Temporal Check-All-That-Apply:

A valuable addition to your Temporal Methods Toolkit

From first bite all the way to aftertaste, the sensory experience of any food or beverage is a complex journey. Even personal care products undergo important changes during application. In sensory science and consumer research, the recent influx in the use of Temporal Methods in testing practices demonstrates that capturing a snapshot of an experience just isn't cutting it anymore. We want the full story. In sensory testing, temporal methods such as Time Intensity, Temporal Dominance of Sensations (TDS), Temporal Order of Sensations (TOS), and Temporal Check-All-That-Apply (TCATA), allow for the evaluation of a sample or product over a portion of, or the entire product experience. By exploring a product from a multidimensional perspective, we create a much more holistic assessment of a product, and consequentially, better and smarter product development.

Check-All-That-Apply (CATA) is a popular question type in many different types of sensory and consumer tests. It is easy for panelists and consumers to use and captures data efficiently. Panelists are presented with a group of words or phrases and are asked to select all that apply. However, CATA is not innately temporal and usually captures an integrated assessment of what terms describe the sample.

Temporal Check-All-That-Apply

The most recent player to the temporal methods table is Temporal Check-All-That-Apply (TCATA). TCATA was developed as an extension of the Check-All-That-Apply method. It involves the continuous selection and de-selection of attributes to indicate the changing sample characteristics over the course of evaluation. An attribute can be selected and deselected as many times as necessary during an evaluation and multiple attributes can be selected at any given moment.

TCATA allows for the evaluation of product attributes simultaneously over time, allowing analysts to get a more complete picture of how an assessor is truly experiencing a product. For example, when you take a spoonful of double chocolate chunk ice cream, there is a lot going on, both simultaneously and sequentially. There is the immediate cooling sensation, followed by a fatty mouth feel and a simultaneous surge of sweetness. This may be followed by your first bite into a chocolaty chunk, which evokes a rush of rich chocolate flavour. TCATA allows the assessor to evaluate the full in-mouth experience, and provide data that captures the symphony, not just the solo performance.

A study was conducted at the Universidad de la República in Montevideo, Uruguay to investigate the use of TCATA with training descriptive panels using 6 different samples of yogurt. In the first session, through open discussion, with a panel leader, the 12 panelists agreed upon the best attributes to describe the sensory attributes of the samples (*Sourness*, *Sweetness*, *Strawberry flavor*, *Off flavor*, *Creamy texture*, *Fatty mouthfeel*, *Artificial flavor*, *Cream texture*). Assessors were familiarized with the TCATA question type over eight 10-minute training sessions (Castura et al., 2016).

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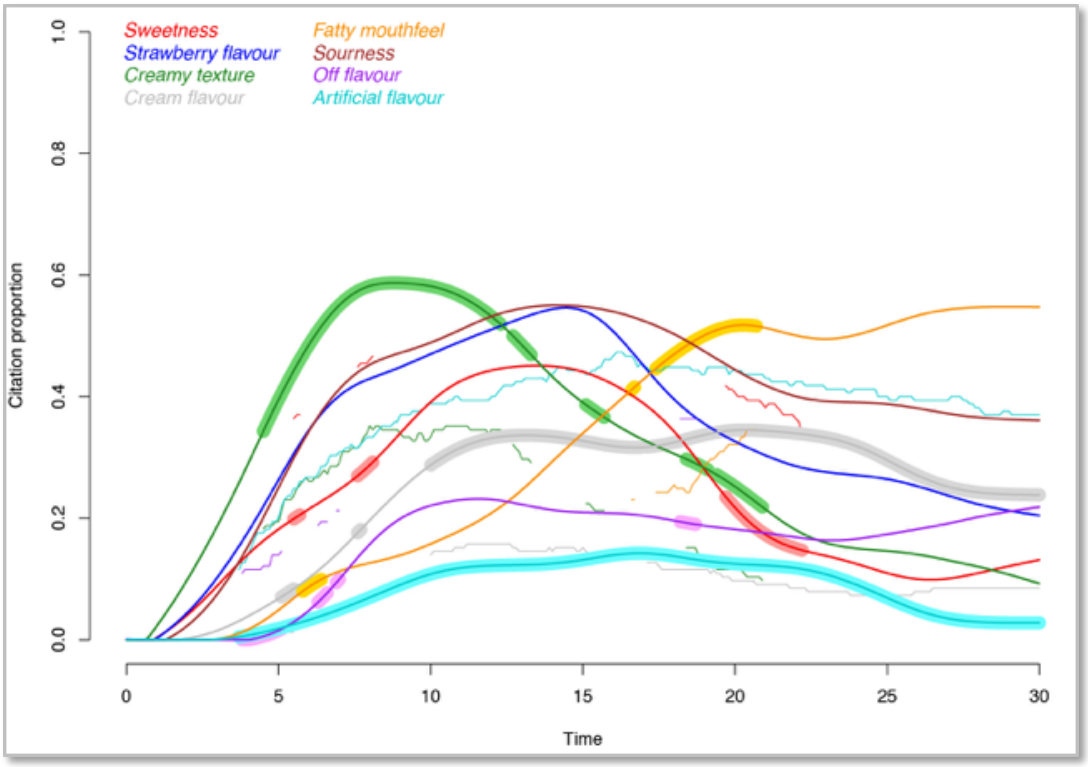

Figure 1. TCATA results for Yogurt 1.
Reproduced from Castura et al. (2016, Fig 3).

Each single-spoon evaluation lasted 30 seconds; all samples were evaluated three times per session over 3 sessions on different days over a 12-day period (each sample was seen 9 times total). The results of the study demonstrated very promising potential for the use of TCATA and, "illustrate some techniques for exploratory data analysis, providing insights into the temporal properties of the evaluated samples, and identifying differences amongst products in their dynamic sensory profiles" (Castura et al., 2016).

Figure 1 is a graphical representation of sample Yogurt 1. The y-axis represents the proportion of evaluations in which an attribute was used to describe the product, while the x-axis represents time over the 30-second evaluation. The highlighted portions of the line attributes show where statistically significant differences are observed between this sample and the average of the other samples. The thin lines represent the average of the other combined samples for comparison. For example, in this particular sample, *Creamy Texture* is cited as applicable early in a large proportion of evaluations in the first 12 s, both relative to other attributes as well as relative to other products.

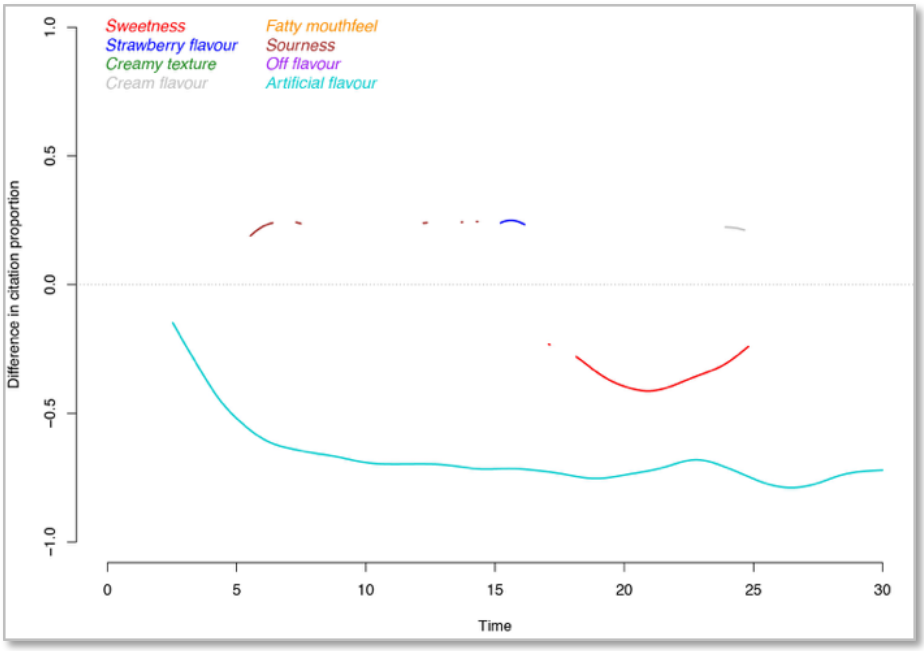

Figure 2. TCATA difference curves for Yogurt 1 vs. Yogurt 5. Reproduced from Castura et al. (2016, Fig 5).

Figure 2 is a comparison between two product samples, Yogurt 1 and Yogurt 5, where the lines indicate significant difference between the two samples. For instance, it can be determined that the proportion of *Artificial Flavour* differed significantly between Yogurt 1 and Yogurt 5 throughout the entirety of the evaluation, while a significant difference in sweetness is seen between approximately 18 and 25 seconds.

Figure 3 illustrates a visual summary of all 6 yogurt products' trajectories in a multivariate sensory space. Dots are placed at 5-second intervals along the trajectories, with each ending at a black numbered box indicating the product number. This plot allows you to visualize changes in how products are described over the evaluation.

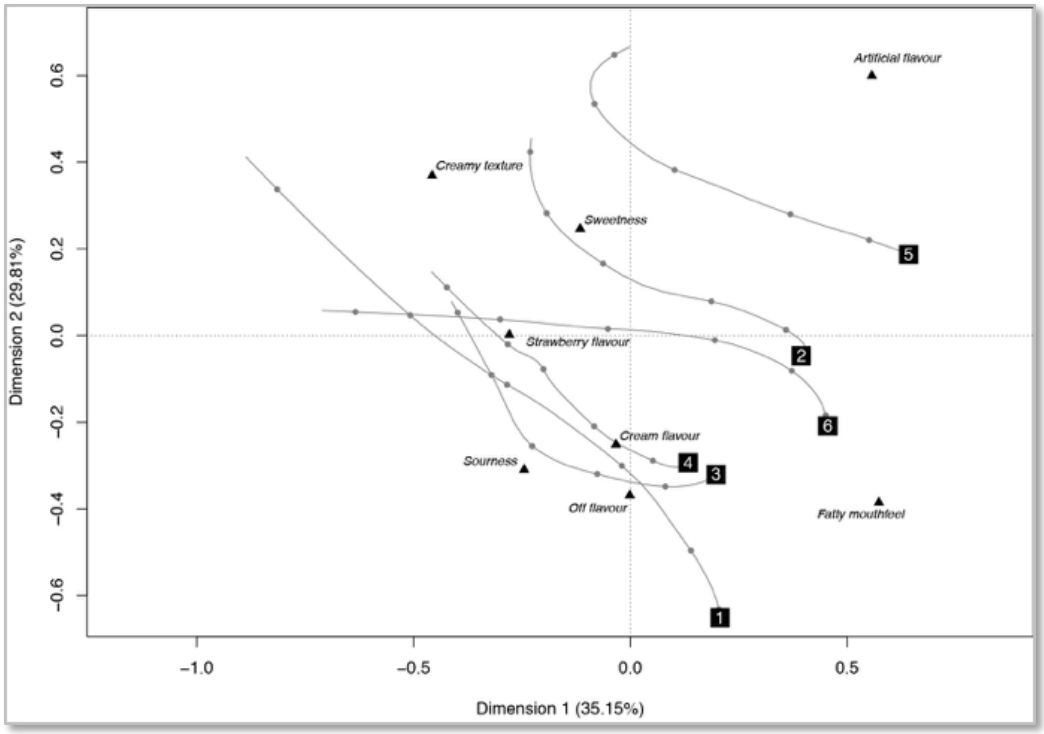

Figure 3. TCATA product trajectories for six yogurt products. Reproduced from Castura et al. (2016, Fig 6).

How TCATA Compares

TCATA is often compared to Temporal Dominance of Sensations (TDS), a forerunning temporal sensory methodology. With TDS, assessors are asked to select the attribute that they perceive as most noticeable, or dominant, at any given moment. The model of this method looks at a sensory experience as if it happens sequentially, not simultaneously, which might fail to capture the complete sensory experience.

	TDS	TCATA
Respondent's task	Indicates the dominant attribute at each moment	Describes the sample at each moment
Underlying model for processing sensations	Sequential, slow	Sequential, parallel
Data	Multinomial (often treated as binomial for simplicity)	Binomial (straightforward statistics)

In a presentation given at the 2014 Society of Sensory Professionals meeting, John Castura discussed collaborative research on differences between TCATA and TDS results. A consumer study evaluation of six orange juices prepared using different sweeteners. Consumers were randomly allocated to one of two groups, TCATA (n=51) or TDS (n=50). Results of the study drew three encouraging findings:

1. TCATA and TDS orange juice profiles are similar for several juices. This indicates that both methods are capturing "signal", not noise.
2. TDS shows a "Kingmaker effect", where information on one attribute is attained at the expense of another attribute. On the other hand, TCATA allows for the selection of multiple attributes at once, eliminating this phenomenon.
3. TCATA does not create a damping effect, commonly seen in TDS, where attributes are competing and ultimately proportions of each attribute become more likely to be selected by chance.

The study concludes with the assertion that "results from the present work suggest that TCATA could be more appropriate than TDS for dynamic sensory profiling with consumers" (Castura et al., 2014).

In a recent multi-country study, TCATA and TDS were compared across a range of product categories with different product complexities (Ares et al., 2016). Results, obtained from both trained assessors and consumer panels, showed that TCATA captured greater nuance and detected more differences between samples than TDS. These studies indicate tremendous promise for the TCATA methodology.

Looking Forward

Further research and application of TCATA in various testing scenarios will stimulate development of best practice guidelines and increase understanding of how TCATA can be used to evaluate a variety of product types. There has already been exciting research on the use of TCATA for the sensory profiling of cosmetic products (Boinbaser et al., 2015) and with more research, further applications of the method will continue to emerge in food, beverage, and non-food products.

Sources

Ares, G., Jaeger, S. R., Antúnez, L., Vidal, L., Giménez, A., Coste, B., Picallo, A., Castura, J. C. (2016). Comparison of TCATA and TDS for dynamic sensory characterization of food products. *Food Research International*, in press, http://dx.doi.org/10.1016/j.foodres.2015.10.023

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