-checked by visual inspection. Data were aggregated for each label by taking the median of the change detection times for the six food products. This resulted in median detection times for each participant for each of the four categories: 'organic' label, recycling label, best-before date, and fat content.

2.2. Results

2.2.1. Main effect of types of product information

The first row of Table 1 shows aggregated detection times in seconds for each product information type. There were systematic differences between the change detection times for the different labels as shown by the one-factor repeated measures ANOVA on $1/X$-transformed change detection times across the four types of food information [$F(3, 90) = 10.3$, MSE = .005, $p < .001$, $\eta p^2 = .26$]. Detection was fastest for the 'organic' product information. Paired comparisons indicated that fat content was detected significantly slower than all other types of product information (p's < .01; other comparisons p's > .19). Note that both in Studies 1 and 2 reaction times were normalized with $1/X$-transformations prior to running the ANOVAs and the paired comparisons of the median detection times. Transformed data should be interpreted as *targets (=label changes) detected per second*. ANOVAs based on non-transformed data lead to similar quantitative and identical qualitative results.

2.2.2. Self-reported allocation of attention

There were systematic differences among the mean self-reported attention paid during a typical grocery shopping at a supermarket to the 'organic' product information, recycling label, fat content, and best-before date (Table 1, 2nd row) as indicated by the repeated measures ANOVA [$F(3, 90) = 27.6$, MSE = .89, $p < .001$, $\eta p^2 = .48$]. With the exception of the difference between 'organic' product information and fat content, all paired comparisons were significant ($p = .029$ for 'organic' product information vs. recycling label; other p's < .001). However, there was no correspondence between the group-level self-report data and the group-level change detection time data reported above. For example, participants reported paying attention to the best-before date more often than to any other type of product information – 49% said "always", 26% "often". However, the change detection time for this label was longer than the detection time for 'organic' information, which was reported to have been looked up "often" by only 18% of the participants and "always" by 9%. Thus, participants did not allocate their attention where they thought they would. Furthermore, there was no correlation between the self-reported attention to any one of the four labels and the detection times for changes in those specific labels. None of the between-participant correlations ($M = .127$) was significant. For this and all other correlational analyses we used the nonparametric Spearman's rho.

2.2.3. Effects associated with age of participants

We found a robust relationship between age and detection time for the more recently introduced 'organic' label (p's < .01; Table 1, 3rd row). Somewhat surprisingly, there was also an age correlation for the detection time of the longer established recycling label. There were no correlations between age and change detection time for the fat content and the best-before date information. Whereas the age correlations of the detection times for the organic and the recycling label did not differ from each other, $Z = .16$, $p = .438$ (see Meng, Rosenthal, and Rubin (1992), for the comparison of correlated correlation coefficients), those two correlations differed significantly from the age correlations of fat content and best-before date (Z's > 2.0, p's < .02).

2.2.4. Control study and analyses

To evaluate the extent to which perceptual salience of the food-related information rather than interest or habitual allocation of attention might have influenced our group-level results, we used two measures – one computed from the stimuli, and one derived from a control study.

2.2.4.1. Size of change. The picture pairs with larger changes tended to yield shorter detection times – the mean of the within-person rank-order correlations of the detection time and percent of pixels changed across the 24 pictures was significant ($M = -.29$; $t = 9.37$,

Table 2
Summary of change detection results of Study 2 together with control measures.

Type of information	'Organic'	Health	General
Change detection latency (s)			
Overall	5.8	3.3	5.0
Label	4.9	3.1	5.8
Text	6.5	3.3	4.0
Age correlation (R)	.47	.41	.22
Pixels changed in %	.88	.41	.2
Instructed search latency (in s, from control study)	1.9	2.1	1.9

$p < .001$). Thus, size of the change affected the detection performance. However, the slightly higher proportion of pixels changed in the 'organic' label than in the other categories did not explain the faster detection times for the 'organic' label (Table 1). Repeating the analyses after excluding the two 'organic' label picture pairs with the largest pixel change did lead to very similar results. Excluding the two pairs reduced the mean proportion of pixels changed for this category from 0.47% to 0.27% (i.e., from highest to lowest). Nevertheless, the average median detection time for the 'organic' labels was very close to the original one ($M = 5.6$ s) and the result in the one-factor within-participants ANOVA across the four types of food information was virtually unchanged – $F(3, 90) = 10.0$, MSE = .005, $p < .001$, $\eta p^2 = .25$.

2.2.4.2. Instructed search in the control study. From the control study, we obtained the mean detection time for each of the pictures by averaging the detection times over participants per picture. In the next step we tested to what extent this profile of mean detection times for different pictures corresponded to the change detection latencies in the flicker paradigm using profile correlations. Within-subject correlations for the profile across pictures were substantial for the pictures used in Study 1. The product information that led to low search times in instructed search in the control study was also detected faster in the flicker paradigm. The mean of the within-person rank-order correlations was $M = .55$; $t = 15.28$, $p < .001$.

2.3. Discussion

Study 1 demonstrated that change blindness assessed with the flicker task can advance our understanding of food product information processing that is not accessible via self-report. We found that different food labels systematically differ with respect to their detection latencies. We also suggested methods to assess and control for the influence of features unrelated to habitual attention or interest. Interestingly, we found that consumer age can predict the change detection performance for specific product information. Thus, beyond measuring differences in attention paid to different types of product information by people in general, the flicker paradigm can also be employed to investigate associations between person-characteristics and differences in the information processing of specific types of products.

Instructed search in the control study on the one hand and flicker change detection in Study 1 on the other hand produced similar results on the group level. This suggests that the change detection profile of products (averaged over participants) does not exclusively mirror the habitual allocation of attention or interests of the population. Rather, a substantial proportion of the variability between pictures might reflect how easily the food information can be found when one is searching for it. We suggest that such a control measure can be informative as to how well-balanced a pool of material used in a change blindness study is in terms of saliency.

The idea of investigating age-related differences in change detection performance for type of product information (recent vs. established) is rooted in the assumption that incorporating a new type of information into the set of to-be-attended-to product information might be harder for older (and thus more experienced) consumers. In a laboratory-training approach, Gaschler and Frensch (2007, 2009) have shown that experience leads to more efficient information processing via narrowing down the set of information attended to. When new information is introduced after repeated exposure, it may pass by unnoticed. Thus, based on their earlier interests, older consumers might have formed the set of food product information they habitually attended to before, for example, sustainability- and health-related information became available; therefore they might be less likely to search for it. The results by Gaschler and Frensch suggest that novel information can be excluded from processing on the perceptual level. We thus think that it is reasonable to study consumer product information processing early in the information stream.

3. Study 2

In Study 1 we have assumed that the content of the labels is linked to detection time. However, a possible alternative explanation for our results is that the form (instead of content) influenced change detection times. The product information that has been available on food packaging for a relatively long time (i.e., best-before date and fat content) was presented as text, whereas the newly introduced information ('organic' and recycling labels) was presented in graphic label format. Therefore, in Study 2 we systematically varied the content and form of the food-related information by presenting three content categories ('organic', health-related, and general information) each in both forms – graphic and text. We hypothesized that the content rather than the form would drive change detection performance. Based on the findings in Study 1 we furthermore expected that detection time for the relatively recent 'organic' and health-related information would correlate substantially with age whereas detection time for general product information would not.

3.1. Method

3.1.1. Participants

We collected data from a new sample of 102 participants between 15 and 73 years of age ($M = 33.3$ years, $SD = 14.8$ years, 57 women) at another open house hosted by the Humboldt-Universität zu Berlin, Germany. Participants agreed to take part in the study prior to starting the experiment; parental consent was obtained for participants under 18. The study was approved by the ethics committee of the Psychology Department.

3.1.2. Stimuli and procedure

We used a design in which the content (general, 'organic', health) of the product information was presented in text and in graphic format with two different pictures in each of the six design cells. Thus, 12 photographs (none of them used in Study 1, see Fig. 2) were used. For each of the 12 pictures, a copy was prepared with one specific piece of information erased and replaced by the background structure. The European Union 'organic' label changed in an on–off mode on a picture of milk (upper left of Fig. 2) and a picture of pasta. The flicker task on the text 'organic' was performed using a picture of a package of eggs and a picture of flour. Change detection concerning the healthy tooth logo was performed on two different pictures of sweets, while the text based health messages "sugar free" and "reduces cholesterol-level" were to be found on a chewing gum and a diet drink. Product information in label form not directly related to health or 'organic' issues was presented on a milk package (certified quality label) and on a cheese package (recycling label), and in text format on an egg and a cheese package (best-before date in both cases). In contrast to Study 1, the response deadline was shortened to 30 s and photographs were in the format of 800×600 pixels. The change in amount of pixels between the two versions of each photograph ranged from 0.15% to 1.51% (720–7340 pixel, $M = .49\%$, see Table 2 for the mean per category).

3.1.3. Pre-analysis

Fig. 2 presents scatter plots of the coordinates of the mouse clicks together with the stimulus material. After data screening, three par-

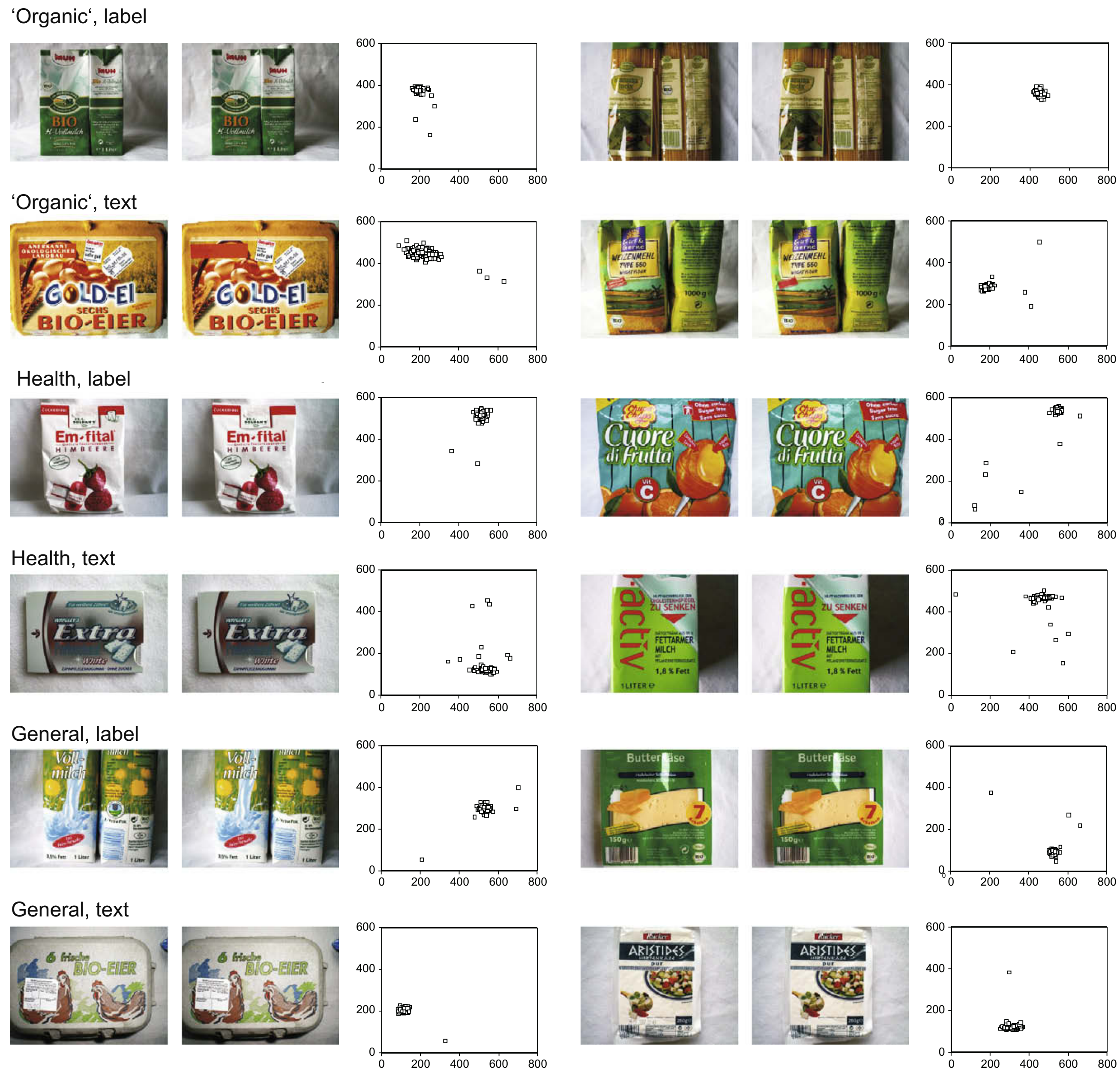

Fig. 2. Stimulus material and scatter plots depicting the coordinates of mouse clicks in Study 2.

ticipants were excluded because they had clicked on wrong change locations in more than 25% of the trials. For the remaining 99 participants the average error rate was 5%. These trials were discarded from further analyses. The data from the 12 change detection trials per participant were aggregated in two ways: first by taking the median detection time for the content categories (general, 'organic', health-related information – four pictures each) for each person, and second by aggregating the data based on format (label vs. text, six instances each) for each participant. Those medians were then averaged across participants (Table 2).

3.2. Results

3.2.1. Effects of type of product information

Table 2 shows the detection times for different types of product information. The 'organic' information was detected at speeds similar to Study 1, but slower compared to the newly introduced health-related and general product information. The repeated measures ANOVA on the $1/X$-transformed change detection times confirmed that the differences among the three types of product information can be regarded as systematic [$F(2,\ 196) = 110.7$, MSE = .007, $p < .001$, $\eta p^2 = .53$]. All three paired comparisons between the 'organic', health and general product information were significant (p's < .001).

Whereas the content of the changing product information influenced change detection performance, we found no differences for the form: text-based form ($M = 4.3$ s) vs. graphic labels [$M = 4.4$ s; $F(1,\ 98) = .08$, MSE = .005, $p > .2$, $\eta p^2 = 0$, see Voelkle, Ackerman, and Wittmann (2007), for effect-sizes with F-values < 1]. Furthermore, the type of product information (content) that was detected faster than the others was highly consistent across formats. The average within-person rank-order correlation between the text based and the graphic label-based measurement of detection time to organic, health, and general product information was high ($M = .82$, $t = 3.58$, $p < .001$).

3.2.2. Effects associated with age of participants

As in Study 1, we found a correlation between age and the detection time for 'organic' product information (Table 2, 4th row). Health-related information showed an age correlation as well (p's < .001 for 'organic' and health-related, $p = .03$ for general product information). The age correlation for the general product information differed significantly from the age correlation for the 'organic' product information ($Z = 2.53$, $p = .006$) and also from the age correlation for the health-related product information ($Z = 1.95$, $p < .026$). When the same data were aggregated based on format instead of content, there was no difference in age trend for graphic labels vs. text. The correlation of participant age with median detection times for information provided with graphic labels ($r = .37$, $p < .001$) did not differ from the correlation of age with detection times of changes in text-based information ($r = .42$, $p < .001$; difference between correlations: $Z = .61$, $p > .2$).

3.2.3. Control study and analyses

The size of the change did not play an important role in the detection performance. The mean within-person rank-order correlation of the detection time and percent pixels changed was negligible ($M = .03$; $t = .98$, $p > .2$). Change detection performance was influenced only to a small extent by how easily the different types of information could be located when being searched for. Also, the average rank-order correlation between the mean profile of the control sample and the profiles of the participants of Study 2 was very low – although significantly different from zero ($M = .15$; $t = 5.22$, $p < .001$).

3.3. Discussion

Study 2 further supported that the systematic differences in change detection latencies for different product information could not be explained by the perceptual salience of the product information. Although our material varied in the *size* of the changes, this had no consistent influence on change detection performance, favoring the explanation that *content* was the major determinant of the change detection latency findings reported above. In contrast to Study 1, the material used in Study 2 was less diverse in terms of saliency of the different types of product information. This suggests that the major amount of variability in detection performance can be attributed to habitual allocation of attention or the interests.

In this study it was rather content of information ('organic', health-related, general) than form (text vs. graphic label) that influenced change detection latency. Future studies should test the conditions under which this pattern holds. Furthermore, we again found age correlations for product information that was only recently added to food packages. Thus, Study 2 replicated the results of Study 1, showing older consumers' difficulty in attending to relatively recent food product information. Study 2 suggested that it was the new information itself (e.g., 'organic' farming information or health-related statements) that older consumers had specific difficulties with, rather than the new format in which information on packaged food was presented (graphic labels instead of text).

4. General discussion

In two studies we found systematic differences in attention allocated to different types of product information. According to our findings, change detection depended on the content, rather than on the format of the information presented, and was independent of self-reported attention towards product information. Furthermore, change detection latency was in part related to consumer characteristics: in both studies we found that older participants had only longer detection times for the information most recently introduced on the packages. Their change detection times for established product information were not slower than that of younger participants. One explanation for the correlation of age and change detection with recently introduced product information could be that such information was not available when the now older consumers learned how to select and process information on packaged food. This view implies that the associations of age and detection time we report represent cohort effects. Due to the cross-sectional nature of our study, we cannot disentangle whether the effects we found are cohort effects or true age effects over time. Specifically, different cohorts of consumers are exposed to different types of product information in the supermarkets when they start to regularly buy groceries and acquire a set of information to attend to – which might have effects in later years when new types and formats of information are introduced. However, as our research was conducted cross-sectionally with convenience samples, it is not entirely clear whether the age correlations really represent a cohort-type effect or true age effects over time. A true age effect would mean that as a person becomes older she shows increasing change detection latencies, especially for the 'organic' product information. The latter would predict that the same younger participants who showed fast detection of 'organic' or health-related product information would be differentially slower in later years for new product information while remaining fast, for example, at detecting the best-before date. Taking these considerations into account, our results based on convenience samples can serve as a basis for future studies with focus on cohort effects that compare separated age groups.

The present results suggest that the change detection task might be a useful paradigm for studying consumers' *habitual* attention allocation in the context of food packaging. First, participants were not asked to look at the same information that they would attend to in the supermarket; instead they were asked to try to detect a change and would have been free to use systematic scanning paths, rather than favoring objects of their interest as was apparently the case. Second, self-report measures did not successfully predict detection latencies. Third, a control study and a calculation of the size of the changes showed which labels were easy to detect due to their graphic properties. Saliency of information could not explain the results of Study 2 but had some impact in Study 1. A measure like the one suggested in our control study could inform future research, for example, used in a within-subjects design together with the change detection task to further disentangle effects of saliency and effects of participants' interests or habitual allocation of attention.

Our results are promising and suggest that incorporating change detection as a measure of selective attention in future consumer studies in addition to self-report instruments might be a fruitful approach. It can complement self-report-based research that has developed theoretical notions concerning consumers' food-related information processing, such as self-reported attention allocation to different information cues (Verbeke & Ward, 2004), or self-reported willingness to seek information as an indicator of an animal-friendly attitude (De Boer et al., 2007). These articles demonstrate that there are important aspects of food-package-related information processing that consumers can reflect upon in self-report assessment. Additionally, by including change detection future research can profit from assessing the kind of information processing that individuals are unable to reflect upon (compare Köster (2003)).

For instance, whereas people can report their *intention* to pay attention to certain aspects of information, it is far from clear whether they can reliably report which aspects they actually attend to (e.g., Bilalić, McLeod, & Gobet, 2008; Kuhn & Land, 2006).

We did not find a relationship between self-reported attention and detection times in the change detection task, but this certainly needs to be studied further. We believe that the methodological approach of De Boer and colleagues (2007), which uses web-based self-reports to obtain a large and more diverse sample, has great potential, especially when combined with the change detection task.

The studies presented here provide first results suggesting that older, as compared to younger, consumers detect changes less readily in more recently introduced food-related information. This finding suggests that newly added information does not necessarily reach all consumers, posing a potential problem to policy makers and marketing scientists. It may be especially challenging to get a new message across to consumers who are highly experienced. Our results demonstrate that it is both important and feasible not to rely on self-report measures alone when studying how certain groups of consumers attend to specific product information.

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