Sensory Analysis

Section 2.

Sensory Evaluation Thresholds

Thresholds are a specific level below which a compound is not detectable, and above which it can be detected by persons with average sensory acuity.

Thresholds will differ:

- among panelists
- within panelists
- among sensory stimuli

Thresholds are used for the following reasons:

- to set defect action levels: “At what level is ethyl acetate detectable in a wine?”
- to determine acceptable levels for additives
- for selecting panelists

There are three types of thresholds:

- detection (absolute) threshold

  - the lowest stimulus capable of producing a sensation: "I can taste *something*"
  - minimum stimulus intensity
  - for example, very dilute solutions of NaCl will taste sweet, not salty
- recognition threshold
  - the level of a stimulus at which it can be recognized and correctly identified: "This is salty"
- difference threshold
  - the extent of change in the stimulus necessary to produce a *reliably* noticeable difference
  - for example, wine A is *more crisp* than wine B
  - experimentally: the amount of stimulus increase (or decrease) that is judged as stronger than the original stimulus intensity on 75% of the trials (or weaker on 25% of the trials)

When thresholds are given in sensory literature, they are the average of the threshold measurements of a given population of panelists. For individuals, the threshold is your 50/50 point: 50% of the time you can detect or recognize a stimulus (or change in stimulus intensity), and 50% of the time you can't.

Factors influencing threshold measurements include the following:

- purity of stimuli
- level of "noise" in the blank
- physiological state of panelist
- panelist attentiveness
- panelist motivation

Psychophysics

Psychophysics is the study of the relationship between physical stimuli and a person's sensory experience, i.e., how changes in stimulus intensity correlate with changes in a person's sensory response.

Complex signal processing in our brains makes seemingly straightforward wine evaluations difficult and complex. An awareness of the interrelations between humans and wine chemistry is essential if we are to manage and understand sensory evaluation. Why do humans like or tend to purchase a product? How can a product be replicated, designed, or improved?

During wine evaluation, the brain processes cognitive information from multiple sensory inputs, including sight, smell, taste, touch, temperature, and irritation. What we sense is the product of the physical stimuli and the mental picture that we develop from those stimuli (Shepherd, 2006). Perception (Figures 1 and 2), therefore, is the culmination and interpretation of multiple inputs.

Figure 1. Is this a perfect circle, or does it bend?

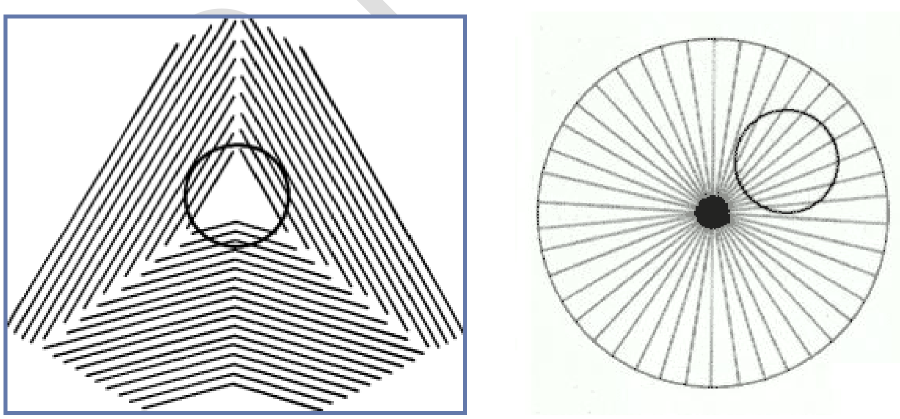
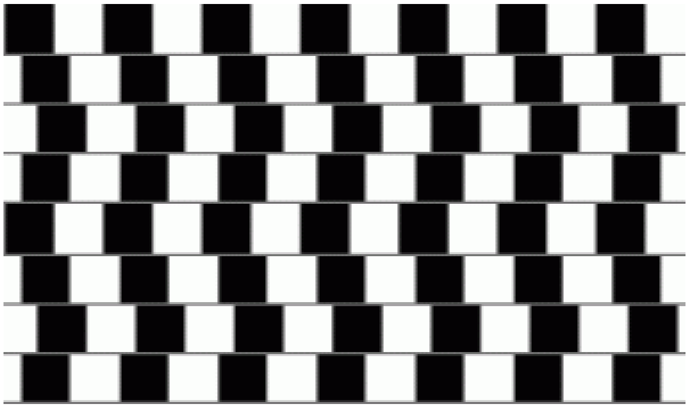


Figure 2. Are these lines horizontal, vertical, or do they slope?



An understanding of these interactions is critical to sensory evaluation. For example, a wine served at the winery with all of the ambiances, autumn colors, and pleasant music, may be perceived quite differently than the same wine served in a loud, raucous amusement park, or even at home (Kennedy et al., 2010).

Examples of multiple sensory inputs on perception are numerous. The same two white wines, one with red food coloring, the other without, can certainly evoke different sets of aroma and flavor descriptors. Sucrose solutions spiked with fruit or berry aromas are usually judged to be sweeter than the same solutions without the aromas (Prescott, 1999).

It is evident that even highly-experienced judges use all sensory information available to arrive at a judgment. Those judgments can be seriously impaired. Are green and unripe tannin descriptors due to tannin structure, or the result of aroma/flavor cues that influence the way we perceive and evaluate astringency? Perhaps green and unripe tannin descriptors are influenced by less red color intensity (Kennedy et al., 2010).

We know that color, bottle shape, closure, etc., creates a certain bias for or against, which can influence our perception of the product. Bias must be eliminated if a true sensory impression is desired. The development of bias often has cultural origins, expressed in ethnic differences in odor/taste judgments.

Rules of Thumb for Successful Evaluations

Proper sensory evaluation at the winery requires the following:

- Always evaluating wines blind.
- Always having as many evaluators as possible to gain a true picture.
- Repeating the evaluation and varying the order of presentation when possible.
- Understanding the importance of sample contrasts.
- Using samples that are representative of the whole.
- Providing a standardized and controlled environment for sensory evaluations.
- Using the proper testing method.
- Standardizing glasses, pour volume, and sample temperatures.
- Minimizing adaptation and other physiological effects.
- Selecting evaluators who are not using perfumes, heavy colognes, scented body soaps, etc., which could impact the other evaluators.
- Understanding that all sensory evaluation is transitory – that is, a snap-shot only for the moment.
- Eliminating bias, including number/letter bias (the reason for three-digit random number codes) and placement order bias. The latter refers to the need for randomizing the order of pour, so that not everyone will taste the same wine first.
- Establishing a common language for the description of samples.

Standardization of Sensory Evaluation

If, as a group, we were to evaluate a wine, it is not likely we would have the same response to the product's attributes and deficiencies. Beyond that, without standardization, it is very difficult for individuals to provide a consistent response.

In proper wine sensory evaluation, we must keep the following confounding problems with non-standardized sensory responses in mind, and minimize their effects:

- adaptation
- cross-adaption
- individual variability
- difficulty in separating some sensory components
- non-standardized language
- expectations /bias

Before a testing method can be selected, it is important to understand the parameters of sensory evaluation that must be standardized and controlled. Standardization of environment and sensory techniques provides control of factors that can influence and bias the results of the sensory test; without these controls, incorrect information and interpretation may result. Therefore, it is very important to control as many variables as possible (ASTM, 1968; Meilgaard et al., 1991; Muñoz et al., 1992; Stone and Sidel, 1985; Yantis, 1992).

Standardization of Environment

Sensory evaluation should be completed in an environment conducive to concentration. Many large wineries have sensory evaluation areas located within the winery. The best are designed to minimize interaction among panelists and allow the individual to focus on the evaluation of the sample. Individual booths, which have side panels that prevent interaction between panelists, are equipped with individual lighting, adequate space for sample evaluation, a signal system for communicating with the sensory technician, and a hatch door for receiving samples.

The technician passes samples to the panelist through the hatch, which minimizes personal contact and influence. Neutral colors on the booth walls avoid creating a mood response or altering the appearance of the sample. Incandescent light within the booth, at an intensity similar to that of a typical office, provides the best indoor light with regard to true wine colors; fluorescent light adds to the perception of brown hues. Red-colored lights or dark-tinted wine glasses may be used to remove any bias from color differences in the wine samples.

Conditions within the evaluation room should be designed for the comfort of the panelist. Control of temperature and relative humidity, at approximately 21°C (70°F) and 45 to 55%, respectively, provides a comfortable setting. A well-ventilated room, with positive pressure, assists in controlling interferences from odors. Extraneous or excessive odors can interfere with evaluation of aromas from the wine samples and cause a bias in sensory measurement. Therefore, sample glasses containing wine are covered with watch glasses or petri plates until the moment of evaluation.

It is important that the evaluation occur in a location convenient to the panelists. Although some facilities have space dedicated for sensory evaluation, not every winery can allocate space for such a specific use. It is possible to prepare an evaluation area for temporary use in another facility, such as a conference room or lounge. Collapsible booths, manufactured from plywood or cardboard, may be set up on tables to provide the privacy for the individual panelist during evaluation.

Preparation of samples for the evaluation is completed in a room convenient to the evaluation room, with controls to prevent observation of sample preparation by the panelists, as well as to minimize noise, odors, and other disturbances.

Sample Preparation and Temperature

The preparation and presentation of the samples must be uniformly controlled to avoid any biasing of response during evaluation (ASTM, 1968; Meilgaard et al., 1991; Muñoz et al., 1992; Stone and Sidel, 1985; Yantis, 1992).

Samples, selected to represent the product under evaluation, are also selected to represent the production lot. Samples are served in a standardized fashion, considering serving temperature, serving size, etc. Glass is an appropriate serving vessel as long as it is clean and free of any soap or chemical residues that can be detected by panelists.

During preparation of the samples, it is important to cover the serving glasses with a glass cover. If the wine glass is not covered, volatile compounds will be lost from the sample, filling the room with aromas that could bias the evaluation. It is wise not to pour all samples too far in advance of serving because the volatile aromas could become variable on serving to panelists.

Serving the wine at room temperature is appropriate, making it easy to control the serving temperature. Palate balance is impacted by a number of features, including temperature:

- Cooling reduces sweetness of sugars.

- Cooling reduces bitterness of alkaloids.
- Cooling increases the sense of acidity.
- Cooling increases bitterness and astringency of tannins.

Sample Size and Number

The panelist must have an adequate sample size to complete the evaluation required. Sensory methods requiring numerous evaluations of flavor, aromas, and body require a sample size of approximately 30 to 40 mL. Other methods involving simple comparisons may require less sample, perhaps only 15 to 20 mL.

Given the complexity of wine flavors and aromas, it is recommended that only a limited number of wine samples be evaluated in one sitting. The exact number will vary depending on the test method, complexity of the wine, and panelist experience, but it is recommended that no more than six samples be evaluated in one sitting. It is, of course, important that wine samples are expectorated to avoid fatiguing the palate and biasing judgments.

Sample Coding and Presentation

Samples must be coded to eliminate bias. A three-digit code, chosen at random, is assigned to each product and used to identify the product sample to the panelist. Use of the alphabet or single- or double-digit numbers as codes is discouraged, because some letters and numbers can have special meaning to panelists. Three-digit random codes may be easily obtained from a random numbers table, available in many sensory evaluation or statistics books (Meilgaard et al., 1991; Stone and Sidel, 1985).

The order in which the samples are presented to panelists must be balanced, so that the influence of such factors as panelist fatigue, positioning of a high-quality wine next to a lower quality product, etc., will have little impact on the outcome of the test. A prejudicial preference for one wine over another, based on the order in which the samples are tasted, may occur. Frequently the first sample is preferred over subsequent samples, particularly by inexperienced evaluators.

Another bias may be created if greatly contrasting wines are evaluated in sequence; the sensory impression of the second wine can be greatly distorted by the response to the characteristics of the first wine evaluated. Balancing the sample order is used to overcome this potential bias.

For example, in a test with three wines, each product should appear in each position an equal number of times. The six possible combinations for positioning of three products (A, B, C) would be ABC, ACB, BAC, BCA, CAB, CBA. If the panelist is to receive more than one set of three samples, the order of presentation of these sample combinations should be randomized.

This may be easily accomplished by drawing sample cards representing each three-sample sequence from a hat until the six combinations have been randomly assigned. This arrangement of samples prevents any undue influence from positional bias or contrast effects between wines.

Adaptation is the short-term loss in acuity, associated with extended exposure to a tastant (flavor substance). Adaptation to a tastant can become complete. It is recommended that wine evaluators properly cleanse their palate and sense of smell between samples to minimize adaptation. Products, e.g., SanTásti, are designed for such purposes.

Cross-adaptation refers to the effect of adaptation to one compound affecting perception of another. Some of the effects are easy to comprehend, for example the apparent sweet sensation of water after tasting bitter or acidic solutions.

To illustrate the effect that can occur in a multiple comparison evaluation, where wine one has a lingering effect on wine two due to cross-adaptation, one can taste lemonade, followed by water (with some sugar in the water). The sweetened water impacts the perception of the sugar/acid balance of the lemonade (McBurney and Bartoshuk, 1973).

Tasting order can have an impact on wine perception due to cross-adaptation. Order error refers to the differences in perception owing to the order in which wines are sampled. This is why, in a true sensory evaluation, all evaluators would not taste wines in the same order.