

Advances in Temporal Check-All-That-Apply (TCATA) methodology and analysis

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What is TCATA?

TCATA extends CATA to *continuously track sensory properties*.

It builds on earlier non-intensity temporal methods: *flavor profile, time-quality tracking, temporal dominance of sensations (TDS), and temporal order of sensations*.

TCATA task

Check and uncheck words to track changes in the orange juice. At each moment, the words that are **checked** should **describe** the **orange juice** (check *all* that apply, in that moment).



0:00

Astringent

Off Flavor

Sourness

Bitterness

Sweetness

Orange Flavor

TCATA task

Check and uncheck words to track changes in the orange juice. At each moment, the words that should describe the orange juice (check all that apply, in that moment).

Timer starts when **Start** button is clicked



Astringent

Off Flavor

Sourness

Bitterness

Sweetness

Orange Flavor

TCATA task

Check/uncheck attributes to describe the sample

...in the orange juice. At each moment, the words that are checked should describe the orange juice (check all that apply, in that moment).

...immediately

Astringent

Off Flavor

Sourness

Bitterness

Sweetness

Orange Flavor

TCATA task

Check/uncheck attributes to describe the sample...
that moment).



0:15

Astringent

Sourness

Sweetness

Orange Flavor

or *after a waiting period*
(e.g. after swallowing)

TCATA task

Check and uncheck words to track change
juice. At each moment, the words that are
shown should be checked (check all
that moment)

Instructions related to
evaluation protocol
could be provided

Swallow the
sample now...

Astringent

Off Flavor

Sourness

Bitterness

Sweetness

Orange Flavor

TCATA task

Check and uncheck words to track changes in the orange juice. At each moment, the words that are **checked** should **describe** the **orange juice** (check *all* that apply, in that moment).



0:45

Astringent

Sourness

Sweetness

Off Flavor

Bitterness

Orange Flavor

Evaluation ends at a set time

(determined by study objectives)

TCATA task

Check and uncheck words to track changes in the orange juice. At each moment, the words that are **checked** should **describe** the **orange juice** (check *all* that apply, in that moment).



0:00

Astringent

Off Flavor

Sourness

Bitterness

Sweetness

Orange Flavor

TCATA task

Check and uncheck words to track changes in the orange juice. At each moment, the words that are **checked** should **describe** the **orange juice** (check *all* that apply, in that moment).



0:09

Astringent

Off Flavor

Sourness

Bitterness

Sweetness

Orange Flavor

TCATA task

Check and uncheck words to track changes in the orange juice. At each moment, the words that are **checked** should **describe** the **orange juice** (check *all* that apply, in that moment).



0:12

Astringent

Off Flavor

Sourness

Bitterness

Sweetness

Orange Flavor

TCATA task

Check and uncheck words to track changes in the orange juice. At each moment, the words that are **checked** should **describe** the **orange juice** (check *all* that apply, in that moment).



0:15

Astringent

Off Flavor

Sourness

Bitterness

Sweetness

Orange Flavor

TCATA task

Check and uncheck words to track changes in the orange juice. At each moment, the words that are **checked** should **describe** the **orange juice** (check *all* that apply, in that moment).



0:18

Astringent

Off Flavor

Sourness

Bitterness

Sweetness

Orange Flavor

TCATA task

Check and uncheck words to track changes in the orange juice. At each moment, the words that are **checked** should **describe** the **orange juice** (check *all* that apply, in that moment).



0:21

Astringent

Off Flavor

Sourness

Bitterness

Sweetness

Orange Flavor

TCATA task

Check and uncheck words to track changes in the orange juice. At each moment, the words that are **checked** should **describe** the **orange juice** (check *all* that apply, in that moment).



0:24

Astringent



Off Flavor

Sourness

Bitterness

Sweetness



Orange Flavor

Why use TCATA?

Can be used to investigate perception dynamics during eating and drinking, e.g.,

- yogurt (Castura et al., 2016)
- chocolate milk (Oliveira et al., 2015)
- salami, cheese, French bread, orange juice, and marinated mussels (Ares et al., 2015)
- red wine finish (Baker, Castura, & Ross, 2016)
- sparkling wine (McMahon, Culver, Castura, & Ross, in preparation)

Also to investigating perception dynamics after application of cosmetic or personal care products

- cosmetic creams (Boinbaser et al., 2015)

Why use TCATA?

Ares et al. (2015) publish results from a multi-product, multi-country study comparing TCATA and TDS. The studies included both trained panels and consumer panels.

Why use TCATA?

“By enabling identification of several sensory characteristics that are concurrently perceived in products, the results from this research also suggest that TCATA may provide a more detailed description of the dynamics of the sensory characteristics of products [than TDS].”

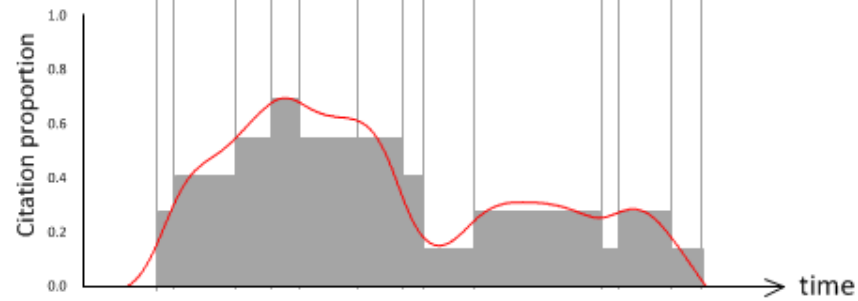
Some examples of TCATA applications

- Early-stage formulation/reformulation
 - Explore the temporal evolution of sensations of prototypes and/or of products in the category
- Investigating impact of ingredients/process
 - Designed experiments to investigate how ingredient/process changes affect sensory outcomes
- Product matching
 - Confirm that products have similar perception dynamics after reformulation/process changes
- Product reformulations
 - Confirm that reformulation/process changes have successfully differentiated the product

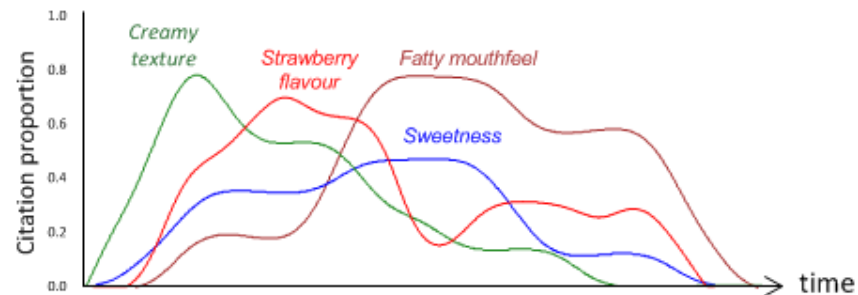
TCATA curves



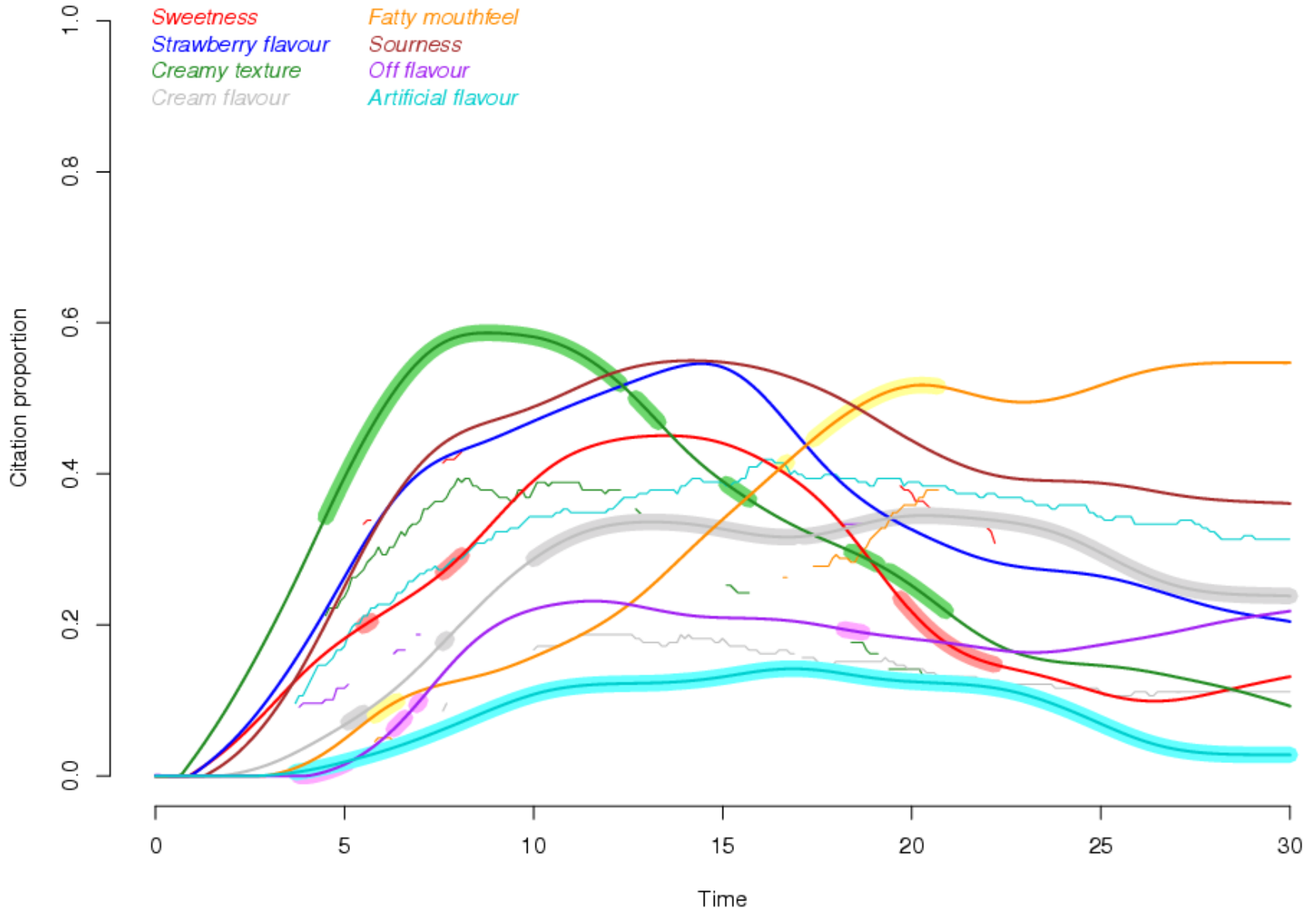
Aggregate TCATA data to get citation proportions for Strawberry flavour
(with optional smoothing)



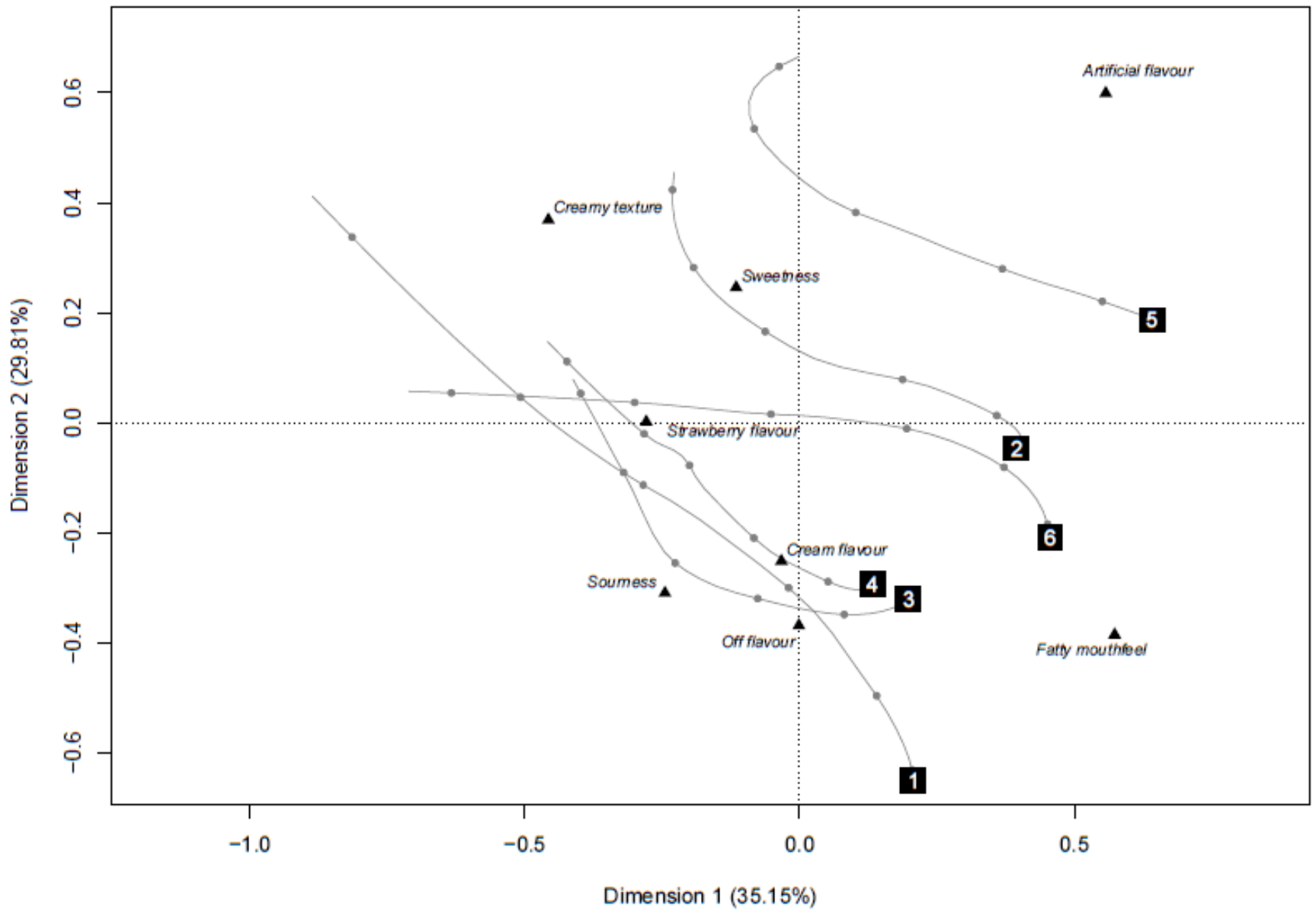
Present TCATA curves for all attributes



TCATA curves & reference lines



Trajectories

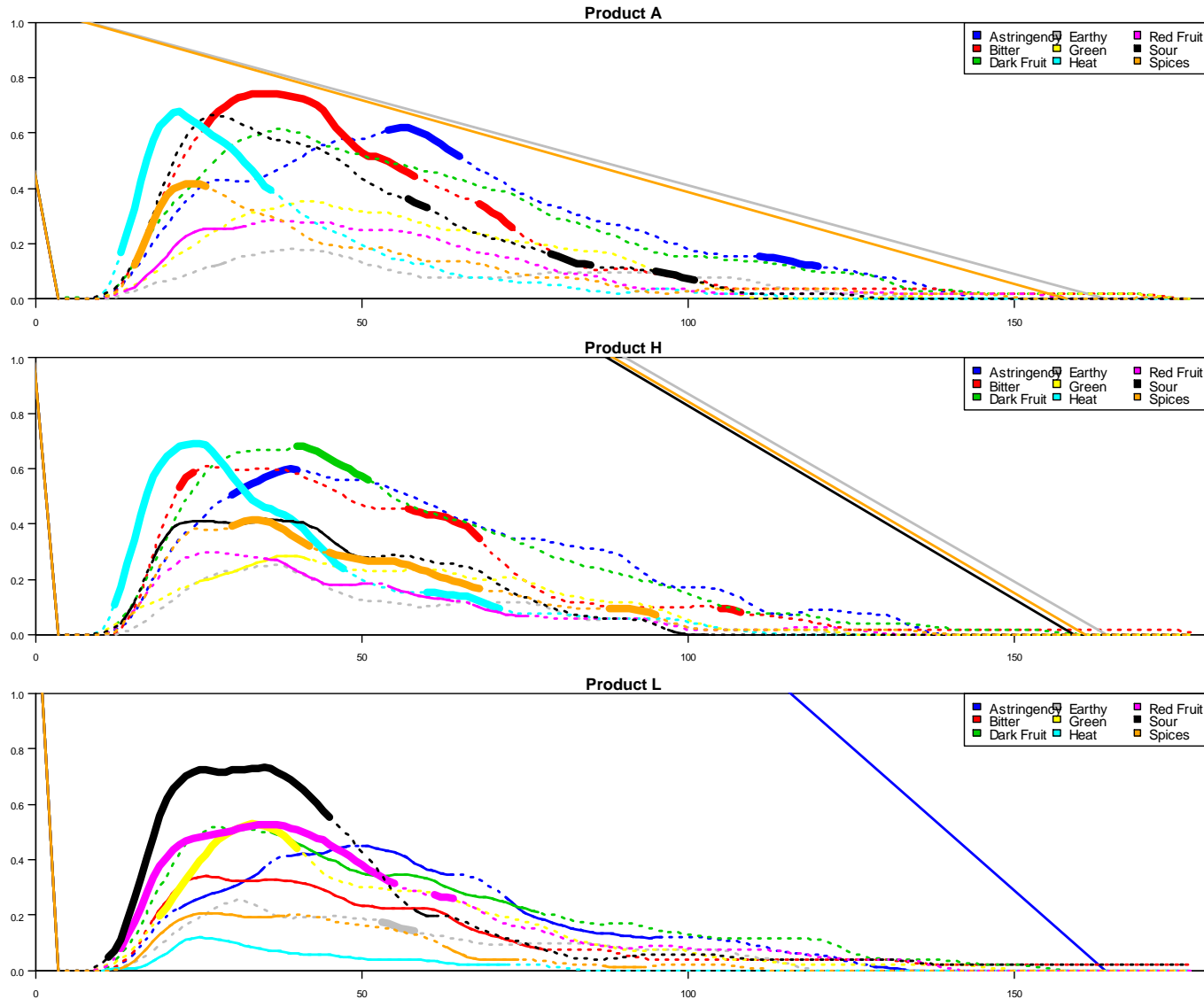


Advances in analysis

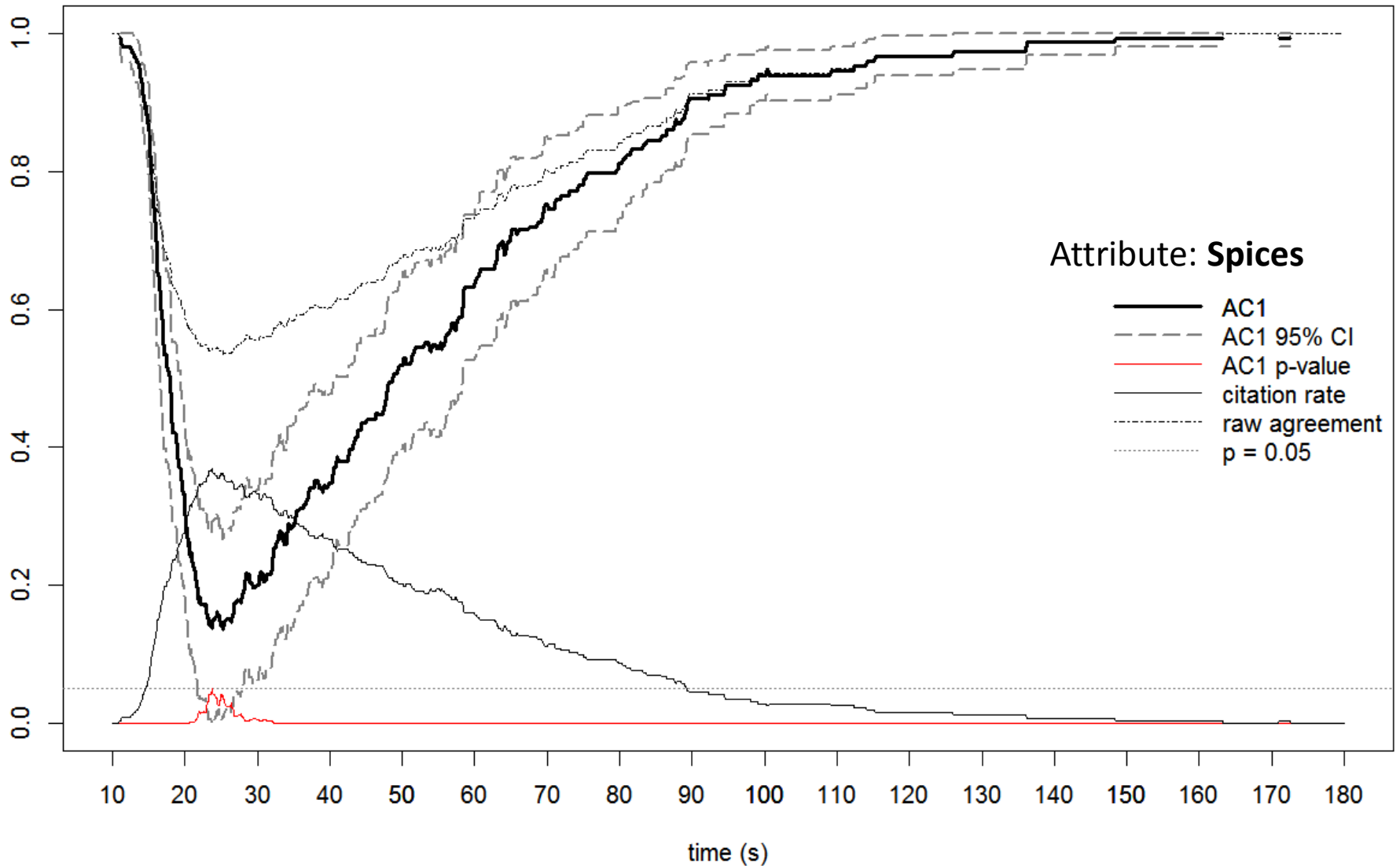


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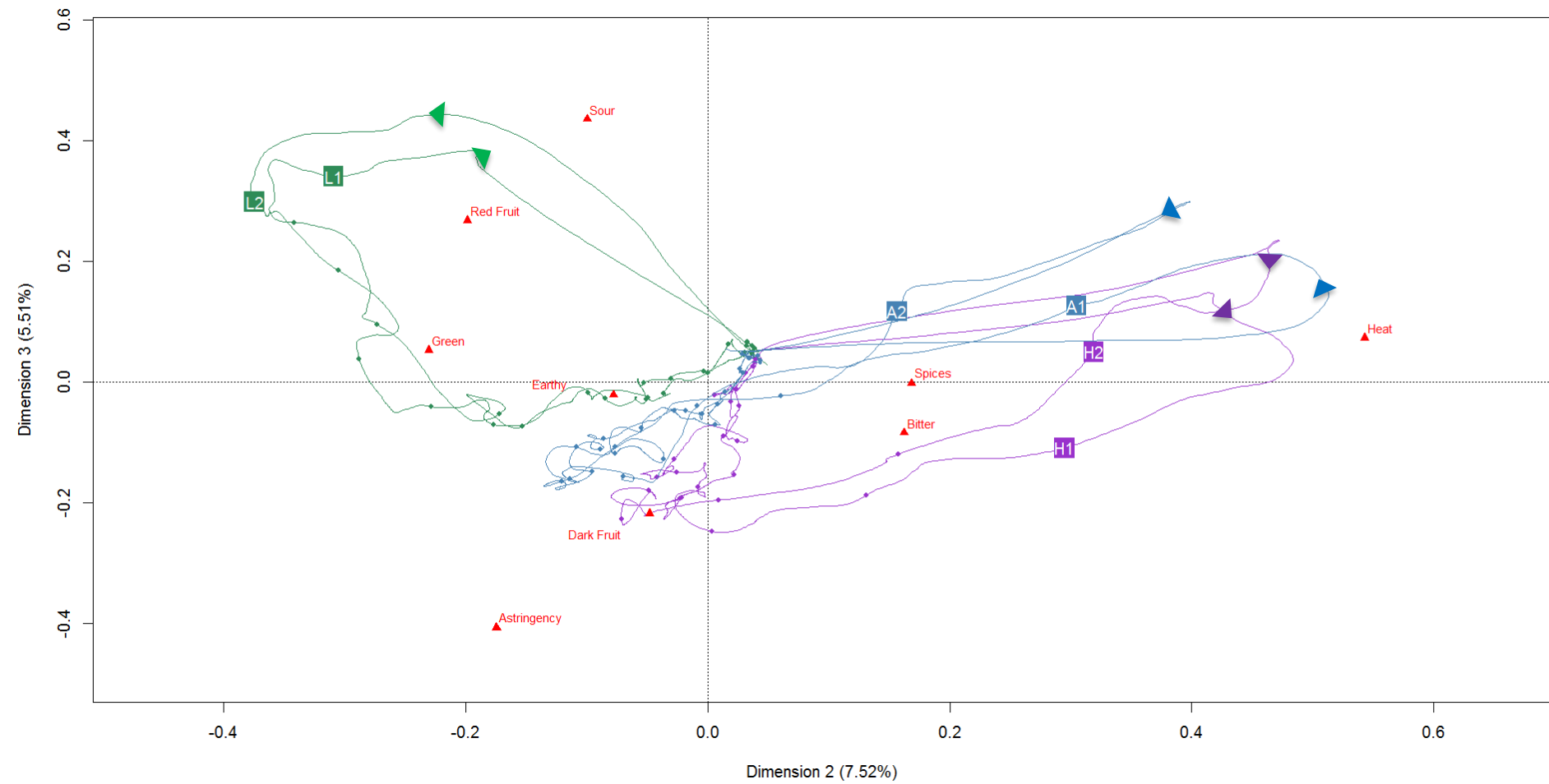
Inferential statistics via Randomization tests



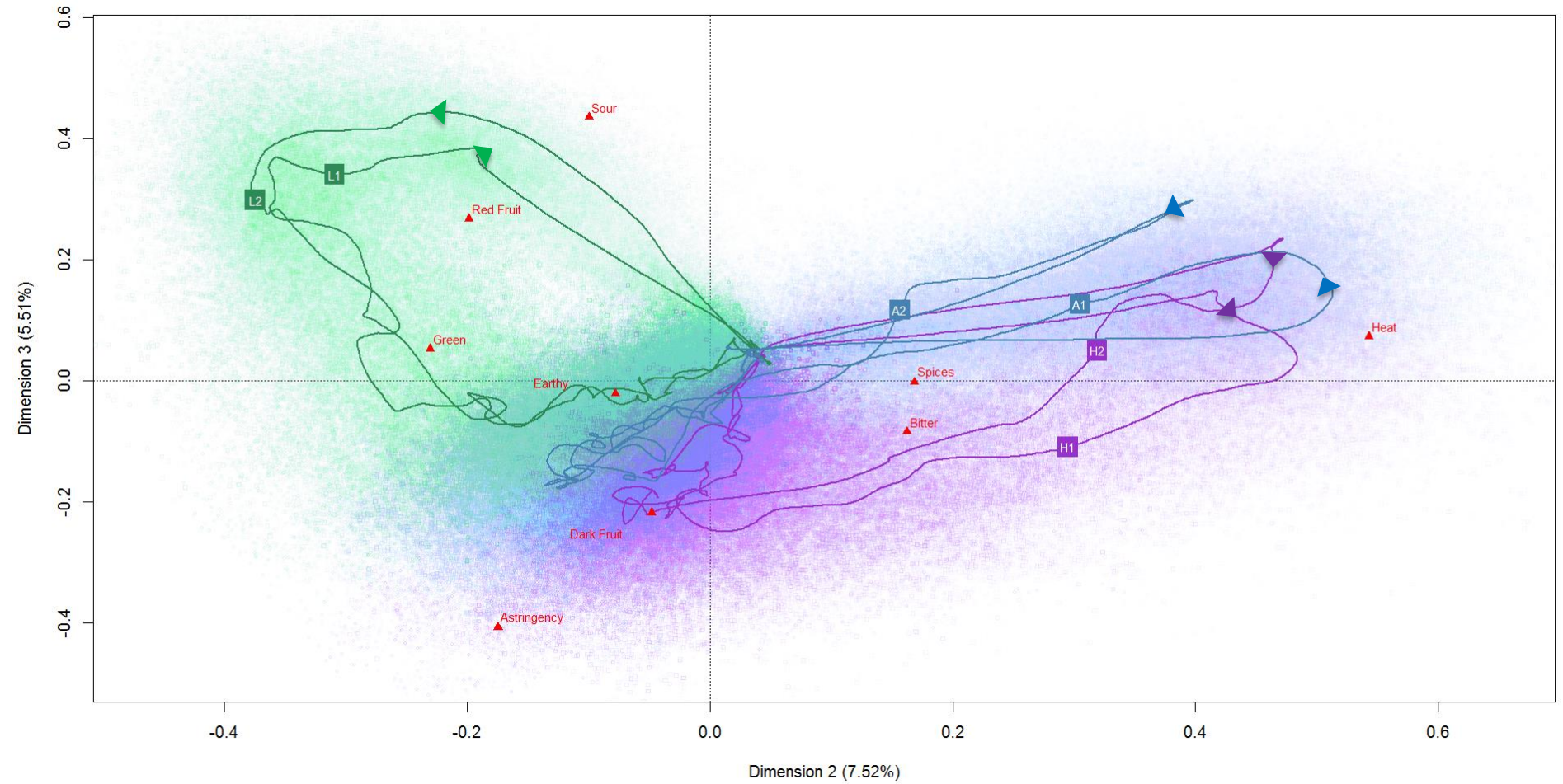
Panel agreement via Gwet's AC1



Trajectories



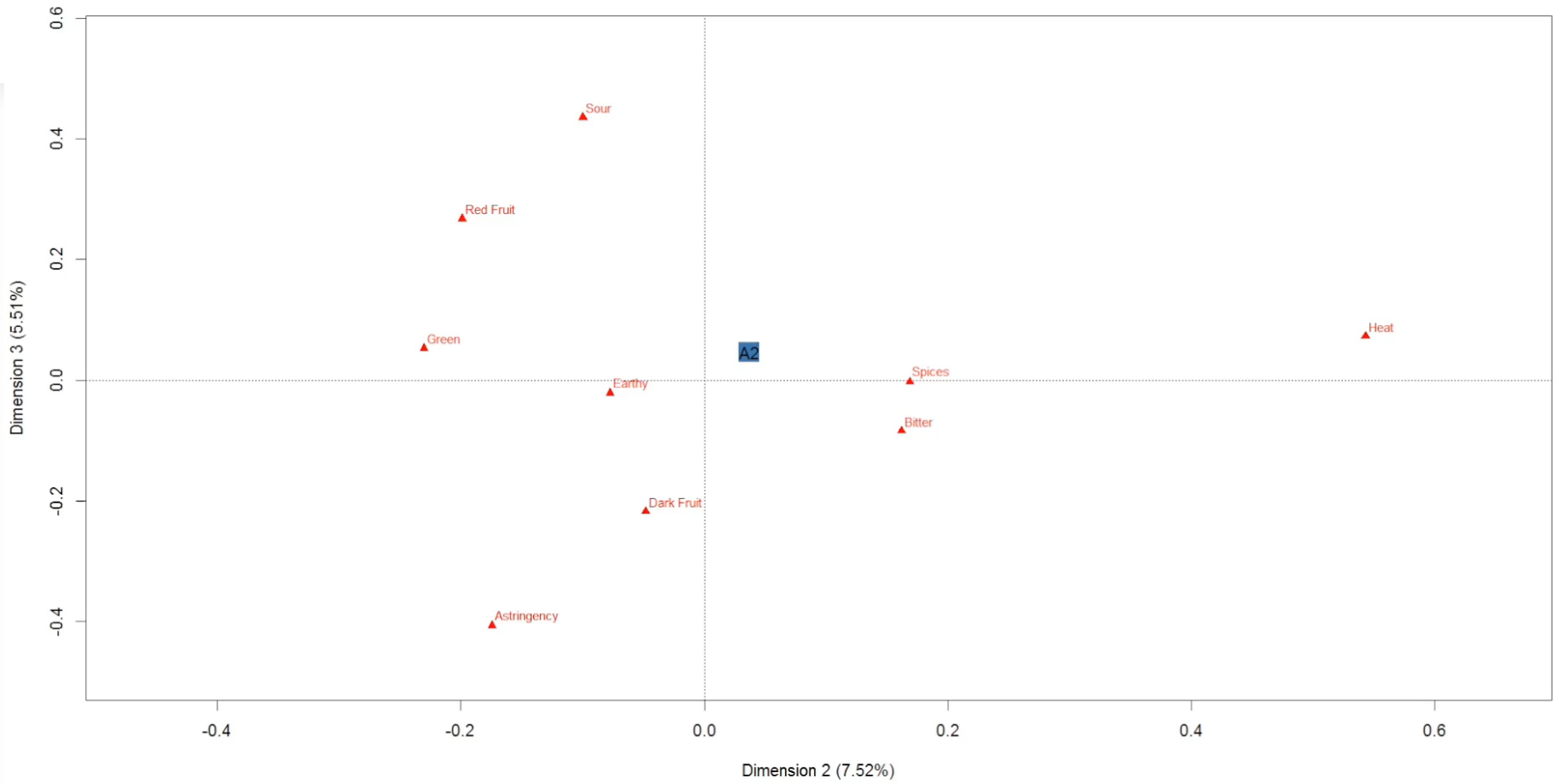
Trajectories & contrails



Animated sequences & data concentration ellipses



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R package tempR

(released June 28, 2016)



tempR: Temporal Sensory Data Analysis

Analysis and visualization of data from temporal sensory methods, including for temporal check-all-that-apply (TCATA) and temporal dominance of sensations (TDS).

Version: 0.9.9.7
Depends: R (\geq 3.3.0)
Imports: grDevices, stats, graphics
Published: 2016-06-28
Author: J. C. Castura [aut, cre]
Maintainer: J. C. Castura <jccastura@compusense.com>
BugReports: NA
License: [GPL-2](#) | [GPL-3](#) [expanded from: GPL (\geq 2)]
URL: NA
NeedsCompilation: no
Citation: [tempR citation info](#)
CRAN checks: [tempR results](#)

Downloads:

Reference manual: [tempR.pdf](#)
Package source: [tempR_0.9.9.7.tar.gz](#)
Windows binaries: r-devel: [tempR_0.9.9.7.zip](#), r-release: [tempR_0.9.9.7.zip](#), r-oldrel: [not available](#)
OS X Mavericks binaries: r-release: [tempR_0.9.9.7.tgz](#), r-oldrel: not available

Methodological advances



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Time standardization

Some researchers preprocess temporal sensory data routinely using time standardization.

The idea is to remove assessor effects (differences in chew rates, chew efficiencies, response times, etc.).

Time standardization

E.g. in TCATA evaluations of sparkling wines, duration of perception was found to increase with carbonation level.

If data were preprocessed using time standardization then it would eliminate not only assessor effects, but also real product effects!

Recommendation: Use with discretion!

TCATA Fading

“...a potential refinement to the TCATA method is to make attribute selections more ephemeral in nature, where the appearance of a selected attribute gradually fades until it becomes obvious to the assessor that the attribute is no longer selected. The assessor can re-endorse the same attribute if it remains applicable.”

TCATA Fading

“it could be that some assessors are more attentive to describing the onset of sensations than the offset of sensations ...

Similar findings have also been reported in other [auditory and visual] sensory modalities”

TCATA Fading task



Cooling

Chocolate

Crunchy

Bitter

Goopy

Sweet

Hard

Soft

Melting

Mint

TCATA Fading task



Cooling	Chocolate	Crunchy
Bitter	Goey	Sweet
Hard	Soft	Melting
Mint		

TCATA Fading task



0:11

Cooling

Chocolate

Crunchy

Bitter

Goopy

Sweet

Hard

Soft

Melting

Mint

TCATA Fading task



0:22

Cooling

Chocolate

Crunchy

Bitter

Goosey

Sweet

Hard

Soft

Melting

Mint

TCATA vs. TCATA Fading

Product	Country	Panel	n	Reps
Bread	Uruguay	Trained	12	3
Pategrás Salami	Argentina	Trained	9	3
Cheese	Argentina	Trained	9	3
Milk Desserts	Uruguay	Consumers	103 (53)	1
Mint chocolate	New Zealand	Consumers	154 (79)	1
Marinated mussels	New Zealand	Consumers	129 (64)	1
Hard cheese	New Zealand	Consumers	155 (79)	1
Hard cheese	New Zealand	Consumers	130 (64)	1

TCATA vs. TCATA Fading

- Similar results were obtained for the two TCATA variants.
- TCATA Fading may lead to more accurate temporal sensory sample profiles.
- Results were similar in studies with trained assessors and consumers.

Analysis of TCATA Fading data

- TCATA Fading data often contain 'gaps' in which an attribute fades completely and then is re-checked
- Gaps are smaller for trained assessors than for consumers
- Imputation of data in 'gaps' might be appropriate.

Final thoughts



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Final thoughts

- Advances in temporal check-all-that-apply (TCATA) methodology and analysis continue, with research findings being openly communicated via peer-review journals.
- TCATA has been applied successfully in many studies, but we are still learning about its limitations.
- The R package **tempR** is freely available and makes exploratory data analyses more widely accessible.

References

Refereed Publications

- Ares, G., Jaeger, S. R., Antúnez, L., Vidal, L., Giménez, A., Coste, B., Picallo, A., & Castura, J. C. (2015). Comparison of TCATA and TDS for dynamic sensory characterization of food products, *Food Research International*, 78, 148-158. <http://dx.doi.org/10.1016/j.foodres.2015.10.023>
- Baker, A. K., Castura, J. C., & Ross, C. J. (2016). Temporal check-all-that-apply characterization of Syrah wine. *Journal of Food Science*, 81, S1521–S1529.
<http://dx.doi.org/10.1111/1750-3841.13328>
- Boinbaser, L., Parente, M. E., Castura, J. C., & Ares, G. (2015). Dynamic sensory characterization of cosmetic creams during application using Temporal Check-All-That-Apply (TCATA) questions. *Food Quality and Preference*, 45, 33-40. <http://dx.doi.org/10.1016/j.foodqual.2015.05.003>
- Castura, J. C., Antúnez, L., Giménez, A., & Ares, G. (2016). Temporal Check-all-that-apply (TCATA): A novel dynamic method for characterizing products. *Food Quality and Preference*, 47, 79-90.
<http://dx.doi.org/10.1016/j.foodqual.2015.06.017>
- Castura, J. C., Baker, A. K., & Ross, C. J. (2016). Using contrails and animated sequences to visualize uncertainty in dynamic sensory profiles obtained from Temporal Check-All-That-Apply (TCATA) data. *Food Quality and Preference*, in press.
<http://dx.doi.org/10.1016/j.foodqual.2016.06.011>
- Oliveira, D., Antúnez, L., Giménez, A., Castura, J. C., Deliza, R., & Ares, G. (2015). Sugar reduction in probiotic chocolate-flavored milk: Impact on dynamic sensory profile and liking. *Food Research International*, 75, 148–156. <http://dx.doi.org/10.1016/j.foodres.2015.05.050>

References

R package

Castura, J. C. (2016). tempR: Temporal Sensory Data Analysis. R package version 0.9.9.7.

<http://www.cran.r-project.org/package=tempR/>.

Unpublished Manuscripts (selected)

Ares, G., Castura, J. C., Antúnez, L., Vidal, L., Giménez, A., Coste, B., Picallo, A., Beresford, M. K., Chheang, S. L., & Jaeger, S. R. Comparison of two TCATA variants for dynamic sensory characterization of food products. *Food Quality and Preference*, in review.

McMahon, K. M., Culver, C., Castura, J. C., & Ross, C. F. Perception of sparkling wines of varying carbonation levels using descriptive analysis (DA) and temporal check-all-that-apply (TCATA), in preparation.

Conference Presentations (selected)

Ares, G., Antúnez, L., Alcaire, F., Zorn, S., Vidal, L., Giménez, A., & Castura, J. C. (2016). Relationship between dynamic sensory profile and static liking: Dominance vs. description. In: *12th Sensometrics Meeting*, 27-29 July. Brighton, UK. (Oral presentation).

Meyners, M., & Castura, J. C. (2016). The analysis of temporal check-all-that-apply (TCATA) data. In: *12th Sensometrics Meeting*, 27-29 July. Brighton, UK. (Oral presentation).

Vidal, L., Castura, J. C., Jaeger, S. R., & Ares, G. (2016). Analysis of TCATA Fading data: data imputation of gaps in temporal profiles. In: *12th Sensometrics Meeting*, 27-29 July. Brighton, UK. (Oral presentation).

Thank you

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