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SHILOH VINES & WINES KNOWLEDGE BASE SERIES

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Sensory Evaluation of Wine¹

by

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Drinking without thinking is like hearing without listening.

M. Robinson

Coordination Draft
Comments Welcome

Wine² and Wine Tasting

Type and Style—There are numerous wine types (e.g., still red) and styles (e.g., dinner wines):



This article applies mostly to red and white still wine types and the three wine styles—light and fruity, dinner wines, and big wines—but is somewhat applicable to the other types as well.

Evaluation Possibilities—These include:

- Evaluation and scoring of the quality of a single wine (e.g., Robert Parker).
- Comparison of two (or more) wines that differ in only one respect (e.g., residual sugar).
- Comparison of wines within single category (e.g., variety, vintage, winery, region).
- Comparison of wines across single categories (e.g., vertical tasting of Opus One wines).
- Comparison of wines within or across more than one category (e.g., Napa Valley Meritages versus Medoc Bordeaux blends for 1997 and 1998 vintages).

The sensory evaluation of wine generally focuses on one or more the sensory components listed to the right.

Sensory Components of Wine³

appearance—The first category by which a wine is judged by sensory evaluation. Includes assessment of clarity and bubble display.

aroma—Odors in the wine that originate in the grape from terroir, variety, rootstock, clone, cultural practices, and other winegrowing factors. Odors are sensations stimulated by the volatile components of wines and perceived in the olfactory epithelium and include aroma, bouquet, and off odors.

bouquet—Odors in the wine that originate from fermentation, aging, and other winemaking factors.

flavor—Odors perceived in the mouth.

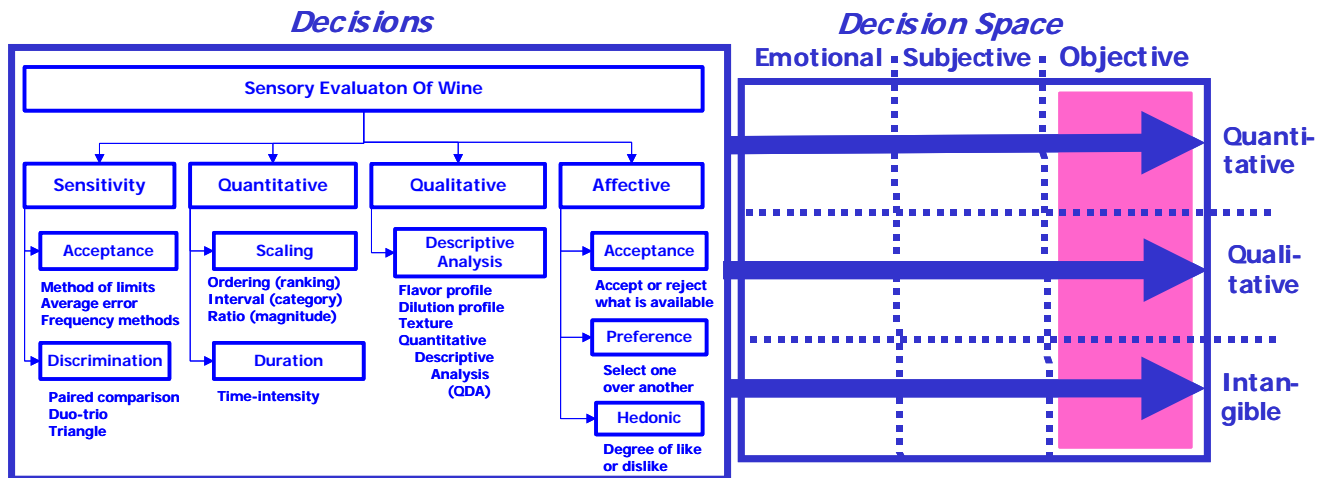
finish—The lingering aftertaste of a wine. Aftertaste comprises the odors and *flavors* that linger in the mouth after swallowing or spitting out the wine—duration.

body—The viscosity or thickness of wine. Correlated with extract and alcohol: the higher the alcohol and extract content, the more full-bodied the wine. A tactile sensation. Also the intensity of *aroma* and *flavor* components. Extract comprises those wine components that remain when the volatiles, alcohol, and water are evaporated and that contribute to a wine's body. Alcohol is ethanol, or ethyl alcohol, formed during fermentation. A component of the odor, taste, and tactile sensations of wines—mouth-feel.

balance—Integration of acidity, sweetness, and *flavor* in pleasing proportions. Acidity is the tartness, taste of natural fruit acids (tartaric, citric, malic, or lactic) in wine.

structure—All of the organoleptic elements—perceived with senses of sight, smell, taste, touch, and hearing—of a wine other than *flavor* which are experienced in the mouth: sweetness, acidity, astringency, hotness, body, effervescence, etc. Astringency is the harsh, drying, tactile sensation in the mouth caused by high tannin levels (the opposite is smooth). (Bitterness is a taste sensation usually sensed on the back of the tongue.) Also mouth-feel.

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Sensory Evaluation Techniques⁴

Analytical vs. Affective—Of the four sensory evaluation categories depicted above, three—Sensitivity, Quantitative, and Qualitative—are considered analytic and one—Affective—is considered non-analytic.⁵

Note that (a) analytic methods generally require a panel of trained tasters and (b) Ann Noble reported: “University researchers found that trained tasters required up to *five* years to consistently use the [U.C.-Davis] 20-point system.”⁶ This suggests that sensory evaluation does not always yield valid results.

Affective—Most wine consumers informally accept or reject wines that are available, select one over another, and often base decisions on whether or not they like the wine. The decision space of the typical consumer typically involves significant emotional and subjective elements. Cost also plays a role. Although industry professionals formalize the affective evaluation process, the objective is to determine consumer preferences, likes, and dislikes. *Affective* means *emotional*.

Hedonic Rating	
Like a lot	+2
Like somewhat	+1
Indifferent	0
Dislike somewhat	-1
Dislike a lot	-2

Serious amateurs might pay heed to Amerine and Roessler:⁷

It is the sensory quality of the wine in the glass that is important, ..., not the words on the bottle label, or the price, or the excellence and extent of the advertising. The intelligent wine connoisseur must therefore have the sensory skill and aesthetic appreciation to be able to ignore with confidence both the ad agencies and the wine snobs.

Analytical Tasting/Testing Conditions—A proper environment includes a clean and odor-free space with separate places for testers with natural-like lighting, clean tulip-shaped glasses, bags or other means to hide true identity of wines (i.e., blind tasting), proper wine temperatures, proper procedures, trained tasters, statistical charts for interpretation of test results, etc.

Sensitivity—Discrimination tests include:

Test	Samples	Objective
Paired Comparison: A>B OR B>A		Detect small but significant change in a sensory component
Duo-Trio: A = ref OR B = ref		Detect small change between reference and one test wine: A or B
Triangle: A = B OR A = C OR B = C		Detect small change between unmarked ref and one of other two

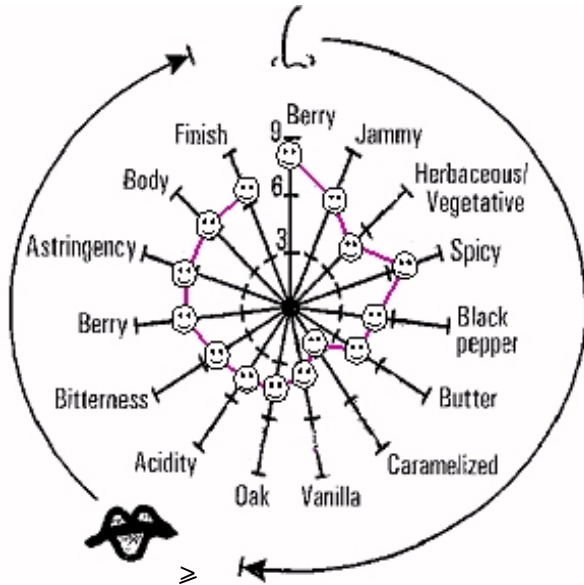
The null hypotheses is accepted or rejected based on binomial probability theory that determines if the judgments resulting from five or more trials could occur by chance or are considered valid based on a pre-selected level of significance.

Quantitative—The U.C. Davis 20 point rating system may be considered quantitative in that trained tasters are asked to evaluate a wine vis-à-vis nine (or so) categories and assign a *numerical score* within each category.

Category	Points
Appearance	0 - 4
Aroma/Bouquet	0 - 4
Vinegary	0 - 2
Acidity	0 - 2
Sweetness	0 - 1
Body	0 - 1
Flavor	0 - 2
Bitter/Astringent	0 - 2
General Quality	0 - 2
Total Score	0 - 20

Yet the judging process is qualitative.

1997 Wellington “Alicante Bouschet”
(using Sue Langstaff’s red wine cobweb plot)



Qualitative—Trained judges describe attributes of wines vis-à-vis flavor, dilution, texture, and many others subsumed by *quantitative* descriptive analysis (QDA). Usually, trained testers are asked to score the intensity of pre-determined wine attributes on an equal-interval scale, for example:



The rating form will usually have scales for several attributes of interest, for example, cherry, black currant, blackberry, and plum.

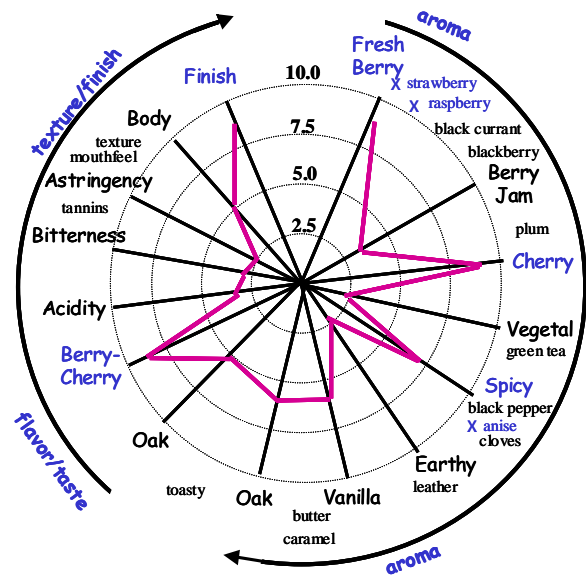
A common technique is to embed a nine- or ten-point interval scale in two-dimensional cobweb plots such as those shown above.⁸ Both provide a visual depiction of a wine with the plot defining an intensity score for each sensory attribute.

Statistical Tests

Test	Objective
Paired-comparison Duo-trio Triangle	Discriminate sensory difference between two wines for single factor (e.g., intensity of acidity)
Ranking	Do judges agree on ranking?
Analysis of variance (Two-way classification)	Do judges differ or agree on relative quality of wines (or selected sensory component)?
Factor analysis (n-dimensions)	Principal component analysis to reduce several factors to a few

Test Design—Numerous methods are available. Statistics-based tests usually rely on trained

2002 Shiloh Estate “Pinot Noir”
(based on Ann Noble’s aroma wheel)



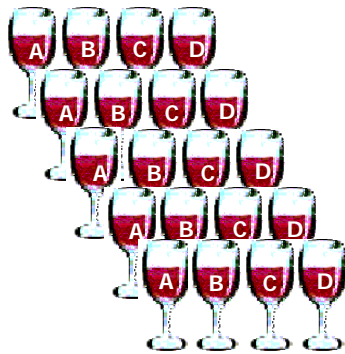
testers, carefully designed data collection instruments and procedures, correct environment, large-enough sample sizes, assumptions of normality (i.e., bell-shaped curve), assumptions of randomness, as well as other factors. Statistical tables to support each test are also required. (See the three references cited in Footnote 4.)

Discrimination tests—The paired-comparison, duo-trio, and triangle test require five or more judges that blind-taste two or three wines where one wine differs somewhat from the others. If a sufficient number of judges detect the difference (using the correct statistical table for the selected level of significance) the null hypothesis is rejected and a difference is considered to exist.

Using the triangle test, if seven or more of 10 trials detect a difference, the null hypothesis that they are the same is rejected and the alternate hypothesis that a difference exists is accepted (at the 5% level of significance, the Type I error, the probability of being wrong, is 5%). The test statistics are based on the binomial probability distribution for a one-tailed test. Note that the statistics underpinning any of the analytical tests are non-trivial.

Ranking—Several tasters are asking to rank a flight of wines with respect to their quality. If the sum of the ranks for one wine exceeds that of another by a certain amount (specified in a table), the wine is considered superior.

Analysis of Variance—Assume five judges each rate a flight of four wines using a 20-point system:



Assume the results are organized into a 5-row by 4-column matrix:

Tasters	Wines			
	A	B	C	D
1	18	13	15	10
2	16	15	12	11
3	15	14	11	9
4	17	12	13	10
5	19	13	12	12

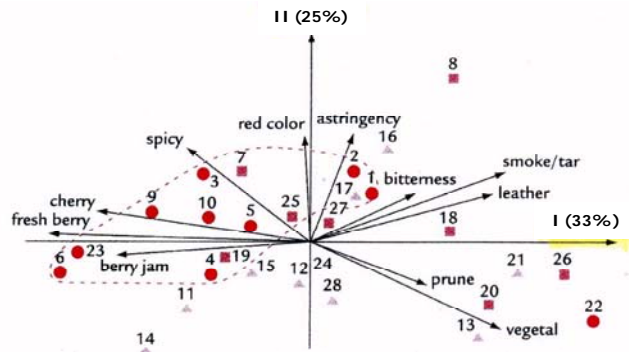
If the 20 values are copied and pasted into a Microsoft Excel worksheet and the Data Analysis function for an ANOVA (two-factor without replication) is invoked, the results at a 1% level of significance reveal that Wine A is significantly better than the other three and that any inconsistencies among the tasters are not significant. The least significant difference method can be used to show that Wines B and C and Wines C and D are not significantly different.

Factor Analysis⁹—A very well designed experiment involving 28 Pinot noirs, many judges, and 24 sessions over several days was used to define terms, and weed out some terms and judges using ANOVA. Seven judges rated the 28 wines vis-à-vis intensity of the 11 terms (i.e., sensory attributes). ANOVA revealed that the terms were not used consistently and the wines differed except for prune.

- 11 Terms**

 - Red color
 - Fresh berry
 - Berry jam
 - Cherry
 - Prune
 - Spicy
 - Leather
 - Vegetal
 - Smoke/tar
 - Bitterness
 - Astringency

Highly significant correlation was shown between: (a) fresh berry and berry jam, (b) fresh berry and cherry, (c) leather and smoke/tar, and (d) bitterness and astringency. The correlation matrix was analyzed by Principal Component Analysis resulting in attribute vectors and two Principal Components.



The 28 wines—coded for origin: Carneros (●), Napa (■), and Sonoma (▲)—are along PC I in accordance with the intensity of their fresh berry, berry jam, and cherry aromas and along PC II according to intensity of their red color and astringency. The Carneros wines (except Wine 22) are clustered (more-or-less) together and are high in fresh berry, berry jam, cherry and spicy aromas and low in vegetal, leather, and smoke/tar aromas.

The Heisenberg Effect

An uncertainty principle states that certain pairs of variables ... cannot be measured simultaneously with absolute accuracy because the measuring process itself interferes with the quantity to be measured....

Werner Heisenberg 1927

Use of people (especially as observers) in analytic tests screws them up. So go hedonistic and enjoy! Or, if beyond joy, delegate to an electronic nose.

- ¹ This article is based in large part on Napa Valley College's VWT 173 *Sensory Evaluation of Wine* taught by Sue Langstaff of Vinquiry Ascent Services. http://www.vinquiry.com/Ascent_Services.htm
- ² See the five-part *Toward Quality Wine* series at: http://www.shilohestate.com/se_towardqualitywine.htm
- ³ Marian Baldy, *The University Wine Course* (1997) <http://www.csuchico.edu/agr/faculty/Mbaldy.shtml>
- ⁴ Three references are particularly useful:
 - a Marian Baldy's *The University Wine Course* (*ibid*)
 - b Susan Duncan, "Application of Sensory Evaluation in Winemaking," in Bruce Zoenklein, *et al Wine Analysis and Production*, Aspen Publication (1999)
 - c R. Jackson, *Wine Tasting*, Elsevier Academic Press (2002)
- ⁵ Rose Marie Pangborn, "Sensory Science Today," *Cereal Foods World*
- ⁶ Ann Noble, "Wine Tasting is a Science"
- ⁷ M.A. Amerine and E.B. Roessler, "Wines, Their Sensory Evaluation"
- ⁸ Note: For a form based on (1) the 20-point U.C. Davis method, (2) the aroma wheel (and descriptors) developed by Ann Noble and her colleagues, and (3) the five-category hedonic rating see: http://www.shilohestate.com/se_svwknowledgebase.htm
- ⁹ J.X. Guinard and M. Cliff, "Descriptive Analysis of Pinot noir Wine from Carneros, Napa, and Sonoma," *American Journal of Enology and Viticulture* (1987)