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Are implicit emotion measurements evoked by food unrelated to liking?

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ABSTRACT

In an effort to find a simple method to measure implicit and unconscious emotional effects of food consumption, a number of methods were compared in an experiment in which 3 groups of at least 24 subjects were each exposed to a pair of yoghurts of the same brand and marketed in the same way, but with different flavours or fat content. The methods used were eye tracking of the packaging, face reading during consumption, a new emotive projection test (EPT) and an autobiographical reaction time test based on mood congruency. In the emotive projection test the subjects rated photographs of others on 6 positive and 6 negative personality traits after having eaten the yoghurt. It showed clear differences in two of the three pairs of yoghurt. The autobiographical congruency test failed to reach significance although all findings went in the same direction as the ones in the EPT. Liking and familiarity with the products were also measured and the fact that they were not related to the emotional effects was established. Eye tracking showed effects of familiarity when the measurements before and after consumption of the yoghurts were compared. The results of the face reading test are not reported due to technical difficulties. Although liking itself was not correlated with the emotional effects in the emotive projection test, shifts in liking caused by consumption of the product did, indicating the emotional importance of pleasant surprise or disappointment in the confrontation between the expected and the actual experience of the product. Sensory differences in the fruit flavours had no effects on the emotional reactions, but change in fat content did, while vanilla flavour had a strong positive emotional effect.

1. Introduction

There is a growing conviction that, next to hedonic valence, the emotional reactions to the consumption of foods or the perception of fragrances play an important role in the acceptance of products in the market (Danziger, 2004; Pawle & Cooper, 2006; Beckley, Moskowitz, & Paredes, 2008). However, it is not clear how to measure this reliably. Several methods have been developed to measure emotional reactions and mood effects (Desmet & Schifferstein, 2008; King & Meiselman, 2010; Chrea et al., 2009; Porcherot et al., 2010). Although the approaches used by the four groups of authors differ substantially, they all use rather explicit ways to measure and characterise the experienced emotions (for critical assessment, see Köster & Mojet, 2015–in this issue).

In the PrEmo® (Product Emotion Measurement Tool) method advocated by Desmet and Schifferstein people have to choose between 14 animated figures expressing 7 positive and 7 negative emotions. This method has the advantage that it is language independent and relies on empathic reaction rather than on cognitive interpretation of experienced emotional feelings.

In contrast, the methods of Chrea et al. (2009), of King and Meiselman (EsSense Profile) and of Porcherot et al. (2010) are heavily language dependent and tend to suggest feelings that people might have, but perhaps never had. King and Meiselman (2010) use 39 adjective terms to scale the consumer's affective responses to foods and Chrea et al. and Porcherot et al. use 36 and 18 (6 basic emotions each in three degrees) terms respectively. Although all these methods try to differentiate carefully in the types of emotions raised, in the end they just seem to be used to provide insight in the numbers of positive and negative feelings evoked by the product, with the exception of the EsSense method which concentrates mainly on the positive emotions and has only little attention for the negative ones. Furthermore, one gets little information about the way in which the specifications demanded from the subjects in these explicit methods (King and Meiselman, Chrea et al., and Porcherot et al.) contribute to the final judgement in the product launching decision. Finally, such methods

Abbreviations: ACT, autobiographical congruency test; AOI, area of interest; EPT, emotive projection test.

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have the disadvantage that they fixate the respondent's explicit attention on the food or the odour under consideration, rather than on implicitly expressing their feelings. In this respect, the PrEmo method is a bit more indirect, but, although the participants are not forced to rate mentioned feelings, they are still explicitly made aware of the relationship between the food eaten and the choice of a figure representing their mood, instead of expressing just the feelings in an implicit way. It is the explicit awareness of this relationship which makes the behaviour demanded from the subject still somewhat artificial and less implicit than the methods tested in the novel approach discussed below.

These other methods proposed in the present paper are also truly implicit in the sense that they reflect automatic reactions, which are not controlled by conscious regulatory mechanisms. The mood of a person was measured via involuntary facial expressions during food consumption or by means of a task that was seemingly unrelated to the food consumption. Although these methods were not particularly successful in the present experiment mainly for technical reasons (see below), they have been chosen in order to see whether they might help to clarify the relationship between the implicit emotions during and after the actual consumption of the products. On the other hand Eye tracking is a tool to characterise gazing behaviour and visual attraction of stimuli and was used here to evaluate the food packaging. Gazing behaviour can be influenced by emotional reactions, but the results of the eye tracking measurements are not able to describe emotion states.

Another important question is whether these methods make an independent contribution to the prediction of market success and whether they offer information that does not just coincide with other easily obtainable information such as liking of the product. In some of the methods this is clearly not the case (see Ng, Chaya, & Hort, 2003; Köster & Mojet, 2015–in this issue). On the other hand, it was shown by Delplanque et al. (2008) that for odours there was no linear relationship between emotional effects and familiarity, while novelty had priority over pleasantness in the temporal order of reactions (Delplanque et al., 2009). This latter finding is in line with the findings on the important role of novelty and change detection in food and odour memory (Food: Mojet & Köster, 2002, 2005; Köster, Prescott, & Köster, 2004; Møller, Mojet, & Köster, 2007; Morin-Audebrand et al., 2009, 2012; Odour: Møller, Wulff, & Köster, 2004; Köster, 2005; Møller et al., 2012). Perhaps the best way to test whether emotional reactions make indeed an independent contribution to market success is to use a reverse engineering approach as advocated by Moskowitz (2000), but the emotion measurement methods described so far have not used this approach to verify their predictive validity. Reverse engineering is a technique in which the factors responsible for market success are studied by using highly accepted and less accepted products of the same type of food. These are compared and the differences that might be responsible for the difference are detected by reducing or excluding the differences in other possible factors. Thus, it has been used on groups of "sister" products that differ in market acceptance although they are launched with the same market strategy and advertising and belong to a same product category. In the cases discussed here they were different yoghurts.

The objective of the present study is to investigate whether there are other simple methods that can measure the emotional impact of using a product in a more implicit way and that can predict positive or negative effects on its future acceptance independently of the effects of liking of the product.

In order to verify this possibility and to find economical ways to assess the emotional effects of consumption, three sets of two yoghurts, differing between pair members in taste, but not in brand, marketing and publicity, were used in an approach using three different methods of emotional measurement. The methods considered Face reading, a new Emotive Projection test, and an equally new Autobiographical Congruency test. Eye-tracking was used to register the impact of packaging.

In summary, the main objectives of these experiments were:

- To see whether using one or more of the tested measures shows different emotional reactions to product variants of the same brand.
- To check whether these methods provide a better differentiation between product variants than the traditional hedonic testing method based on expected liking, tasted liking, familiarity and appetite to consume more. Once proven effective, they could then be compared in their effectiveness with the more common explicit methods in a subsequent study.
- To establish the relationship between the emotion measurements and liking, familiarity and appetite for more and to verify whether the emotion measurements make an independent contribution to the characterisation of the product experience,

2. Methods and material

Here we present the general sequence of the measurements in the two sessions of the experiment which were held with an interval of one week. The sequence of tests was the same for all subjects. The experiment was executed as a within-subjects comparison of two products that were tested a week apart. For statistical analysis we only used the data of participants who successfully completed the whole test sequence. The procedural and specialised details of the different methods are given in the descriptions of the separate methods (Fig. 1).

2.1. Products

Three brands of yoghurt were each represented with two products differing in fat content, in taste or in both (Activia: yoghurts Y1 (normal strawberry) and Y2 (fat-free pineapple); Arla: yoghurts Y3 (strawberry) and Y4 (vanilla); Valio: yoghurts Y5 (normal raspberry) and Y6 (fat-free raspberry)). It was intended to use one product that was successful in the market and one less successful. In the case of Y1 and Y2 the products were not provided by the company and data on their successfulness are lacking. The choice of the products had to be made on guesses by the experimenters. In the other cases the choice was made by the member companies of the European Sensory Network in respectively Sweden and Finland, who provided the products on the basis of the idea of a proposed reverse engineering approach in which a successful and an less successful product of the same brand and marketed in the same way would be tested against each other. Unfortunately, the success of the products chosen by the companies was only measured in the country of origin and might therefore not be representative for the Dutch population from which the participants in this experiment were recruited. These handicaps made it impossible to do a veridical reverse engineering experiment, but at least there was an indication that consumers in the countries where the products were already on the market differed in their use of them. The products had been kept at 8 °C and were taken out of the cooling about ten minutes before distribution. The most important sensory differences between the products have been described by an experienced descriptive panel in Finland and are given in Fig. 2.

2.2. Participants

96 Dutch citizens (age between 25 and 65 years), who regularly ate yoghurt and had no taste or smell problems, were invited to take part in a study about the perception of familiar and less familiar yoghurts. They gave their informed written consent to take part in a study to test novel test methods. They were randomly divided in three groups. One group assessed the Activia yoghurts Y1 and Y2, while another group assessed the Arla yoghurts Y3 and Y4, and the third group assessed the Valio yoghurts Y5 and Y6. Half of the subjects in each subgroup (Activia, Arla or Valio) started with tone of the two products in the first week consumed

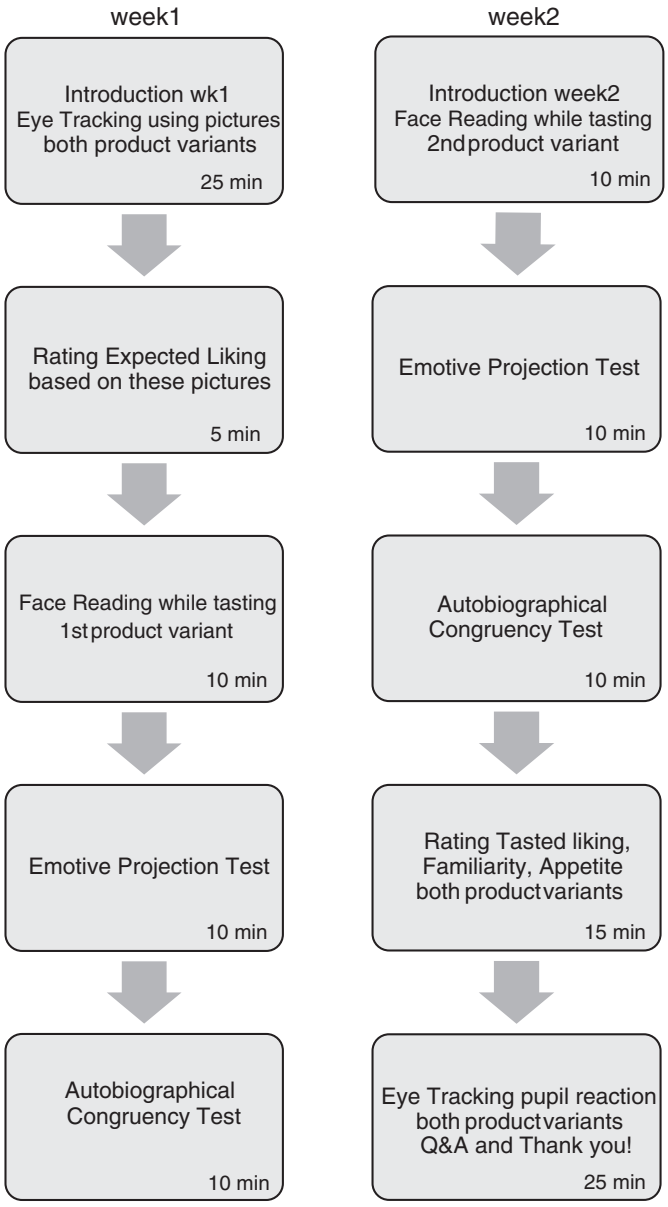

Fig. 1. Flow chart of the sequence of tasks in the two experimental sessions.

the other one in the second week. The other half of the subjects ate the products in reversed order. At the end of the tests the subjects received a fee for participation.

2.3. General procedure

The tests started with the Eye tracking experiments, measuring several aspects of their visual inspection of the product packages, followed by a measurement of their expected liking (without consumption of the products) and questions about their familiarity with the products.

Subsequently the subjects received one of the two twin versions within their product group (sample allotment was randomised and counterbalanced) and their facial expressions were monitored while they were eating a blind version of the yoghurt. After eating the sample, they performed the emotive projection test (EPT): presented as an independent intervening task, in which they rated the photographs of people on a number of positive and negative personality traits. This was immediately followed by the autobiographical test (ACT), in which their mood was tested by measuring their reaction time needed to think of a happy or a sad life event.

In the second session, one week later, the sequence varied slightly from the first session. The participants started with tasting the second version of the same brand, followed by the EPT and ACT. Subsequently the tasted liking, familiarity and appetite to consume more were measured. The results of these latter measurements are shown in Table 1 together with the results of expected liking measurements. All ratings are later correlated with the ratings of the emotion measurements in order to establish their relationship. Finally, the second eye tracking test was performed.

In a final section of this paper, the usefulness and validity of the different methods will be discussed. Here, attention should nevertheless be drawn to the fact that in two sets of products the preferences in respectively the expected and tasted conditions are inversed for the two products. Thus, Y2 (marginally), and Y4 and Y5 taste better than expected, whereas the reverse is true for Y6, which disappoints when tasted. At the same time it should be noted that in the final tasted preference and the "appetite for more" measurement there were no significant differences in liking between the pair members, Only Y4 seemed to taste marginally better than Y3 ($P = 0.07$),

3. Eye tracking

3.1. Test method

A Tobii® T60 Eye Tracker was used to characterise the packaging in its visual attraction and the gazing behaviour of the participants before and after tasting the products. In the Tobii® T60, the eye tracking sensor unit is integrated into a 17 in. flat screen monitor. According to the experimental design the following pictures of the product pairs were presented:

Picture 1: single product (A).

Picture 2: single product (B).

Picture 3: both products (AB or BA).

Pictures of products A and B were given in balanced order, the position of the products in the third picture was randomised over participants and each of the pictures was presented for 12 s.

During the presentation the following gazing characteristics were measured:

1. Time to first fixation: time elapsed between the appearance of a picture and the user first fixating his gaze within an area of interest (AOI).
2. First fixation duration: time a user gazes at his first fixation point.
3. Fixations before: number of fixations before the user first fixates inside a given AOI.
4. Fixation length: length of a fixation within an AOI (in seconds).
5. Fixation count: number of fixations within an AOI.
6. Observation length: time elapsed between the user's first fixation within a specific AOI and the next fixation outside the AOI (in seconds).
7. Observation count: number of "visits" to an AOI.

These terms were measured for the two products presented simultaneously, defined as areas of interest (AOI).

3.2. Results of eye tracking test

For investigating the gazing behaviour three 2^3-factorial designs were used; one design for each of the three product pairs. Influencing factors on the various parameters characterising gazing behaviour were defined as order (left and right), week (1 and 2) and the product variant. Statistical analyses were performed for the first 5 s and for the whole 12 s of observation. Since the effects of the 5- and 12-second analyses were similar only the first 5 second data are shown here in detail (see Table 2).

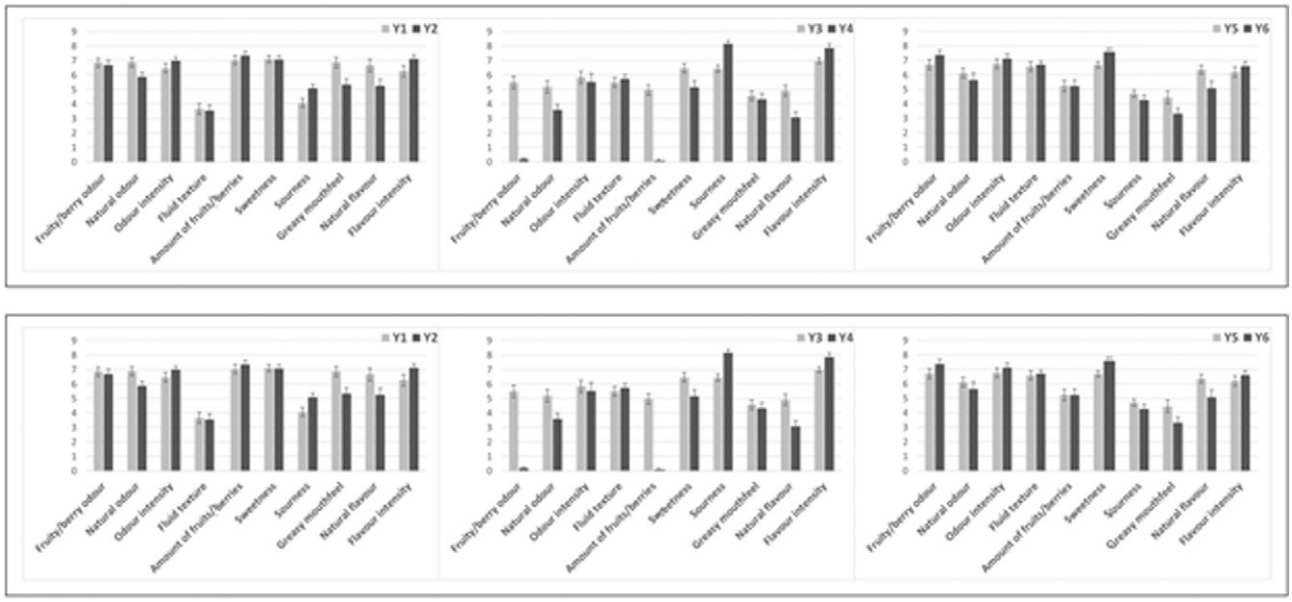

Fig. 2. Sensory profiles of yoghurts Y1–Y6. Means, standard errors and significant differences are presented in bar graphs for Y1 & Y2, Y3 &Y4, and Y5 & Y6.

For product pairs Y1/Y2, Y3/Y4 and Y5/Y6 significant order effects were observed. Showing that the right product on the screen is gazed at later than the left one and that there are more fixations at other parts of the picture before the right product is gazed at.

Significant product effects were only found for the Y1/Y2 product pair, indicating a slightly higher visual attention for product Y1 in comparison to product Y2, in the form of longer first fixation duration. No product effects were found for comparisons of Y3/Y4 and Y5/Y6.

No significant effects of the presentation week were found for factors week Y1/Y2, Y3/Y4 and Y5/Y6.

No significant correlations ($p < 0.05$) were found between the eye tracking parameters and liking, desire or appetite for more, and familiarity.

The Tobii T60 Eye Tracker records pupillary reactions always during the eye tracking procedure. Having a look at the data of our experiments shows that the pupillary reactions are inconsistent and they are therefore not presented in this work. Experiments have to be designed very carefully for the purpose of measuring pupillary reactions in a valid way.

4. Psychological approaches

Two well-known psychological phenomena are applied: emotive projection and autobiographical congruence. They are described shortly below.

5. Emotive projection

In the psychological part of the project, projective tests were used to see whether they could provide a quick and easy way to differentiate between products that raised positive or negative moods. Projective techniques are based on the idea that people tend to project their feelings onto others and will judge them in accordance to these feelings. Such tests have been and still are used in psychology to measure moods and emotional reactions (Forgas & Bower, 1987).

In earlier experiments, the test has been used with success to measure the positive mood effects of the presence of flowers or of faint and not consciously noted odours in a dining room. In the present series of experimental approaches, it is tried to use it for measuring possible implicit mood effects of the eating of different yoghurts. In order to promote the implicitness the test is presented as a non-food-related experiment to fill the interval between two tests. In the emotive projection test (EPT) used, two equivalent sets of portraits of people are judged on 6 positive and 6 negative personality traits and the influence of the consumption of the yoghurt products on these judgments is seen as an indication of the positive or negative emotions created by the food. Such an approach has several advantages above other methods of measuring food related emotions:

1. The test does not focus the attention on the food, but on the emotions and mood effects as seen in the photographs. This is an advantage because it avoids analytical thinking about the product on the part of the subject.

Table 1
Means of liking, familiarity, and appetite, measured on scales with 9 boxes from "not at al" at the first box at the left to "very much" at the last box at the right. Bold figures indicates significant differences $P < 0.05$.

		Liking			Familiarity		Appetite
		Expected	Tasted	*T*-test P	1) Eaten often	2) Resembling	For more
Activia	Y1	7.00	7.08	0.714	3.26	6.00	6.08
	Y2	6.21	6.75	0.062	2.25	4.04	5.29
	P ($T \le t$)	**0.004**	0.37		**0.002**	**0.002**	0.167
Arla	Y3	7.35	7.00	0.188	2.08	5.83	6.63
	Y4	6.70	7.65	**0.006**	1.79	3.86	6.79
	P ($T \le t$)	**0.02**	0.07		0.47	**0.001**	0.761
Valio	Y5	6.29	6.96	**0.046**	2.37	4.59	6.00
	Y6	7.00	6.21	**0.015**	2.04	4.52	5.44
	P ($T \le t$)	**0.023**	0.109		0.249	0.852	0.376

Table 2
Mean values and standard errors of the measured eye-tracking comparisons of Y1–Y2, Y3–Y4 and Y5–Y6. Significant product effects are marked with ** $p < 0.01$. TTFF (time to first fixation), FFD (first fixation duration), FB (fixations before), FL (fixation length), FC (fixation count), OL (observation length), and VC (observation count).

		TTFF [s]		FB [counts]		FFD [s]		FD [s]		FC [counts]		VD [s]		VC [counts]	
	Product	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Week A	Y1	0.499	0.154	1.915	0.674	0.197	0.021	0.227**	0.015	7.347	0.883	2.001	0.224	2.311	0.220
	Y2	0.862	0.225	2.047	0.666	0.194	0.015	0.183 **	0.010	9.032	0.845	2.173	0.168	2.419	0.238
Week B	Y1	0.588	0.472	1.639	1.096	0.217	0.034	0.196	0.015	10.018	1.207	2.383	0.334	2.327	0.254
	Y2	0.704	0.336	2.285	1.184	0.208	0.035	0.207	0.033	7.052	0.795	1.856	0.184	1.903	0.318
Week A	Y3	0.980	0.212	3.114	0.756	0.182	0.034	0.226	0.032	7.511	0.934	1.893	0.243	2.250	0.249
	Y4	0.785	0.164	3.097	0.712	0.324	0.137	0.296	0.074	7.391	0.917	2.266	0.187	2.361	0.219
Week B	Y3	0.506	0.252	1.810	0.850	0.222	0.049	0.217	0.026	3.214	0.439	8.405	1.338	2.068	0.349
	Y4	0.576	0.283	2.175	1.008	0.206	0.042	0.206	0.022	3.397	0.350	8.683	0.897	2.050	0.288
Week A	Y5	0.832	0.164	3.202	0.613	0.185	0.028	0.211	0.021	8.583	0.777	2.156	0.238	2.357	0.261
	Y6	0.633	0.113	2.250	0.447	0.165	0.017	0.226	0.017	7.321	0.653	1.998	0.203	2.262	0.199
Week B	Y5	0.696	0.296	2.500	1.017	0.190	0.059	0.218	0.025	8.244	0.964	2.163	0.338	2.389	0.348
	Y6	0.934	0.253	3.144	0.947	0.218	0.032	0.198	0.026	7.767	1.122	1.977	0.335	2.056	0.327

2. The method directly reflects the positive and negative emotions aroused by the food and no translation of the evoked emotional terms is needed. Other methods often try to link the food to emotional descriptions of a large number of emotions that in themselves may have very different meanings to different subjects (e.g., King and Meiselman).
3. The method does not use artificial methods to express the mood of the person and does not ask the person to express her/his own feelings as some other methods do. It deducts the positive and negative mood effects from the changes in the way other people are seen. Although seemingly less direct, this is a better way to approach the non-reflexive emotional state of the subject.
4. The existence of two equivalent versions of the test pictures makes it possible to compare the emotional effects of two versions of a product by the same subjects with less risk of order effects than with some other tests.

6. Autobiographical congruency

It is well known that moods and affective states have an influence on the ease and speed with which people remember sad or cheerful events in their lives depending on whether these events are congruent or incongruent with these moods or affective states (MacLeod & Campbell, 1992; Joorman & Siemer, 2004). It is expected that congruent feeling and question pairs (bad affective states with finding the sad moments or positive affective states with the finding of glad moments) will result in shorter reaction times than incongruent combinations (e.g., bad affective state with finding a glad moment). In the autobiographical congruency test (ACT) this principle was applied to see whether food-evoked mood effects would influence the reaction times to access autobiographical sad or glad memories. In all cases, subjects first performed the EPT and then immediately afterwards the ACT.

6.1. Stimuli

Each week 125 g of one of the two products was given to the subjects in open blank containers with a 3-digit code.

Table 3
Personality traits used in the assessment of the photographs of the emotive projection test.

Positive traits		Negative traits	
In English	In Dutch	In English	In Dutch
Friendly	Aardig	Arrogant	Arrogant
Adventurous	Ondernemend	Stressed	Gespannen
Cheerful	Vrolijk	Shy	Verlegen
Open	Open	Suspicious	Achterdochtig
Reliable	Betrouwbaar	Depressed	Neerslachtig
Warm	Warm	Solitary	Eenzelvig

7. The emotive projection test [EPT]

7.1. Procedure and stimuli

The Face-reader recorded the facial expressions of the participants while they were eating their yoghurt sitting in front of the computer screen (data not reported here due to technical problems, i.r.t. mouth movements). When the subjects indicated they had finished eating, the instruction of the EPT started automatically. They were asked to judge pictures of people that would appear one by one on the computer screen. Each photograph had to be judged on twelve personality traits (see Table 3) with the help of 7-point scales anchored at the extremes 'not at all applicable' (left) and 'very much applicable' (right). The positive and negative traits were presented in the same random order to each participant. The order of the 6 photographs in each of the two equivalent sets (determined in extensive preliminary research) was also the same for all participants. In week 1, about half of the participants in each subgroup received one set of the photographs and the other half of the subjects received the other set. This was reversed in week 2. When the first picture appeared on the screen, the subjects noted the code of the picture, rated their answers on the twelve trait scales and moved to the next picture. They had no possibility to go back to earlier pictures. Depending on the time taken by the subject for eating the yoghurt, the task lasted 6 to 10 min.

7.2. Data treatment

For each product pair, participants which completed all tasks (including the liking, familiarity and appetite test) and the results of the four subjects who tested only one of the pair members were left out of the analysis.

The ratings of the participants were first averaged over the 6 judged photographs and the resulting individual averages were then normalised to correct for the influence of possible scale use differences by dividing each of the resulting averages by the individual average score of the subject over all attributes and multiplying the result with the average of all subjects for the attribute involved. Finally, the normalised data of the two products of the pair were submitted to a paired *t*-test in order to check for product dependent differences in each of the attributes.

7.3. Results of the emotive projection test

The results of the emotive projection test are represented in Table 4 below.

74 participants completed the EPT and ACT. For Activia 24 subjects, for Arla 23 subjects and for Valio 27 subjects completed the tests for both products in a pair.

Table 4
Means of the normalised ratings for each of the Yoghurts (Y1 to Y6), differences of these means (Yx − Y (x + 1)) and the P-values of the paired *t*-tests in the three groups of 24 participants who tested each one of the yoghurt pairs. Significant differences are shown in bold, tentative differences in italic.

Positive	English	Friendly	Adventurous	Cheerful	Open	Reliable	Warm
Y1	Mean	5.221	4.787	4.183	3.656	5.137	4.53
Y2	Mean	5.503	4.756	4.483	3.916	4.953	4.545
Y1–Y2	Diff	−0.282	0.03	−0.3	−0.261	0.184	−0.015
N = 24	*T*-test P	0.155	0.874	*0.057*	0.156	0.385	0.924
Y3	Mean	5.476	4.745	4.612	3.619	4.75	4.333
Y4	Mean	6.077	5.25	4.115	3.853	5.467	4.752
Y3–Y4	Difference	−0.601	−0.505	0.496	−0.234	−0.717	−0.419
N = 24	*T*-test P	<**0.001**	**0.001**	**0.003**	*0.098*	<**0.001**	**0.001**
Y5	Mean	5.879	4.694	4.237	3.646	5.155	4.503
Y6	Mean	5.762	5.113	4.445	3.983	5.489	4.885
Y5–Y6	Diff	0.117	−0.419	−0.208	−0.336	−0.334	−0.382
N = 24	*T*-test P	0.396	**0.004**	*0.079*	**0.008**	**0.026**	**0.014**

Negative	English	Arrogant	Stressed	Shy	Suspicious	Depressed	Solitary
Y1	Mean	3.329	3.598	3.484	3.219	2.389	4.1
Y2	Mean	3.573	3.868	3.275	3.03	2.216	3.913
Y1–Y2	Diff	−0.243	−0.27	0.209	0.189	0.173	0.188
N = 24	*T*-test P	0.222	0.122	0.295	0.32	0.279	0.379
Y3	Mean	3.166	3.079	2.95	3.054	2.338	4.439
Y4	Mean	2.924	3.332	3.05	2.924	2.28	3.887
Y3–Y4	Difference	0.241	−0.253	−0.101	0.13	0.059	0.552
N = 24	*T*-test P	*0.083*	*0.078*	0.559	0.275	0.629	**0.006**
Y5	Mean	3.001	3.407	3.479	3.197	2.537	3.587
Y6	Mean	2.778	3.252	3.273	3.103	2.082	3.312
Y5–Y6	Diff	0.224	0.155	0.206	0.094	0.455	0.275
N = 24	*T*-test P	*0.063*	0.346	0.12	0.48	**0.002**	**0.045**

As can be seen from this table, no major differences in projected feelings were found for the first two yoghurts. Only in one case, the Y1 variant (normal strawberry) of the product was judged to have marginally less (P = 0.057) projected cheerfulness than Y2 (fat free pineapple). In contrast, the two pair members Y3 and Y4 produced different projected trait ratings in 9 of the 12 cases. Y4 (vanilla) gave rise to significantly

Table 5
Correlations between trait scores and respectively *expected* and *tasted* liking for each of the products on each of the personality traits and on the means of the positive and negative traits. Bold figures are significant with P < 0.05 and figures in italic have a P between 0.05 and 0.10.

	Correlation with positive traits						
	Friendly	Adventurous	Cheerful	Open	Reliable	Warm	Mean
Expected liking							
Y1	0.13	0.17	0.01	0	0.14	0.05	0.15
Y2	0.35	0.23	*0.35*	0.08	0.33	0.16	*0.36*
Y3	−0.02	−0.08	0.04	0.11	0.14	−0.22	−0.01
Y4	0.26	0.06	−0.21	0.08	−0.18	−0.09	0
Y5	0.09	0.01	0.01	0.05	0.06	−0.24	0
Y6	0.04	0.22	0.2	−0.09	0.12	0.26	0.22
Tasted liking							
Y1	0.12	0.14	−0.12	−0.11	−0.09	−0.22	−0.07
Y2	0.07	0.19	0.05	0.29	0.12	0.01	0.18
Y3	0.13	0.13	0.06	0.07	0.18	0.06	0.14
Y4	−0.02	0.3	−0.18	−0.12	−0.04	−0.01	−0.01
Y5	−0.17	−0.01	−0.03	0.26	−0.09	−0.31	−0.09
Y6	0.17	0.33	0.25	−0.25	0.12	0.28	0.27

	Correlation with negative traits						
	Arrogant	Stressed	Shy	Suspicious	Depressed	Solitary	Mean
Expected liking							
Y1	−0.14	0.04	0.08	0.01	−0.3	−0.09	−0.13
Y2	−0.27	−0.12	0.39	**−0.44**	**−0.51**	−0.29	−0.34
Y3	0.1	0.08	−0.24	0.12	−0.01	−0.01	0.01
Y4	0.36	0.12	−0.22	−0.29	0.26	−0.03	0
Y5	−0.2	−0.19	0.15	0.08	0.18	−0.01	−0.01
Y6	0	−0.23	−0.25	0.05	−0.16	−0.06	−0.23
Tasted liking							
Y1	0.06	0.16	−0.08	0.17	−0.23	0.13	0.09
Y2	−0.09	−0.09	0.25	−0.26	−0.31	−0.15	−0.18
Y3	0.18	0.14	0.04	−0.17	**−0.49**	−0.12	−0.13
Y4	0	−0.06	0.02	−0.06	0.01	0.15	0.02
Y5	−0.22	0.13	0.11	0.12	0.18	−0.07	0.07
Y6	−0.27	−0.1	−0.11	−0.17	0.05	−0.13	−0.28

more positive projected traits than Y3 (strawberry), the only exception being cheerfulness, where Y3 provoked a stronger projected feeling than Y4. With regard to the negative projected traits, Y3 led to significantly more projected feelings of solitariness and to marginally more projected arrogance than Y4, whereas the reverse was true for projected stress, where Y4 was judged to lead to a slightly higher projection.

With the exception of friendliness for which very high values were obtained for both products, all projections on the positive items provoked by Y6 (fat free raspberry) were clearly stronger than those of Y5 (normal raspberry), whereas on three of the negative traits Y5 led to stronger projections than Y6.

7.4. Do the results of the test make a contribution independent from liking?

In order to verify whether the positive and negative projective effects could be explained by the liking of the products, the data of both the expected liking (noted before tasting on the basis of the visual information of the packaging) and the liking after having tasted the product were correlated with the rated traits in the projective tests. An overview of these correlations is given in Table 5.

As can be seen from this table, in general the correlations are rather low explaining (with three exceptions) not more than 16% of the variance and in the strongest case less than 26%. Thus, it can be concluded that the projective measures seem unrelated to liking, but make an independent contribution to the characterisation of the emotions raised by the products.

At the same time, it can be seen that some products (e.g., Y2) have mainly positive correlations between the positive traits and both expected and tasted liking and negative correlations between negative traits and both forms of liking. For other products no such links seem to exist.

At the end of the second session the subjects received once more small portions of the two products they had been testing. After tasting each one of them they were asked whether they would like to eat more of it (1 = no more to 9 = a very large portion), whether they had eaten this particular product often before (familiarity question 1; 1 = never; 9 = very often) or to what extent this product resembled a product they knew well (familiarity question 2: 1 = not at all; 9 = very much). The data that were obtained with these three questions were correlated respectively with expected liking, perceived liking, and the mean positive and mean negative trait judgments and between the three questions themselves. High correlations were found between the desire to eat more of the product and tasted liking (varying between $r = 0.703$ and $r = 0.838$) for products 1, 2, 5 and 6, but not for products 3 and 4 ($r = 0.237$ and $r = 0.273$ respectively). With expected liking, correlations were lower for products 1, 2, 5 and 6, and were even negative for products 3 and 4. All correlations between the other variables were lower than $r = 0.472$ (and in most cases much lower) explaining not more than 23% of the variance and indicating the relatively solid independence of the induced mood changes from liking and familiarity of the products.

8. Discussion

It is clear that the test differentiated between the yoghurts in the projected moods evoked by the yoghurts in two of the three sets of stimuli and that the differences as indicated by the results of the individual subjects were independent of their liking of and familiarity with the products (Table 4). Furthermore, inspection of Table 1 also shows that in the one pair (Y1–Y2) in which no difference in mood effects was found, there was also no overall difference in tasted liking although one of the products (Y1) evoked more expected liking than the other one (Y2). This seems to indicate that the expected liking had no effect on the projected mood after consumption. On the other hand, the shifts between expected liking and tasted liking in the other two pairs seemed only partly to coincide with the development of the projective mood. Thus, pleasant surprise (higher tasted than expected liking see Y4) had a positive mood influence, whereas unpleasant surprise (lower tasted than expected liking, see Y6) did not lead to more negative and even to more positive mood effects than in Y5. The fact that discrepancies between expected and tasted liking may exert an influence on the emotions in some cases but not in others is in good agreement with the ideas and findings on the role of disconfirmed expectations leading to assimilation or contrast in food acceptance, as described by Cardello (2007) and illustrated by Schifferstein, Mojet, and Kole (1999). It also stresses the role of memory and especially of shifts in remembered emotion such as disappointment or pleasant surprise as recently supposed by Spinelli, Masi, Dinnella, Zoboli, and Monteleone (2014), Spinelli, Masi, Zoboli, Prescott, and Monteleone (2015). The role of memory is also stressed by the implicit relationship between the food consumption and the seemingly independent emotive projection test taken after and not during food consumption (see also Köster & Mojet, 2015–in this issue).

With regard to the influence of differences in the sensory characteristics themselves (Table 2) on the projected emotions it is clear that the change in fruit flavour (Y1 strawberry and Y2 pineapple) does not seem to influence the emotional reaction as expressed in the projection test. The same is true for the change in fat content in Y1 and Y2, but in the equally flavoured pair Y5 and Y6 the fat-free version (Y6) led to more positive and less negative projected emotion than the fat version (Y5). However, the most remarkable effect on the projected emotion was obtained in the vanilla flavoured Yoghurt (Y4). This product already received more attention in the eye tracking measurements in the form of longer first fixation duration and more fixation counts, longer fixation and observation length. In the projective test it showed very high projected emotion on 5 of the 6 positive traits in the test and lower negative projected emotion in 3 (two only marginally) of the 6 negative traits than product Y3. This finding is in accordance with the findings in research where low and consciously unnoticed concentrations of ambient vanilla odour were used in a restaurant situation (De Wijk & Zijlstra, 2012) and in the waiting rooms of emergency hospitals (Van't Hof, Zandbergen, Van de Velde, & Eysenk Smeets, 2012) with positive and/or stress- and aggression-reducing effects.

8.1. Conclusions: emotive projection test

The test differentiates between the elicited emotional effects of two of the three pairs of yoghurts.

The test is easy to perform, does not take much time and is well appreciated by the participants.

The test may throw a light on subtle differences in the effect of foods on the emotional feelings towards other people.

This emotional interpersonal effect of food on the judged personality of others underlines the possible positive effects of eating together (business lunches, etc.).

The test showed no correlation with either liking or familiarity of the products.

9. The autobiographical congruency test (ACT)

In view of the lack of certainty about the market success of the products in the Dutch population, it has been decided to use the outcome of the EPT rather than the market success indications as the basis for the prediction of the congruent and incongruent effects in the Autobiographical Congruency Test. After all, this is a test that can only function in the linkage between the mood people are in and the affective tone of the recollected memory. This means that in this test the yoghurts Y1, Y 4 and Y6 were considered the highly appreciated (H) and Y2, Y3 and Y5 as the less appreciated ones (L).

9.1. Procedure

The autobiographical test immediately followed the EPT. After the subject indicated that he/she had finished responding to the last photograph of the EPT, a screen appeared that told them that on the next screen they would receive a question that they should try to answer as quickly as possible by a mouse click when they knew the answer and then give a short description of it. The next screen asked them to think of either the saddest or the happiest moment of their life. About half of the subjects received the happiest moment question in the first week and the saddest moment question in the last week and for the other half of the participants this order was reversed. The reaction times (Rts) were registered and the written responses (saddest (S): death of relatives, divorces etc.) and happiest or gladdest (G: birth of children, marriages etc.) were discarded.

9.2. Participants

Not all subjects who performed the EPT provided responses to these questions in both weeks. Since in this test only within-subject data seem to be relevant, given the strong individual differences in reaction times and the strongly individual emotions involved, the final groups whose data were considered where reduced to 16 participants for the comparison of Y1 and Y2, 16 for the comparison of Y3 and Y4, and 21 for the comparison of Y5 and Y6. About half of each of these groups received the congruent combinations of the highly appreciated product (H) with the Glad question and the less appreciated product (L) with the Sad question, while the other half received the incongruent combinations of the highly appreciated product (H) with the Sad question or the less appreciated product L with the Glad question.

9.3. Data treatment

The Rts were compared for the congruent combinations (HighGlad and LowSad) and for the incongruent combinations (HighSad and LowGlad) with paired *t*-tests (within-subject comparison), whereas the between subject comparisons (combinations HighGlad with HighSad or LowSad with LowGlad) were compared with unpaired *t*-tests.

9.4. Results: autobiographical test

The congruency effect (testing the hypothesis that congruent combinations of products and answers lead to faster responses than incongruent combinations) was marginally confirmed in the data over all subjects and products. The average reaction times (Rts) for the congruent combinations [either a highly positive product (H) with the question about the happiest moment (Glad) or the less positively judged product (L) with the saddest moment (Sad)] were indeed somewhat shorter than those to the incongruent combinations [H-Sad or L-Glad]. On average the congruent combinations took 5.75 s, and the incongruent combinations 7.60 s ($T_{(1,93)} = 1.78$; $P = 0.079$).

The detailed within subject results of those who completed the ACT over both weeks are given in Table 6. Although again in all cases it took longer to answer the incongruent combinations HS and LG than to answer the congruent combinations HG and LS respectively, none of these differences was statistically significant. This was probably due to the large individual variation in Rt and the relatively low number of subjects in each subgroup.

A comparison of the Rts of the highly positive (Y1, Y4, and Y6) products and the Rts of their less positive counterparts (respectively Y2, Y3 and Y5) showed a consistent outcome. In all three cases (Y1–Y2, Y4–Y3 and Y6–Y5) the congruent responses were slower for the highly positive product. For the incongruent responses the Rts of the highly positive products Y4 and Y6 were longer than those for their less positive counterparts Y3 and Y5, but for the Y1 and Y2 the reverse was true. Since none of the differences were statistically significant anyhow, it must be concluded that the autobiographical test did not differentiate between the products, although the principle of differentiation between the Rts for congruent and incongruent combinations was not violated and even marginally confirmed in two of the three cases (congruent shorter than incongruent (Y1–Y2 and Y3–Y4) but not in one case (Y5–Y6)) were the expected liking for the most positive product Y6 led to a deception when it was tasted again (see the difference expected tasted liking for Y6 in Table 1), which might perhaps explain this result and might indicate that negative feelings are produced faster than positive emotions.

10. Discussion and conclusion: autobiographical congruency test (ACT)

Notwithstanding the fact that most effects are in the right direction, the test does not deliver more than marginally significant results. Combined with the fact that it lays a heavy emotional burden on the participants, asking them to remember very sad moments in their lives (e.g., death of children of parents) the method should be considered unfit for use in product research.

11. General discussion

When the three different implicit measurement methods (face reading, emotive projection and autobiographical congruency) are compared on their effectiveness in measuring the emotional effects of consumption, it becomes clear that two of them (face reading and autobiographical congruency) were unsuccessful in the present experiment. In the case of face reading, this was probably also due to the lack of control over the head movements while measuring facial expressions during eating. In the case of the autobiographical test the sensitivity of the test was insufficient and the evoked emotional memories were in some cases rather painful. In the way it was used in this experiment, Eye-Tracking did not shed any light on the emotive effects of food consumption.

Thus, in the present experiments the emotive projection test is the most promising of the tests used, but questions may be raised about

Table 6
Mean reaction times (MRt) obtained for the congruent and incongruent combinations of a highly appreciated (H) and less appreciated (L) products with questions about the happiest (Glad) and saddest (Sad) moments. N = number of participants.

	Code yoghurt	N	High (H) success	Mean MRt	Code yoghurt	Low (L) success	Mean MRt	*T*-test P
Congruent	Y1	6	H-Glad	5.03	Y2	L-Sad	4.45	0.719
Incongruent		10	H-Sad	6.34		L-Glad	7.72	0.585
			T-test P	0.496			0.171	
Congruent	Y4	9	H-Glad	6.13	Y3	L-Sad	5.1	0.562
Incongruent		7	H-Sad	8.9		L-Glad	5.66	0.146
			T-test P	0.364			0.336	
Congruent	Y6	10	H-Glad	11.39	Y5	L-Sad	9.06	0.603
Incongruent		11	H-Sad	5.57		L-Glad	7.4	0.336
			T-test P	0.153			0.569	

the possibility that this was due to the fact that only one relatively simple product type was used in the experiment.

The fact, that important sensory differences like the use of very different fruits (Y1, Y2 in Table 2) had no influence on the emotional effects, whereas differences in fat content (Y5 and Y6) did, may be very specific for yoghurt. The combination of methods used here (with the exception of the autobiographical test) should therefore be tested with different types of products to get more insight in the relationship between sensory properties and mood shifts as expressed in the emotive projection test. Another important point would be to find out how the methods that do discriminate between the products are related to each other and to which extent they provide concordant, contrasting or completing information. Thus it has become clear here that the liking of some products either has grown by eating them (Y2, Y4 and Y5), has remained the same (Y1 and Y3), and has diminished in another case (Y6), and that the resulting pleasant surprise or disappointment seemed to be more important in some cases than the sensory characteristics of the yoghurts themselves, except for the strong emotional effect of a flavour like vanilla. Thus, using a combination of methods might reveal more unexpected specific emotional effects, than the explicit rating of suggested emotions as in most of the verbal measuring methods used so far. Finally, another less important point of discussion might be the relationship between the two measures of familiarity used in this study and the possibly different relationship of each of them with the other measures. They deliver quite different degrees of familiarity and it is at least good to point out that the habit of just asking familiarity is a bad one because one does not know in which of the two senses the participants interpret it.

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