Descriptive Analysis

Specify the intensities of attributes
Descriptive Analysis (DA)

Content:
- Definitions
- Applications
- Components of DA
- General procedures
- Judge performance
- Descriptive analysis method
Definition

Descriptive analysis methods involve:

- the detection (discrimination)
- the description of the sensory attributes in a product (qualitative)
- and the scaling of the intensities of these attributes (quantitative)

**a trained panel** of five to twenty judges
Applications

- Obtain **detailed profiles** of the appearance, aroma, flavor and oral texture of foods and beverages, or the skinfeel of personal care products, or the handfeel of fabrics and etc.

More generally, profile the sensory properties of any product.
Applications

- Define the sensory properties of a target product and document the sensory properties of prototypes for new product development.
Applications

- Define the characteristics/specifications of a control for quality assurance and quality control purposes.
Applications

- Track a product’s sensory changes over time to understand shelf-life properties.
Applications

- Correlate a product’s sensory attributes with instrumental physical or chemical measurements of sensory properties.
  - Color
  - Texture
  - Flavor
Applications

- Document a products’ attributes before a consumer test to help in questionnaire design and results interpretation.
- Correlate descriptive profile of products with consumers’ liking mapping (external preference mapping).
Components of DA

- For all descriptive analysis methods:
  - Descriptor = **qualitative** aspect
  - Intensity scaling = **quantitative** aspect
Some DA methods also:

- Consider the order of appearance of the attributes (e.g., the Texture profile method)
- Include some integrated or overall measure (of intensity, complexity, balance, quality, …, NOT LIKING)
General Procedures

- Recruiting panelists
- Developing an attribute lexicon
- Training panelists
- Validating panelists
- Collecting and analyzing data (actual evaluation)
- Maintaining panelists
Recruiting panelists

- Panelists
  - screened: 2-3 times than the amount of final panelists
  - training

- Execution staff
  - panel leader
  - supporting staff
Recruiting panelists

- Screen candidates using an online survey
- Interview candidates in person
- Panelists’ qualities to look for:
  - more interested in research than compensation
  - responsible, mature, and scientific-minded
  - avoid loud and/or dominant personalities
    (can be intimidating for other panelists during discussion sessions—discourages communication)
Descriptive Language

- The **perceived sensory attributes** in the products are identified and described by various terms referred to as:
  - Characteristics
  - Descriptive terms
  - Descriptors
  - Attributes
  - Descriptive terminology
Term generation

- Panelists are given a range of products (representative of the samples to be rated in the actual descriptive analysis), and are asked to develop terms describing the sensory attributes in the samples (focusing on those attributes for which the samples are different).
Descriptive Language

- Descriptive terms should be:
  - Objective (not subjective)
  - Unique (no redundancies)
  - Understandable
  - Can be translated into other languages
  - Standards can be prepared
Descriptive Language

- **Flavor or aroma wheels** have been developed by the:
  - Whisky industry (UK)
  - Brewing industry (UK and US)
  - Wine industry (US)
The Wine Aroma Wheel
Descriptive Language

• Concept alignment
  - It is critical that all judges on the panel understand the descriptive terms in the same way. This is achieved by:
    - Carefully defining each term and its evaluation protocol
    - Preparing references/standards for most attributes
Table 2. Aroma and flavor by mouth terms selected for descriptive analysis and composition of the corresponding reference standards.

<table>
<thead>
<tr>
<th>Term</th>
<th>Composition of reference standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fresh berry (strawberry, raspberry, black currant)</td>
<td>5 mL red berry fruit drink (Capri Sun™) · 3 mL black currant syrup (Vedrenne™)</td>
</tr>
<tr>
<td>2. Berry jam (strawberry, raspberry, blackberry)</td>
<td>6.5 g each of strawberry, raspberry and blackberry jam (Empress™)</td>
</tr>
<tr>
<td>3. Cherry</td>
<td>5 mL cherry drink (Hi-C™)</td>
</tr>
<tr>
<td>4. Prune</td>
<td>10 mL prune juice (Town House™)</td>
</tr>
<tr>
<td>5. Spicy (black pepper, cloves)</td>
<td>pinch of black pepper · 2 cloves</td>
</tr>
<tr>
<td>6. Mint/eucalyptus</td>
<td>2 cm² green mint · 4 cm² eucalyptus leaf</td>
</tr>
<tr>
<td>7. Earthy (potato, mushroom)</td>
<td>7.5 mL canned potato liquor · 10 mL canned mushroom liquor (Town House™)</td>
</tr>
<tr>
<td>8. Leather</td>
<td>4 cm² leather</td>
</tr>
<tr>
<td>9. Vegetal (green bean, green tea)</td>
<td>10 mL canned green bean liquor (Town House™) · 1.2 g green tea (Dynasty™)</td>
</tr>
<tr>
<td>10. Smoke/tar</td>
<td>0.01 mL liquid hickory smoke (Wright's™) · 1 g tar</td>
</tr>
<tr>
<td>11. Berry by mouth</td>
<td>1 mL I.F.F.™ strawberry extract in 150 mL Pinot noir</td>
</tr>
<tr>
<td>12. Bitterness</td>
<td>0.2 g caffeine in 150 mL water/0.4 g caffeine in 150 mL Pinot noir</td>
</tr>
<tr>
<td>13. Astringency</td>
<td>0.6 g aluminum sulfate in 150 mL water/1.2 g aluminum sulfate in 150 mL Pinot noir</td>
</tr>
</tbody>
</table>

* In 30 mL Mountain Castle Burgundy™ (unless otherwise specified)
‘Earthy’ = Soil + olives

‘Ocean-like’
= Green seaweed + anchovy + olives
Intensity Scale

• **Category scale**
  - Unstructured line scale (6-inch, 15-centimeter)
  - Numerical scale (0-10 or 0-15)
  - Labeled scale (low-high, none-extreme)
  - Anchor points?
- Some methods allow judges to use the scale any way they want (provided they discriminate among the samples and are consistent with the rest of the panel).

- Other methods require that judges use the scale exactly in the same way (calibration), and extensive training is required: judges assign the same score to a given sample.
Training

- **Group exercises** (e.g., go around the table and ask for dominant attributes or ratings for a sample, then discuss).

- **Individual ratings** (e.g., have the panel rate the attributes across a few samples).

- Plot ratings to show individual panelists.

- Examine standard deviations.
Judge Performance

- **Performance criteria:**
  1) Ability to discriminate
  2) Reproducibility
  3) Consistency with the rest of the panel = concept alignment
Judge Performance

Performance criteria:
1) Ability to discriminate:

Samples F-ratio in ANOVA
Judge Performance

Performance criteria:

2) Reproducibility
- Replications F-ratio in ANOVA
- Judge by Replication interaction F-ratio in ANOVA
Judge Performance

Performance criteria:

3) Consistency with the rest of the panel = concept alignment

- Judge by Sample interaction F-ratio in ANOVA
Descriptive Analysis Methods

- Flavor Profile Method
- Texture Profile Method
- Quantitative Descriptive Analysis
- Spectrum Method
- Free-Choice Profile
- Flash Profile
- Time-intensity Profile
- Temporary Dominant Scale
- ......
The Flavor Profile Method

- Analysis of a product’s perceived aroma and flavor attributes, their intensities, order of appearance, and aftertaste by a panel of four to six trained judges.
- The panel **arrives at a ‘consensus’ profile** for each sample. (not individual ratings)
- Uses a numerical type category scale anchored with words.
- An ‘amplitude’ (balance/blend) rating generally is included in the profile.
The Flavor Profile Method

FLAVOR PROFILE

INTENSITY

0 not present
1 slight
2 moderate
3 strong
The Flavor Profile Method

- Problems associated with the scale:
  1) Does not allow for parametric statistical treatment of the data. (need to analyze using a non-parametric statistics.)
  2) Not enough categories
  3) Threshold category: Prone to response bias
  4) Not equally spaced
# The Flavor Profile Method

<table>
<thead>
<tr>
<th>AROMA</th>
<th>Amplitude</th>
<th>Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hop fragrance</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Fruity (apple)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Sour</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Yeast</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malt</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Phenylacetic acid (honey)</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FLAVOR-BY-MOUTH</th>
<th>Amplitude</th>
<th>Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO₂ tingle</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Salt</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Sweet</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Sour</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Fruity (winy)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Bitter (metallic)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Malt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yeast</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Others:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Astringent</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The Texture Profile Method

- Includes specific attribute descriptors for semisolid foods, beverages, skincare products, fabric and paper goods.
- Focuses on texture/feel characteristics.

- The sensory analysis of the texture of a complex food in terms of its **mechanical, geometrical, fat and moisture characteristics**, the degree of each present, and **the order in which they appear** from first bite through complete mastication.
The Texture Profile Method

1. Mechanical properties
   Primary (hardness, cohesiveness, springiness, adhesiveness, viscosity)
   Secondary (fracturbility, chewiness, gumminess)

2. Geometrical properties
   Size and shape (powdery, chalky, grainy, gritty, lumpy, beady)
   Shape and orientation (flaky, fibrous, pulpy, puffy, crystalline)

3. Fat and moisture content
   Moistness, dryness, oiliness, fattiness
The Texture Profile Method

- Textural attributes are subdivided according to order of appearance:
  
  1. **Initial** (perceived at first bite)
  2. **Masticatory** (perceived upon chewing)
  3. **Residual** (changes induced during mastication and swallowing) - afterfeel
The Texture Profile Method

- Judges are selected on the basis of ability to discriminate known textural differences in the products under study.
- Judges define all terms and procedures for evaluation.
- Samples are evaluated individually using category, line or magnitude estimation scales (ratio scale), yet panel verdict may be derived by group consensus.
The Quantitative Descriptive Analysis (QDA) Method

- Measures all sensory attributes
  - Screening (user of the product; discrimination test) with products from category
  - Language training is 1 week
  - Attributes and explanations provided by subjects; references as needed
  - Panel leader does not participate
  - Graphic rating scale
  - Products scored on repeated trial basis
  - Analyses specified
QDA

- There are four stages to establishing a QDA panel capability:
  - Recruit and screen subjects
  - Develop a scorecard and set of definitions
  - Data collection
  - Analysis and reporting
QDA Graphic Scaling

- QDA® uses a line scale to measure relative intensities for individual dimensions.

- Familiarity with the scale is necessary to use it as an equal interval scale.
Product Evaluation in QDA

- Subjects evaluate products while seated in booths or in typical usage at home
  - Products scored using a repeated trials balanced block design
  - Products are served and scored one at a time (i.e., monadic sequential)
Summary of QDA

- Small panel procedure, 10-12 subjects
  - Subjects qualified based on liking for and usage of products tested, and their sensory skill with the products being tested
    - Training with the products being tested
    - Measures all sensory attributes
    - Attributes and definitions provided by the subjects (a consumer language)
Summary of QDA

- References may be used during training
- Graphic rating scales to provide intensity measures
- Products individually scored on a repeated trials basis
- Analysis of variance (and other statistics) used to identify product attribute differences, subject sensitivity and reliability, and the overall quality of the information
The Spectrum Method

- **Provides the tools** – reference lists of descriptors, scaling procedures and methods of panel training – with which to design a descriptive procedure for a given product.
  - Uses a 15-cm graphic scale or a 15-point numerical scale.
  - Standards – used to anchor scale
  - Long training required
The Spectrum Method

**STANDARD DENSENESS SCALE**

*Place sample between molars and compress.*

*NOTE:* Compactness of cross-section.

<table>
<thead>
<tr>
<th>AIRY</th>
<th>DENSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>Cool Whip (General Foods)</td>
</tr>
<tr>
<td>2.5</td>
<td>Marshmallow Fluff (Fluff-Durkee-Mower)</td>
</tr>
<tr>
<td>4.0</td>
<td>Nougat (Three Musketeers / M&amp;M Mars)</td>
</tr>
<tr>
<td>6.0</td>
<td>Malted Milk Balls (Whoppe – Leaf Confectionary)</td>
</tr>
<tr>
<td>9.0</td>
<td>Frankfurter (Oscar Mayer – cooked 5 mins)</td>
</tr>
<tr>
<td>13.0</td>
<td>Fruit Jellies (Chuckles, Nabisco)</td>
</tr>
</tbody>
</table>
The Spectrum Method

**STANDARD COHESIVENESS SCALE**

Place sample between molars; compress fully.

**NOTE:** Extent to which sample deforms rather than crumbles, cracks or breaks

**RUPTURING** ——— **DEFORMING**

<table>
<thead>
<tr>
<th>Score</th>
<th>Sample Description</th>
<th>Brand</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Corn muffin</td>
<td>(Pepperidge Farm)</td>
</tr>
<tr>
<td>5.0</td>
<td>Yellow American pasteurized cheese</td>
<td>(Land O'Lakes)</td>
</tr>
<tr>
<td>8.0</td>
<td>Pretzel</td>
<td>Soft Pretzel</td>
</tr>
<tr>
<td>10.0</td>
<td>Sun dried seedless raisins</td>
<td>(Sun Maid)</td>
</tr>
<tr>
<td>12.5</td>
<td>Candy Chews</td>
<td>(M&amp;M Mars)</td>
</tr>
<tr>
<td>15.0</td>
<td>Chewing Gum</td>
<td>(Freedent)</td>
</tr>
</tbody>
</table>
# The Spectrum Method

## 8. Standard Viscosity Scale

<table>
<thead>
<tr>
<th>Scale value</th>
<th>Reference</th>
<th>Brand/type/manufacturer</th>
<th>Sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Water</td>
<td>Bottled Mountain Spring</td>
<td>1/2 tsp.</td>
</tr>
<tr>
<td>2.2</td>
<td>Light cream</td>
<td>Sealtest Foods</td>
<td>1/2 tsp.</td>
</tr>
<tr>
<td>3.0</td>
<td>Heavy cream</td>
<td>Sealtest Foods</td>
<td>1/2 tsp.</td>
</tr>
<tr>
<td>3.9</td>
<td>Evaporated milk</td>
<td>Carnation Co.</td>
<td>1/2 tsp.</td>
</tr>
<tr>
<td>6.8</td>
<td>Maple syrup</td>
<td>Vermont Maid, R. J. Reynolds</td>
<td>1/2 tsp.</td>
</tr>
<tr>
<td>9.2</td>
<td>Chocolate syrup</td>
<td>Hershey Chocolate</td>
<td>1/2 tsp.</td>
</tr>
<tr>
<td>11.7</td>
<td>mixture: 1/2 cup</td>
<td>Magnolia Sweetened</td>
<td>1/2 tsp.</td>
</tr>
<tr>
<td></td>
<td>condensed milk</td>
<td>Borden Foods</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+ 1 T. heavy</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>cream</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.0</td>
<td>Condensed milk</td>
<td>Borden Foods</td>
<td>1/2 tsp.</td>
</tr>
</tbody>
</table>

**Technique:**

(A) Place 1 tsp. of product close to lips; draw air in gently to induce flow of liquid; measure the force required.

(B) Once product is in mouth, allow to flow across tongue by moving tongue slowly to roof of mouth, measure rate of flow (the force here is gravity). The rate of flow per unit force:

**Definition:**

(A) the force to draw between lips from spoon

(B) the rate of flow across tongue.

[Not viscous ———————————————————————————————————— Viscous]
The Spectrum Method

- Claims to provide ‘absolute’ ratings
- Judges are extensively trained to produce the same ratings for the same samples
- The Spectrum Method is well suited for quality assurance (if product specifications include a specific attribute profile).
F value: difference within group/difference between groups

MSE: repeatability
Free-Choice Profiling

Steps:
• Each judge receive all products and describes.
• Produces own list of terms: own concepts and labels
• Personalized scoresheet is created
• Practice a few times to (make sure to be internally consistent)
• Rate products with ones own descriptor list
• Analyze data: Generalized Procrustes analysis
Time-Intensity Profiling

- The time-intensity technique monitors the **intensity** of specific attributes **over time**.
- The data is **continuously recorded** with a joystick or mouse interfaced to a computer.
Time-Intensity Profiling

Examples:
- Chewing gum (matrix release)
- Chocolates (fats – flavor release; melting)
Time-Intensity Profiling

T-I Bitterness of IAA’s in H₂O

(18 Ss x 3 Reps)

Average Intensity (n = 54)

- 33 ppm
- 24
- 17
- 12

Time (sec)