Food Quality and Preference xxx (2014) xxx–xxx

Contents lists available at ScienceDirect

Food Quality and Preference

journal homepage: www.elsevier.com/locate/foodqual

Static vs. dynamic liking in chewing gum: A new approach using a background task and a natural setting

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ARTICLE INFO

Article history:
Received 4 September 2013
Received in revised form 10 November 2013
Accepted 6 January 2014
Available online xxxx

Keywords:
Consumers
In-home test
Internet
Preference
Dynamic

ABSTRACT

Chewing gum is a particular product, consumed during long periods of time and usually while doing something else. Therefore, traditional hedonic tests might not provide sufficient information. The aim of the present work was to compare the liking scores resulting from asking consumers whether they liked the product only once (static liking, SL) to those obtained when asking repeatedly during consumption (dynamic liking, DL). For this purpose, three different mint chewing gums were evaluated by two groups of 50 consumers. In both cases, consumers evaluated the samples at home using an Internet application specifically designed for the experiment. In the SL, consumers were prompted to rate their liking only after 5 min of chewing. During this time, consumers were presented with a series of curious facts ("Did you know…?") which they would read from the screen as a background task. For the DL, consumers were asked to rate the samples every 45 s during a period of 10 min while performing the same background task, having a maximum of 10 s to answer.

Comparing the results obtained by both techniques at the same moment of consumption (5 min), ratings were found to be significantly higher with the SL for all samples. This could indicate that, when asked once, consumers gave their overall liking score and not their liking at precisely 5 min. Nonetheless, at that moment, the sample ranking was the same for both methods. Moreover, DL showed that when taking into account preference throughout consumption time, a significant product ranking inversion could be found, revealing that preference was time dependent and also that this change was different among products.

1. Introduction

Conventional sensory methods, such as quantitative descriptive analysis or other forms of profiling, implicitly regard the sensory properties under investigation as a static phenomenon (Dijksterhuis & Piggott, 2000). Nonetheless, it is well-known that the perception of flavor is not a single event but a dynamic process (Piggott, 1994) where every step must be considered to fully understand it. For this purpose, many sensory techniques have been developed attempting to describe the sensations generated by food taking into consideration its dynamic aspect. Time-Intensity (T-I) technique (Lee III & Pangborn, 1986; Neilson, 1957), Dual Attribute Time-Intensity (Duizer, Bloom, & Findlay, 1997), Progressive Profiling (Jack, Piggott, & Paterson, 1994), Temporal Dominance of Sensations (TDS) (Pineau et al., 2009) and Sequential Profile (Methven et al., 2010) showed the importance of the temporal dimension in sensory evaluation.

Therefore, if perception changes as a function of time, it might also be expected that hedonic responses would modify during consumption. The first work to investigate temporal liking was done by Lee and Pangborn (1986): they proved that liking changed along time, and that these changes could be measured using the T-I methodology. Later, Taylor and Pangborn (1990) measured the degree of liking of chocolate milk continuously along a consumption period of 80 s, finding that hedonic responses showed systematic changes during tasting, and that these changes were product dependent. At this point, it was suspected that changes in the hedonic response could be a mere reflection of the variation of the intensity of different attributes. Veldhuizen, Wuister, and Kroeze (2006) worked with orange juice lemonades and found that intensity and pleasantness responses did not occur simultaneously; the intensity response happened before the pleasantness response and

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http://dx.doi.org/10.1016/j.foodqual.2014.01.002
0950-3293/

also had a different duration time. Therefore, time-hedonic curves were different from the time-intensity curves, showing the importance of the dynamic hedonic evaluation. More recently, Sudre, Pineau, Loret, and Martin (2012) proposed two new methods for measuring the dynamics of liking during a one bite consumption event. Their aim was to find the specific moments at which preference changed during the one bite of wheat flakes, in order to relate this change in preference to the variation in the perceived attributes. In the first proposed method, they recorded liking at four specific times of the mastication period. In the second method, consumers recorded any change in their liking by clicking on a button corresponding to a level of the same 7-category scale. In this way, the temporal dimension was included, not as a continuous phenomenon but at 30 s intervals of consumption time. Their results proved the importance of tracking liking over time, and that this could be done at short intervals rather than in a continuous manner as proposed by the time-hedonic curves. In addition, they indicated that this type of study is highly product dependent, and that tasting conditions should be closer to natural settings as opposed to laboratory conditions.

In all of the aforementioned studies, consumers were repeatedly asked about their preference throughout consumption time of the product, but it is to be noted that this time was in all cases shorter than 2 min (a sip, a bite, a mouthful). However, for chewing gum a different approach is needed, since it is designed to have different rates of release of sweetness and aroma. Moreover, taste is supposed to last for long periods of time (Lenzi et al., 2012; Song, Knutsen, Broderick, & Seielstad, 2010). Some research can be found on evaluation of taste, texture and aroma in chewing gum by Time-Intensity methods (McGowan & Lee, 2006) or on flavor release by dual Time-Intensity (Duizer et al., 1997); but there are few published references on how to study the preference of this product. Delarue and Loescher (2004) stated that with chewing gum, it might be confusing for consumers to be asked how much they like or dislike a sample several times in a row. According to them, using Time-Intensity to assess hedonic response creates an unnatural environment and the measurements are likely to be subject to response bias. So, they evaluated preference only at three different chosen moments of consumption (1, 5 and 30 min). Nonetheless, in their methodology, consumers were grouped and each group gave their preference at one time. So, since consumers were not asked about their preference at different moments of consumption, liking along time was not really obtained.

The test done by Delarue and Loescher (2004) clearly showed that chewing gum is consumed during long periods of time, and that long tests can be problematic: they can easily become boring, and boredom might lead to bias and probably low preference ratings. In addition, consumers usually chew gum while doing something else. For example, in a survey with 8930 university students, 41% reported that they chewed gum while revising to reduce stress (Princeton Review & Wrigley, 2005). With this in mind, we proposed a background reading task during the tasting. We believe that being relatively entertained while performing the tasting could distract consumers from the fact that the same question is being asked repeatedly along time. In this way, a dynamic hedonic response can be obtained, diminishing the influence of boredom in the task and making the test more similar to situations in which chewing gum is usually consumed.

Furthermore, Delarue and Loescher (2004) showed that an inconvenience of performing long preference tests was that subjects had to go to the sensory laboratory many times. Another improvement proposed in the present work was that the test was done in in-home conditions with the help of a web application. Therefore, consumers would be in a more natural environment, and the information obtained might be closer to real consuming conditions. Using this tool, the test becomes cheaper and more efficient since the number of consumers performing the test is independent from the facilities of the sensory lab.

The aim of the present work was to compare the information obtained on chewing gum preference by means of a static (consumers evaluated their liking only once) and a dynamic liking (they were asked about their liking several times during product consumption) methodologies; both done in in-home conditions and while performing a background task.

2. Materials and methods

2.1. Samples

Three different commercial Argentinean chewing gums (hereon CH-1, CH-2, CH-3) were used for this study. The three were mint flavoured, not sugar coated and sugar free. They were all intended for the same market segment: young consumers (16–30 years old) of medium/upper class, and the price per unit of chewing gum was of around AR$ 0.85.

2.2. Consumers

A total of 100 mint chewing gum consumers participated in the experiment. Consumers were recruited among students and staff of the Universidad Católica Argentina (Buenos Aires) based on their frequency of consumption of mint chewing gum. The whole population was homogeneous, consisting of 50% females and 50% males, ages ranging from 19 to 32 years old. Of this population, 55% consumed mint chewing gum at least 2–3 times a week and 38% consumed 2–3 times a month.

This population was randomly divided into 2 groups of 50 consumers. Each one tested the chewing gums under one or the other of the two protocols described in Section 2.3.

2.3. Testing protocols

Both testing protocols were carried out at consumers' homes, and while performing a background task. Those interested in participating were prompted to go to the Sensory Laboratory at the Universidad Católica Argentina, where they were given a sealed envelope containing all three samples in their original wrappings and the instructions needed to access their online session. At the same time, they were explained that the test could be done at any moment of the day needing a computer or a tablet with Internet service. Moreover, they were explained that the test should be carried out three days in a row, taking one gum per day at approximately the same moment of the day. All data was acquired by TimeSens online software (www.timesens.com). The way to carry out the test was explained at the beginning of the tasting (example for dynamic liking protocol in Fig. 1a) and the sample to be tested was instructed by the brand (Fig. 1b). Having branded samples is usually not recommended since it can be a source of bias for consumers. This could be avoided by re-wrapping samples in neutral papers. Since in the present work the focus was placed on the sensory techniques to be used and with both techniques chewing gums were presented in the same way the wrappings were kept. Moreover, in this particular case, samples were recognizable even without the wrappings. The order of presentation of samples was balanced and randomized among consumers.

The background task in both cases consisted on reading a series of curious facts ("Did you know…?", Fig. 1d) which changed frequently along consumption time. The main aim of this background task was to entertain consumers along the tasting period and to distract them in order to avoid boredom and even "over analysis" of the samples, trying to approach them to a more realistic

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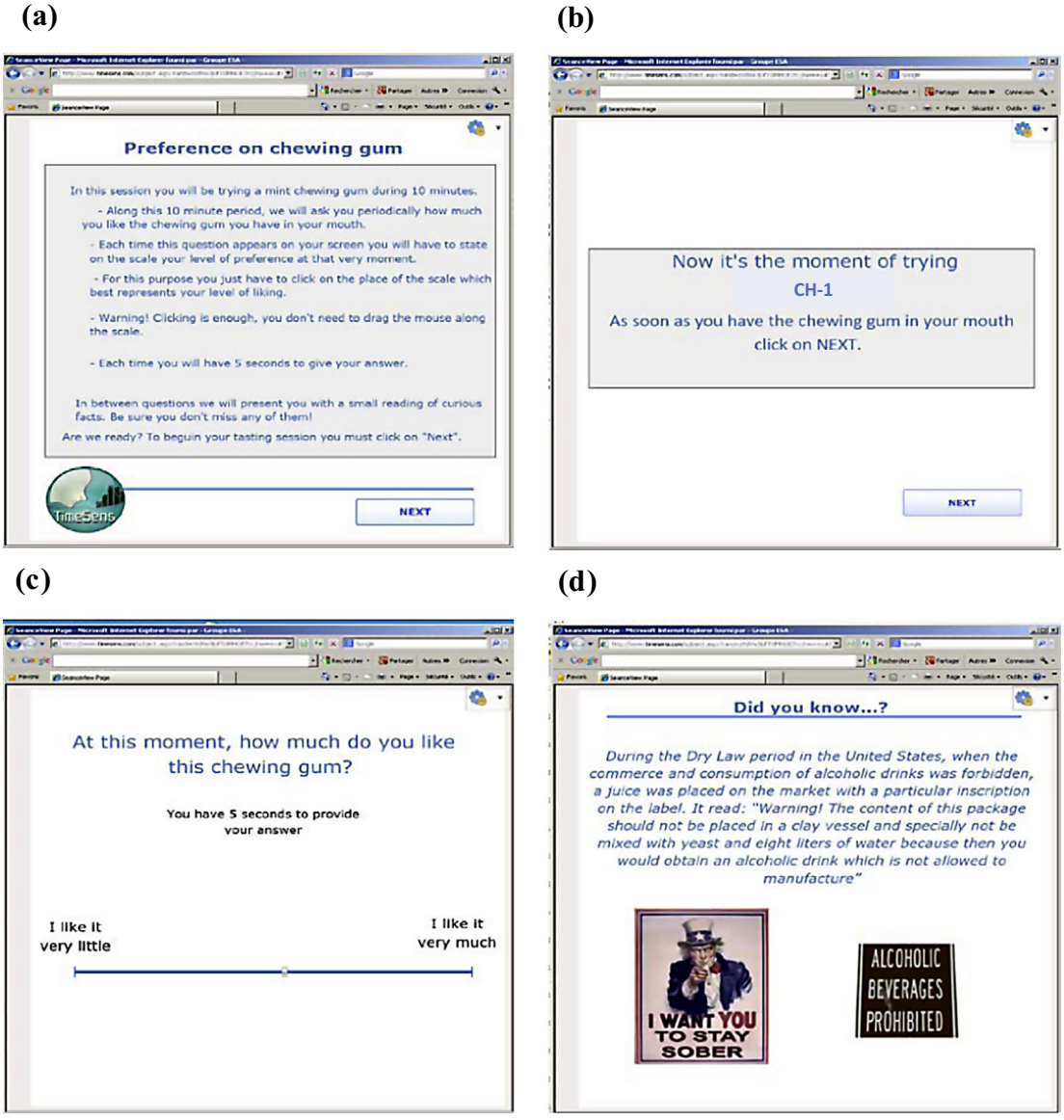

Fig. 1. (a to d) Protocol of data acquisition in in-home conditions. (a) Instructions given to consumers before the test (dynamic liking technique); (b) instructions given to consumers before trying a particular sample; (c) example of the scale used which appeared every 45 s; (d) example of the reading proposed as a background task. Every 22.5 s the "Did you know...?" changed. In all cases, this information was presented in Spanish (mother tongue of Argentinean consumers); it was here translated to English from the original screen for the purpose of clarity.

consuming scenario. This task had to be entertaining, but yet not highly distracting from the hedonic test. Previous studies showed that chewing gum and reading are highly compatible tasks (Wilkinson, Scholey, & Wesnes, 2002) even though claims that chewing a gum improves cognition should be viewed with caution (Tucha, Mecklinger, Maier, Hammerl, & Lange, 2004).

2.3.1. Static liking (SL)

The liking score was asked only once after consumers had chewed the gum during a period of 5 min (mid-time of the dynamic liking, Section 2.3.2) while performing the distracting background task. During the whole tasting time, the curious facts which appeared on the computer screen (Fig. 1d) changed every 20 s, meaning that they read a total of 15 different facts before giving their score. At the end of the 5 min consumers were asked to rate their liking on a continuous visual analogue scale (VAS; Aitken, 1969) being the extremes "I like it very little – I like it very much". Fig. 2 depicts a summary of the protocol.

Fig. 2. Description of the dynamic (DL) and static liking (SL) processes across time.

2.3.2. Dynamic liking (DL)

Level of liking was evaluated at intervals of 45 s on a VAS along a 10 min period (Fig. 1c). Here, consumers were also prompted to read different curious facts (Fig. 1d) which changed every 22.5 s, meaning that they read two different facts in-between ratings; except for the first note which was asked 10 s after they had put the sample in their mouth in order to record the first impression. Afterwards, each liking score had to be given in less than 5 s. The process during time is shown in Fig. 2. In order to analyze the data, in those cases when consumers did not give an answer, the previous liking score was considered (if any). In this way a total of 14

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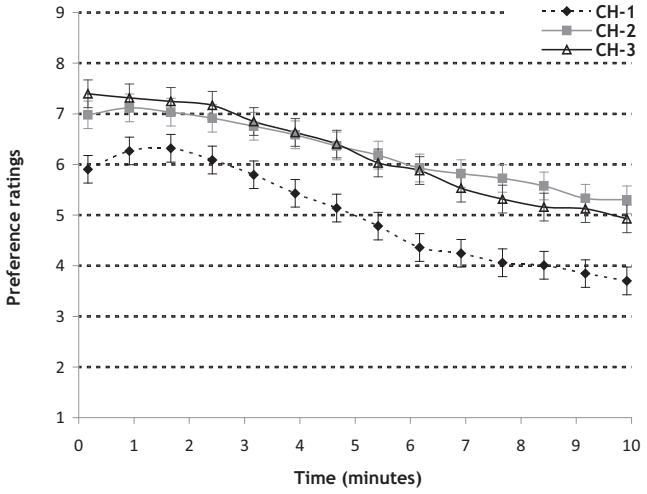

Fig. 3. Evolution of preference along time for the three studied samples. Bars represent the standard error.

liking scores were obtained per consumer for each chewing gum for all the consumption period.

2.4. Data analysis

For SL scores, the mean and the standard error for each product were calculated. For DL, average scores and standard error were calculated for each chewing gum every 45 s.

Difference in preference among samples and its relationship with time was evaluated by ANOVA with lmerTest package in R using the following model: Liking ~ Product + Consumer + Time + Product * Time + Consumer * Time + Consumer * Product, where consumers were considered as a random variable. Time and all interactions were removed from the model when: (1) DL was studied at a particular moment, (2) SL was analyzed and (3) for the comparison of both hedonic techniques after 5 min of consumption.

To test the significance off the inversion in liking along consumption time of two samples, a contrast test was performed. Data was averaged considering time in three periods: beginning (from time 10 s until 2.6 min), middle (3.5–6.8 min) and end (7.6–10.16 min). The contrast test compared the difference between the average liking of one chewing gum at the beginning minus the average liking of the other chewing gum also at the beginning period vs. the same difference but at the end period.

3. Results and discussion

3.1. Dynamic liking

Fig. 3 shows the evolution of preference along time for the three tested chewing gums. As expected, preference decreased along consumption time. In a different type of preference evaluation on chewing gum, Delarue and Loescher (2004) stated that panelists would try to remain consistent when answering several successive questions. So, it could be hypothesized that consumers decreased their liking only because liking is expected to diminish. However, the rate of decrease was not the same for the three evaluated samples, and a significant interaction Product × Time was observed. Here, CH-1 had the lowest ratings in the first bite and, even though liking increased slightly between 1 and 2 min, its preference remained always lower than for the other two and it also decreased faster. As for CH-2 and CH-3, they both seemed to have similar ratings; however, a pattern of ranking inversion along time was found. This inversion was tested and proved to be significant ($p = 0.0151$) by grouping consumption time in three periods: beginning (from time = 10 s until 2.6 min), middle (3.5–6.8 min) and end (7.6–10.16 min) and then comparing the average liking rates at each period for both samples. CH-3 was the sample with the highest preference score at the beginning of the test, but since preference for this sample decreases faster, after 10 min of consumption it was less liked than CH-2 which had a more constant liking along time. Even though these findings were highly related to the samples here tested and might seem like small differences, they highlight how dynamic liking can give important information that would not be acquired by having only one record of product liking. This way of evaluating preference, where subtle differences during consumption can be found, could be most useful when comparing the performance of a new product formula versus the actual one or competitors.

The level of discrimination among samples also changed during time. Fig. 4 shows the evolution of the Fisher statistic obtained by doing an ANOVA Liking ~ Product + Consumer at each measured time, revealing how the magnitude of the differences for preference among samples were different along consumption time. It was observed that the first ratings given by consumers discriminated strongly the three chewing gums. Then, discrimination decreased abruptly reaching a new maximum around 6–7 min. This high differentiation among chewing gums only 10 s after having it in the mouth could be explained by the bias generated by the fact that consumers were able to see the brand of the chewing gum before tasting it. Therefore, their first response could be expressing their preference towards the brand and the pre-concept of the chewing gum rather than to its sensory characteristics. Then, as consumers got involved in the tasting which includes a cognitive distracting task, the real sensory preference was revealed. In this case, sensory preference was the most different among chewing gums towards the 6–7 min of consumption. Needless to say, these results are highly dependent on the samples. However, this shows a type of information which would be very valuable for product design since it shows the moment in which product preference is the most different among samples. Therefore the moment where the product has a weakness/strength can be found and by correlating this with sensory dynamic descriptive data the source of this weakness/strength in preference could be identified.

3.2. Dynamic vs. static liking

The ratings obtained by both techniques at the same moment of consumption (5 min) were compared, finding that preference values were significantly higher in the SL (SL at 5 min vs. DL at 5 min, Fig. 5) for all samples. However, the pattern of liking was

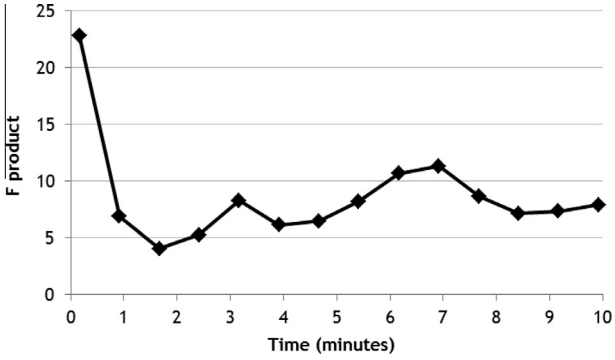

Fig. 4. Evolution of the Fisher statistic of product effect along time for the dynamic liking procedure.

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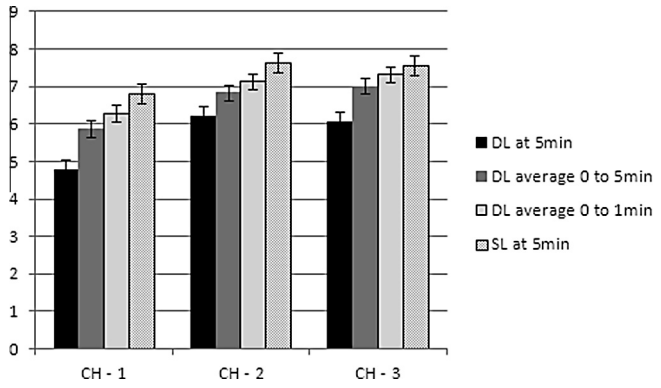

Fig. 5. Comparison of ratings at 5 min by each method for the three studied samples. Bars represent the standard error.

the same in both methods: CH-1 was less liked than CH-2 and CH-3 which had similar preference ratings. This difference between methods could be showing that, when asked only once, consumers gave more relevance to their initial sensation than to their actual liking at 5 min, therefore giving higher ratings. To evaluate this hypothesis, SL values were also compared to the average of all the liking scores given by consumers in DL from 0 to 5 min (DL average 0–5 min, Fig. 5) and also to their first impression in DL, integrating time 0–1 min (DL average 0–1 min, Fig. 5). On the one hand, it could be observed that the DL average 0–5 min (which would be representing the whole 5 min consuming experience) was higher than the single value of liking extracted at 5 min for DL, but it was still significantly lower than SL at 5 min values. On the other hand, there was no significant difference between SL and DL average 0–1 min. This is showing that, when asked only once, even after 5 min of chewing consumers rated the samples based on their initial impression more than integrating all the consuming experience. Taylor and Pangborn (1990) hypothesized that a judge might quickly decide whether a stimulus is pleasant, neutral or unpleasant, this impression remaining static during and after the time of testing. Present data might be showing that this would be the case when consumers are asked only once about their preferences, even if the question is made after 5 min of this first impression. Alternatively, it is possible that taking the decision might take a few seconds, and this can be modified depending on the breakdown of the product in the mouth (Taylor & Pangborn, 1990). But apparently, this second option is only elicited when consumer are asked repeatedly over time about their preferences.

Table 1 shows that both methodologies gave different results in terms of discrimination, being static liking significantly less discriminative than the dynamic liking. Rating samples only once might make consumers more at ease, encouraging them to give higher and more similar ratings. Also, asking consumers repeatedly about their liking might be forcing them to lower their scores, at least in terms of absolute values. However, it might also be making them more attentive to the task, allowing them to be more precise and therefore more discriminant about their preference. Even though two different groups participated in each test, their rate of consumption was not significantly different and they were equally familiar with the samples. Therefore, the difference in discrimination could be attributed to the techniques. In their work on dynamic preference on chewing gum Delarue and Loescher (2004) hypothesized that it may be confusing for a subject to be asked repeatedly how much he likes or dislikes the same sample several times in a row; however, here we found that it was the other way around. Consumers became more focused and discriminant when asked several times rather than when asked only once about their preference.

Table 1
Discrimination among samples by the different tested methodologies.

Method	*F*-prod	*p*-Value
DL 5 min	8.22	0.0005
DL 0–5 min	8.16	0.0005
DL 1 min	6.90	0.0016
SL	2.96	0.0562

4. Conclusions

The two tasting protocols tested here gave somewhat different information about product preference. But, with both techniques, the same tendency in product ranking was observed.

In static liking, consumers gave higher values, which were closer to their first impression than to their preference after 5 min. Moreover, discrimination among samples was smaller. In dynamic liking, consumers gave lower rating scores, which could have been related to the continuous inquiries about preference. However, even if ratings were lower, discrimination among samples was higher than with static liking. Moreover, thanks to the analysis of the *F*-value of the Anova Product ~ Consumer at each time, the moment at which preference becomes discriminant among samples could be obtained. Also, an inversion pattern of preference was found between two samples. This information could not have been found by the SL technique. In this way, the use of a dynamic approach to study preference in chewing gum would seem more pertinent when working on the development of new products and when the preference along the whole performance of the chewing gum needs to be validated. On the other hand, once the liking dynamic profile has been obtained and the moment in which preference change is crucial was found, the industry could validate liking among competitors using a SL test and they could obtain enough information.

Finally, even though it was not the aim of the study, in-home testing conditions while reading as a background task seemed to be an effective tool for collecting data in a closer-to-natural consuming environment. We believe that further research in order to compare in-home to laboratory conditions and having a background task vs. not having it should be performed.

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