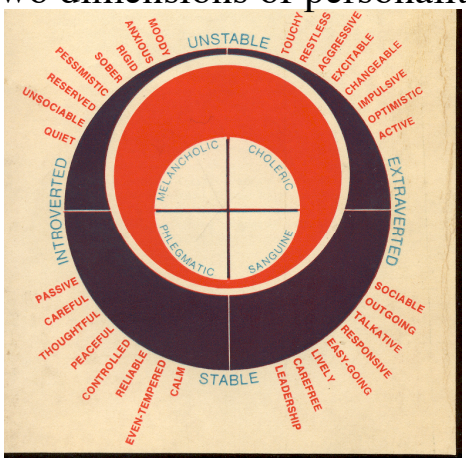
Melancholic (NI)

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

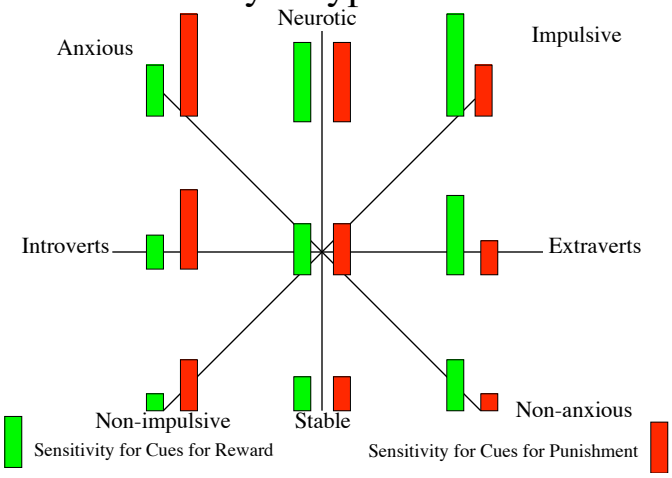
I-E Early work

- 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)

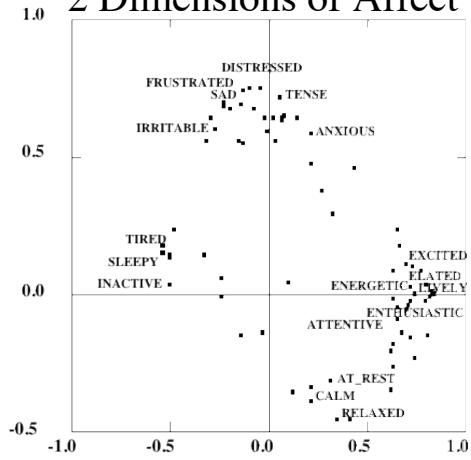
Gray's hypothesis



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

2 Dimensions of Affect



Representative MSQ items (arranged by angular location)

Item	EA-PA	TA-NA	Angle
energetic	**0.8**	0.0	1
elated	**0.7**	0.0	2
excited	**0.8**	0.1	6
anxious	0.2	**0.6**	70
tense	0.1	**0.7**	85
distressed	0.0	**0.8**	93
frustrated	-0.1	**0.8**	98
sad	-0.1	**0.7**	101
irritable	-0.3	**0.6**	114
sleepy	**-0.5**	0.1	164
tired	**-0.5**	0.2	164
inactive	**-0.5**	0.0	177
calm	0.2	**-0.4**	298
relaxed	0.4	**-0.5**	307
at ease	0.4	**-0.5**	312
attentive	**0.7**	0.0	357
enthusiastic	**0.8**	0.0	358
lively	**0.9**	0.0	360

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

Basal arousal differences

- Sedation threshold
  - Shagass, Claridge
- Skin Conductance
  - Revelle (1973)
  - Wilson (1989)
- Spontaneous GSR
  - Crider and Lunn
- Photic Driving
  - Robinson (1982)

Threshold differences detected by psychophysical methods

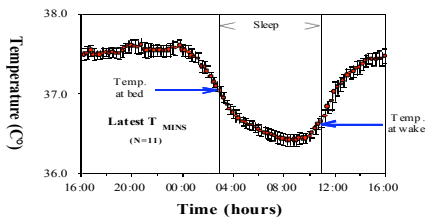
- Light Sensitivity (threshold)
  - Siddle (1967) staircase method
- Sound sensitivity
  - Smith (1968) forced choice
- Pain sensitivity
  - Haslam (1967)
  - Petrie (1960)
- Bi-modal sensitivity
  - Shigehisa and Symons (1973)
- Reaction to lemon juice
  - Eysenck, 1967

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)

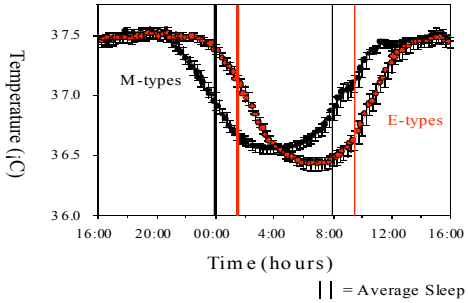
Body Temperature as f(time of day)

(Baehr, Revelle & Eastman, 2000)



Morningness/Eveningness and BT

(Baehr, Revelle and Eastman, 2000)



Is it level, or rates of change?

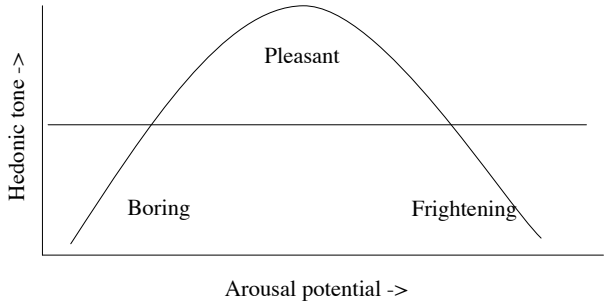
- Do stimuli lose arousing properties faster for extraverts/
- Habituation of orienting response
- Bowyer, Humphreys and Revelle suggested that the effect was a decay rate in arousal
- But Anderson and Revelle show interaction with Time of Day

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

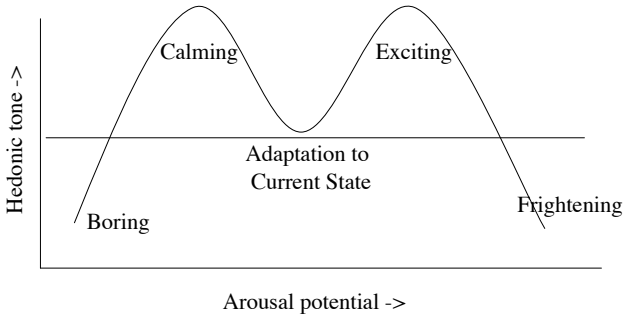
Wundt's hedonic curve

(adapted from Berlyne)



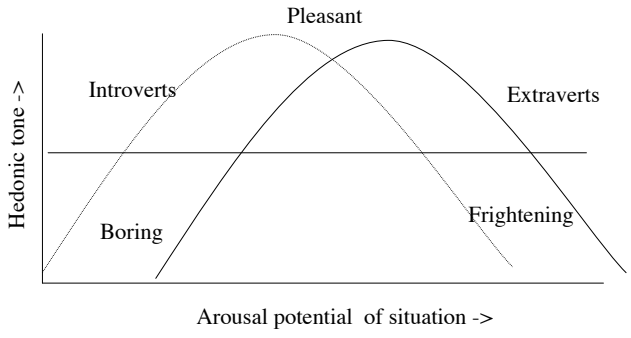
Berlyne's hedonic curve

(adapted from Berlyne)



Wundt's hedonic curve + Individual Differences

(adapted from Eysenck)



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 (eg.,McCloud, Mathews, Matthews, etc.)
  - Systematic pattern of results with cognitive performance by stress manipulations (eg., Anderson, 1990; Anderson and Revelle, 1994; Revelle, Humphreys, Simon, Gilliland, 1980; 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

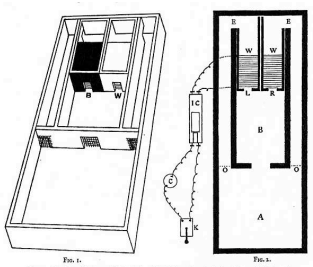


FIG. 1.

FIG. 1. Discrimination box. *W*, electric box with white cardboards; *B*, electric box with black cardboards.

FIG. 2. Ground plan of discrimination box. *A*, nest-box; *B*, entrance chamber; *W W*, electric boxes; *L*, doorway of left electric box; *R*, doorway of right electric box; *E*, exit from electric box to alley; *O*, swinging door between alley and *A*; *IC*, induction apparatus; *C*, electric battery; *K*, key in circuit.

Yerkes and Dodson Learning and shock level

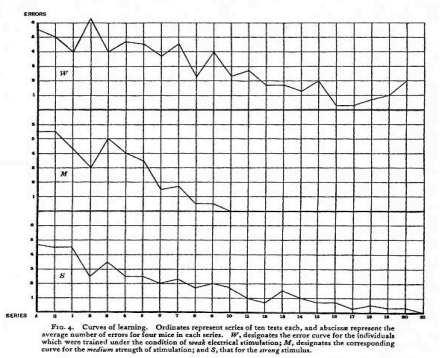


FIG. 4. Curves of learning. Ordinates represent series of ten tests each, and abscissæ represent the average number of errors for four mice in each series. *W*, designates the error curve for the individuals which were trained under the condition of *weak* electrical stimulation; *M*, designates the corresponding curve for the *medium* strength of stimulation; and *S*, that for the *strong* stimulus.

Yerkes and Dodson, 1908

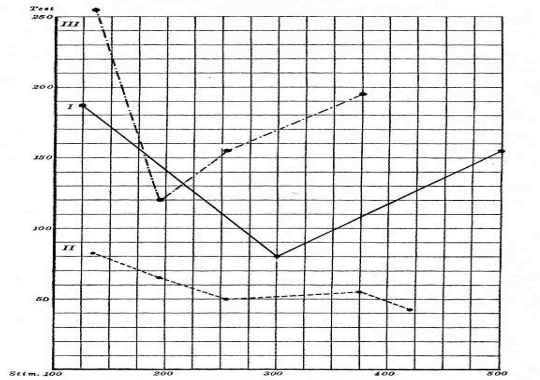


FIG. 5. A graphic representation of the relation of strength of electrical stimulus to condition of visual discrimination and rapidity of learning. Ordinates represent value of electric stimulus in units of stimulation; abscissæ represent the number of tests given. Curve *I* represents the results of the experiments of Set I. Each dot indicates a value of stimulus which was used in the experiments. For example, the first dot to the left in curve *I* signifies that the stimulus whose value was 125 units was the perfect habit, in the case of the four individuals trained, with 187 tests; the second dot, that for the stimulus value of 100 units 80 tests were necessary; and the third that for the stimulus value of 200, 155 tests. Curves II and III similarly represent the results of the experiments of sets II and III, respectively.

Yerkes and Dodson, 1908

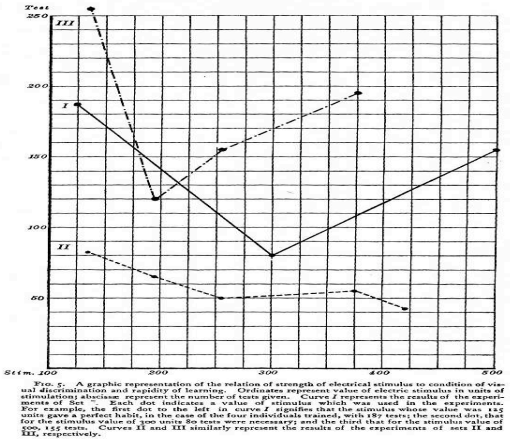
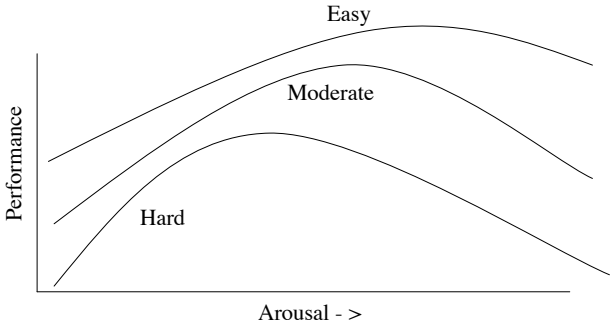


FIG. 5. A graphic representation of the relation of strength of electrical stimulus to condition of visual discrimination and rapidity of learning. Ordinates represent value of electric stimulus in units of stimulation; abscissæ represent the number of tests given. Curve I represents the results of the experiments of Set . Each dot indicates a value of stimulus which was used in the experiments. For example, the first dot to the left in curve I signifies that the stimulus whose value was 145 units gave a perfect habit, in the case of the four individuals trained, with 187 tests; the second dot, that with a stimulus value of 300 units 80 tests were necessary; and the third that for the stimulus value of 400, 155 tests. Curves II and III similarly represent the results of the experiments of sets II and III, respectively.

Yerkes and Dodson curve in terms of arousal and task difficulty



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

Hebb Curve

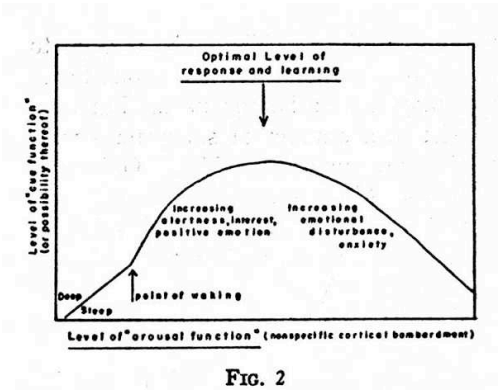
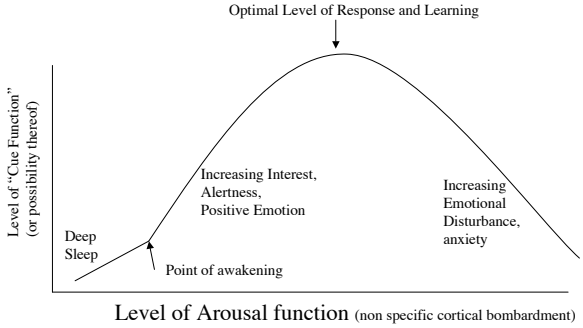


FIG. 2

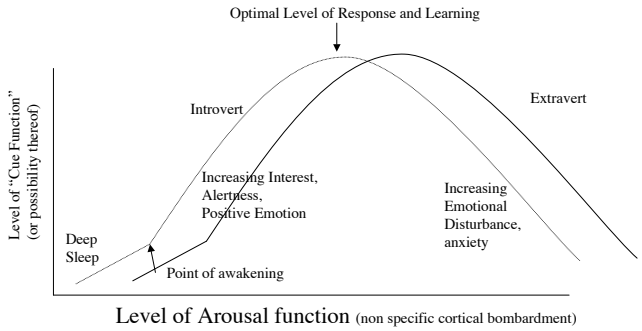
Hebb Curve (1955)



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

Eysenck + Hebb (1967)



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)

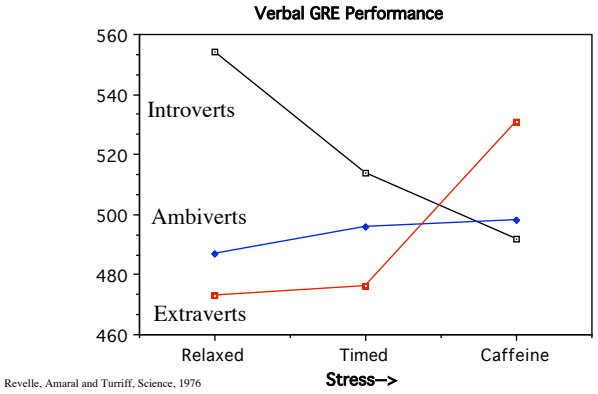
Supporting evidence

- 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

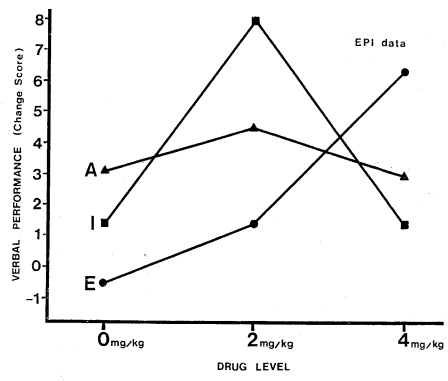


Revelle, Amaral and Turriff, Science, 1976

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

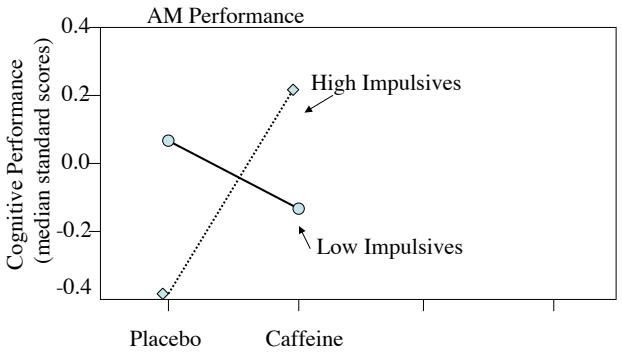
Extraversion, Caffeine, and Cognitive Performance



Gilliland, 1976

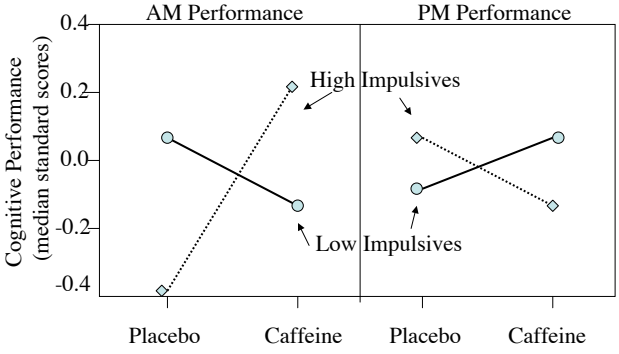
Figure 9. EPI based group means for change in number of items correctly answered on GRE practice tests.

Impulsivity, Caffeine, and Time of Day: the effect on complex cognitive performance



Revelle, Humphreys, Simon and Gilliland, JEP:G, 1980

Impulsivity, Caffeine, and Time of Day: the effect on complex cognitive performance



Revelle, Humphreys, Simon and Gilliland, JEP:G, 1980

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

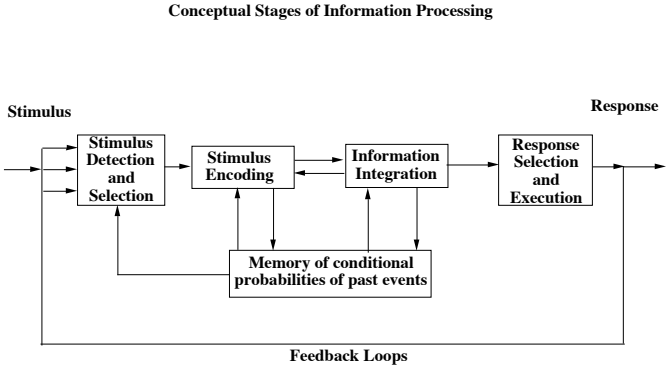
General reanalysis of previous I-E effects -- were they impulsivity

- 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

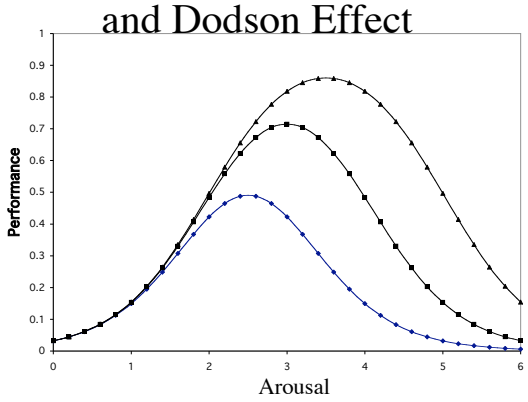
Simple stage model of processing- Personality effects at each stage



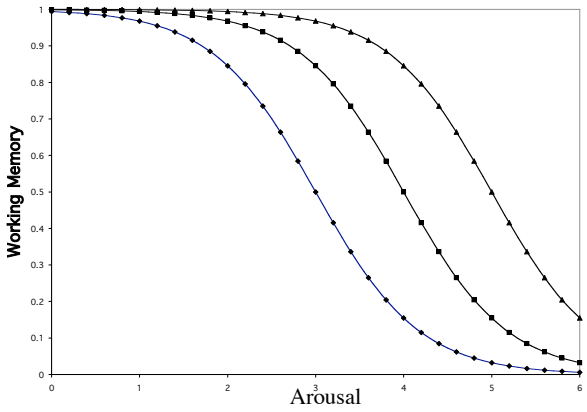
Personality affects each stage of processing

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

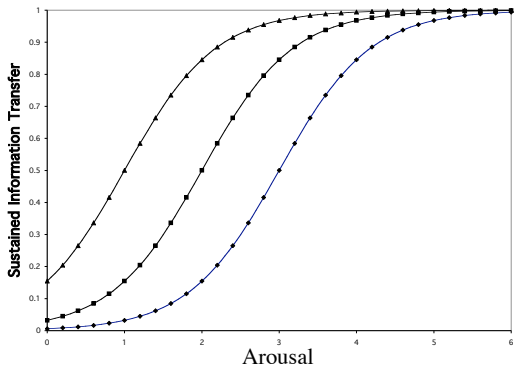
Arousal and Performance (Hypothetical description of Yerkes and Dodson Effect



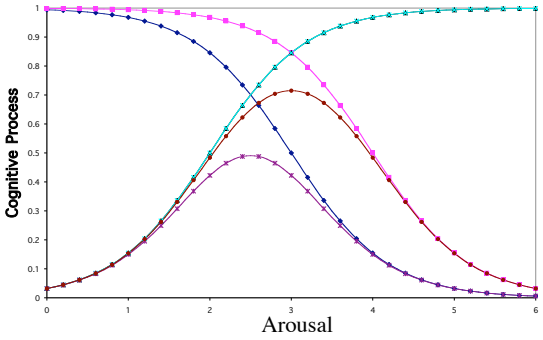
Arousal and Working Memory

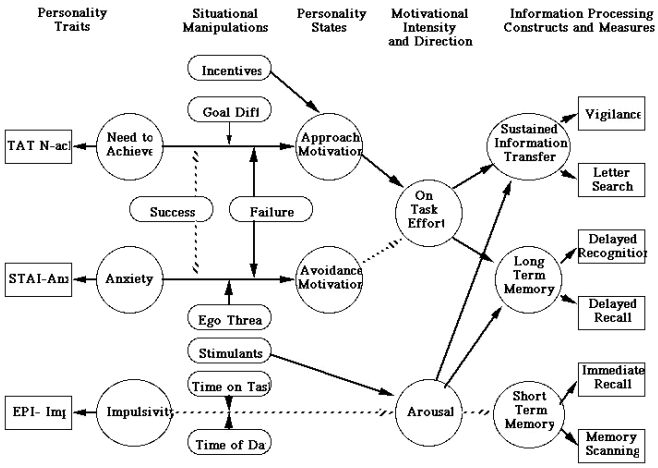


Arousal and Information Transfer



Arousal and Performance: Arousal, Working Memory and Information Transfer





Humphreys and Revelle, Psychological Review, 1984

Yet another "plumbing diagram" relating personality, affect, and cognition