Melancholic (NI)
Choleric (NE)
Phlegmatic (SI)
Sanguine (SE)

Two dimensions of personality

Introversion Extraversion

- Simple Descriptive Basis
  - Self reports
    - Sociable
    - Active
    - Impulsive
    - Spontaneous
- Peer ratings correlate with self reports
  - People who describe themselves as outgoing are more known to others

Obvious behavioral correlates

- E’s talk more
  - But this interacts with group size
  - More well known
- Occupational differences
  - Extraversion and success in sales
    (but is this ambition or sociability?)
- Introversion and preference for isolation

Obvious behavioral correlates (continued)

- Extraversion and stimulation seeking
  - Higher risk of arrest
    - (interacts with social class)
  - Higher risk of auto accidents
- Greater sexual activity
  - E’s have
    - More partners
    - Earlier onset
    - Prefer more positions

Theoretical - Causal basis

Does I/E have a biological basis?

- Contributions of Hans Eysenck and his collaborators
  - Eysenck attempted to unite experimental and individual differences psychology
  - Attempted to apply best current theory to the study of individual differences
  - I-E research as an example of programmatic research
I-E Early work

• Differences in conditionability
  - Original hypothesis
    • Introverts are easily conditioned
    • Introverts become well socialized
  - Later findings
    • Conditioning differences depend upon situation
    • Low arousal situations lead to better conditioning for introverts
    • Impulsivity more important than extraversion (Levy and Eysenck, 1972)

I-E and conditioning

• Newman’s work on psychopaths and conditioning
• Gray’s model of anxiety, impulsivity and conditioning
• Zinbarg
  - Sensitivity to cues of reward and action (impulsivity)
  - Sensitivity to cues of punishment and inaction (anxiety)

Gray’s hypothesis

<table>
<thead>
<tr>
<th>Anxious</th>
<th>Introverts</th>
<th>Neurotic</th>
<th>Impulsive</th>
<th>Extraverts</th>
<th>Non-impulsive</th>
<th>Non-anxious</th>
</tr>
</thead>
</table>

Hypothesis of arousal differences

• What is arousal?
  - Arousal of the hand, the heart, and the head
    • Skin conductance
    • Heart rate
    • EEG desynchronization
  - Self reports (Robert Thayer, Gerry Matthews)
    • Energetic arousal
    • Tense arousal

Representative MSQ items (arranged by angular location)

<table>
<thead>
<tr>
<th>Item</th>
<th>EA-PA</th>
<th>IA-N/A</th>
<th>Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>energetic</td>
<td>0.8</td>
<td>0.0</td>
<td>1</td>
</tr>
<tr>
<td>elated</td>
<td>0.7</td>
<td>0.0</td>
<td>2</td>
</tr>
<tr>
<td>excited</td>
<td>0.6</td>
<td>0.1</td>
<td>6</td>
</tr>
<tr>
<td>anxious</td>
<td>0.2</td>
<td>0.0</td>
<td>90</td>
</tr>
<tr>
<td>tense</td>
<td>0.1</td>
<td>0.5</td>
<td>85</td>
</tr>
<tr>
<td>distressed</td>
<td>0.6</td>
<td>0.8</td>
<td>93</td>
</tr>
<tr>
<td>frustrated</td>
<td>0.8</td>
<td>0.8</td>
<td>98</td>
</tr>
<tr>
<td>sad</td>
<td>-0.1</td>
<td>0.7</td>
<td>101</td>
</tr>
<tr>
<td>inspire</td>
<td>-0.1</td>
<td>0.6</td>
<td>114</td>
</tr>
<tr>
<td>sleepy</td>
<td>-0.5</td>
<td>0.1</td>
<td>164</td>
</tr>
<tr>
<td>tired</td>
<td>-0.5</td>
<td>0.2</td>
<td>164</td>
</tr>
<tr>
<td>inactive</td>
<td>-0.5</td>
<td>0.0</td>
<td>177</td>
</tr>
<tr>
<td>calm</td>
<td>0.2</td>
<td>-0.4</td>
<td>298</td>
</tr>
<tr>
<td>restless</td>
<td>0.4</td>
<td>-0.5</td>
<td>300</td>
</tr>
<tr>
<td>at ease</td>
<td>0.4</td>
<td>-0.5</td>
<td>312</td>
</tr>
<tr>
<td>attentive</td>
<td>0.7</td>
<td>0.0</td>
<td>357</td>
</tr>
<tr>
<td>enthusiastic</td>
<td>0.0</td>
<td>0.0</td>
<td>358</td>
</tr>
<tr>
<td>lively</td>
<td>0.9</td>
<td>0.0</td>
<td>380</td>
</tr>
</tbody>
</table>
Basal arousal differences

- Detected in psychophysiological experiments
  - (see Stelmack, 1990 for a review)
  - Electrophysiology (EEG)
    - Now you see it, now you don’t
    - Gale, 1981
    - Gale and Coles suggestion conditions need to be just right

Threshold differences detected by psychophysical methods

- Light Sensitivity (threshold)
  - Siddle (1967) staircase method
- Sound sensitivity
  - Smith (1968) forced choice
- Pain sensitivity
  - Haslam (1967)
  - Petrie (1960)
- Bi-modal sensitivity
  - Shigehisa and Symons (1973)
- Reaction to lemon juice
  - Eysenck, 1967

Body temperature and time of day

- Blake (1967) was cited as showing biological differences related to arousal but how relevant is this to basic theory?
- Folkard (1976)
- Eysenck and Folkard (1980)
- Wilson (199x)

Body Temperature as f(time of day)
(Baehr, Revelle & Eastman, 2000)

Morningness/Eveningness and BT
(Baehr, Revelle and Eastman, 2000)
Is it level, or rates of change?

- Do stimuli lose arousing properties faster for extraverts?
- Habituation of orienting response
- Bowyer, Humphreys and Revelle suggested that the effect was a decay rate in arousal
- But Anderson and Revelle show interaction with Time of Day

Behavioral Consequences of arousal differences

- Differences in Arousal preference
  - Wundt’s curvilinear hypotheses
    - Moderate levels of arousal are more pleasing than extreme levels
    - (“the Goldilocks hypothesis”)
  - Berlyne
    - Changes in arousal are more pleasing than a steady state
    - Increases or decreases are pleasant

Wundt’s hedonic curve

Berlyne’s hedonic curve

Wundt’s hedonic curve + Individual Differences

Most preferred arousal level

- Sound preference
  - Elliot
  - Hockey
- Complexity preference
  - Bartol
- Extraversion and the “three F’s syndrome”
  - Fags (cigarettes)
  - Fornication
  - Firewater
Logical problems with arousal preferences hypothesis

- **What is arousing?**
  - Mountain climbing? Chess playing? Small boat sailing?
- **What has subject done before coming to laboratory**
  - Extraverts being sociable
  - Introverts studying

Does Personality make a difference?

- **Important Life Criteria**
  - Longevity (Friedman et al.)
  - Job Performance (Hunter and Schmidt)
  - Psychological well being
- **Laboratory tasks**
  - Cognitive sensitivities and biases (e.g., McCloud, Mathews, Matthews, etc.)
  - Systematic pattern of results with cognitive performance by stress manipulations (e.g., Anderson, 1990; Anderson and Revelle, 1994; Revelle, Humphreys, Simon, Gilhooly, 1988; Revelle, 1993)

I-E and performance differences under stress and boredom

- **Performance as a curvilinear function of arousal and task difficulty**
  - Yerkes and Dodson, 1908
  - Hebb (1955)
  - Broadhurst (1958)
  - Broadbent (1971)

Yerkes and Dodson, 1908
**Discrimination learning**

Yerkes and Dodson, 1908
**Learning and shock level**
Yerkes and Dodson revisited

- Is it a lawful relationship?
- Does performance in fact vary as stress/arousal
- Is there a relationship with task difficulty
- Continues to be controversial interpretation

Hebb (1955) and arousal

- Level of “cue function as a function of arousal
- Arousal as pleasing up to a point
- Arousal as facilitating performance up to an optimal level
Eysenck and the Hebb Curve

- Performance as curvilinear function of arousal
- Introverts more aroused than extraverts
- Therefore, introverts should do well under low stress situations, extraverts in high stress situations

Evidence in support of I-E performance hypothesis

- No curvilinearity, but consistent
  - Frith (1967) detection of flicker fusion
    - Quiet versus noise
    - Extraverts versus introverts
  - Corcoran (1972) tracking performance
    - Sleep deprivation (12, 36, 60 hours)
    - Extraversion-introversion

Supporting Evidence

- Curvilinear and consistent
  - Davies and Hockey (1966)
    - Detection task
    - Quiet versus noisy
    - Low versus high signal frequency
    - Extraverts versus introverts
    - (note that 2*2*2 design has many possible compatible results)

Supporting evidence

- Gupta 1977: IQ tests
  - 0, 5, 10, 15 mg of amphetamine
  - Extraverts versus introverts
  - But later work from this lab was plagiarized from Anderson

Feeble attempts at theory testing

- Revelle, 1973
  - Performance on digit symbol, maze tracking, and anagrams (3 levels of difficulty for each task)
  - 6 stress levels
    - 1 person, relaxed
    - 2 person, relaxed
    - 2 person, competing
    - 2 person, competing for money
    - 8 person, competing for money
    - 8 person, competing for money, noise
  - Mixed results
    - What is arousing?
Introversion, time pressure, and caffeine: effect on verbal performance

Multiple attempts at replication

- Multiple studies tried to replicate the original Revelle, Amaral and Turiff results
- Mixed results
  - Sometimes would see it
  - Sometimes would not
- Eventually discovered the problem

Extraversion vs. Impulsivity

- Caffeine effects were systematic, but not for extraversion, but rather for impulsivity
- Systematic interaction with time of day
- Implications
  - Performance does vary as function of personality and arousal, but depends upon time of day
  - Personality dimension of relevance was impulsivity
General reanalysis of previous I-E effects -- were they impulsivity

- Relationship of impulsivity to extraversion
  - Old Eysenck scales were Impulsivity + Sociability
  - Newer scales (including Big 5 markers) are more sociability and ambition
- Theories of extraversion and arousal - were they theories of impulsivity?

Personality and Cognition: early attempts at a synthesis

- Humphreys and Revelle, 1984
  - Personality Traits x situational cues produce
  - Motivational States (arousal and on task effort)
  - Inverted U between arousal and performance is the result of two processes
    - Arousal facilitates Sustained Information Transfer (SIT) and inhibits Working Memory
    - On task effort facilitates SIT

Simple stage model of processing: Personality effects at each stage

Personality affects each stage of processing

- Introversion facilitates detection in vigilance tasks
- Anxiety facilitates detection of threat terms
- Depression facilitates memory for negative events
- Intelligence facilitates processing speed

Arousal and Performance
(Hypothetical description of Yerkes and Dodson Effect)

Arousal and Working Memory
Arousal and Information Transfer

Arousal and Performance: Arousal, Working Memory and Information Transfer

Yet another “plumbing diagram” relating personality, affect, and cognition