


How to Train Your Nose
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1


Training your nose can result in:

- Higher accuracy in aroma identification
- Higher accuracy in judging aromatic intensity
- Higher accuracy in selecting a wine that matches a sample
- Lower *JND* threshold
- More aromas seem pleasant; fewer aromas seem irritating



Franklin Mariño-Sánchez, Hospital Universitario Ramón y Cajal (Madrid).
"Smell training increases cognitive smell skills of wine tasters compared to the general healthy population." *Rhinology*, September 2010.

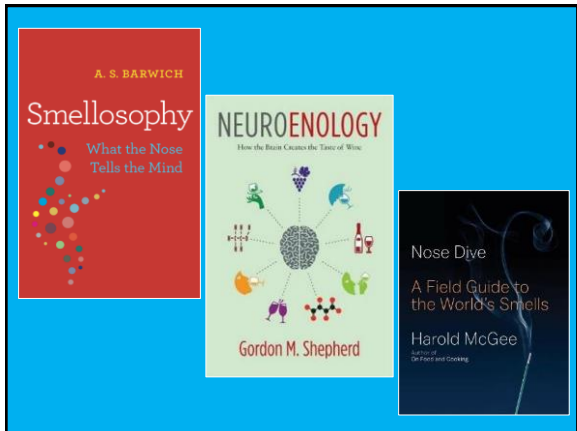
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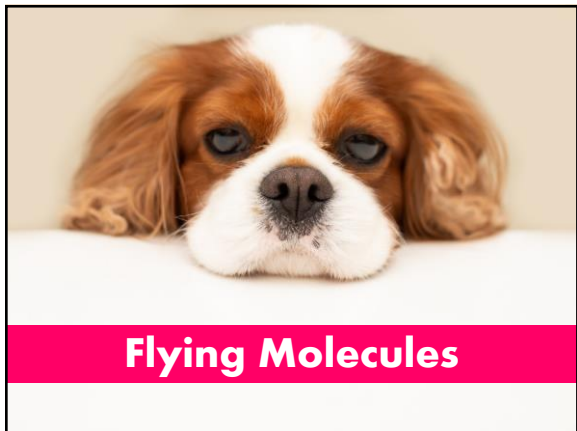
How to Train Your Nose

- Flying Molecules
- Our Olfactory Inferiority Complex
- From the Air to the Nose to the Brain
- Becoming Le Nez
- How to Train Your Nose
- Sniffing Strategy

3




4



5



6




Volatile compounds in wine will vary in both concentration and vapor pressure

Not every volatile compound has an aroma (that can be detected by humans)


7

Aromatic Compounds are **Promiscuous**

1,1,6,6-trimethyl-1,2-dihydronaphthalene also known as *TDN*



8



It's complicated.

Endless Possibilities (really)

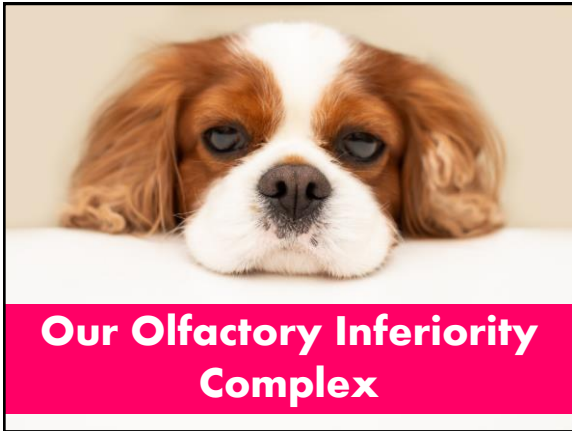
Invisible

Fleeting

Often Unconscious

Challenging Vocabulary

9



Our Olfactory Inferiority Complex

10

**Wine-tasting:
it's junk science**

Exhibit A: Wine experts contradict themselves. Constantly.

Oaky, With Notes Of BS

Skeptical Science: Wine-tasting ... even the supposed experts are fooled.

The Color of Odors

Gil Merril
Unité de Recherche Biopolymères et Arômes, Centre JREI de Montpellier, Montpellier, France

and
Frédéric Brochet and Denis Dubouche
Faculté d'œnologie de l'Université de Bordeaux 2, Talence, France

Published online August 28, 2001

The interaction between the colors and odor determination is investigated through lexical analysis of experts' wine tasting comments. The analysis shows that the colors of wine are, for the most part, represented by adjectives that have the color of the wine. The assumption of the existence of a perceptual illusion between color and odor is confirmed by a psychophysical experiment. A white wine artificially colored red with an achromatic dye was olfactorily described as a red wine by a panel of 34 tasters. Hence, because of the visual information, the tasters discounted the olfactory information. Together with recent psychophysical and neuroimaging data, our results suggest that the above perceptual illusion occurs during the verbalization phase of odor determination. © 2001 Academic Press

Key Words: color identification; color perceptual illusion; lexical analysis; psychophysical; wine.

INTRODUCTION

Smell is often considered a peculiar sensory modality, the main function of which remains to be specified. A number of structural characteristics distinguish olfaction from other sensory modalities. The peripheral olfactory system has a low specificity for substrate: A single receptor recognizes multiple odorants, and a single odorant is recognized by multiple receptors (Malnic et al., 1999). The projection of peripheral information toward the central structures is primarily ipsilateral. Olfactory information is the only sensory information that is integrated directly into cortical regions without a preliminary processing in the thalamus. Olfactory neuronal transduction, carried out by unmyelinated axons, is the slowest of the nervous system. Olfactory detection (about 400 ms) is approximately 10 times slower than visual detection (Herr & Engen, 1996). Moreover, the definition of olfactory images is relatively slow (approximately 50,000 mitral cells) compared with the million pixels per visual

11

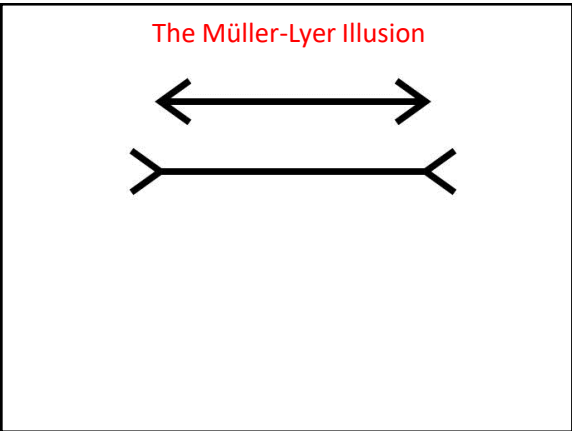
Aromas are often discounted because they are considered

Subjective

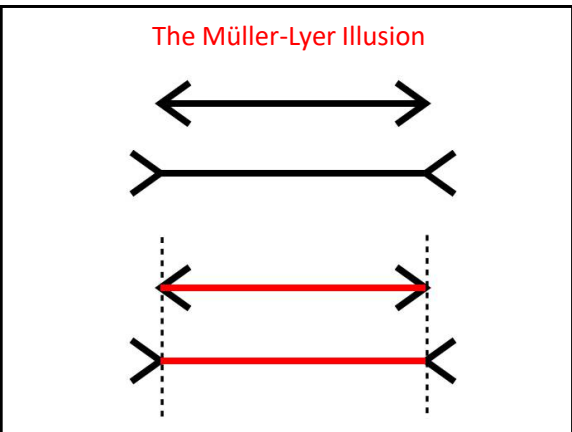
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13



14



15

Eriksson, Nicolas, Shirley Wu, Chuong Do, and Amy Kiefer, et al. "A genetic variant near olfactory receptor genes influences cilantro preference." *Flavour*, December 2012.

16

Michael, Johan Lundström, Martin Witt, Karl-Bernd Hüttenbrink, Stefan Heilmann, and Thomas Hummel. "Assessment of olfactory function and androstenone odor thresholds in humans." *Behavioral Neuroscience*, December 2003

17

Rotundone

"Approximately 20% of panelists could not detect this compound at the highest concentration tested, even in water."

Siebert, Tracy, Claudia Wood, Gordon M. Else, and Alan P. Pollnitz. "Determination of Rotundone, the Pepper Aroma Impact Compound, in Grapes and Wine." *Journal of Agricultural and Food Chemistry*, May 2008

18

How do we even...
end up with *relatively stable* and
commensurable aroma experiences?



19



20

**How do we get from
flying molecules to
perception?**



21

**1991:
Linda Buck and Richard Axel
discover the olfactory
receptor neurons.**



Photos from the Nobel Foundation archive

22

(There are 400 of them.)

**This is by far the largest
multigene family in the
mammalian genome.***

*Genome: the complete set of genetic material

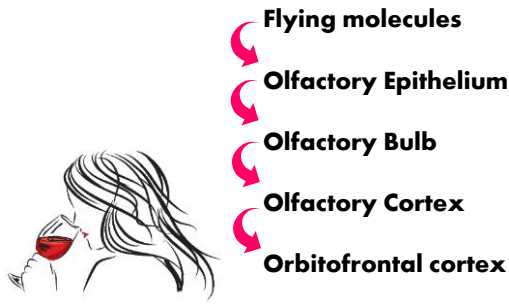
23

2004:

**The Nobel Prize in Physiology
or Medicine was awarded to
Richard Axel and Linda Buck
for their discoveries of odorant
receptors and the organization
of the olfactory system.**

24

Olfactory Perception



25

Orthonasal

Retronasal

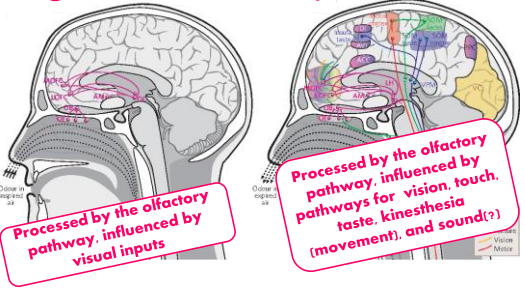


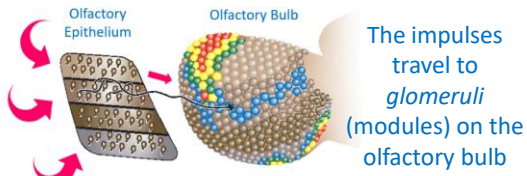
Image: Gordon M. Shepard

26

The Process...

27

Aromatic compounds hit the olfactory receptors in the olfactory epithelium

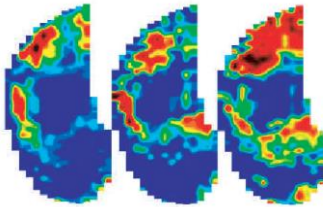


The stimuli create spatial patterns of activity—odor maps or odor images—that are passed onto the olfactory cortex.

Images: Gordon M. Shepard

28

Activity patterns in the olfactory bulb:
Odor Images



In the olfactory cortex, odor images are bundled into “smell objects” and sent to the orbitofrontal cortex.

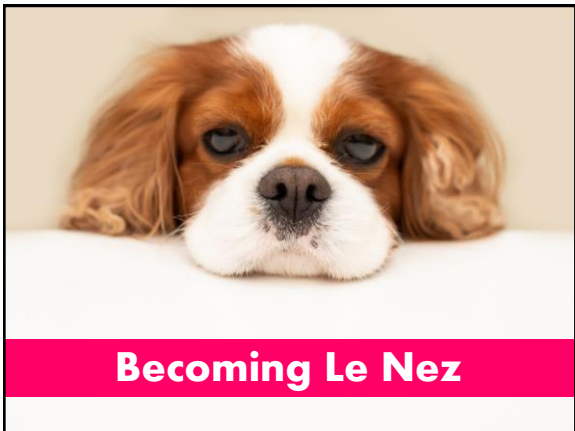
Images: Gordon M. Shepard

29

This is where processing of the sensation begins and (most likely) where conscious perception occurs.



30



Becoming Le Nez

31

Training your nose can result in:

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- More aromas seem pleasant; fewer aromas seem irritating

Franklin Mariño-Sánchez, Hospital Universitario Ramón y Cajal (Madrid).
 "Smell training increases cognitive smell skills of wine tasters compared to the general healthy population." *Rhinology*, September 2010.

32

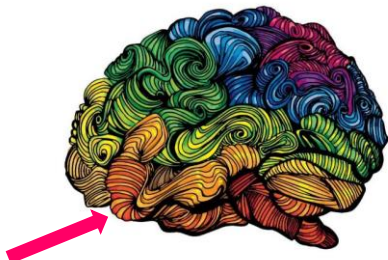
During wine sniffing, the **brain activity** of trained tasters differ from those of novice tasters.

<p>Expert</p> <p>Memory Language</p>	<p>Novice</p> <p>Emotion</p>
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Franklin Mariño-Sánchez, Hospital Universitario Ramón y Cajal (Madrid). "Smell training increases cognitive smell skills of wine tasters compared to the general healthy population." *Rhinology*, September 2010.

33

After six weeks of aroma training, the gray matter in the olfactory cortex thickens.



Johannes Frasnelli, Université du Québec à Trois-Rivières. "Smell training improves olfactory function and alters brain structure." *Neuroimage*, April 2019

34

We have two types of explicit (conscious) memory:



Episodic

Memories that result from doing something (experiences)



Semantic

Memories that result from learning (facts, figures, concepts, vocabulary)

35

We want both.



Episodic

Experiences
Elaboration
Emotions
Journaling



Semantic

Vocabulary
Taxonomy
Images
Aroma Profiles

36

How does aroma training affect cognitive function?

- Creates new aroma memories
- Creates visual anchors
- Develops the required language skills
- Constructs a taxonomy of aromas
- Builds a library of aromatic profiles & enables its use

37



38

Warm-up

Try to remember the first five things you smelled this morning...

A stick figure character is shown in a thinking pose, with a hand on its chin and a large thought bubble above its head. The character is simple, with a round head, a single line for a body, and a small tuft of hair. The thought bubble is empty, suggesting the character is trying to recall something.

39

Pay attention. Establish a Base Line.



Details are included in your handout.

40

Pay attention. Establish a Base Line.

- Using a list of standard wine aromas, take note of: what are you familiar with? what draws a blank?
- Start to pay attention to the aromas around you: when step outside, when you cook, when you sit down to eat...take a moment to notice the aromas. Try to identify the different fragrance notes.
- At the end of the day or when on a break, try to recall three or four smells you recently encountered.
- Pick a day and record every aroma you remember encountering that day.
- At the beginning of the day, choose four smells and notice when/if you encounter them sometime during the day.

41

The Starter Set (the basic wine aromas to know)

Fruit: Green Apple Yellow Pear Lemon Lime Orange/ Orange Zest Peach Apricot Pineapple Cherry Raspberry Strawberry Blackberry Blueberry Cranberry Currant Raisin	Floral: Rose Violet Dried Flowers Herbal/vegetal: Mint Green Grass Green Bell Pepper Dried Herbs Lavender Spice: Black Pepper Cloves Cinnamon Anise	Earth: Wet Dirt/Barnyard Mushroom Forest Floor Oak (derived): Oak/Woody Cedar Vanilla Coconut Other: Cocoa Coffee Smoke Toast Yeast Leather
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Everyone's experience of the world of wine is different.
What would you add?
What would you delete?

42

Keep a Journal (Take Notes).



Writing it down will help you remember...and
aroma recognition begins with memory.

Details are included in your handout.



43

Keep a Journal (Take Notes).

- Keep a written record of your aroma-centric exercises and refer to it often.
 - Writing it down will help you remember...and aroma recognition begins with memory.
- Record your experiences of smelling/tasting whether it be from nature/outdoors, food/wine, everyday living, or specific aroma training (using wine or aroma kits/prepared samples).
- Note if certain smells trigger an emotional response or a memory.
- Depending on the circumstances, details surrounding a specific aroma may include: the setting (date, place, occasion), the source of the aroma, the label (name of the aroma), and a description (vibrant, fruity, floral, warm, sharp,, tingly, tangy, fresh, cooling, woody, soft, or other). If you're crafty, draw a sketch of the item or anything that will help build your memory.
- Review your notes on a regular basis (maybe once a week).
 - Best practice: read out loud!

44

You need the thing.



45

Nearly all of the published studies cited used aromas/aroma kits.

[^]specially-formatted, chemically-specific

For wine students: many brands (Le Nez du Vin, Aromamaster, Aromabar, Tasterplace) and themes (red wine, white wine, rosé, oak, faults, bourbon, rum) are available. Kits (typically) contain anywhere from 6 to 88 aromas; prices range from \$50 to \$500



Aroma Recovery Kits contain four to five aromas, typically: rose, lemon, eucalyptus, birch, clove

46

Build-your-own: Aroma Kits

Dry/unperishable items. Store in cute, tiny jars indefinitely.

- Spices
- Dried herbs
- Ground coffee
- Ground cocoa
- Almonds
- Dried fruit (raisins, prunes, dates, figs)
- Dried mushrooms
- Tobacco (cigarette, pipe tobacco)
- Cedar or oak chips
- Black tea
- Green tea

Perishable items: Use as-is or macerate in wine, refrigerate for a few days.

- Fruit (citrus, berries, apples, melons, peaches, apricots)
- Canned fruit/syrups
- Fruit juices
- Jams (gooseberry)
- Veggies (bell pepper)
- Canned fruit
- Juices
- Green Grass
- Fresh herbs

Other Possibilities:

- Extracts or essential oils (coconut, vanilla, peppermint, menthol, various floral aromas)
- A visit to the florist
- Dried flowers
- Candles
- Candy
- Chalk, dirt, compost
- "Liquid Smoke"
- Liqueurs (cassis)
- Toast
- Honey
- Yeast

Lists of suggested aromatics and other ideas for making aroma kits are included in (the last pages of) your handout



47

Installing Olfactory Memories

- Sniff.**
- Identify.**
- Elaborate.**
- Visualize.**
- Recall.**
- Journal.**
- Repeat.**

Details are included in your handout.



48

Installing Olfactory Memories

- Smell the item—anchor your memory with a label (word).
- Say the name out loud (sniff and repeat); write it down.
 - Keep talking...describe the aroma. Is it vibrant, fruity, floral, warm, sharp,, tingly, tangy, fresh, cooling, woody, soft, or ?
- Concentrate on the visual aspect of the source item—if you don't have the actual item in front of you, use a photo (or visualization).
- Repeat: smell the item again, visualize the item (in your mind), say the name of the item out loud (again); periodically, close your eyes.
- Does the aroma remind you of something? Describe it.
 - Is the aroma similar to another? What is it? How are they similar?
- Repeat some or all of the steps several times; close your eyes periodically.
- Note the experience in your journal.
- Later in the day, try to remember and describe the experience.
- Repeat the sniffing exercises several times over the course of a week.
- After you've run through the exercise with several aromas, see if you can identify them blind.

49

Let's Practice!



50

Using aromas/aroma standards



Details are included in your handout.



51

Using aromas/aroma kits

Some ideas:

- Work with a single or random aroma (identify, recall, visualize, elaborate).
- Sniff four aromas, twice a day, for about 30 seconds each. At the end of the week, approach them "blind" and quiz yourself.
- Use a few aromas with a typical wine or a flight of wines. (Did you find roses in your Gewürztraminer? Did you find raspberry in your Cab Franc?)
- Blend single aromas into a small portion of wine to see how the aroma evolves/appears differently when in a complex solution (The aroma may evolve when it is in a solution with alcohol, volatile acids, etc.)
- Pair it up: Use two separate, but similar aromas: lemon, lime; black cherry, red cherry: try to explain how they compare/contrast.
 - Alternatively, use two—totally different aromas (same exercise)
- Arrange samples by category.
- Make a series of samples that vary in intensity by blending the aroma with wine. (First, make a strong solution with the aroma and 10 tablespoons (5 ounces) of wine. Then, add the following amounts to 4 tablespoons of base wine: 4 tablespoons (strongest), 3 tablespoons, 2 tablespoons, and 1 tablespoon (weakest). Level off the samples so that each container holds the same amount (you can discard the excess), and practice arranging them in order from most intense to least; work on aroma memory until you can detect the aroma from the weakest samples.

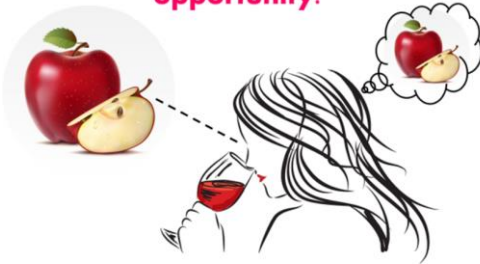
52

Let's Practice!



53

Use visual anchoring at every opportunity!



Vision. Dominates. Learning.

54

Let's talk about the disconnect:

Aroma ↔ **Language**

55

Elaboration: Connect the aroma with a label and say it out loud.

Gooseberry!

Triggers the Production Effect
Allows for Dual Coding
Draws focus
Triggers semantic memory

56

Let's Practice!

57



58



Master the standard set of wine aromas
Create a set of generic "internalized grids"
Create aromatic profiles for specific wines

59



Use the Power of Suggestion

- Red/Blue Fruit
- Red Cherry
- Strawberry
- Blueberry
- Raspberry
- Cranberry
- Plum

60

Let's Practice:



Grüner Veltliner

(Tree Fruit)

- Apricot
- Peach
- Nectarine

(Citrus Fruit)

- Lemon
- Lime
- Grapefruit
- Orange

(Green Fruit)

- Green Apple
- Green Plum

(Floral)

- Orange Blossom
- Honeysuckle

(Vegetal)

- Fennel
- Asparagus
- Celery

(Herbal)

- Tarragon
- Sage

(Minerality)

- Flint
- Graphite
- Wet Stones

(Spice)

- White Pepper

(Other)

- Yeast
- Lanolin



61



62

“A professional wine taster controls sniffing like a professional tennis player controls ground strokes.”

—Gordon M. Shepherd, MD, PhD



63

Sniffing Strategy




Mix it up—quick, prolonged
Affected Sniffing
Wait 30 seconds between sniffs/
Use a cleansing sniff

Details are included in your handout. 

64

Sniffing Strategy

- Sniffing: the conscious effort of inhaling repeated forceful intakes of air through the nose; a motor adaptation for increasing the detection and discrimination of weak odors in the environment
- Mix it up—use both quick sniffs and prolonged inhales—these methods of *affected sniffing* may yield different results. Odor molecules differ in ease of sorption (the speed/ease in which the molecule is absorbed into the mucus of the olfactory bulb)
 - High sorption molecules (highly soluble, high-vapor pressure molecules like diacetyl) produce higher olfactory responses with fast sniffs. Low-sorption (low solubility, low-vapor-pressure) molecules need to sit on the mucus a while before it is absorbed...these need slower sniffs.
- Take your time: wait a few seconds (up to 30 is ideal, if the situation permits) between sniffs to allow the olfactory receptors to recover from adaptation (decrease in perception due to physiological factors) or fatigue.
- Use a cleansing sniff: opinions vary as to makes for the best action to combat adaptation or fatigue; sniffing your own forearm to “reset” is the best option I have heard.


More details are included in your handout. 

65

Using affected sniffing techniques

“Their use is purely physiological: you create a different airflow, and this influences which molecules hit your receptors first. It’s the same molecules, but when they hit different receptors your brain says, ‘I perceive this differently’”

—Ann-Sophie Barwich, PhD



66

Sniffing Strategy: Enter the glass



Use a consistent *starting stance*
Focus, focus, focus (mind your eyes)
Sniff—swirl—sniff (repeat)
Use affected sniffing techniques

Details are included in your handout.



67

Enter the glass

Find and use a consistent *starting stance* that is most comfortable for you:
Hold the wine glass by the stem.

- Tilt the glass to somewhere around 45° and 50°(every glass has a sweet spot)
- Find the most comfortable spot for the glass to rest (for most people it is on or near the upper lip)

Decide what you are going to do with your eyes: choose on a starting eye position and use it consistently. This will help you shut out the rest of the world and *focus, focus, focus*.

To begin, sniff the wine before swirling. For this step, it is typically advised to position your nose about an inch above the rim of the glass and keep your mouth slightly open. Start with your nose in the middle of the glass and use a series of short, quick inhales. Follow this up—with your nose in the same spot—with a longer, deeper inhale. If none of the above reveals anything notable, repeat the process but move your nose to the edge of the glass or closer to the surface of the wine.

- This is your chance to sense the most volatile components of the wine. Keeping your mouth slightly open may help prevent you from being overwhelmed with affects of the alcohol. What did you smell? Take note.

Swirl the glass and go through the series—short, quick sniffs & longer, deeper inhales.

- Make sure to hit several different points in the air (around & above the glass).
- If the situation permits, note how the wine evolves over time.

68

Three's the limit. (Well, maybe).



69

Your impulse responses are strongest when you are:



Hungry



**Well-Rested
(noradrenaline)**



**In a Good Mood
(serotonin)**

70

For peak sniffing performance:



**Get a bit of
exercise**



Stay hydrated

71

Let's Practice:



Shiraz

- Ripe Cherry
- Red Plum
- (Black Fruit)**
- Blackberry
- Blueberry
- Black Plum
- Cassis
- (Citrus Fruit)**
- Orange Peel
- (Dried Fruit)**
- Raisin
- Prune
- (Floral)**
- Lavender
- Violet

- (Spice)**
- Black Pepper
- Clove,
- Cinnamon
- Anise
- (Oak)**
- Oak
- Smoke
- Vanilla

- (Earthy)**
- Barnyard
- (Other)**
- Coffee
- Leather
- Tar
- Cocoa




72




73

Aromatic compounds are known as _____, named after the Latin word for "to fly."



74

In 1991, Linda Buck and Richard Axel discovered that humans have over _____ specific types of olfactory receptors.



75

_____ olfaction occurs with inspired air, and

_____ olfaction occurs on the exhale (with expired air).



76

Aroma maps (or images) are created in the

_____ and passed on to the

_____.



77

_____ memory is concerned with facts, figures, and concepts that are learned, rather than experienced.



78

_____ memories result from the experience of doing something.



79

_____ is a fancy word for “saying it out loud” and is very useful for encoding words alongside aromas.



80

As _____ dominates learning in a profound way, it is an excellent idea to use _____ at every opportunity.



81

The Starter Set (the basic wine aromas to know)

Fruit:	Floral:	Earth:
Green Apple	Rose	Wet
Yellow Pear	Violet	Dirt/Barnyard
Lemon	Dried Flowers	Mushroom
Lime		Forest Floor
Orange/ Orange Zest	Herbal/vegetal:	Oak (derived):
Peach	Mint	Oak/Woodsy
Apricot	Green Grass	Cedar
Pineapple	Green Bell	Vanilla
Cherry	Pepper	Coconut
Raspberry	Dried Herbs	
Strawberry	Lavender	Other:
Blackberry		Cocoa
Blueberry	Spice:	Coffee
Cranberry	Black Pepper	Smoke
Currant	Cloves	Toast
Raisin	Cinnamon	Yeast
	Anise	Leather

Everyone's experience of the world of wine is different.

What would you add?

What would you delete?

To make an aroma kit using dry ingredients/non-perishable items:

Acquire a set of inexpensive, small vials or jars with study lids. Stickers or dry erase markers of any kind may work for labels (put the labels on the bottom if you plan on using “blind sniffing” as part of your training). I personally have used the 1.5 ounce “Hexagon Mini Glass Jars with Silver Lids and Labels by Homemade Perfect” (available on Amazon). From there, it’s very simple: secure the label, place the item(s) in the jar, and secure the lid. When using the aromas, keep in mind that some items—such as dried spices, whole spices, and dried herbs—may need a bit of help to volatilize their aromas into the air. Try crushing, cutting, or rubbing the items in your hands to make them more sniff-fable.



To use perishable items:

Using fresh items has its benefits; they are 100% accurate and (in the case of foodstuffs) safe to consume—but beware of allergies, both known and unknown. Making aroma standards from fresh foods, herbs, flowers, or other perishables can be as simple as cutting a piece of fruit (or other item) storing it in a small plastic container in the fridge. The drawback is you’ll only be able to use them for a few days before they start to spoil. (Of course, there is certainly something to be learned from the scent of slightly-spoiled fruit). 4-ounce deli containers with lids or smaller portion cups (typically 1- or 2-ounce) are readily available at grocery stores or via Amazon. If you want to buy in bulk, visit your local restaurant supply store.



It is also useful to mix or infuse the aroma standards in a few ounces of neutral-smelling white wine. If you are using fresh produce-type items (as opposed to extracts or oils), you can cut a small piece of the item and leave it in the wine, or let it infuse (for anywhere from one to four hours) before straining the solids out. For this method, I have used 4-ounce square spice jars made by Aozita (available via

Amazon); I poured the liquid into a wine glass for my training sessions. If you’d rather just sniff from the jar, a jar with a wider bowl would be best. Either way, sealed and stored in the refrigerator, they should last a few days.

Non-Perishables

Spices (Dry)

Allspice
Anise
Black Pepper
White Pepper
Clove
Cinnamon
Dried Ginger
Nutmeg

Dried Herbs

Dill
Anise
Oregano
Bay Leaf
Sage
Thyme
Tarragon
Lavender
Herbs de Provence

Dried Fruit/ Vegetables

Candied Orange Peel
Raisins
Dates
Figs
Prunes
Dried Apricots
Dried Cherries
Dried Mushrooms
Sun-dried Tomatoes

Other

Non-Perishables

Pipe Tobacco
Tobacco (cigarette)
Cedar Chips
Oak Chips
Coffee beans
Cocoa Powder/Chocolate
Eucalyptus Leaves
Pine Needles, Pinecones
Nuts (almond, hazelnut, walnut)
Vanilla Bean
Beeswax
Popcorn
Toast
Yeast
Marshmallows
Marzipan
Burnt Sugar/Caramel
Black Tea, Green Tea

Perishables

Fruit

Fresh/canned/jams/juice

Lemon
Lime
Orange
Tangerine/Mandarin
Grapefruit
Apples (Red, Yellow, Green)
Applesauce
Green Pears
Yellow Pears (super-ripe)
Peach
Apricot
Nectarine
Pineapple
Mango
Banana
Quince
Green Plum
Gooseberry
Lychee (litchi)
Passion Fruit
Melon (Honeydew, Cantaloupe)
Watermelon
Strawberry
Raspberry
Cranberry
Blackberry
Blueberry
Red Currants
Black Currants
Red/Black Plum

Fresh Herbs/Vegetables

Rosemary
Thyme
Lemongrass
Eucalyptus
Dill
Sage
Mint
Celery/Celery Leaf
Fennel
Freshly Cut Grass
Ginger
Green & Black Olives
Green Bell Pepper
Asparagus
Tomatoes
Tomato Leaf

Fresh Flowers

Rose
Lavender
Honeysuckle
Violets
Jasmine
Apple, Pear, Cherry Blossoms
Orange Blossoms
Hawthorne
Acacia

Extracts/Liquids/Other

Extracts/Liquids

Almond Extract
Vanilla Extract
Cassis (liqueur)
Liquid Smoke
Honey
Coconut Extract
(flavor)
Butter Essence (flavor)
Peppermint Extract

Candy

Licorice
Jolly Rancher
Banana (Laffy Taffy)
Pear Drop
Bubble Gum

Essential Oils/Floral (and other)

Rose Oil
Violet
Geranium
Lavender
Sandalwood

(Possible) Faults

Sulfur Dioxide (Kitchen
Match)
Oxidized/Spoiled
Apple
Apple Cider
Rotten Egg (argh!)
Onion
Cabbage/Cooked
Cabbage
Horse/Wet Saddle
(don't get too close)
Wine Vinegar

Other Ideas

Candles for floral
aromas

Suggested aromas to seek out, but (perhaps) best left to the wild

Forest Floor
Barnyard
Petrichor
Resin
Green Wood
Smoke
Cured Meat
Bread Dough
Old Leather
New Leather
Gasoline

Nail Polish Remover
Gasoline/Petrol
Pipi du Chat
Ethanol (NGS)
Wet Dog
Chalk
Gravel
Wet Rocks
Musk
Hay
Medicinal/Band-Aid

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1



Thank you for joining us!
How to Train Your Nose
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2