To see is to hold: Using food surface textures to communicate product healthiness

Does the surface texture of a biscuit influence how healthy it is perceived to be? If so, can it be used as a cue to encourage healthy food choice? The answer to these questions would appear to be yes, as previous research has demonstrated that extrinsic information such as packaging and labelling can alter the experiences and perception of food products. (e.g., Andrews, Netemeyer, & Burton, 1998; Belei, Geyskens, Goukens, Ramanathan, & Lemmink, 2012; Hersey, Wohlgenant, Arsenault, Kosa, & Muth, 2013; Liem, Aydin, & Zandstra, 2012; Verbeke, Scholderer, & Lähteenmäki, 2009). Implicit cues, such as packaging shape, have also been found to have the capability to alter healthiness perception of products (e.g. van Ooijen, Fransen, Verlegh & Smit, 2016). However, it is not clear if this is equally applicable to food items as it is to food packaging. Hence, in this paper, we investigate whether explicit and implicit food surface textures have the ability to influence healthiness inferences. Furthermore, it is explored whether specific surface roughness of biscuits can alter peoples' perception and thus help manufacturers to create biscuits that can communicate a 'healthy' message.

Background literature and hypotheses

The World Health Organisation (WHO) has declared that there is an ongoing global obesity epidemic and unfortunately unhealthy foods, such as biscuits, contribute to the development and maintenance of obesity (WHO, 2016). Many scientists have called for a reduction in the intake of added sugars (e.g. Johnson et al., 2009) and food policy related authorities are looking for ways to decrease the intake of unhealthy foods. This is most commonly done through the communication of nutrition information (FDA, 2016). For example, in the UK, products have a traffic light display system on the front of packaging to warn people whether products contain high levels of sugar and fat. However, such systems do not appear to deter people from choosing unhealthy products. At least partially, this is because the nutrition information is offset by the appealing physical appearance and packaging of high fatty and sugary foods (Chandon, 2013). Thus, we need a better understanding for how consumers can be encouraged to eat healthier.

Explicit and implicit cues

In a meta-analysis conducted by Piqueras-Fiszman and Spence (2015), 65 out of 78 studies showed that extrinsic information affects taste and hedonic evaluation. Thus showing that

information retrieved from packaging can alter a consumer's experience of food as extrinsic attributes are transferred to their sensory perception of a product. This happens because consumers have expectations aligned to the extrinsic information about how it may taste and what it represents. For example, when packaging is used that signifies a slim body shape it acts as a symbolic cue for being a low calorie product (van Oijen et al., 2016). Though the product body shape only increases likelihood of choice when people have a health-relevant shopping goal. However, explicit information is not always effective in that if consumers scrutinize it, it has the capacity to induce resistance to persuasion and thus reduce the effectiveness (Brehm, 1966; Darke & Ritchie, 2007; Fransen, Verlegh, Kirmani, & Smit, 2015; Friestad & Wright, 1994). This raises the possibility that implicit cues may be more effective to communicate healthiness of foods. Implicit visual cues are subtle and often go unnoticed by a person. Recently there has been a spate of interest in implicit means of communication (Becker, van Rompay, Schifferstein, & Galetzka, 2011; Spence, 2012; van Rompay, Fransen & Borgelink, 2014), but it has not focussed on the healthiness of foods. It is possible that implicit food cues can be used to steer consumers' perception for perceived healthiness. If so, it could be a useful tool in settings such as supermarkets, where consumers often lack the cognitive ability to explicitly process information aimed to influence their purchases (Newman, Howlett, & Burton, 2015; van Ooijen et al, 2016). Therefore, knowing whether implicit and explicit cues both have the capacity to affect food perception can have important implications for food manufacturers trying to promote healthy foods. Hence this is reflected in the first hypothesis.

H1: Implicit cues, just like explicit cues, have the ability to affect food perception.

Cross-modal correspondence

Sensory input through one sense can affect another (Labbe Damevin, Vaccher, Morgenegg, & Martin, 2006; Lawrence, Salles, Septier, Busch & Thomas-Danguin), which is known as cross-modal correspondence (Spence, 2011). Commonly, the first sensorial instrument relied upon when choosing and evaluating food products is vision (Imram, 1999). It is therefore essential to understand how other sensory cues such as touch can influence visual perception. The last decade has seen a considerable amount of evidence for how cross-modal correspondence can affect consumer perception. Such work has provided valuable insight into how materials and textures can influence the taste experience (Biggs et al., 2016; Piqueras-Fiszman & Spence, 2012; Schifferstein, 2009; Spence & Wan, 2015; Van Rompay et

al., 2018). For example, biscuits in rough packaging are rated crispier than identical biscuits in a smooth package (Piqueras-Fiszman & Spence, 2012). Whilst vanilla ice cream is perceived to be sweeter when sampled from a smooth textured rather than a sharp feeling cup (van Rompay et al., 2018). Such findings indicate that expectations of taste are based on visual or tactile exposure prior to tasting and this is most likely guided by previous experiences which has taught us to associate specific properties with different foods (Deroy, Crisinel, & Spence, 2013).

Texture and haptic input

Predominantly, researchers have focussed on how textural characteristics affect the liking of food whilst eating. For example, Slocombe, Carmichael and Simner (2016) got participants to taste food items that had a rough or a smooth surface but were otherwise identical. They found that food was rated as significantly more sour if it had a rough surface. However, in addition to taste, tactile input through our hands can also create sensations related to food textures (Szceszniak, 2002). Haptic information can have a significant impact upon consumer perception (Jansson-Boyd, 2011) including food texture (Jansson-Boyd, 2018). There are some indications as to what specific textures can enhance or alter food perception. For instance, Barnett-Cowan (2010) revealed that touching the food has an impact on perceived freshness. In his experiment, participants evaluated freshness, staleness, crispiness and softness of pretzels. In half of the tests, participants were given pretzels in incongruent condition (half fresh-half stale) while in the other half of the tests, they were given pretzels in congruent condition (whole stale or whole fresh pretzel). The stale half of pretzel was perceived as significantly fresher and crispier when the fresh side was touched and held in the hand, and vice-versa. Similarly, this has also been found by Piqueras-Fiszman and Spence (2012). They investigated how changing the surface texture of packaging affects consumers' perception of the product contained within. In their study, participants were handling a serving pot in one hand and taking the food contained within the pot with the other hand. After the tasting, samples from a rougher pot were rated as significantly crunchier than those from a smooth pot. Also, Biggs et al. (2016) investigated the influence of crockery texture on people's taste and mouthfeel ratings of food, this time using biscuits. They found that participants perceived biscuits to be crunchier, more salty and gingery when taken from a rough plate and sweeter when taken from a smooth plate. This was similarly reported by Mesz et al., (2011) who found that uneven and rough surfaces enhance saltiness impressions. The aforementioned studies indicate that texture has an integral part to play in

the perception of foods. The fact that haptic information can alter the perception of a consumed product in the mouth can be explained by an associative learning approach to cross-modal experiences (Deroy et al., 2013). This would explain why in the aforementioned studies that rough and uneven surfaces can produce a salty based perception of foods (e.g. Biggs et al. 2016; Mesz et al., 2011), as the visual and tactile properties of salt crystals feel and look rough and irregular and thus people come to associate rough surfaces with salt. Rough surface textures in previous studies have generated food perceptions such as sour (Slocombe et al., 2016) and salty (e.g. Biggs et al. 2016; Mesz et al., 2011). It is therefore, supposed that applying a rough surface texture to a biscuit that is commonly cognized to be 'sweet' will alter such perceptions. Furthermore, food textures have been found to influence people's dieting choices. In a study where participants were presented with orally based haptic cues, smooth vs. rough, it was found that smooth textures lead to higher calorie estimations (Biswas, Szocs, Krishna & Lehmann, 2014). The outcome was that people perceived the smooth textures as less healthy than the rough ones, thus suggesting that some textures can be more closely connected with healthiness.

Consequently, some food surface textures may be more likely to be perceived as healthy, whilst others as unhealthy. Based on this we hypothesised that:

H2: A rough textured surface will generate a healthier perception than smoother textures.

As distinct textures remind people of haptic properties of a product and thus guide their perception based on what something may 'feel' like to touch (e.g. Jansson-Boyd & Hurling, 2018), this can also influence perceived crunchiness and chewiness. Crunchy and chewy textures can significantly contribute to whether foods are enjoyable (Szczesniak & Khan, 1971; 1984, Tunick et al., 2013; Vickers, 1983; 1991). Such enjoyment is likely to be product specific but in the case of oat biscuits, it is feasible to assume that consumers associate them with a relatively hard texture. Based on the associative learning approach to cross-modal experiences, course textures ought to be perceived as crunchier, whilst smoother surfaces are more likely to generate a perception of chewiness. Thus, it was hypothesised that:

H3: Participants will perceive rough surfaced biscuits as crunchier.

H4: Smooth surfaces will be perceived as chewier than rough surfaces.

Opposing healthy foods

If consumers are adverse to eating healthy foods, it should be possible to use non-healthy textures to enhance hedonic evaluations of healthier food options. Hence surface textures could be used by food manufacturers to overcome health-compromising heuristics, such as "healthy is not tasty" (Raghunathan, Naylor, & Hoyer, 2006) that some consumers may have. As people are capable of judging texture non-orally by simply looking at the surface of the products (Imran, 1999), and textural characteristics are an important parameter for influencing purchase (Bower & Whitten, 2000), it is important to get the visual surface characteristics right. Thus, understanding whether surface texture communicates specific food properties is important. Based on the findings of Piqueras-Fiszman and Spence (2012) as well as Biggs et al. (2016), it was thought that biscuits with a rougher surface would be perceived as being healthier. If this is correct, the rough textured biscuit should generate lower ratings for likelihood of purchase. We test this notion on the basis that people are less likely to want their biscuits to be healthy:

H5: Rough surface textures will influence the likelihood of purchase negatively.

Product aesthetics are known to influence likelihood of purchase (Jansson-Boyd, 2011). Therefore, it stands to reason that textures that are perceived as unappealing (perhaps due to being perceived as healthy) will also affect purchase likelihood. This being because people are not always willing to compromise sensory characteristics for health (Carillo et al., 2012). Equally, if rough surface textures are perceived as healthier, this should in turn affect perceived pleasantness of the different surface textures as well as perceived tastiness. This underpins the last two hypotheses:

H6: Smooth textures are perceived as more pleasant than rough textures.

H7: Smooth textures are perceived as tastier than rough textures.

The primary area of interest here is to establish whether surface textures play a key role in the perception of healthiness. This could have simply been explored without the inclusion of measuring additional measures of inferential (i.e. tastiness and likelihood of purchase) and texture based (i.e. texture pleasantness, crunchiness and chewiness) attributes. However, if we wish to better understand how to entice consumers with healthy products it is also important to be aware of whether textures that are associated with healthiness are also perceived as, for example, tastier. That way a more holistic perspective is produced.

METHODOLOGY

Participants

Eighty-eight participants took part in this study. There were 57 female, 26 male and 5 participants who did not wish to state their gender. Participants were recruited on a voluntary basis among students and staff at a UK based university. All were given a copy of the participant information sheet and they signed the consent form at the beginning of the experiment. At the end, participants were debriefed and given a small sweet to thank them for participating. The study was approved by the psychology department's research ethics panel at Anglia Ruskin University.

Stimuli

Six round oat biscuits with a diameter of 8.5 centimetres were used in the study. Great care was taken to ensure that all samples had an identical composition in terms of size, colour and shape. Three biscuits were 'clearly textured' (explicit stimuli) and three were 'non-clearly textured' (implicit stimuli) see Figure 1a and b. Both the intrinsic and extrinsic category had biscuits with a smooth, medium and rough surface texture. The explicit stimuli had an uneven slightly rough surface, and thus the 'smooth' textured biscuit was left with its original surface. To make medium and rough textured biscuits a ridged surface pattern was added by using a cake scraper decorating comb with a jagged edge. The rougher the surface texture the closer together the ridges were. The implicit surface textures were created by using oats and they were attached by using food glue. The rough surface texture had 2/3 more oats than the medium surface texture that had 2/3 more oats on it than the smooth textured biscuit.

Oat biscuits were used because they can represent a "healthy" or an "unhealthy" snack and it is relatively easy to manipulate their surface to create different textures. Explicitly and implicitly textured biscuits were used to test if participants would perceive different surface textures, as smooth, medium and rough, in a similar fashion regardless of whether they were implicit or explicit. The decision to use 3 types of surface textures was based on the fact that previous studies have mainly looked at smooth and rough differences. Thus, we wanted to include a medium texture as a comparison as we did not just wish to look at extreme differences.

Pre-test

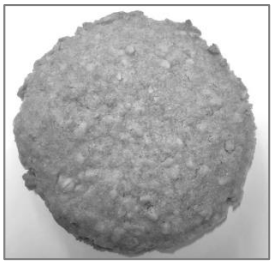
The surface textures had been pre-tested both visually and through a blind haptic evaluation. In the first pre-test, eight participants (four female and four male, mean age 35.8) were asked to put their hand over the surface textures, one biscuit at the time, and rate how rough they thought it was. In the second pre-test, participants visually rated roughness of each one of the biscuits. Participants indicated (using a 9 point Likert scale) to what extent they considered the stimuli to be rough. The pre-tests were conducted to ensure that it was visually obvious that the 'clearly textured' biscuits had a smooth, a medium and a rough texture. Whilst the 'non-clearly textured' biscuits were haptically perceived as having different tactile surfaces but that it was visually not obvious. Additionally, blind haptic testing was conducted to ensure that tactile properties were aligned with the visual properties to ensure congruency between the two. For the visual evaluation for the explicitly textured biscuits a mean value of 4.0 was found for the smooth texture, 5.2 for the medium texture, and 7.1 for the rough texture. A similar result was also generated for the blind haptic testing where the smooth texture had a mean value of 3.9, the medium texture 5, and the rough texture 6.8. Whilst for the implicitly textured biscuits the visual evaluation generated a mean value of 6 for the smooth texture, 6.1 for the medium texture, and 6.2 for the rough texture. The blind haptic evaluation generated a mean value of 4.1 for the smooth texture, 5.1 for the medium texture, and 6.2 for the rough texture. The blind haptic evaluation differed from the visual evaluation of the implicit textures. Thus, confirmation that participants could not visually detect the surface difference, but they could feel that they were different. The blind haptic evaluation also confirmed that both implicit and explicit textures were comparable in terms of how they felt.

Procedure

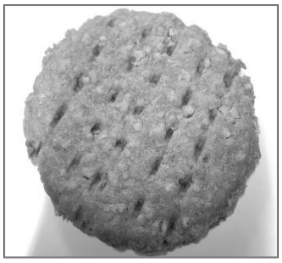
Participants had to rate the explicitly and implicitly textured biscuits. The six biscuit samples were presented one by one on a white plate. Participants were asked to look at the biscuits but they were not allowed to touch them. They were not told to pay attention to any particular characteristic of the presented samples and they could look at the biscuits for as long as they wanted. For each biscuit, participants had to fill in a 9-item response sheet based on two categories of attributes.

1. *Texture based attributes*: attributes that are closely aligned with textures. The attributes were roughness, texture pleasantness, crunchiness and chewiness. Roughness was included as a control measure to ensure that they were similar to the results from the pre-test.
2. *Inferential attributes*: attributes that are predominantly inferred from the biscuits. These were healthiness, tastiness and likelihood of purchase.

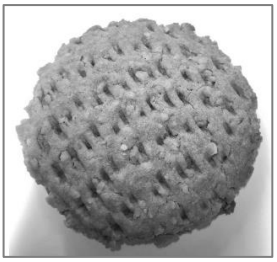
All questions were answered on a 9-point Likert scale where 1 indicated “not at all” and 9 “extremely”. In order to control for order effect, both the orders of the evaluations and the individual stimuli within each of the evaluations were randomised across the 6 biscuits.



Biscuit 1: Smooth texture



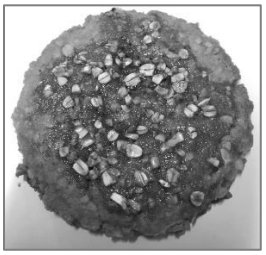
Biscuit 2: Medium texture



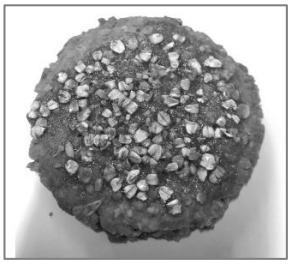
Biscuit 3: Rough texture

Figure 1a. Shows the explicitly textured biscuit category used in the pretest and main study.

Biscuit 4: Smooth texture



Biscuit 5: Medium texture



Biscuit 6: Rough texture

Figure 1b. Shows the implicitly textured biscuit category used in the pretest and main study.

RESULTS

The study set out to investigate to what extent different surface textures affects perception of biscuits. Seven hypotheses were explored by testing 4 texture based and 3 inferential attributes. Repeated measures ANOVA was used to analyze the data for each one of the concepts tested. Additionally, paired sample t-tests were used for post hoc-testing to allow for the comparison of two specific variables.

Implicit and explicit cues and their relationship to perceived healthiness

The results showed that there was a significant difference between the ratings for explicitly and implicitly textured biscuits (F (1, 87) = 34.94, p = 0.000). The explicitly textured biscuits were perceived as having different surface textures (F (2, 174) = 30.31, p = 0.000). Post-hoc paired sample t-tests revealed that there was a significant difference between Biscuit 1 and Biscuit 2, t = -4.57, df =87, p < .001, biscuit 1 and 3 t = -7.49, df = 87, p < .001, as well as Biscuit 2 and 3 t = -3.25, df = 87, p < .002. The implicitly textured biscuits were rated as having a less obvious surface texture and thus no significant difference was found. Hence confirming that the participants perception of the biscuits were aligned with those in the pre-test. For mean values see Figure 2.

A significant difference was found between implicit and explicitly textured biscuits for perceived healthiness (F (1, 87) = 11.54, p = 0.001). An interaction effect between implicit/explicit surfaces and texture was also found to be significant (F 2, 174) = 5.38, p = 0.005). Therefore, hypothesis 1 is accepted. Post-hoc tests revealed that there was a significant difference in implicitly textured biscuits F (2, 174) = 5.12, p = 0.007) and specifically there was a difference between Biscuit 5 and 6, t = -3.39, df =87, p < .001. Thus, hypothesis 2 is accepted but only based on implicitly textured biscuits.

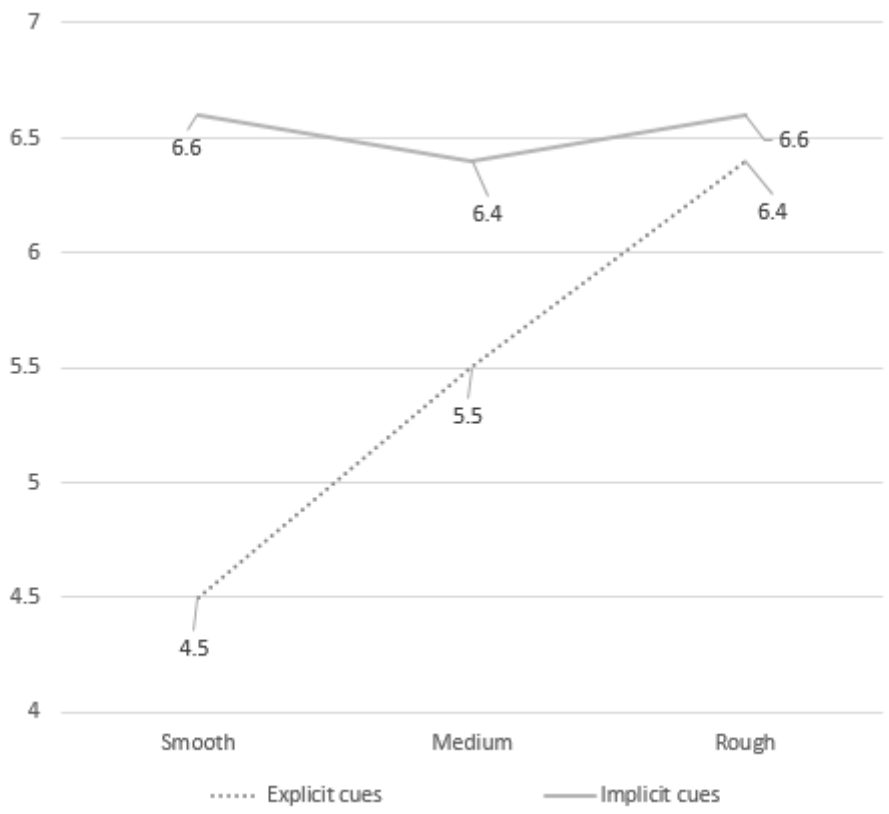


Figure 2. Mean ratings for how rough the surface texture of the cookies were perceived to be

Texture based attributes

A significant difference was found between implicit and explicit textures for perceived crunchiness (F (1, 87) = 17.80, p = 0.000). Additionally, a significant difference between textures was found for perceived crunchiness (F (1, 87) = 3.88, p = 0.023). The mean values for textures were 5.54 for the smooth, 5.67 for the medium and 5.92 for the rough textured biscuit. This shows that overall the rough textures were perceived as crunchier and H3 can be accepted. Post-hoc tests revealed that there was a significant difference for perceived crunchiness but only for the implicitly textured biscuits F (2, 174) = 2.94, p = 0.05). Specifically, the difference in perception was found to be between Biscuit 4 and 6, t = 2.06, df =87, p < .05, as well as biscuit 5 and 6, t = 2.19, df =87, p < .05. For mean values see Table 1. No significant differences were found for texture pleasantness or chewiness. Consequently, hypotheses 4 and 6 have to be rejected.

Explicitly textured	**Healthiness**	**Tastiness**	**Likelihood of purchase**	**Crunchiness**	**Chewiness**	**Pleasantness**
Biscuit 1	5.61	4.56	4.27	5.08	5.67	4.27
Biscuit 2	5.81	4.58	4.00	5.30	5.55	4.00
Biscuit 3	5.54	4.52	4.27	5.44	5.62	4.23
Overall mean	5.65	4.55	4.18	5.27	5.61	4.16
Implicitly textured						
Biscuit 4	4.86	5.53	4.80	6.01	5.34	4.80
Biscuit 5	4.69	5.98	4.94	6.04	5.35	4.94
Biscuit 6	5.22	5.86	4.92	6.39	5.51	4.92

Overall mean	4.92	5.79	4.89	6.15	5.40	4.88

Table 1. Individual and overall mean values for all six biscuits.

Inferential attributes

Likelihood of purchase was found to have a significant difference between implicitly and explicitly textured biscuits (F (1, 87) = 9.01, p = 0.003). Overall, implicitly textured biscuits were rated as more likely to be purchased. There is no clear evidence that rough surfaces decreased likelihood of purchase and thus H5 is rejected. A significant difference was also found between implicit and explicitly textured biscuits for perceived tastiness (F (1, 87) = 36.03, p = 0.000). Mean values can be seen in Table 1 and a visual overview of the significant variables measured can be seen in Figure 3a and 3b.

No support was found for hypothesis 7 in that smooth textures were not consistently found to be perceived as tastier.

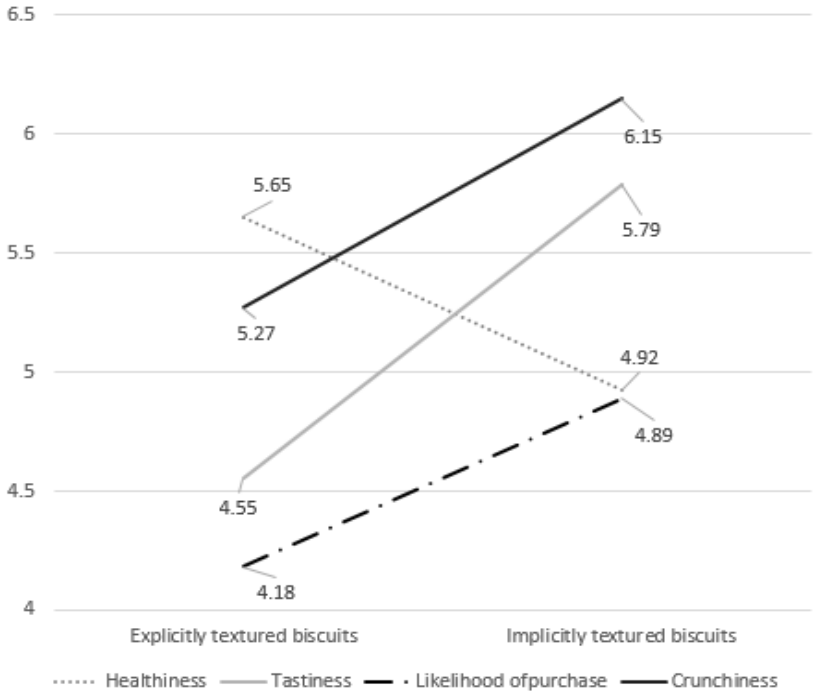


Figure 3a

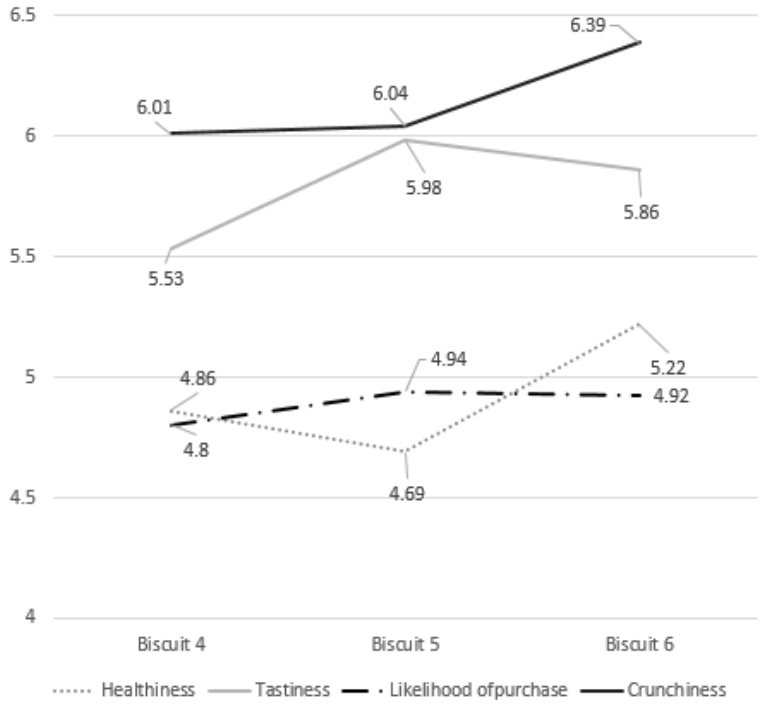


Figure 3b

Figure 3a shows overall significance ratings between explicitly and implicitly textured biscuits. Figure 3b shows the relationships between significant variables measured for the implicitly textured biscuits.

DISCUSSION

A clear difference was found between implicitly and explicitly textured biscuits. Participants rated the surface textures of Biscuits 1, 2, and 3 as being noticeably different whilst 4, 5 and 6 were rated as having an equally rough surface texture. Thus, you would expect that Biscuits 1, 2, and 3 would be perceived differently and that 4, 5, and 6 would be perceived the same. However, this is not what was found. Instead, we found significantly different ratings for 4, 5 and 6 and it therefore shows that implicit food cues are overall more effective in altering biscuit perception. It is likely that obvious surface textures on 1, 2 and 3 were 'apparent' persuasive cues and participants scrutinised the explicit information and consequently reduced their effectiveness (e.g. Darke & Ritchie, 2007; Fransen et al., 2015).

Implicitly perceived textures were seen as being overall less healthy (M = 4.92) than explicitly textured biscuits (M = 5.65). Furthermore, implicitly based textures were overall perceived to be more tasty (M = 5.79), crunchy (M = 6.15) and likely to be purchased (M = 4.89) than explicitly textured biscuits, as can be seen in Figure 3a. It is clear from this that cross-modal correspondence of implicit and explicit surface textures takes place as they are perceived differently. Hence, people use their previous experience to deduce how they should perceive the biscuits based on the surface textures.

A significant difference in perceived healthiness for the implicitly textured biscuits was only found between Biscuit 5 (M = 4.69) and Biscuit 6 (M = 5.22). For the implicitly textured biscuits it was also found that ratings increased linearly for perceived crunchiness. Biscuit 4 was perceived as the least crunchy (M = 6.01), followed by Biscuit 5 (M = 6.04) and then Biscuit 6 (M = 6.39). Both Biscuit 4 and 5 was significantly different to Biscuit 6.

The idea that rougher surface textures would affect likelihood of purchase negatively (H5) did not prove to be correct. Neither was the postulation that smooth textures would be perceived as tastier than rough textures (H7). In both cases, a difference was found between implicitly and explicitly textured surfaces, and overall implicitly textured biscuits were found to be tastier and more likely to be purchased. These results may also be related to the lack of apparent persuasive textural cues on the implicitly textured biscuits. It seems that the explicitly textured biscuits are 'off-putting' in that it is evident that the texture is trying to communicate something (e.g. Darke & Ritchie, 2007; Fransen et al., 2015).

When implicit cue textures are used, it increases the possibility that people are affected by the different surface textures as they are unaware of any differences. This is clear from both the healthiness and crunchiness measures. Looking at the means for the implicitly textured biscuits (Table 1) it appears that Biscuit 5 (the medium texture) generates noteworthy differences as it is rated the lowest on healthiness, highest on tastiness and highest on likelihood of purchase. Equally, it is worth noting that the rougher the texture, the more healthy and crunchy they are perceived to be. It may be that there is such a thing as an 'optimal' surface texture that generates specific desirable assessments that are based on previous experiences. In this study, it appears that when there is an implicitly medium texture, it generates an overall more favourable outcome. That is if it is assumed that a biscuit that is very 'healthy looking' is considered a negative attribute in that it is likely to decrease perceived tastiness, a key criteria for purchasing biscuits.

Even though tastiness was not significantly different, a trend can be noted from Figure 3b in that perceived tastiness increases as healthiness decreases. This can also be observed for likelihood of purchase as it increases when perceived healthiness is low and decreases when healthiness is higher.

Denotations

In this study, three out of the seven hypotheses tested were accepted. Of the three accepted, one was partially accepted. Nevertheless, there is real value in the outcome of the study in that it shows, just as with packaging (e.g. Liem, et al., 2013), that food surface textures can be used as a means to communicate (or not to communicate) product healthiness. Bearing in mind that in many instances food items such as biscuits are not always sold with packaging, it is important to understand how nutritional cues can be conveyed to consumers. Moreover, it was found that implicit cues are more effective than explicit surface textures when it comes to the influence of biscuit perception. Thus, proving that less obvious surface textures can be helpful in altering consumer perception, something that had previously not been tested. Interestingly, the ratings for tastiness, likelihood of purchase and crunchiness, all increased when the biscuits were implicitly textured. It can also be noted that the implicitly rough textured biscuits generated an even higher rating of crunchiness and thus providing an overall better understanding for how the textures interact with other variables.

Limitations and future directions

Whilst we recognise that this is an exciting starting point in furthering how food surface textures affect health perception, we do also recognise that there are some shortcomings with this study. The visually textured differences between the implicit and explicit biscuits may have generated some of the effects recorded. Creating ecologically valid stimuli that considers the implicit and explicit differences is difficult. For this study, we wanted to make use of real biscuits that did not look artificial. It is likely that this had some affect on this study. However, our pretest found that the participants could not see a visual difference but could detect it when touching the surfaces. Whilst for the explicitly textured biscuits they could both feel and see the differences. Therefore, whether they could visually see the differences is not disputable but it is possible that the specific biscuit surface designs had a

role to play in participants' responses. This ought to be taken into account in future studies so that it can be confirmed or discounted.

Whilst this study has shown that there is an association between healthiness perception and rough textures for implicitly textured biscuits, it is essential to explore this in more detail as well as on other food items. It would also be interesting to look at whether textured cues are more or less influential depending on how health conscious people are as well as whether the textures affect calorie perception (Biswas et al., 2014).

Just like many other food products, biscuits are associated with numerous different types of physical attributes and not just those tested here, e.g. crunchiness. Therefore, it would be interesting to extend the number of both texture based attributes and inferential attributes to generate a clearer picture of their direct or indirect relationship with healthy surface textures.

Furthermore, it would be useful to test our findings alongside different types of orally based haptic cues. Presumably, if orally and visually based cues are congruent, a unimodal affect should emerge and a stronger health perception should be evoked. This could also be tested against how it feels to hold differently textured biscuits and whether that in turn has a significant role to play.

Conclusion

Due to the fact that no tasting is usually allowed before buying food products, the results have potentially important implications for how food manufacturers may entice consumers to purchase healthy products. Visually based textures function as a reminder of what something may feel like and thus cross-modal correspondence takes place that is most likely based on associative learning from cross-modal experiences (Deroy et al., 2013). The results indicate that in order to avoid resistance to persuasion, it would be better to make use of implicit surface textures. Furthermore, a sweet item, such as a biscuit, benefits from having an appearance as being less healthy as it increase perception of tastiness and thus increase likelihood of purchase. Thus, using a non-healthy looking texture can help to overcome consumer perception that healthy is not tasty (Raghunathan et al., 2006) as the surface texture of biscuits can be used to guide purchase choice of biscuits. It therefore provides a good starting point in how to promote healthier food products.

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