



# Sensory Irritation, Odor and mVOCs

*Mold Components: Impact on Health  
AIHA Roundtable  
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## Outline of Talk

- What do we mean by sensory irritation?
- Can mVOCs elicit it?
- What role does odor play?
- Are mVOCs good markers of exposure?

## What is Sensory Irritation?

- Functional: activation of free-nerve endings of (1) ethmoid branch of trigeminal nerve, (2) glosso-pharyngeal nerve or (3) vagal nerve
- Perceptual: adverse temporary elicitation of burning, stinging, tingling, prickling, in eyes & upper airways

*Chemesthesis -chemical stimulation of somasthetic modality*

% of Population Responding

ODOR  
PERCEPTION

IRRITATION



1

100

1000

Concentration (ppb)

From: Shusterman, 2001

# How is sensory irritation measured?



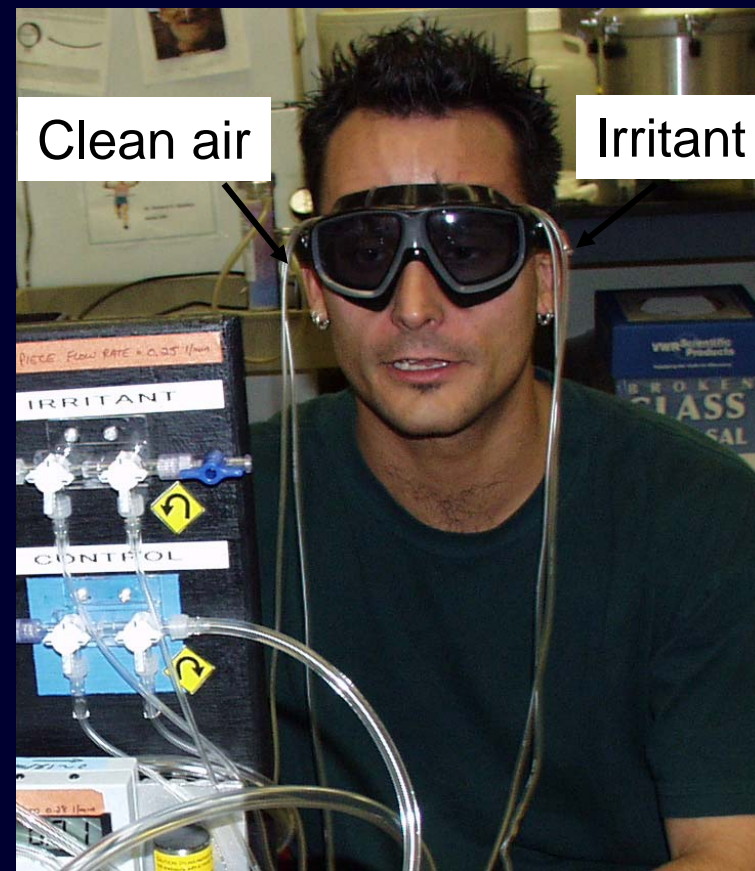
## RD<sub>50</sub> assay

Inhalation exposure linked to respiratory rate of mouse

SI threshold= 50% depression

$0.03 \times \text{RD}_{50} = \text{human threshold}$

# How do we measure a nasal or ocular threshold for irritation in humans?



We can take advantage of the fact that trigeminal sensations can be **localized** to one nostril or one eye

# Sensory Irritants and Secondary Effects

- Ocular Hyperemia
- Nasal Inflammation
- Rhinitis
- Sore Throat
- Effects are typically transient and abate when exposure ends, unlike IgG-mediated responses



# Are mVOCs Potential Sensory Irritants?

- Alcohols
- Terpenes
- Ketones
- Esters
- Amines
- Sulfides

## Are mVOCs Potential Sensory Irritants?

Compound	RD <sub>50</sub> mg/m <sup>3</sup>	
1-Octen-3-ol	182	
3-Octanol	1359	ABSOLUTELY- most compounds become irritants at specific concentration
3-Octanone	17586	
2-Heptanone	4163	
3-Methyl-1- butanol	2624	
2-Methyl-1- propanol	5499	

## Do airborne levels exceed irritancy thresholds?

Compound	RD <sub>50</sub> mg/m <sup>3</sup>	RIL ug/m <sup>3</sup>	IA Concentrations Measured (ug/m <sup>3</sup> )
1-Octen-3-ol	182	100	0.1-904
3-Octanol	1359	0.2	0.04-7.46
3-Octanone	17586	2.5	0.092-0.41
2-Heptanone	4163	3000	0.91-0.320
3-Methyl-1- butanol	2624	2000	0.37-10.00
2-Methyl-1- propanol	5499	4000	1.74

## Are SI effects due to combinations of airborne mVOCs?

- Possibly....
- However, irritancy from mixtures is presumed to be additive
- Levels of combined mVOCs do not approach irritancy thresholds

## Summary: mVOCs and Irritation

- Most mVOCs are potential sensory irritants
- Thresholds for eliciting SI differ among compounds
- Even if no single mVOC is present at levels capable of eliciting SI, mixture additivity may account for some symptoms
- However.....no field or lab studies have measured single or combined airborne mVOC levels approaching SI thresholds

## What about mVOCs and Odor?

- Odor can be early signal of microbial presence
- Odor perception occurs orders of magnitude below sensory irritation
- Odor does not directly mediate health effects
- However, adverse responses, including symptoms, occur to mVOC odors ..... Why?

"That mold," she said. "It smells like death."



--Veronica Randazzo,  
St. Bernards Parish  
September 27, 2005

Both the sensory quality of mVOCs and what they represent are capable of generating adverse responses

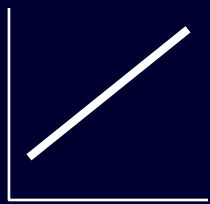


## Three Types of Factors Can Influence Perception and Response to VOCs

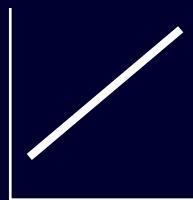
- Variables that alter properties of the stimulus
  - concentration, quality
- Variables that alter an individual's sensitivity
  - genetics, age, gender, disease, exposure
- Variables that influence the way an individual interprets chemosensory information

# Physiological Response vs. Subjective Experience

There are three types of patterns that can describe the relationship between a sensory or physiological response to an odorous irritant stimulus and the subjective experience of that stimulation



1



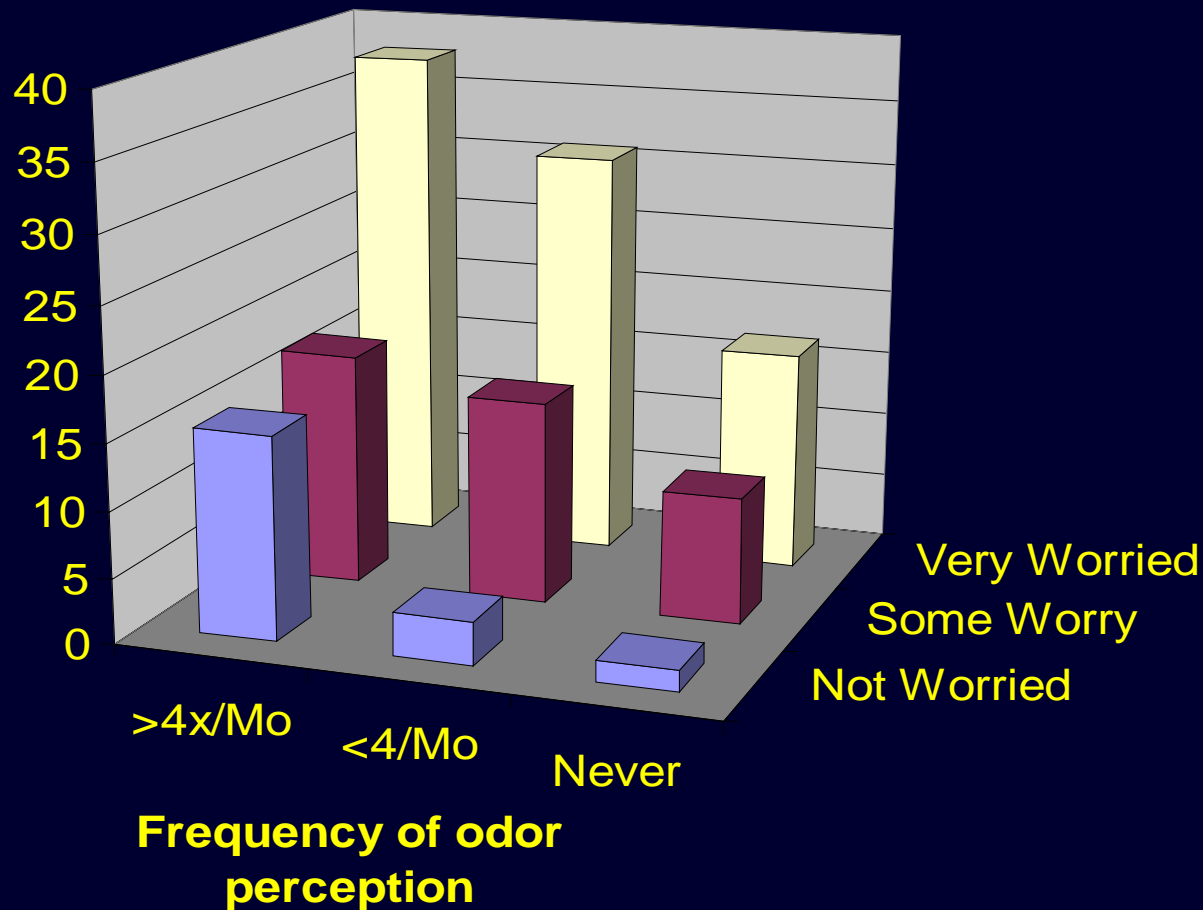
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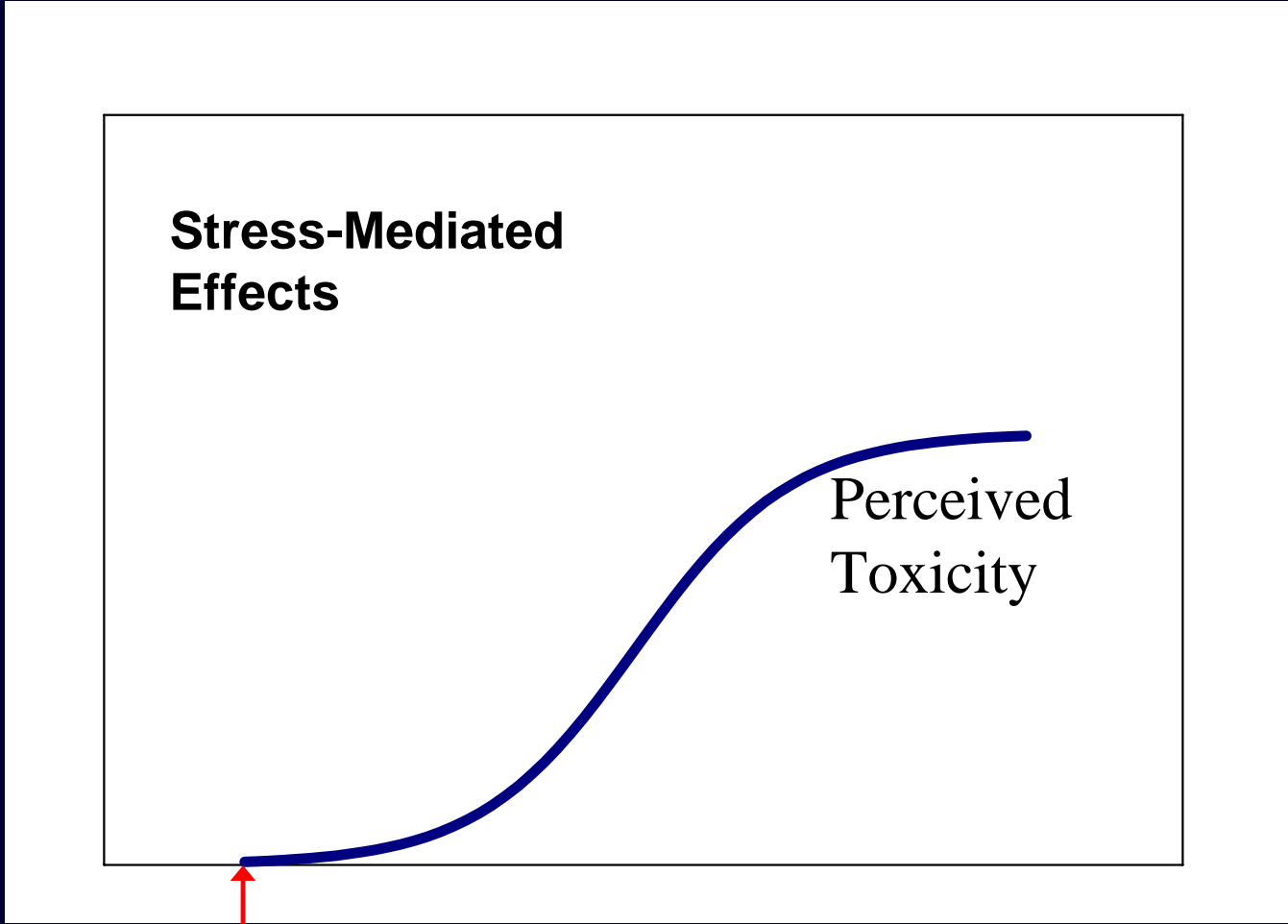
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# Cognitive and Emotional Interactions with Health Symptoms (Shusterman et al, 1991)

## Prevalence of headaches/100 adults



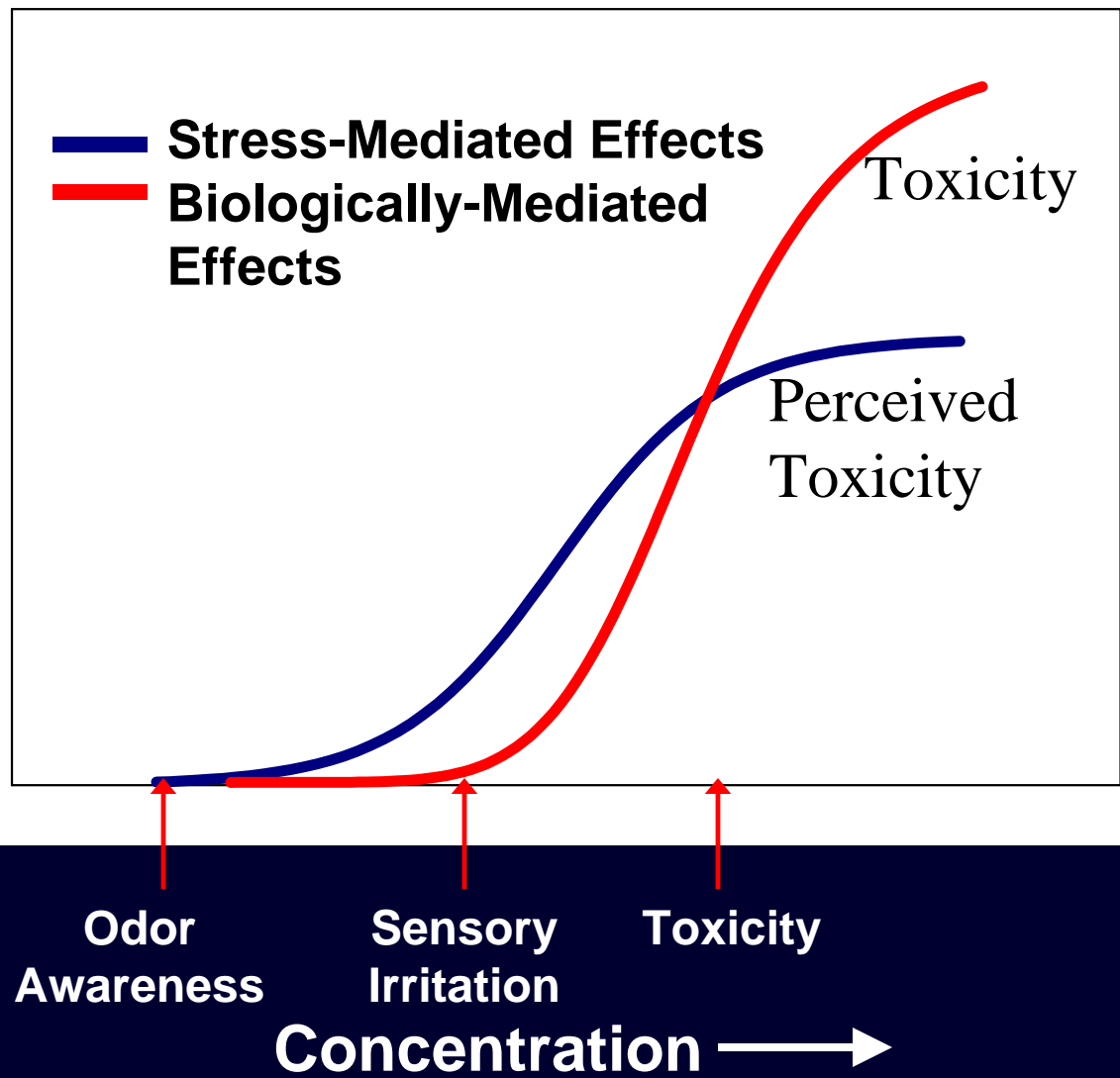
Cumulative Adverse Effects



Odor Awareness

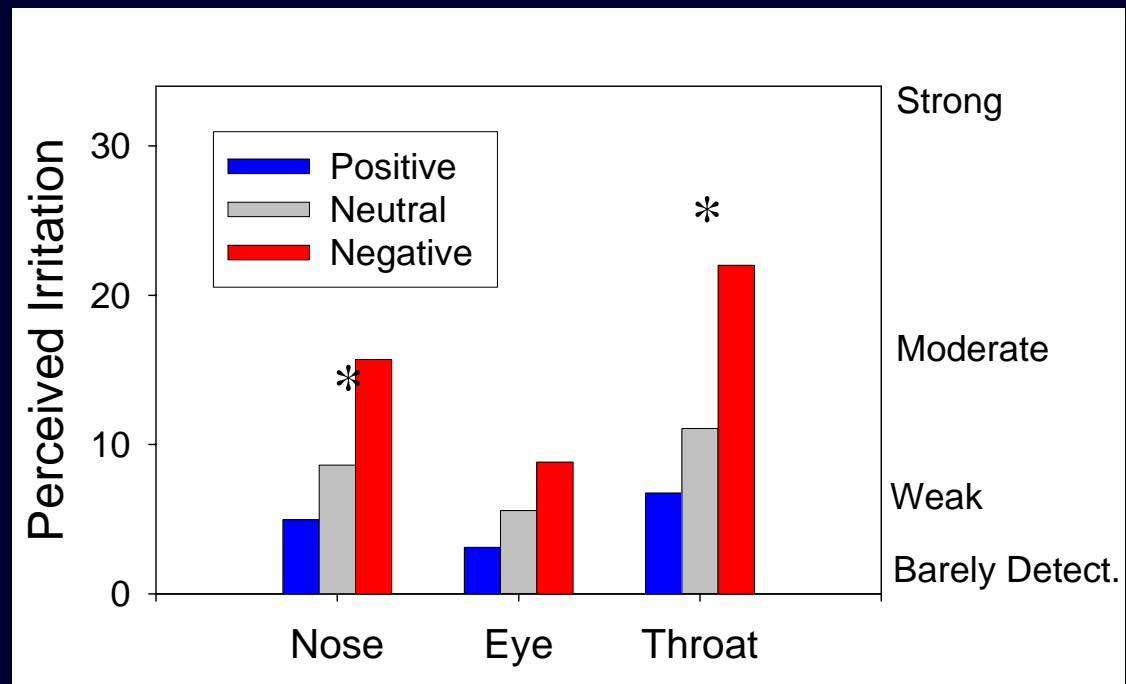
Concentration →

Cumulative Adverse Effects



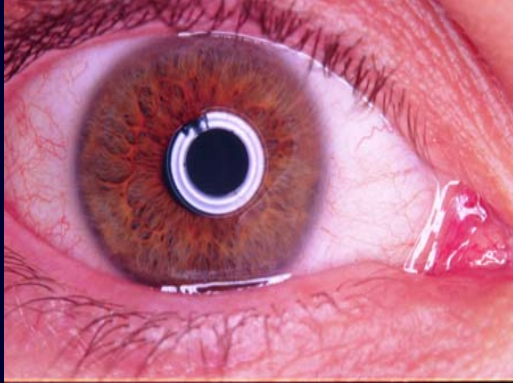
# Informational Effects on Perceived Irritancy of Butanol

- 20- min chamber exposure to n-butanol (50 ppm)
- 3 groups; n=25/gp
- Groups given positive, neutral or negative information about odorant source



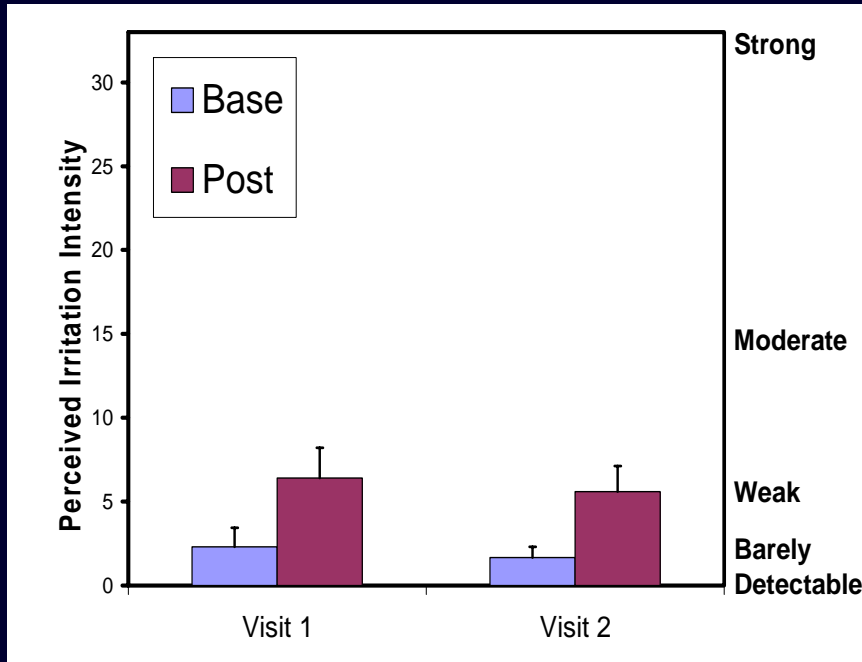
Dalton, 1999

# Personality Traits & Perceived Ocular Irritation

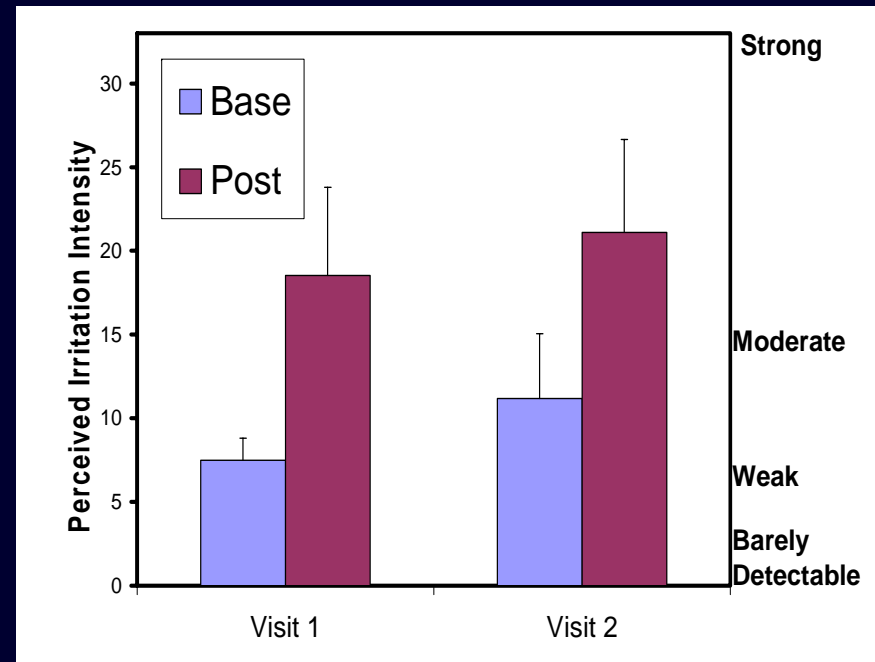


- High NA group reported significantly more ocular irritation— before & after exposure to IPA
- No evidence of hyperemic changes in either gp

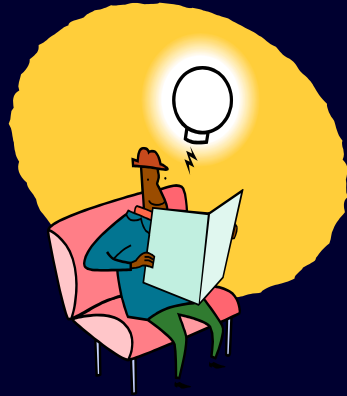
## Low NA



## High NA



Media coverage can lead to increased awareness & symptom reports



## Symptom Reports Before/After Public Awareness of Fungal Contamination

Symptom	School A		% Increase	School B		% Increase
	Before	After		Before	After	
Cough/Wheezing	75	127	69	35	48	37
Sneezing	28	72	157	22	29	32
Dizziness	53	110	108	43	42	-
Eye Irritation	29	63	117	16	22	38
Headache	127	227	79	90	118	31
Itching	12	43	258	7	10	43
Nose Bleeds	18	23	28	15	21	40

Handal et al, *Indoor Air* 2004

## Why Differentiate Between Odor-Stress-Mediated and Irritant-Mediated Symptoms?

- Sources of variation in population response to perceived and actual toxicity are different
- Factors that are capable of mitigating responses to perceived risk may be ineffective mediators of actual risk and vice versa.

## Are mVOCs reliable indicators of mold/mycotoxin exposure?

- Can odor from mVOCs serve as early warning of microbial growths?
  - Our noses would suggest “Yes”
- Can a single VOC or VOC pattern specific to microbial growths be identified?
- Are mVOC emissions significantly different from background material emissions?
- Can field instrumentation deliver the sensitivity needed to detect mVOC levels?

## mVOCs, Odor and Irritation



- mVOCs are potential sensory irritants
  - airborne levels alone or in combination may exceed irritation thresholds
- Odor from mVOCs occurs at low levels and can generate adverse responses due to
  - quality
  - associations
  - fear of source
- mVOCs may be reliable indicator of microbial growth
  - specific emission patterns need to be identified
  - background levels need to be verified
  - field instrumentation needs to achieve required sensitivity levels