Characterizing Dynamic Sensory Properties of Nonnutritive Sweeteners with Temporal Check-All-That-Apply (TCATA)

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Background

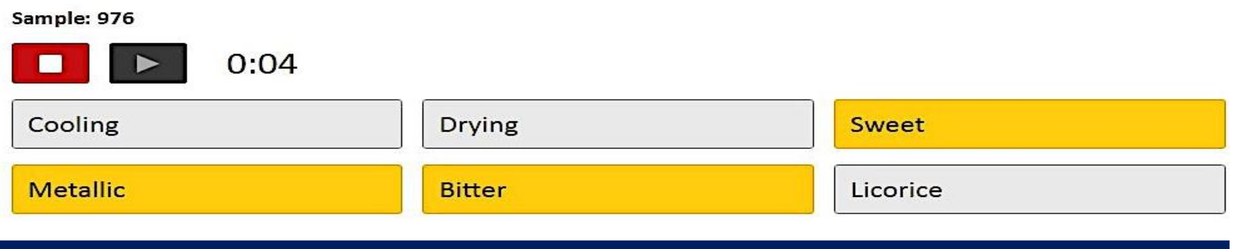
Temporal Check-All-That-Apply (TCATA) is a novel rapid sensory method that involves checking and unchecking words to track changes in the sample over time, such that at any given moment the words that are checked completely describe the sample. The use of multiple attributes in TCATA allows for tracking of side tastes that are not the most intense / dominant sensation, potentially making it a useful technique to study the differing temporal profiles of nonnutritive sweeteners. Accordingly, the objective of this study was to characterize dynamic properties of nonnutritive sweeteners using TCATA.

Methods

Participants – Healthy, non-smoking individuals with no defects in taste or smell were recruited. In two separate experiments, ~125 adults per study, for a total n of 248. Data was collected using Compusense Cloud (Compusense Inc., Guelph, Ontario, Canada).
Stimuli – Sucrose, fructose, glucose, AceK, aspartame, sucralose, saccharin, thaumatin, NHDC, and RebA were tested in RO water at concentrations shown to elicit weak to moderate sweetness intensity ratings on a gLMS (Reyes & Hayes 2016).
Orientation –Prior to testing, participants were given attribute references and definitions for the following TCATA terms: sweetness, bitterness, drying, licorice, metallic, and cooling.

TCATA Term	Reference	Conc (g/L)	Definition
Sweetness	Sucrose	100	The taste characteristic of table sugar
Bitterness	Quinine Monochloride Dehydrate	0.5	The taste characteristic of substances like caffeine or quinine
Drying	Alum	2.75	The lack of lubrication or moistness resulting in friction in your mouth
Licorice	Essential Anise Oil	~0.12	Characteristic of black licorice or anise
Metallic	Ferrous Sulfate	0.272	Characteristic flavor of blood, copper pennies, and metal spoons
Cooling	Menthol	~0.15	The sensation of cold in your mouth

Protocol – Participants were given 10 mL aliquots of sweet solutions, consisting of a single compound in water, and asked to track the attributes perceived using TCATA.



Results & Discussion

Finding 1: Temporal profiles follow similar pattern among sweeteners

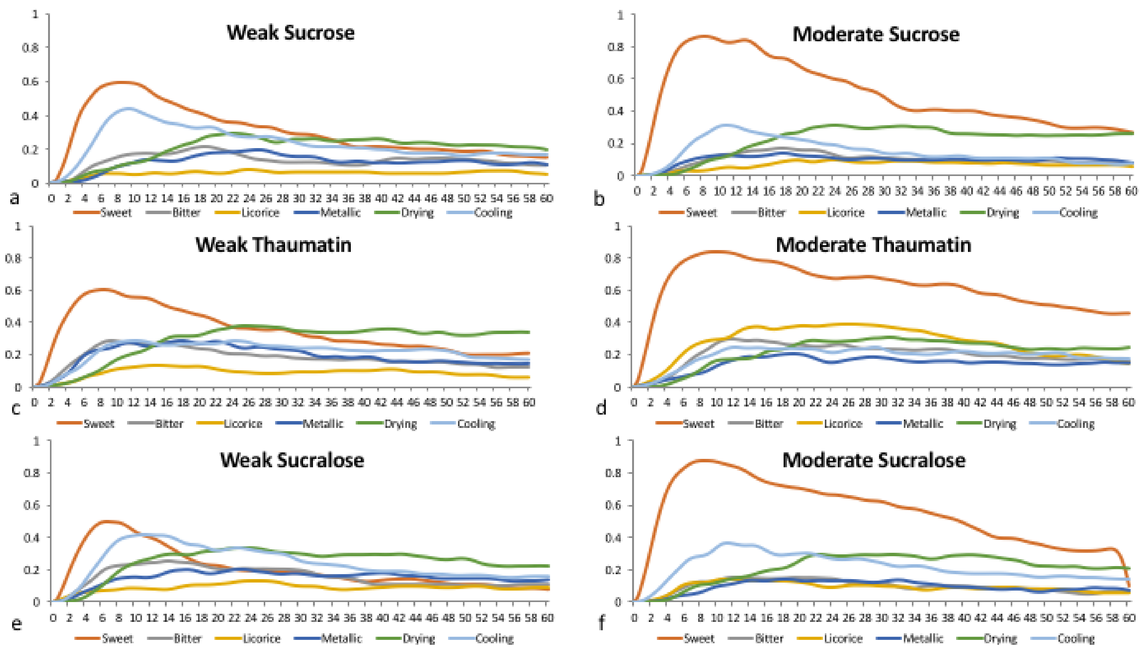


Figure 1: TCATA curves for sucrose (a &b), thaumatin (c & d), and sucralose (e & f). TCATA curves graphically represent citation frequencies for each attribute and were calculated as the proportion of times an attribute was selected at each moment of evaluation.

Results & Discussion

Finding 2: More perceived sweetness corresponded to fewer side tastes

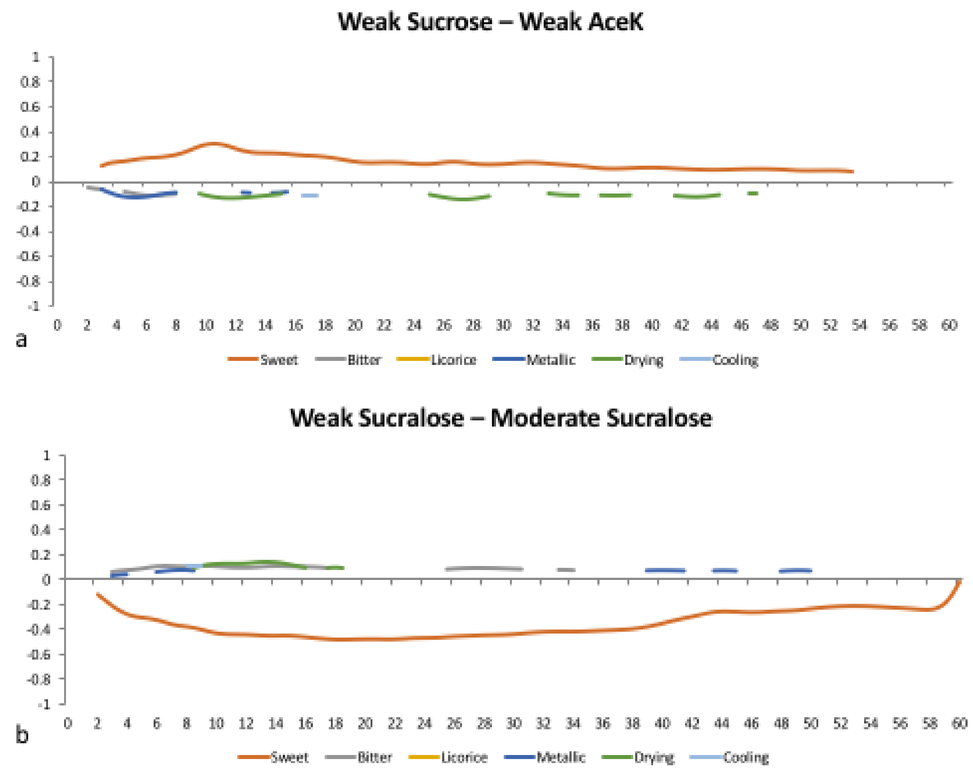


Figure 2: TCATA difference curves for weak sucrose compared to weak AceK (a) and weak sucralose compared to moderate sucralose. TCATA difference curves compare pairs of samples and are plotted by subtracting the citation proportions for each attribute in two samples at each time point.

Finding 3: Weak level samples associated more with side tastes

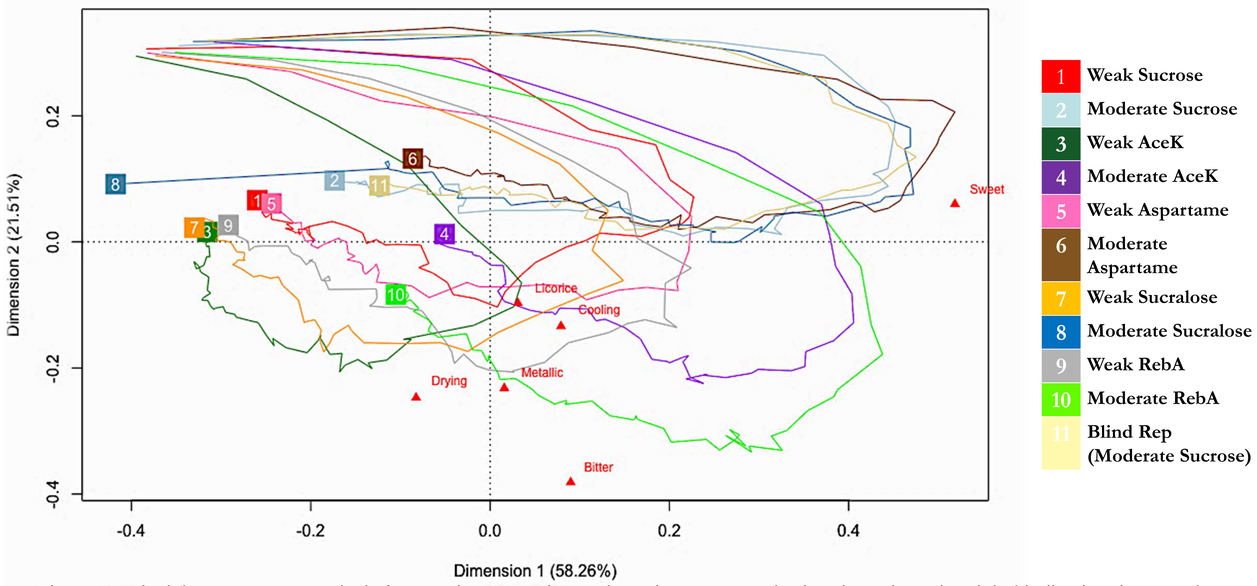


Figure 3: Principle component analysis for test day 1. Product trajectories are smoothed and terminate in a label indicating the sample number.

Conclusion

- Results from our experiments found similarities among temporal profiles of sweeteners. Sweet and bitter occur earlier, then metallic and cooling around 10 -25 s time, and then drying much later.
- We also found that sweetness and side tastes were inversely related: more perceived sweetness corresponded to fewer side tastes, while less sweetness associated with more side tastes.
- Additionally, unfamiliar side tastes can lead a smearing bias wherein participants check every attribute in an attempt to characterize those unfamiliar side tastes (e.g., Bennett & Hayes 2012).
- Lastly, extinction time was not found with our samples, therefore studies with TCATA fading may be an appropriate future direction for this research.

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