Can TDS Deliver a Great Sensory Symphony?

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Introduction

Temporal Dominance of Sensations (TDS) describes the sensory evolution of a product in terms of the key attribute dominances. For example, two wines may share similar maximum attribute intensities in descriptive profiling, but the order in which attributes become dominant and the time and length of dominance may differentiate an average wine from a great wine, or if the wine is ready for consumption or not.

A number of studies in the literature have demonstrated the potential value of TDS over traditional time intensity methods. We wanted to demonstrate the value of TDS to the business through a proof of principle study alongside descriptive profiling.

Methodology Overview

Seven commercial products in the 4.5% - 5.5% ABV range were selected to provide a sensory stretch, including temporal aspects.

Descriptive Profiling

Descriptive profiling was undertaken on 7 samples of a fruit based beverage alcohol product. A trained panel described key similarities and differences between the liquids on both nose and palate.

Attribute Selection

Ten palate attributes were selected for TDS based on the profiling results and tasting by the project team. Temporal character over consumption was an important consideration.

Attribute	Definition
Acid	Basic taste.
Sweet	Basic taste.
Bitter	Basic taste.
Astringent	Drying effect on the palate, puckering.
Fruit	Overall intensity of the fruit character.
Citrus	Citrus notes, lemon in character.
Estery	Fruity estery notes – confectionery style.
Farmyard	Manure notes associated with farms.
Fermented	Frothing fruits, overripe, yeasty, bruised fruits.
Ammonia	Perm solution, ammonia.

TDS Training

Prelude

The sensory panel were introduced to TDS using musical pieces.

An exercise using chocolate was then conducted to build confidence in the concept of dominance and to provide familiarisation with the TimeSens software used for data collection.

Beverage Alcohol Study

Assessors were re-familiarised with the selected TDS attributes using a range of samples.

Two assessment protocols were initially presented based on trial by the project team, and a final protocol agreed through discussion.

Practice on the selected assessment protocol then ensured each assessor was comfortable with the details of the tasting procedure.

TDS Assessment Protocol

Two x 10ml cups of liquid, representing 2 sips, were presented.

Assessors were instructed to start evaluation the moment the 1st cup of liquid was taken into the mouth.

The 1st sample was held and moved around the mouth before swallowing at 10 seconds.

The 2nd sample was directly consumed after holding in the mouth only momentarily.

A total of 100 seconds was allowed for evaluation, with assessors instructed to stop the program at the end of perceiving the liquid.

Data Collection

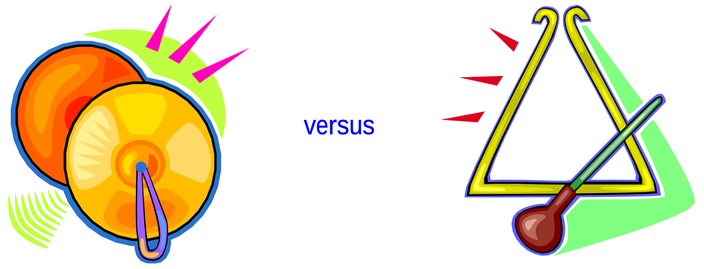
Twelve assessors evaluated 7 samples on 4 occasions, and sample presentation randomised using a Balanced Incomplete Block Design.

Six samples were presented each day over 90 minutes to allow adequate cleansing between samples and to respect internal alcohol consumption guidelines.

What is Dominance?

Something that catches your attention at a particular moment in time.

It may be 'quiet' or 'loud' – a new note making an appearance.



Data Analysis

Descriptive Profiling

Analysis of variance was undertaken with PCA on the key attributes.

TDS

Band Plots

Illustrate the sequence of attribute dominances over time, and where 2 or 3 attributes may have been competing for dominance.

Enables evolution of dominances to be visualised for the sample set.

Time Curves

Provide a visualisation of the evolution of attribute dominance over the consumption journey for a single sample.

TDS Difference Curves

Time curves from 2 samples compared to highlight key differences in dominance at different stages of the consumption journey.

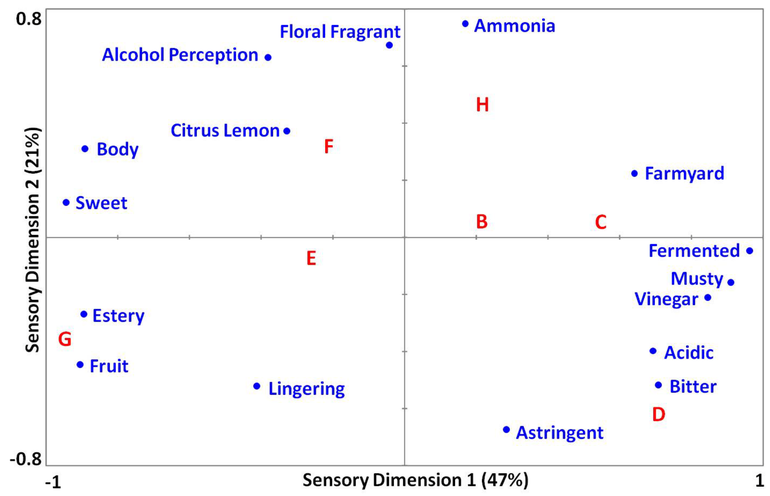
Trajectory Plot

Maps the evolution of the dominance rates using a PCA: variables are the attributes; observations are the dominance rates.

Multivariate Comparison of Products

Allows significant differences between the samples to be measured based on a multivariate analysis of the Duration parameter.

Results – Descriptive Profiling



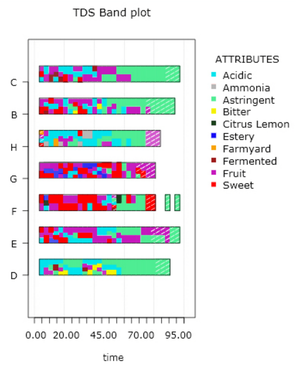
Results – TDS

Band Plot

- Astringent finish is a common character for most samples, notably B, C and D.
- G is fruity, with sweet and estery competing for temporal dominance.
- E also has fruit dominance, but other notes compete for dominance.
- Acidity is important in the temporal profile of H, D and E.
- Some liquids appear more 'complex'?

Significant Dominance

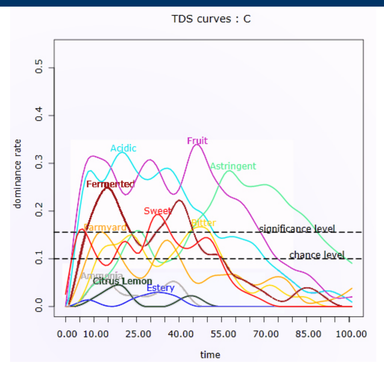
Directional Dominance

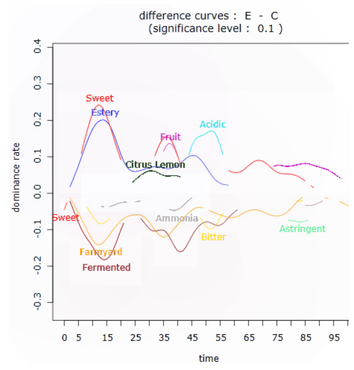


Results – TDS

Time Curves

- Liquid C is characterised by acidic & fruit character on 1st and 2nd sips with an underlying dominance of fermented character on the 2nd sip.
- As the acidity fades, fruit comes through as dominant, followed by a notable astringent finish.



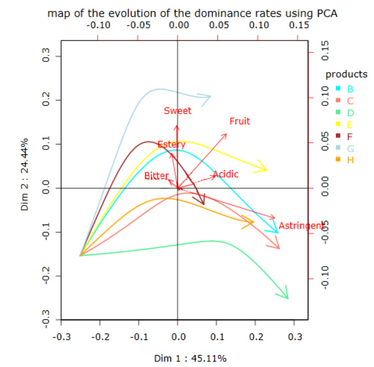


TDS Curves Compared

- E has upfront sweet estery character with fruit and acidity discriminating on aftertaste.
- C has a noticeable farmyard and fermented character upfront with an astringent finish.

Trajectory Plot

- Overall, astringent, sweet, fruit, estery and acidic were the main attributes defining temporal evolution of the liquid set.
- Liquid D, for example, is astringent throughout.



Multivariate Comparison of Products

- The Hotelling's test p-values (table) highlight that the overall temporal profiles of most liquids are quite different.
- Liquids B and C are the least different overall.

	B	C	D	E	F	G	H
B	1						
C	0.1709	1					
D	0.0019	0.0294	1				
E	0.0093	0.0000	0.0001	1			
F	0.0023	0.0003	0.0000	0.0172	1		
G	0.0006	0.0000	0.0000	0.0234	0.0413	1	
H	0.0458	0.0557	0.0095	0.0060	0.0052	0.0001	1

Discussion and Conclusions

- TDS is a valid descriptive tool, providing richness of understanding and new insights through a product's temporal profile.
- TDS can compliment a study involving descriptive profiling; it could also standalone where interest is in key temporal attributes only.
- TDS could be particularly useful in evaluating subtle differences between products in a range.
- Challenges still exist to communicate the information, insights and actionable guidance to marketing, R&D and other key stakeholders.

Potential Business Applications

- Product matching where samples pass similarity testing, yet are perceived as different by consumer over full serve.
- Optimising a product to better deliver a desired multi-sensory experience against the emotional cues of a concept.

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