Introspection:
The Analysis of Consciousness

Fall 2014

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Rene Descartes (1596-1650)

"Cogito, ergo sum"

"Sum res cogitans"

"Thinking"
for Descartes includes
***all* conscious mental states**

2

William James (1842-1910)

"Psychology
is the science of mental life…
The first fact for us, then,
as psychologists,
is that thinking of some sort goes on"
***Principles of Psychology* (1890)**

"Psychology
is the description and explanation
of states of consciousness as such"
***Psychology: Briefer Course* (1892)**

3

James on Introspection

Principles (1890), Chapter VII, p. 185

"*Introspective Observation is what we have to rely on first and foremost and always*. The word introspection… means, of course, looking into our own minds and reporting what we discover. *Every one agrees that we there discover states of consciousness.* So far as I know, the existence of such states has never been doubted by any critic, however skeptical in other respects he may have been.

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"Five Characters of Consciousness"

James (1890), Chapter IX

- Personal Subjectivity
- Constant Change
- Continuity Despite Change
- Intentionality ("Aboutness")
- Selective Attention

5

"Thought tends to Personal Form"

- "It seems as if the elementary psychic fact were not *thought* of *this thought* or *that thought*, but *my thought*, every thought being *owned*…."
- "The universal conscious fact is not "'feelings and thoughts exist' but 'I think' and 'I feel'" (p. 221).

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"Thought is in Constant Change"

- "*No state once gone can recur and be identical with what it was before*….
- "*There is no proof that the same bodily sensation is ever got by us twice. What is got twice is the same* OBJECT" (p. 224).

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"Within each personal consciousness, thought is sensibly continuous"

- "Consciousness… does not appear to itself chopped up in bits…. It is nothing jointed; it flows. A 'river' or a 'stream' are the metaphors by which it is most naturally described. *In talking of it hereafter, let us call it the stream of thought, of consciousness, or of subjective life*" (p. 233).

8

"Human thought appears to deal with objects independent of itself"

- "That is, it is cognitive, or possesses the function of knowing" (p. 262).
- "A mind which has become conscious of its own cognitive function, plays what we have called 'the psychologist' upon itself. It not only knows the things that appear before it; it knows that it knows them. This stage of reflective condition is, more or less explicitly, our habitual state of mind" (p. 263).

9

"It is always interested more in one part of its object than in another, and welcomes and rejects, or chooses, all the while it thinks"

"The phenomena of selective attention and of deliberative will are of course patent examples of this choosing activity….

- "Accentuation and Emphasis are present in every perception we have. We find it quite impossible to disperse our attention impartially over a number of impressions" (p. 273).

10

Immanuel Kant (1724-1804)

"There are three absolutely irreducible faculties of mind: knowledge, feeling, and desire"

***Critique of Judgment* (1790)**

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The Trilogy of Mind

Hilgard (1980)

• Cognition – Sensation, Perception – Knowledge, Memory – Thinking, Imagining	• Knowledge, Belief
• Emotion (Affection)	• Feeling, Affect
• Motivation (Conation)	• Needs, Wants, Goals

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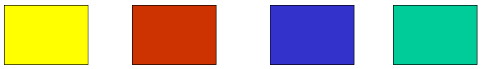
Consciousness as Sensory Qualia

- Subjective Qualities of Conscious Experience
- Sensory Modalities
  - Vision, Audition, Taste, Smell, etc.
- Qualities of Sensation Within Modalities
  - Red vs. Blue, Sweet vs. Sour



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Properties of Qualia

Dennett, "Quining Qualia" (1988)

- Ineffable
  - Indescribable
- Intrinsic
  - Unanalyzable
- Private
  - No Interpersonal Comparisons
- Directly Apprehended
  - Unmediated

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Ineffability 1: Mary, The Color Scientist

Jackson (1982, 1986)

- Mary, a Visual Neuroscientist
- Raised in Achromatic Chamber
- Knows All There is to Know About the Nervous System

What Does She Experience When She Emerges from the Chamber?

Will She Have a New Experience of Color?

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Ineffability 2: Fred, the Scientist with Super-Vision

Jackson (1982, 1986)

- Fred, Another Visual Neuroscientist
- Has Visual Range Beyond Normal
  - Infrared, >780 nm
  - Ultraviolet, <380 nm
- Observer Knows All There is to Know about the Nervous System

What Color Does Fred Experience When Stimulated with Infrared/Ultraviolet Light?

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A Congenitally Color-Blind Color Scientist

Knut Nordby (1990)

"Although I have acquired a thorough theoretical knowledge of the physics of colors and the physiology of the color receptor mechanisms, nothing of this can help me to understand the true nature of colours.

"From the history of art I have also learned about the meanings often attributed to colours and how colours have been used at different times, but this too does not give me an understanding of the essential character or quality of colours."

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Acquired Color-Blindness in Patient JI

Sacks & Wasserman (1987); Sacks (1995)

- Visual Artist
  - Traumatic Injury to Area V4
- Retained Conceptual Knowledge of Color
  - Color Mixture, etc.
- No Longer Saw or Imagined Color
  - No Longer Dreamed in Color

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Deutanopia

Reds and Greens Both Look Greenish-Gray

Terrance Waggoner, TestingColorVision.com
Wall Street Journal

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Protanopia

Reds and Greens Are Difficult to Distinguish
Red Appears Dark, Purple Appears Blue

Terrance Waggoner, TestingColorVision.com
Wall Street Journal

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Tritanopia

Blues Are Dim, Yellows Look White, Purples Look Red

Terrance Waggoner, TestingColorVision.com
Wall Street Journal

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Consciousness as Intentionality

Brentano (1874)

- From Latin *intentio*
  - Ideas, Representations of Things
- Brentano's Thesis
  - *Intentionality is the Mark of the Mental*
    - All Mental States are Intentional
    - Only Mental States are Intentional
- Consciousness is Representational
  - Mental States are Always *About* Something

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Propositional Attitudes

Russell (1912)

John believes that it is raining outside.

- Intentionality = Attitude + Proposition
- Attitude = *Believes, Knows, Thinks, Perceives, Remembers*
- Proposition = *Truth Value/Conditions*

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What about Non-Cognitive States?

Emotion:

John likes pizza.
John is happy.

Motivation:

John wants pizza.
John is hungry.

No Propositional Content

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Cognitive Constructivism Adds Propositional Content

e.g., Schachter & Singer (1962)

- Emotion:
  - John likes pizza.
    - John *believes that* he likes pizza.
  - John is happy.
    - John *believes that* he is happy
- Motivation:
  - John wants pizza.
    - John *believes that* he wants pizza.
  - John is hungry.
    - John *believes that* he is hungry.

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Subjectivity

Searle (1992, 2004)

"Conscious States Exist Only as They Are Experienced by a Human or Animal Subject."

Consciousness is Inherently Subjective

But What Do We Mean by *Subjective*?

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Two Objective-Subjective Distinctions

Searle (1992, 2004)

- Subjective vs. Objective Epistemology
  - Truth Value Depends on Feelings/Attitudes
    - "Rembrandt was born in 1606"
    - "Rembrandt was the best Dutch painter ever"
- Subjective vs. Objective Ontology
  - 1st-Person vs. 3rd-Person Ontology
  - Existence of Entity Depends on Observer
    - "Mountains, Molecules, and Tectonic Plates"
    - "Pains, Tickles, Suspicions, and Impressions"

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Subjectivity and Consciousness

- Consciousness is Ontologically Subjective
  - It Exists Only by Virtue of Being Experienced
- The Challenge for a "Scientific" Approach to Consciousness
  - Epistemically Objective Knowledge
  - Ontologically Subjective Phenomena
- Problem of Reductionism
  - Can't Reduce Ontologically Subjective Facts to Ontologically Objective Facts
    - Leaves Out Subjectivity!

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The Scientific Challenge of Consciousness

Searle (2004)

"The… ontological subjectivity of the subject matter does not preclude an epistemically objective science of that very subject matter."

- Psychology
- Neurology
- Cognitive Science
- Cognitive Neuroscience

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Objective Knowledge of Subjective States: The Case of Synesthesia

Cytowic (1989, 1993)

- Sensation (Stimulation) in One Modality Elicits Sensation in Another
  - One Quality within Modality Elicits Another
- Basic Features
  - Elicited Involuntarily
  - Projected Outside the Body
  - Durable, Discrete, Generic
  - Memorable
  - Emotional and Noetic
  - Unidirectional

Letter-Color Synesthesia in Subject MLS

Mills, Viguers, Edelson, Thomas, Simon-Dack, & Innis (2002)

- Multilingual
  - Russian, German, French, English, Polish
- One Set of Colors for Roman Letters
  - Colors for Cyrillic Based on Roman

Subject C's Digit-Color Synesthesia

Dixon, Smilek, Cudahy, & Merikle (2000, 2001, 2002ab)

0 **1** 2 3 4 5 6 7 8 9

- Extraordinary Memory
  - 4 9-Digit Lists After 2-Hour, 2-Month Intervals
- When She Sees, Hears, Thinks of Digits
  - Color Overlays Black Digits

Color-Digit/Letter Synesthesia

Ramachandran & Hubbard (2000)

- Subject JC
  - Experienced Colors for Both Digits and Letters
- Subject ER
  - Experienced Colors for Digits Only
- Visual Grouping Task
- "Pop-Out" Task (Treisman & Gelade (1980)
  - Search Array for Distinctive Object
    - Easy if Target is Distinctive
    - Difficult if Target Shares Many Features with Background

Perceptual Grouping Task

Ramachandran & Hubbard (2000)

3 8 3 8 3 8 3
7 0 7 0 7 0 7
3 8 3 8 3 8 3
7 0 7 0 7 0 7
3 8 3 8 3 8 3

Are These Digits Arranged Horizontally or Vertically?

Perceptual Grouping Task

Ramachandran & Hubbard (2000)

3 8 3 8 3 8 3
7 0 7 0 7 0 7
3 8 3 8 3 8 3
7 0 7 0 7 0 7
3 8 3 8 3 8 3

Similarity of Shape Between 3s and 8s
Induces a Tendency to Group Items Horizontally

Perceptual Grouping Task

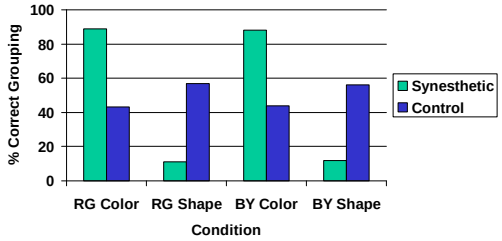
Ramachandran & Hubbard (2000)

Subject ER

3 8 3 8 3 8 3
7 0 7 0 7 0 7
3 8 3 8 3 8 3
7 0 7 0 7 0 7
3 8 3 8 3 8 3

Grouping Task

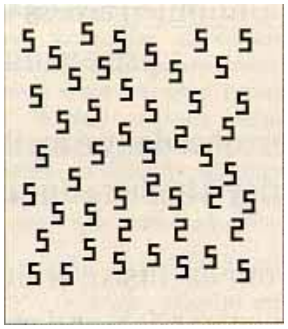
Ramachandran & Hubbard (2000)



Detection Task:
Raise Your Hand If You Find the Digit "2"

- Ready...

Raise Your Hand If You Find the Digit "2"



Did You Notice Anything Else About the Array?

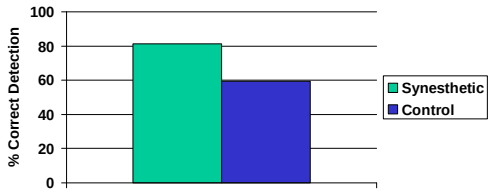
Raise Your Hand If You Find the Digit "2"

- Ready...

Raise Your Hand If You Find the Digit "2"

Pattern-Detection Performance

Ramachandran & Hubbard (2002)



Reframing Questions About Consciousness

- Can Qualia and Intentional States be Unconscious?
  - Perspective on Neural Correlates
- Can you Have Consciousness Without Qualia or Intentionality?
- Can Nonhuman Animals Have Intentional States?
- Can Machines Have Intentional States?
- Do Intentional States Cause Anything?

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"What Is It Like To Be a Bat?"

Nagel (1979)

"The fact that an organism has conscious experience *at all* means, basically, that there is something it is like to *be* that organism.

There may be further implications about the form of the experience; there may even (though I doubt it) be implications about the behavior of the organism.

But fundamentally an organism has conscious mental states if and only if there is something that it is like to be that organism -- something it is like *for* the organism."

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Consciousness as Qualia

- Qualities of Conscious Experience
  - Sensory Modalities
    - Seeing, Hearing, Tasting, Smelling, etc.
  - Qualities Within Modalities
    - Red vs. Blue, Sweet vs. Sour, etc.
- What are the Neural Correlates of Qualia?
  - Sensory Psychophysics
  - Sensory Neurophysiology

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Modalities of Sensation

Aristotle, *De* Anima; Sherrington (1906)

Exteroception

- Distance Senses
  - Vision
  - Audition
- Chemical Senses
  - Gustation
  - Olfaction
- Skin Senses
  - Tactile (Haptic)
  - Thermal
  - Pain

Proprioception

- Kinesthesis
- Equilibrium

Interoception

- *Homeostatic Regulation*
- *Ocular Cues*

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Defining the Sensory Modalities

• Feature	• Example of Vision
– Proximal Stimulus	– Light Waves
– Sensory Receptor	– Rods and Cones
– Sensory Tract	– Optic Nerve
– Sensory Projection Area	– Occipital Cortex

Doctrine of Specific Nerve Energies

Muller (1833-1840)

"Sensation consists in the sensorium's receiving… a knowledge of certain qualities… of the nerves of sense themselves; and these qualities of the nerves of sense are in all different, the nerve of each having its own peculiar quality or energy.

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Psychophysics as Experimental Introspection

- Relations Between…
  - Physical Properties of Stimulus
    - Third-Person Objectivity
  - Psychological Properties of Experience
    - First-Person Subjectivity
- Psychophysical Principle
  - Every Psychological Quality of a Sensory Experience is Related to a Physical Property of the Corresponding Stimulus

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Psychophysical Methods

- Just-Noticeable Differences
- Constant Stimuli
- Adjustment

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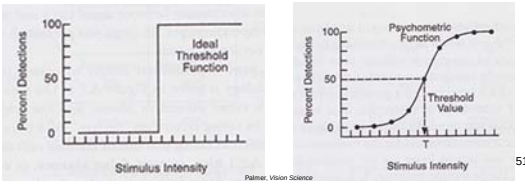
Thresholds for Conscious Awareness

- Absolute
  - Stimulus Detected on 50% of Trials
- Relative
  - Absolute Threshold a Special Case



Palmer, Vision Science

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"Psycho-Physical" Parallels

Kulpe (1893); Titchener (1908)

Fundamental Dimensions in Classical Physics	*Fundamental Dimensions in Psychology*
Mass	Intensity
Space	Extensity
Time	Protensity
	Attensity (Vividness)
	Quality

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Intensity

- "Strength" of Sensory Experience
  - Vision, *Brightness*
  - Audition, *Loudness*
- Amount of Stimulus Energy
- Coding in Nervous System
  - Temporal Summation
  - Spatial Summation
- No Isomorphism

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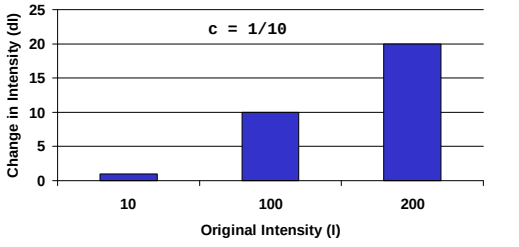
Weber's Law

Weber (1846)

$$\Delta I/I = c$$



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Representative Weber Fractions for Human Sensation

Geldard (1962)

Modality	c
Visual Brightness (White)	1/60
Lifted Weight	1/50
Thermal Pain	1/30
Auditory Loudness	1/10
Cutaneous Pressure	1/7
Smell of Rubber	1/4
Taste of Salt	1/3

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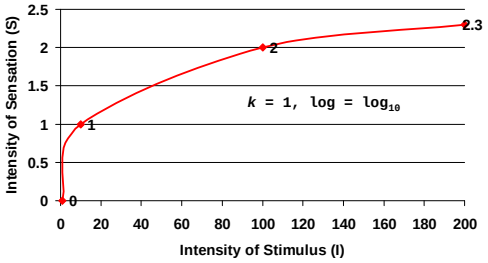
Fechner's Law

Fechner (1860)

$S = k \log I$



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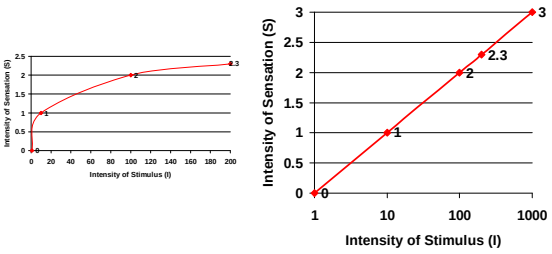
Fechner's Law as Logarithm

Fechner (1868)

$S = k \log I$



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Fechner's Law

Fechner (1868)

$S = k \log I$

- Sensation Grows More Slowly than Stimulation
- Exceptions
  - Perceived Length
  - Perceived Pain

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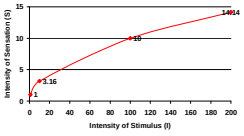
Stevens' Law

Stevens (1961)

$S = kI^N$

Fechner's Law



$k = 1, N = 1/2$

Physical Intensity	Sensory Intensity
1	1
10	3.16
100	10
200	14.14

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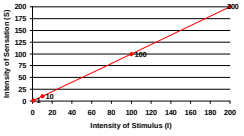
Stevens' Law

Stevens (1961)

$S = kI^N$

The Case of Length



$k = 1, N = 1$

Physical Intensity	Sensory Intensity
1	1
10	10
100	100
200	200

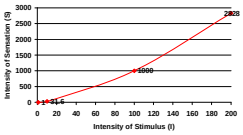
60

Stevens' Law

Stevens (1961)

$$S = kI^N$$

The Case of Pain



$k = 1, N = 3/2$

Physical Intensity	*Sensory Intensity*
1	1
10	31.6
100	1000
200	2828

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Psychophysics as a Scientific Approach to Consciousness

- Empirical Studies
  - Systematic Observation
  - Controlled Experimentation
- Quantitative Data
- Statistical Analysis
- Mathematical Function
  - Stimulus Environment
  - Conscious Sensory Experience

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The Psychophysical Principle Beyond Intensity

- Intensity Common to All Modalities
  - Vision: Brightness
  - Audition: Loudness
- Specific Qualities Within Modality
  - Vision: Hue, Saturation
  - Audition: Pitch, Timbre

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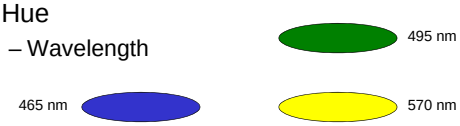
Qualities of Visual Sensation

- Hue
  - Wavelength



- Saturation
  - Amount of Gray

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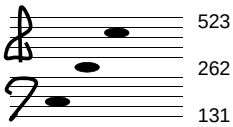
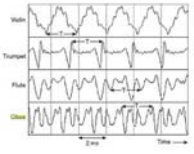
Qualities of Auditory Sensation

- Pitch
  - Frequency
- Timbre
  - Shape of Wave
    - Fundamental Frequency
    - Distribution of Harmonics
      - Flute, sine wave
        - » Pure fundamental
      - Oboe, square wave
        - » Fundamental + Odd harmonic





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The Doctrine of Specific Fiber Energies

Helmholtz (1863, 1866)

- Muller's Original Doctrine

  Every Modality of Sensation is Mediated by a Specific Neural System

- Helmholtz's Extension (1866)

  Within each Modality, Every Quality of Sensation is Mediated by a Specific Neural System

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Structuralism and Experimental Introspection

Wundt (1873); Titchener (1910); Boring (1953)

- Mental Chemistry
  - Conscious Experience = Molecules
  - Constituent Elements = Atoms
- Elements of Experience
  - Sensations
  - Feelings?
    - Feelings as Sensations
  - Images?
    - Wundt vs. Kulpe on Imageless Thought

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The Stimulus Error

- Describing the Meaning of the Stimulus
  - Instead of the Qualities of the Experience
- Confusion of Observation, Inference

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Qualities of Visual Hue

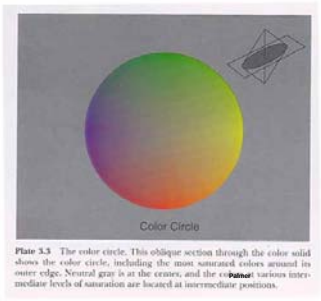

Plate 3.3 The color circle. This oblique section through the color solid shows the color circle, including the most saturated colors around its outer edge. Neutral gray is at the center, and the colors of various intermediate levels of saturation are located at intermediate positions.

Red
Green
Yellow
Blue

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Trichromatic Theory of Color Perception

Young (1802); Helmholtz (1852)

- All Visible Colors Can Be Produced by Mixture of Just Three Colors
  - Additive Mixture: Red, Green, Blue
  - Subtractive Mixture: Red, Yellow, and Blue
- Three Types of Cones
  - **Short**, **Medium**, **Long** Wavelengths
- Replaced by Opponent-Process Theory
  - Hering (1874); Hurvich & Jameson (1957)

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Primary Colors as Models for Primary Qualities

Cutting (2008)

- Physical Mixture
  - Yields All Other Qualities
- Physiological Attunement
  - Unique Neural Pathway for Each Primary Quality
- Language
  - Monolexemic
  - High Frequency of Use

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Cultural Salience of Primary Qualities

Cutting (2008)

- Basic Categories
  - Encoded in Most Languages
    - Black (Dark), White (Bright)
    - Red, Yellow or Green, Blue
    - Grey, Pink, Orange, Purple, Brown
- Etymology
  - BWG/RYGB Do Not Refer to Any Object
  - Orange, Violet, Olive, etc. Borrowed from Objects

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Qualities of Gustatory Experience

Hanig (1901); Henning (1916)

- Sweet
- Sour
- Salty
- Bitter

- ***Umami***

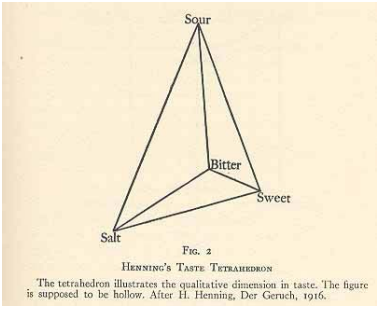

FIG. 2
HENNING'S TASTE TETRAHEDRON
The tetrahedron illustrates the qualitative dimension in taste. The figure is supposed to be hollow. After H. Henning, Der Geruch, 1916.

Boring (1933)

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Qualities of Olfactory Experience

Zwaardemaker (1895); Henning (1916)

- Spicy
- Fragrant
- Ethereal
- Resinous
- Putrid
- Burned

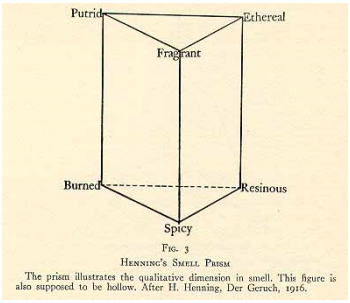

FIG. 3
HENNING'S SMELL PRISM
The prism illustrates the qualitative dimension in smell. This figure is also supposed to be hollow. After H. Henning, Der Geruch, 1916.

Boring (1933)

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Pheromones: Unconscious Olfaction

Karlson & Luscher (1959)

- Aggregation (Attractant Both Sexes)
- Alarm (Flight/Fight; Tend/Befriend?)
- Epideictic (Egg-Laying Female Insects)
- Releasers (Attract Mates)
- Primer (Developmental Changes)
- Territorial (Male and Female)
- Trail (Social Insects)
- Sex (Availability for Breeding)

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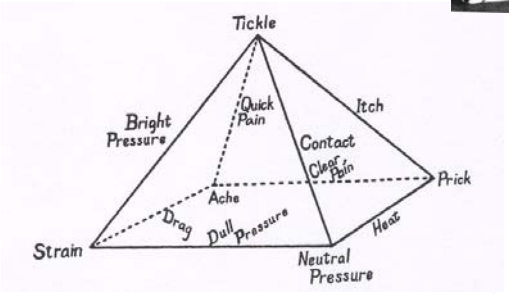
A Touch Pyramid

"Tentative"

Titchener (1920)



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Qualities of Tactile Experience

Proposed by Boring (1953)

- Pressure
  - Pain
- Warmth
  - Cold
- Roughness?
- Wetness?

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Flavor = Taste + Smell + Touch

- The Raspberry Test
  - – Taste of Sweet
  - – Smell of Berry
- "Trigeminal" Sense
  - – Irritants
    - Mint
    - Pepper

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Qualities of Pain

Titchener (1920); Bishop (1946); Melzack & Torgerson (1971)

- Titchener (1920)
  - Prick
  - Clear Pain
  - Quick Pain
  - Ache
  - Fast
  - Slow
- McGill Pain Questionnaire
  - Sensory Pain
  - Suffering
  - Intensity
- Bishop (1946)
  - "Fast"
    - A-delta Fibers
  - "Slow"
    - C Fibers

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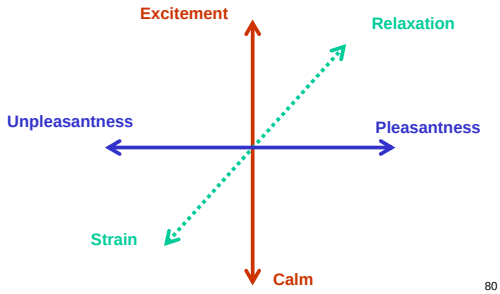
Dimensions of Feeling

Wundt (1899)



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Looking Back on Structuralism

- Positive Legacy
  - Addressed Consciousness Directly
  - Tied Consciousness to Public Observables
  - Formed Basis for Sensory Neuroscience
- Failure
  - Fruitless Debates
  - Behaviorist Revolution
  - Gestalt Psychology
  - Focus on Qualia vs. Intentionality

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Structuralism as a Scientific Approach to Consciousness

- Qualities Within Modality
  - Boring's *Physical Dimensions of Consciousness*
- Precursor to Psychophysical Relations
  - Connect Internal Mental States to External Reality
- Precursor to Physiological Correlates
  - Connect Mental Life to Brain Structure, Process

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