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Making salt-reduced products more appealing to consumers: impact of front-of-pack messages on liking and table salt use over time

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Abstract
Objective: The current study investigated the impact of different front-of-pack messages on liking, salt perception and table salt use of salt-reduced soups over repeated consumption.
Design: In a between-subjects design, participants consumed a chicken noodle soup five times over 3 weeks. Participants were assigned to one of five experimental conditions and were categorized into three 'Interest in Salt Reduction' groups based on their self-reported interest in salt reduction. They consumed a regular-salt soup or a 30 % salt-reduced soup, either with or without a front-of-pack message (nutritional, sensory or social based). Liking, salt perception and table salt use were measured at each consumption.
Setting: Central location test.
Subjects: British consumers (*n* 493) aged 24–65 years.
Results: The soups remained stable in liking over repeated consumption, with no significant differences between the experimental conditions. However, liking did differ among the different Interest in Salt Reduction groups: the 'not aware, no action' group liked salt-reduced soups with a nutritional message the most, whereas the 'aware and action' group liked salt-reduced soups with a social message the most. There was no change in the amount of table salt added as people got more familiar with the salt-reduced soups, suggesting a strong role for habit in table salt use.
Conclusions: It mattered whether consumers were thinking about reducing their salt intake or not: a communication message tailored to a country's interest in reducing salt is recommended to motivate consumers to lower their salt intake.

Keywords
Salt reduction
Labelling
Salt perception
Long-term liking
Table salt use

Globally, average daily dietary salt intake is much higher than the WHO-recommended level of less than 5 g/d for adults[1,2]. Excessive salt intake is associated with higher risk of CVD as it raises blood pressure level with age[3–5] and there is evidence that reducing salt intake can lower blood pressure[6,7]. Most salt intake comes from commercially prepared or manufactured foods (e.g. bread, soup, olives, restaurant meals), although there are significant variations among products and countries[8,9]. The food manufacturing industry has already lowered salt levels in many products using a 'stealth' approach, gradually reducing salt over the years in a stepwise fashion without actively informing consumers[10–12]. However, the need for further salt reductions in manufactured food products remains pressing. This is a significant challenge, as further reductions in salt might affect taste and liking of these products[10,13,14].

The relationship between liking and salt intensity is described in an 'optimum salt curve' in which a certain salt level in food is preferred the most, and higher and lower levels are liked less[15,16]. There are individual differences in people's preferred salt concentration based on prior food experience and dietary habits[17,18] such as habitually adding table salt and regularly consuming products with high salt levels[19–22]. Ultimately, it is important to shift this curve to lower salt levels. There is evidence that preferred levels of saltiness can be modified through repeated exposure, for example by placing people on salt-restricted diets for several months[23–25] or by repeatedly exposing people to the taste of a single salt-reduced product, even when it is not accompanied by a reduction in the salt levels of the total diet[17,26–29]. The implication is that people should be able to shift their preference and 'learn'

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to prefer products with lower salt concentrations. However, it is not yet known how many exposures are required to shift salt preference and how long the observed preference shift persists[14,30].

One risk of introducing lower-salt products is that consumers may add salt back via the salt shaker at the table, thereby reducing the impact of salt-reduced products. A key question is therefore whether people compensate for lower salt content by adding it back via a salt shaker[14]. On a daily basis, it is estimated that salt use at the table accounts for 15–20 % of total salt intake compared with 75 % from commercially prepared and manufactured foods in Western-style diets[8,31,32]. Although it has been shown that people only partly compensate via a salt shaker when their total diet was reduced in salt[33], recent research has also shown that if the salt content of a single product was reduced to an unacceptably low level, consumers added extra salt at the table, even to the point of overcompensation[34,35].

The introduction of salt-reduced products may therefore benefit from an increase in consumer awareness of the need to reduce salt intake[36]. The underlying assumption is that if people are not aware they need to change their behaviour, they are unlikely to do this. In line with this, the Transtheoretical Model proposes that individuals can be categorized according to their temporal stage of change for particular health behaviours[37,38]. In this model, behaviour change starts with awareness; for example, one has to be aware of the risks of a high salt intake before one considers lowering one's salt intake. Consumers who are not aware of the need to change their salt intake are called 'pre-contemplators' (stage 1). Once they are aware of the need to change they are categorized as 'contemplators' (stage 2). They subsequently move into a 'preparation' phase (stage 3), then an 'action' phase (stage 4) and finally a 'maintenance' phase (stage 5). Thus, consumers may respond differently to the introduction of salt-reduced products depending on the stage they are in and it may be necessary to tailor messages to these different stages, to ensure that consumers adopt lower-salt products and do not add salt back at the table. No research has investigated whether and how the stage in which people are influences liking and the use of table salt when repeatedly consuming a single salt-reduced product with or without accompanying communication messages.

One way to increase consumers' awareness to consume lower-salt products is via specific communication messages on packaging. Previous research has shown that communication messages can influence both expected and perceived smell, taste and acceptance of food products[39–42]. Two approaches of communication have been described before[43]: (i) a functional approach (i.e. messages with a focus on the nutritional value of foods and their health consequences); and (ii) a psychological approach (i.e. messages with a focus on sensory, social or emotional aspects of consumption). The extent to which these types of communication messages influence the liking of food products is less clear. A psychological approach in communication seems to be more effective in increasing liking than a functional approach. For example, Dubé and Cantin showed that a (psychological) message with a focus on taste and emotions increased liking of a food product ('Milk, so refreshing! So silky! Milk has the taste of my childhood! Come on! The milky way is waiting for you!'), whereas a (functional) message with a focus on nutrition and health increased consumption of the food product ('Milk, So convenient! So wholesome! Milk feeds you! To your health!'). In addition, other research showed that salt-reduced soups with a nutritional message ('Now reduced in salt') were expected to be less liked, were perceived to be least salty and were less liked after tasting[43]. It also increased the use of table salt[35]. In these studies, people were exposed to the messages only once.

The present study investigated the impact of different types of communication messages on the liking of salt-reduced soups and the use of table salt over repeated consumption, something that has not been investigated before. Three communication messages were investigated in relation to salt reduction: (i) a nutritional message ('30 % reduced in salt'); (ii) a sensory (taste) message ('Same great taste, less salt'); and (iii) a sensory/social message ('More taste, less salt and kids will love it'). These three message conditions were compared with a control condition (no message). The sensory and social messages were constructed on the basis of the finding that consumers want high-quality food products that are healthy yet tasty at the same time[13,14,35,44]. However, people often appear to make a 'healthy = not tasty' inference, such that they expect and perceive healthier alternatives of foods to be less tasty[45–48]. We therefore examined whether adding a reassurance about taste would increase the long-term liking of the product and would result in a decreased salt use at the table. Additionally, we added a social aspect of eating to the taste reassurance in the social message as research showed it is possible to increase liking of a food by providing information about others' liking for the food[49,50].

We hypothesized that: (i) salt-reduced products with a sensory or a sensory/social message on-pack would score higher on liking and result in less table salt use compared with the same products with a nutritional message and no message, and that this effect would be sustained over repeated consumption; and (ii) consumers who are actively reducing salt intake in their diet (stage 4 and 5) would add less salt back to the salt-reduced product with a nutritional message, whereas consumers who are not aware or interested in reducing their salt intake (stage 1) would add less salt back to the same products with a sensory and social message. Also, this effect would become larger over time due to the learning process that would take place over repeated exposure.

Materials and methods

Participants

In total, 518 participants were recruited by a market research agency (Sensory Dimensions, UK) according to four selection criteria: (i) 25–65 years of age; (ii) likes chicken noodle soup (scoring ≥4 on a 7-point scale); (iii) is (partly) responsible for the groceries; and (iv) consumes dry soups at least once every half year. Twenty-five subjects dropped out due to personal reasons (Christmas obligations and influenza). Of the remaining 493 subjects (47 % male; 51 % with children), 240 participated in the study at the sensory facilities of the market research agency in Nottingham (UK) and 253 participated in Reading (UK) in November and December 2013. The two sensory facilities followed the same protocol, and the data were combined for all analyses. Table 1 shows the main characteristics of all 493 subjects per experimental group (see also Table 2 for the meaning of the five experimental groups). Consumers were not informed about the actual purpose of the study (i.e. assessing discretionary salt use) but were informed at the start of the study that the study consisted of tasting and eating a chicken noodle soup.

By means of a questionnaire at the end of the study, based on the five stages of the Transtheoretical Model of Behavioural Change[37], we assessed participants' interest in engaging in salt reduction (i.e. what behavioural stage of change they were in). Participants were asked to describe which statement best represented their current interest in salt reduction from the following options: 'I am not at all interested in lowering salt in my diet and I have no intention in doing so in the next 6 months' (stage 1); 'I am interested in lowering salt in my diet and I have the intention of doing that within the next 6 months' (stage 2); 'I am interested in lowering salt in my diet and I have the intention in doing that in the next month' (stage 3); 'I am interested in lowering salt in my diet and I have started lowering my salt intake during the last 6 months' (stage 4); and 'I am interested in lowering salt in my diet and I have already lowered my salt intake for longer than 6 months' (stage 5)[9]. Participants were then regrouped into three 'Interest in Salt Reduction' groups: 'not aware, no action' group (stage 1); 'aware, no action' group (stages 2 and 3); and 'aware and action' group (stages 4 and 5)[29]. Men and women and the two age groups (25–44 years and 45–65 years) were distributed equally across the five experimental groups. The study was performed according to the ICC/ESOMAR Code on Market and Social Research guidelines[51] and participants received £50 on study completion.

Materials

Soups

Two dry soups varying in salt content were included in the study: (i) a regular-salt chicken noodle soup as available on the UK market at the time of the study in 2013 (555 mg salt/100 ml prepared soup); and (ii) a 30 %-reduced-salt chicken noodle soup (389 mg salt/100 ml prepared soup). The recipe for the soups was the same, only the salt content was different. The soups were specifically developed for the purposes of the present study (Unilever Deutschland GmbH, Germany).

Table 1 Characteristics of the participants per experimental group: British consumers (*n* 493) aged 24–65 years, November–December 2013

	Group 1 (*n* 104)	Group 2 (*n* 107)	Group 3 (*n* 96)	Group 4 (*n* 94)	Group 5 (*n* 92)
	%	%	%	%	%
Age 24–44 years	43	50	45	51	46
Age 45–65 years	57	50	55	49	54
Male	50	48	50	44	41
Has one or several children under the age of 21 years	58	49	43	56	50
Interest in Salt Reduction group†					
Not aware, no action	35	29	30	39	26
Aware, no action	36^{A}	40^{A}	41^{A}	39^{A}	47^{B}
Aware and action	29	31	29	22	27

^{A,B}Percentages within a row with unlike superscript upper-case letters from group 1 to group 5 were significantly different ($P < 0{\cdot}05$).
†The three Interest in Salt Reduction groups were based on the five stages of the Transtheoretical Model of Behavioural Change[37], i.e. 'not aware, no action' group (stage 1), 'aware, no action' group (stages 2 and 3) and 'aware and action' group (stages 4 and 5)[29].

Table 2 Soups and communication messages used in the present study

Group	Soup repeatedly consumed	Focus	Communication message on pack
1 (*n* 104)	30 %-reduced-salt soup	No communication	n/a
2 (*n* 107)	30 %-reduced-salt soup	Nutritional	30 % reduced in salt
3 (*n* 96)	30 %-reduced-salt soup	Sensory	Same great taste, less salt
4 (*n* 94)	30 %-reduced-salt soup	Social	More taste, less salt and kids will love it
5 (*n* 92)	Regular-salt soup	No communication	n/a

Fig. 1 (colour online) Soup pack images with messages that were shown to the participants during tasting the soups. From left to right: no message, nutritional message, sensory message and social message

Communication messages, soup bowls and salt shakers

All participants were offered a bowl of soup together with a visual of the soup pack (Fig. 1). The visuals of the soup pack had a similar layout as the commercial soup pack available on the UK market with the Knorr brand name and logo. The soup packs contained either no message or one of the three communication messages (see Fig. 1). These communication messages were chosen based on the results of a message selection test. In this message selection test, 500 British consumers (50 % male; aged 18–65 years) completed an online questionnaire individually at home. Consumers had to rank and score three sets of soup packages with four different on-pack messages each on how appealing they were. The most preferred message within each condition was selected for the main study. The consumers from the message selection test did not participate in the main study. The three selected communication messages were: (i) nutritional message: '30 % reduced in salt'; (ii) sensory message: 'Same great taste, less salt'; and (iii) sensory and social message (referred to as 'social message' hereafter): 'More taste, less salt and kids will love it'.

Each participant was served 200 ml of soup in a 280 ml porcelain bowl. Participants were provided with stainless steel spoons and commercially sourced salt shakers that were made from glass, were completely transparent and contained 16 g of salt (2·5 cm × 2 cm, six holes). Unknowingly to the participants, the salt shakers were weighed on a digital weighing scale that measured at 0·001 g accuracy before and after participants consumed the soup. The salt shaker provided on average 0·05 g salt per shake. A weight difference of 0·02 g was recorded as a change in salt intake (i.e. this person was considered to have used the salt shaker).

Procedure

Each participant consumed five servings of one of the two soups (with or without one of the three messages) at five different tasting sessions (Table 2).

The tasting took place at the same time twice weekly across 3 weeks in individual tasting booths. Participants were asked not to eat or drink anything 2 h before each tasting session. They were instructed to consume a full portion of chicken noodle soup each time. The soups were served at about 65–70 °C in a soup bowl. Participants were offered the same soup–message combination every tasting session. The communication message was provided on a plasticized, full-colour image of the package just before the start of the tasting session and was visible during the whole tasting session. The salt shaker was provided next to the communication message and soup bowl. Food intake was measured by weighing the amounts served and the leftovers when participants did not eat the full portion. We measured this to check that participants consumed sufficient amounts of the soups to really taste them. On average, participants consumed 87 % of the soup, with no differences between the groups ($P > 0{\cdot}05$).

Measures

Just before tasting the soup, participants were asked how hungry and thirsty they were, and they rated the expected liking, greasiness, saltiness, sweetness and sourness of the soup. Participants then rated the soups twice on perceived liking, greasiness, saltiness, sweetness, sourness and buying intention: once after tasting one spoonful of the soup and once directly after finishing the soup. All questions were answered on 9-point scales, ranging from respectively 'not at all hungry' to 'very hungry', 'not at all thirsty' to 'very thirsty', 'not liked at all' to 'liked very much, 'not at all greasy' to 'very greasy', 'not at all salty' to 'very salty, 'not at all sweet' to 'very sweet', 'not at all sour' to 'very sour' and 'not at all likely to buy' to 'very likely to buy'. The questions on the sensory attributes (expected) greasiness, sweetness and sourness were part of the cover story to divert attention away from the salt reduction (and are therefore not reported here). After tasting and rating the first spoonful of soup, participants were instructed to eat the rest of the soup and they were then allowed to add as much salt as they wanted. Participants were free to decide whether they wanted to add salt or not. At the fifth session, a choice behaviour task was added: 'If someone were to offer you some of these packets to take home to use yourself at home, how many packets would you want

to take home?', with a response scale from 0 to 8. And finally, at the end of the fifth tasting session, respondents answered additional questions on salt awareness, attitudes and beliefs about salt intake (not reported here).

Statistical analysis

Data are presented as means and standard errors. Statistical analyses were performed using the statistical software package SPSS version 16.0. $P < 0{\cdot}05$ was used as the criterion for statistical significance.

Data on expected and perceived liking and saltiness as well as buying intention and table salt use were analysed using ANOVA with repeated measures. We used models with Experimental Group, Time (the five visits as repeated measures), Interest in Salt Reduction and their two-way interactions as independent variables and each product rating and table salt use as dependent variables. Tukey multiple range tests were applied to test for significant differences.

For those who added salt after tasting the soups, a salt compensation score was calculated for the salt-reduced soups by expressing the added table salt as a percentage compared with the amount of salt that was taken out of the regular-salt soup.

Results

As we observed no statistically significant differences by gender, age and having children or not ($P > 0{\cdot}05$), we report only the means of the experimental groups for all analyses. There was a significant difference in terms of Interest in Salt Reduction for experimental group 5, with relatively more participants in the 'aware, no action' group than in the 'not aware, no action' and 'aware and action' groups ($P < 0{\cdot}05$). Furthermore, we do not report the results of liking, saltiness and buying intention after one spoonful of the soup, since the results of these were similar to the results of liking, saltiness and buying intention directly after finishing the full portion of the soup.

Liking, salt intensity and buying intention

For expected liking, there was a significant main effect for Experimental Group in that, averaged across the five visits, participants expected salt-reduced soups with a social message to be liked less than salt-reduced soups with a sensory message (mean 5·71 (SE 0·09) *v.* 5·93 (SE 0·09) respectively, $P < 0{\cdot}05$). There was also a significant interaction effect for Experimental Group × Time: the soups without communication (regular and salt-reduced) and the salt-reduced soups with the social message scored significantly higher on the first visit than on the fifth visit, whereas expected liking of the salt-reduced soups with the nutritional or social message did not change over time ($P < 0{\cdot}05$; Table 3). The main effect of Interest in Salt Reduction ($P > 0{\cdot}05$) and the interaction effect between Experimental Group and Interest in Salt Reduction ($P > 0{\cdot}05$) were not significant.

For perceived liking, the main effects for Experimental Group, Time and Interest in Salt Reduction, and the interaction for Experimental Group × Time, were not significant ($P > 0{\cdot}05$; Table 3). However, there was a significant interaction effect between Experimental Group and Interest in Salt Reduction ($P < 0{\cdot}01$; see Fig. 2). The 'not aware, no action' group and the 'aware and action' group differed significantly for the nutritional and social messages. More specifically, participants in the 'not aware, no action' group had the highest liking scores for the salt-reduced soup with the nutritional message, whereas they liked the salt-reduced soup with the social message significantly less than the soups with the other messages. Moreover, the 'aware, no action' group liked the salt-reduced soup with the nutritional message significantly better than the other soups. The 'aware and action' group scored the opposite and liked the soup with the nutritional message significantly less than the soups with the sensory and social messages and no message.

The ANOVA for expected saltiness showed a significant main effect for Experimental Group ($P < 0{\cdot}05$): participants expected the salt-reduced soups with a sensory or nutritional message to be less salty (mean 3·83 (SE 0·08) and 3·80 (SE 0·08), respectively) than the salt-reduced soup without a message (mean 4·13 (SE 0·08)). There was also a main effect for Time ($P < 0{\cdot}05$), with follow-up Tukey's tests indicating that expected saltiness was significantly higher at the first visit than at the fourth and fifth visits. The main effect of Interest in Salt Reduction and the interaction effect for Experimental Group × Interest in Salt Reduction were not significant (all $P > 0{\cdot}05$).

For perceived saltiness, there were no significant main effects for Experimental Group, Time and Interest in Salt Reduction, and no significant interaction effects (all $P > 0{\cdot}05$): participants perceived the soups with the different messages to be similar in saltiness, initially and over repeated consumption. Interestingly, although the salt-reduced soup was 30 % lower in salt, the salt-reduced soup without a message was perceived as similar in saltiness as the regular-salt soup without a message (Table 3).

For buying intention, none of the main effects (Experimental Group, Time, Interest in Salt Reduction) nor any of the interactions were significant (all $P > 0{\cdot}05$). At the end of the last session, respondents were asked how many packs they would take home if they were allowed to take between zero and eight packs of the soup that they had been presented with. The mean number of packs taken home ranged from 4·9 (SE 0·3) packs for the salt-reduced soup without a message to 5·4 (SE 0·3) packs for the regular soup without a message. There were no significant main (Experimental Group, Interest in Salt Reduction) or interaction effects (all $P > 0{\cdot}05$): the number of packs

chosen was not significantly different between the different experimental conditions or between the three Interest in Salt Reduction groups.

Adding salt

The amount of salt added back varied greatly across respondents. Overall, 31 % of participants did not add salt to the soups at all, whereas 51 % infrequently added salt (adding salt at two to four visits) and 18 % added salt at each visit (Table 4).

When averaged across the five visits, there were no differences in the average grams of salt added to the soups between the experimental groups ($P > 0{\cdot}05$; Table 4). However, there was a significant interaction effect for Experimental Group and Time ($P < 0{\cdot}05$), such that participants added significantly less salt to the salt-reduced soup with a sensory message at visit 4 (0·15 (SE 0·06) g) than at visit 1 (0·27 (SE 0·05) g). Surprisingly, the decrease in the amount of added salt at visit 4 was no longer observed at visit 5 (0·24 (SE 0·08) g). The main effect for Interest in Salt Reduction and the interaction effects were not significant ($P > 0{\cdot}05$). Importantly, consumers added similar amounts of table salt to the salt-reduced soups as to the regular-salt soup, suggesting that adding salt at the table was a habitual behaviour. Across all participants, on average less salt was added back than was originally taken out, with compensation percentages ranging from 60·6 % for the salt-reduced soup with a social message to 75·8 % for the salt-reduced soup without a message (i.e. a 100 % compensation means full compensation via use of table salt; Table 4). This indicates that the net effect for the total group was on average a 29 % reduction in salt intake (i.e. salt content in soups plus added table salt). However, the group of consumers who added salt at each visit (18 %) overcompensated the reduction in salt, with a 30 % higher salt intake for the salt-reduced soups overall.

Discussion

The present study investigated the impact of different front-of-pack messages and repeated consumption on liking, salt taste perception and table salt use of salt-reduced products. The main outcome was that it mattered whether consumers were considering salt reduction or not: the 'not aware, no action' group liked salt-reduced soups with a nutritional message most, whereas the 'salt aware and action' group liked salt-reduced soups with a social message most. In addition, consumers added similar amounts of table salt to the salt-reduced soups as to the regular-salt soup, not only the first time but also over repeated consumption, suggesting that adding salt at the table was a habitual behaviour. Importantly, the net effect

Table 3 Mean (expected) liking, (expected) saltiness and buying intention scores (and their standard errors) for the soups with different communication messages, averaged across the five visits and separate from visit 1 to visit 5, among British consumers (*n* 493) aged 24–65 years, November–December 2013

				Averaged across the five visits		Per visit									
						Visit 1		Visit 2		Visit 3		Visit 4		Visit 5	
	Group	Soup	Message on pack	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Expected liking before tasting†	1 (*n* 104)	30 % reduced salt	No	5·83^{a,b}	0·08	6·37^{A}	0·16	5·87^{A,B}	0·18	5·69^{A,B}	0·18	5·74^{A,B}	0·2	5·46^{B}	0·19
	2 (*n* 107)	30 % reduced salt	Nutritional	5·91^{a,b}	0·08	6·07	0·16	6·06	0·19	5·89	0·18	5·67	0·22	5·87	0·19
	3 (*n* 96)	30 % reduced salt	Sensory	5·93^{a}	0·09	6·16	0·20	5·96	0·17	5·96	0·19	5·77	0·20	5·80	0·20
	4 (*n* 94)	30 % reduced salt	Social	5·71^{b}	0·09	6·22^{A}	0·16	5·83^{A,B}	0·18	5·63^{A,B}	0·21	5·47^{A,B}	0·21	5·38^{B}	0·21
	5 (*n* 92)	Regular salt	No	5·74^{a,b}	0·09	5·99^{A}	0·18	5·75^{A,B}	0·20	5·82^{A,B}	0·19	5·71^{A,B}	0·21	5·46^{B}	0·21
Perceived liking after tasting†	1 (*n* 104)	30 % reduced salt	No	5·50	0·10	5·43	0·24	5·64	0·22	5·42	0·24	5·66	0·23	5·34	0·23
	2 (*n* 107)	30 % reduced salt	Nutritional	5·76	0·10	5·64	0·23	5·92	0·21	5·68	0·23	5·89	0·23	5·66	0·22
	3 (*n* 96)	30 % reduced salt	Sensory	5·59	0·10	5·70	0·24	5·43	0·24	5·31	0·24	5·79	0·22	5·74	0·21
	4 (*n* 94)	30 % reduced salt	Social	5·40	0·11	5·69	0·22	5·35	0·25	5·33	0·22	5·37	0·24	5·27	0·25
	5 (*n* 92)	Regular salt	No	5·57	0·11	5·74	0·25	5·75	0·23	5·38	0·28	5·54	0·25	5·45	0·27
Expected saltiness before tasting†	1 (*n* 104)	30 % reduced salt	No	4·13^{a}	0·08	4·92^{A}	0·18	4·27^{A,B}	0·17	4·12^{A,B}	0·19	3·75^{B}	0·18	3·57^{B}	0·19
	2 (*n* 107)	30 % reduced salt	Nutritional	3·80^{b}	0·08	4·50^{A}	0·17	3·95^{A,B}	0·16	3·73^{A,B}	0·18	3·45^{B}	0·19	3·36^{B}	0·17
	3 (*n* 96)	30 % reduced salt	Sensory	3·83^{b}	0·08	4·75^{A}	0·16	4·29^{A,B}	0·19	3·50^{B}	0·17	3·32^{B}	0·18	3·26^{B}	0·19
	4 (*n* 94)	30 % reduced salt	Social	3·92^{a,b}	0·09	4·73^{A}	0·20	4·06^{A,B}	0·18	3·79^{A,B}	0·20	3·65^{B}	0·20	3·35^{B}	0·19
	5 (*n* 92)	Regular salt	No	3·93^{a,b}	0·08	4·49^{A}	0·18	3·98^{A,B}	0·19	3·74^{B}	0·20	3·62^{B}	0·21	3·82^{A,B}	0·20
Perceived saltiness after tasting†	1 (*n* 104)	30 % reduced salt	No	3·54	0·08	3·44	0·20	3·75	0·19	3·54	0·17	3·63	0·18	3·35	0·18
	2 (*n* 107)	30 % reduced salt	Nutritional	3·36	0·08	3·12	0·17	3·44	0·19	3·48	0·18	3·46	0·18	3·30	0·17
	3 (*n* 96)	30 % reduced salt	Sensory	3·25	0·09	3·11	0·19	3·44	0·20	3·14	0·18	3·23	0·20	3·34	0·20
	4 (*n* 94)	30 % reduced salt	Social	3·27	0·09	3·09	0·19	3·13	0·18	3·44	0·21	3·40	0·22	3·30	0·20
	5 (*n* 92)	Regular salt	No	3·50	0·10	3·34	0·21	3·34	0·21	3·65	0·23	3·79	0·23	3·40	0·21
Buying intention	1 (*n* 104)	30 % reduced salt	No	4·63	0·12	4·60	0·28	4·80	0·25	4·53	0·27	4·80	0·26	4·44	0·26
	2 (*n* 107)	30 % reduced salt	Nutritional	4·90	0·12	5·00	0·27	4·79	0·26	4·73	0·28	5·14	0·27	4·82	0·27
	3 (*n* 96)	30 % reduced salt	Sensory	4·92	0·12	5·01	0·27	4·78	0·27	4·75	0·27	5·09	0·25	4·98	0·26
	4 (*n* 94)	30 % reduced salt	Social	4·65	0·12	5·10	0·27	4·54	0·27	4·52	0·26	4·51	0·27	4·57	0·27
	5 (*n* 92)	Regular salt	No	4·94	0·13	5·23	0·31	5·02	0·28	4·73	0·31	4·95	0·29	4·78	0·32

^{a,b}Mean values within columns with unlike superscript lower-case letters were significantly different ($P < 0{\cdot}05$).
^{A,B}Mean values within rows with unlike superscript upper-case letters from visit 1 to visit 5 were significantly different ($P < 0{\cdot}05$).
†Expected and perceived liking and saltiness were measured on a 9-point scale: 1 = 'not liked at all'/'not at all salty' to 9 = 'liked very much'/'very salty'.

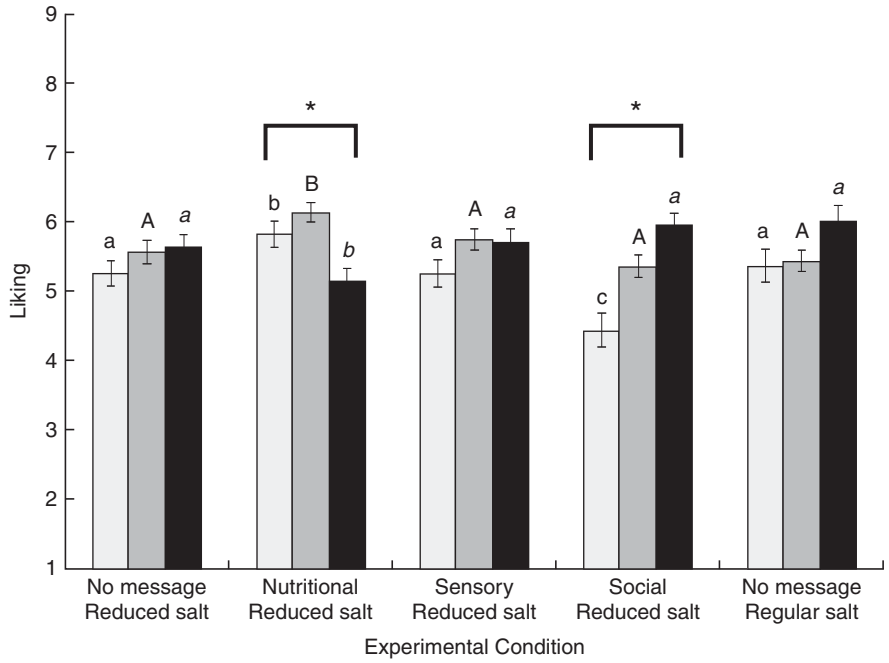

Fig. 2 Mean liking scores of the soups (with their standard errors represented by vertical bars) per experimental condition for the 'not aware, no action' (□), 'aware, no action' (▨) and 'aware and action' (■) Interest in Salt Reduction groups, measured on a 9-point scale (from 1 = 'not liked at all' to 9 = 'liked very much'), among British consumers (n 493) aged 24–65 years, November–December 2013. *Mean values were significantly different between the three Interest in Salt Reduction groups for the same soup. [a,b,c]Mean values for products with unlike superscript lower-case letters were significantly different within the 'not aware, no action' group across the soups ($P < 0{\cdot}05$). [A,B]Mean values for products with unlike superscript upper-case letters were significantly different within the 'aware, no action' group across the soups ($P < 0{\cdot}05$). [*a*,*b*]Mean values for products with unlike superscript lower-case italic letters were significantly different within the 'aware and action' group across the soups ($P < 0{\cdot}05$)

for the total group was on average a 29 % reduction in salt intake (i.e. salt content in soups plus added table salt). Further research under realistic choice conditions in a 'real-world' environment is required to confirm these findings.

Salt is commonly used to provide a salty taste and to enhance or interact with other flavour elements of foods, for example to suppress unpleasant tastes such as bitterness[18,52]. We therefore expected the salt-reduced soup to be less salty and less liked than the regular-salt soup: the salt was removed and not replaced by other salts nor was the recipe adjusted in other ways to compensate for the reduction in salt. In contrast to our expectations, the perceived saltiness and liking of the salt-reduced soup were similar to the saltiness and liking of the regular-salt soup without a message, initially and over repeated consumption. This is in line with earlier research showing similar effects in soups where salt had been reduced by up to 32 %[20,28,29]. It contradicts other research showing significantly lower saltiness and liking scores for comparable reduced-salt samples[35]. An explanation for these contrasting findings might be found in the study design used. Whereas the former studies and the current study used a between-subjects design in which participants tasted only one of the products as such, the study of Liem *et al.*[35] used a within-subjects design in which participants tasted all products successively in one session and could directly compare one product with another. These different results may thus reflect context effects on judgements of taste intensity and liking[53,54]. This also implies that a coordinated industry-wide approach is required to reduce the salt content of food segments simultaneously, because if only some food manufacturers in a certain food segment reduce the salt content of their products it will be more difficult for consumers to learn to like the taste of salt-reduced foods[14].

The fact that we did not find a main effect of the front-of-pack messages on liking is surprising, as we predicted based on earlier research that salt-reduced soups with a sensory or social message would score higher on liking than the same products with a nutritional message or no message. However, when we compared consumers in the different stages of change, we found an interaction between experimental group and the stages of change: the 'not aware, no action' group had the highest liking scores for the soups with the nutritional message, whereas the 'aware and action' group had the highest liking scores for the soup with the social message. The present study is the first one that has investigated the stages of behavioural change for salt reduction in relation to salt taste perception and acceptance of salt-reduced foods. With regard to behaviour change and salt intake behaviours, the most impactful salt reduction initiatives around the world were those that combined food reformulation with consumer

Table 4 Mean table salt use and salt compensation (and their standard errors) among consumers who added salt over time, per 200 ml of soup and message condition, among British consumers (*n* 493) aged 24–65 years, November–December 2013

				Averaged across the five visits		Per visit									
						Visit 1		Visit 2		Visit 3		Visit 4		Visit 5	
	Group	Soup	Message on pack	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Salt added (g)	1	30 % reduced salt	No	0·25	0·04	0·29 (*n* 58)‡	0·04	0·21 (*n* 44)	0·04	0·28 (*n* 46)	0·05	0·17 (*n* 35)	0·05	0·29 (*n* 43)	0·08
	2	30 % reduced salt	Nutritional	0·23	0·02	0·28 (*n* 65)	0·03	0·19 (*n* 43)	0·03	0·25 (*n* 47)	0·05	0·18 (*n* 40)	0·05	0·27 (*n* 53)	0·07
	3	30 % reduced salt	Sensory	0·21	0·03	$0·27^{A}$ (*n* 51)	0·05	$0·22^{A,B}$ (*n* 35)	0·05	$0·17^{A,B}$ (*n* 30)	0·05	$0·15^{B}$ (*n* 23)	0·06	$0·24^{A,B}$ (*n* 39)	0·08
	4	30 % reduced salt	Social	0·20	0·04	0·21 (*n* 52)	0·04	0·20 (*n* 37)	0·05	0·20 (*n* 41)	0·04	0·20 (*n* 32)	0·05	0·21 (*n* 33)	0·07
	5	Regular salt	No	0·24	0·02	0·27 (*n* 43)	0·04	0·22 (*n* 40)	0·04	0·25 (*n* 38)	0·05	0·21 (*n* 30)	0·07	0·26 (*n* 40)	0·05
Compensation (%) relative to regular-salt soup†	1	30 % reduced salt	No	75·8	7·8	87·9	11·9	63·6	13·6	84·9	12·4	51·5	27·4	87·9	12·1
	2	30 % reduced salt	Nutritional	69·7	5·7	84·9	10·0	57·6	10·1	75·8	14·2	54·6	12·3	81·8	16·1
	3	30 % reduced salt	Sensory	63·6	6·4	$81·8^{A}$	12·5	$66·7^{A,B}$	13·6	$51·5^{A,B}$	12·1	$45·5^{B}$	14·4	$72·7^{A,B}$	18·0
	4	30 % reduced salt	Social	60·6	11·5	63·6	9·9	60·6	13·1	60·6	10·9	60·6	55·10	63·6	16·0

[A,B]Mean values within a row with unlike superscript upper-case letters from visit 1 to visit 5 were significantly different ($P < 0·05$).
†0·33 g salt was taken out per portion of 200 ml soup.
‡Number of participants who added salt.

education and front-of-pack labelling actions, such as the Healthy Choice logo or Guideline Daily Amounts (%)[12,55]. The national salt campaigns in the UK and Finland are the most cited examples to show that modest reductions in dietary salt intake can be achieved at population level, although it is not precisely clear which specific aspects of the strategies contributed to this[36,56–58]. In a study conducted by Newson *et al.*[9], countries differed in the extent to which their populations were interested in reducing salt intake. Given the observed differential effects of front-of-pack messages among the Interest in Salt Reduction groups in our study, tailored, country-specific communication strategies based on countries' action states may be required not only in nutrition communication and education programmes, but also in front-of-pack communication messages of salt-reduced products.

Participants expected salt-reduced soups at first exposure to be saltier than on the fourth and fifth exposure. However, we could not confirm our hypothesis that salt-reduced soups with a sensory or social message on-pack would score higher on salt expectations compared with salt-reduced soups with a nutritional message. It could be that familiarity with the brand or the presence of other packaging information may have overruled the specific message effects on saltiness expectations. In addition, participants perceived the soups with the different messages to be similar in saltiness, initially and over repeated consumption. A reason could be that a longer exposure period is required to have larger impacts from the front-of-pack messages on salt taste responses while tasting.

Despite clear effects of front-of-pack messages on expected liking and saltiness of the soup, no evidence was found for transfer of these effects to buying intention. It is important to realize that buying intention was measured after respondents had tasted the soup and that actual liking did not differ across the different front-of-pack messages. We would argue that expected liking and expected saltiness will influence the decision to buy a product in store, where there is usually not an opportunity to taste the soups (cf. Zandstra *et al.*[50]).

There does not seem to be any evidence of reduced table salt added over time due to a learning process that would take place over repeated exposure. Interestingly, the amount of salt added back to the regular-salt soup was similar to that of the salt-reduced soup, which suggests a strong role for habit in table salt use. Earlier research showed that people only partly compensated via a salt shaker when their total diet was reduced in salt[33]. Recent research showed that if the salt content of a single product was reduced to an unacceptably low level, consumers added extra salt at the table, even to the point of over-compensation[34,35]. In line with earlier research, our study showed that some respondents compensated as well: 51 % of participants infrequently added salt to the soups (adding salt at two to four visits) and 18 % added salt at each visit. Despite this, a 29 % reduction in salt intake overall was still achieved. A further reduction of table salt use may be achieved by increasing consumers' awareness of the need to reduce salt intake. A recent study showed that the number of people in the UK adding salt to food at the table fell by more than a quarter in the five years following a national salt reduction campaign[36]. The study showed that from 1997 to 2007 there was a steady decline in salt use at the table, but this reduction was greater after the introduction of the national salt reduction campaign in 2003. An additional reduction of table salt use may be achieved by reducing the size of holes in salt shakers because of the strong role for habit in table salt use[59,60]. For example, research has shown that significantly less salt was used with small- as compared with large-holed salt shakers, both in a canteen setting at a company[19] as well as in takeaway meals from shops[61]. Importantly, just as in our study, there was no evidence that this effect disappeared over time as people got more familiar with the salt shakers and/or products[19].

A few limitations of our research should be mentioned. Salt preference may depend on overall dietary salt intake: individuals who consume a high-salt diet generally prefer saltier foods[62] and consumers who consume a low-salt diet generally prefer less salty foods[23,24]. Our study would therefore have benefited from dietary assessment measures to assess each participant's dietary salt intake and how this may have affected liking and salt taste perception scores of the salt-reduced soups. Also, it could have been that the social message was not framed in the most optimal way to maximize its effectiveness. Almost half of the population did not have children, and the social message 'More taste, less salt and kids will love it' may have been perceived as less relevant for them compared with the other half of the population with children. In addition, this research took place in a laboratory setting in sensory booths at a central location. Previous research showed that the context in which testing is conducted can bias observations: larger reductions in salt content of a food were accepted when assessed in a home environment compared with a laboratory setting[29]. It is therefore critical to extend the current research towards realistic choice and consumption conditions in natural contexts as well. In a similar vein, the study needs to be replicated to confirm the applicability of the findings in other manufactured products and other populations.

Conclusion

In conclusion, research in the area of consumer perception of salt reduction is limited, while the need for acceptable salt-reduced products is high. To our knowledge, the present study is the first that investigated the impact of different front-of-pack messages on salt taste perception and table salt use of salt-reduced products over

time. Given the observed differences in acceptance of salt-reduced products between different front-of-pack messages and Interest in Salt Reduction groups, this research provides further evidence that a country-specific tailored communication strategy is recommended to attract consumers towards salt-reduced products based on their action state. How to best inform consumers about healthier options, drive purchase and choice behaviour, and minimize counteractive table salt use behaviours are still unanswered questions.

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