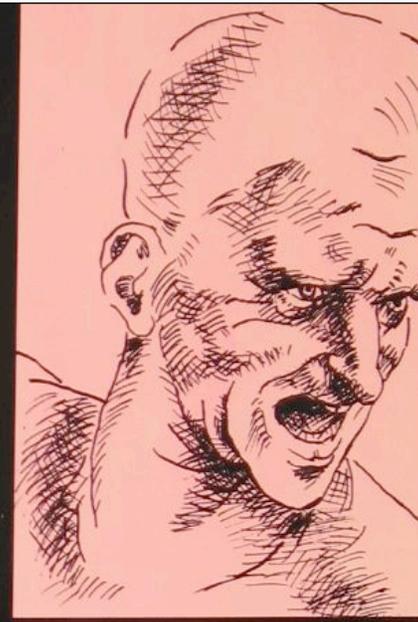


Melancholic  
(NI)



Choleric  
(NE)



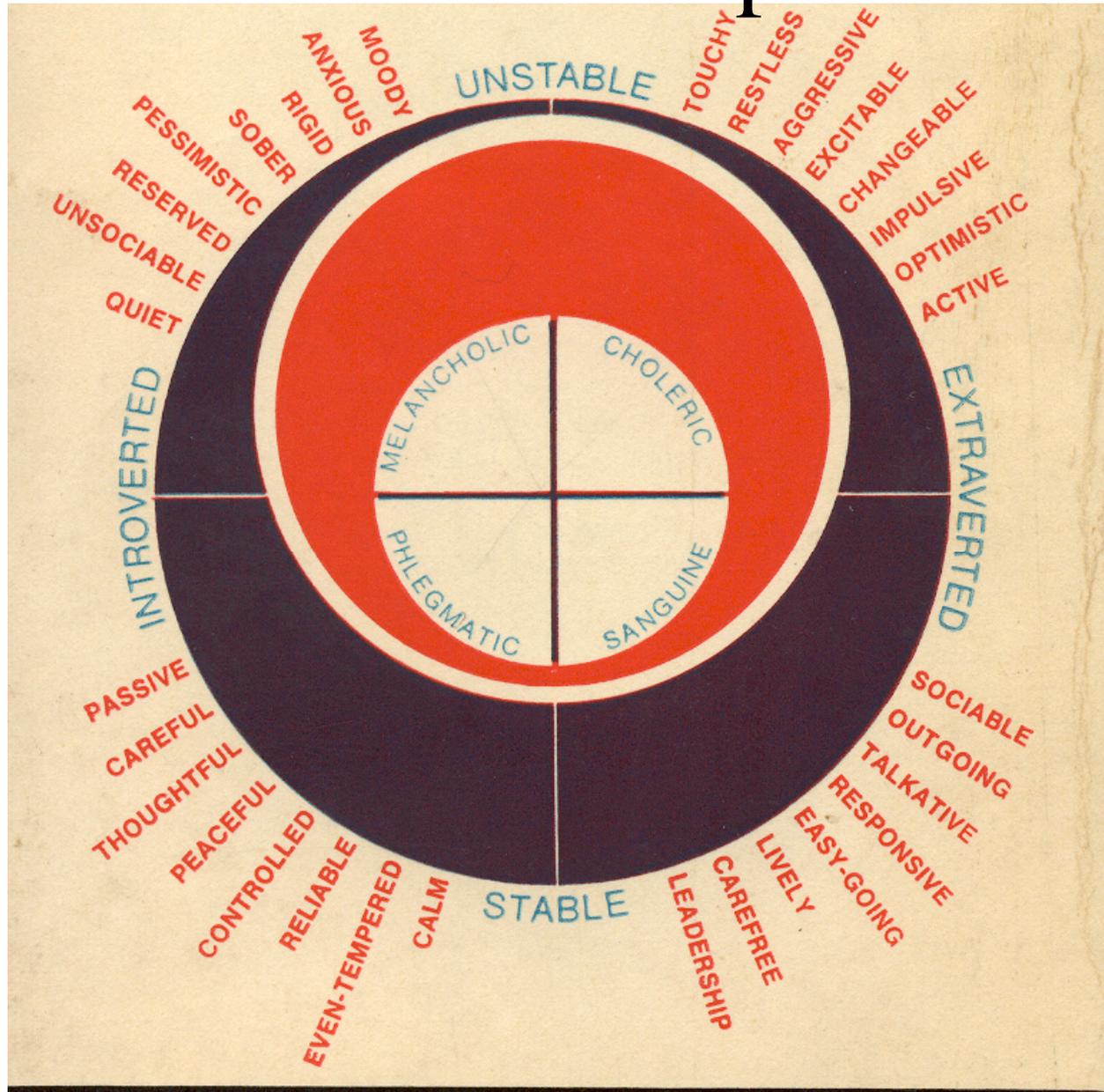
Phlegmatic  
(SI)



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

# Defining items from IPIP

- Am skilled in handling social situations.
  - Am the life of the party.
  - Don't mind being the center of attention.
  - Know how to captivate people.
  - Start conversations.
  - Feel comfortable around people.
  - Make friends easily.
  - Cheer people up.
  - Warm up quickly to others.
  - Talk to a lot of different people at parties.
- 
- Don't talk a lot.
  - Retreat from others.
  - Am hard to get to know.
  - Avoid contacts with others.
  - Don't like to draw attention to myself.
  - Have little to say.
  - Keep in the background.
  - Find it difficult to approach others.
  - Would describe my experiences as somewhat dull.
  - Keep others at a distance.

# 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?)
- Introversions 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 as an example of programmatic research in personality
  - 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
    - More recent work on I/E has not been as programmatic

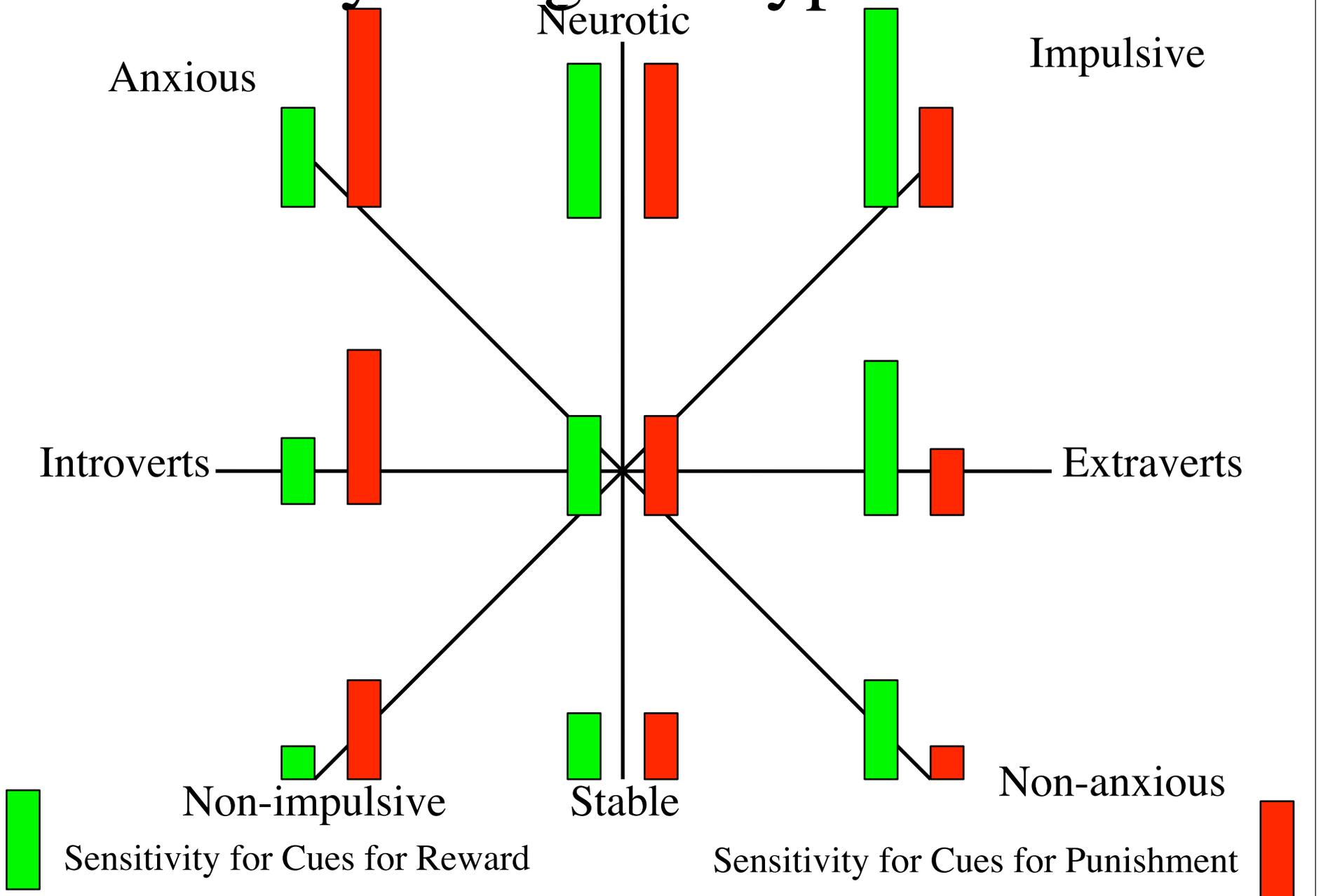
# I-E Early work

- 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
  - ability to stop
- Gray's model of anxiety, impulsivity and conditioning (reinforcement sensitivity)
- Zinbarg
  - Sensitivity to cues of reward and action (impulsivity)
  - Sensitivity to cues of punishment and inaction (anxiety)
- Gray's revised model of Reinforcement Sensitivity Theory
  - Gray and McNaughton (2000); Corr (in press)

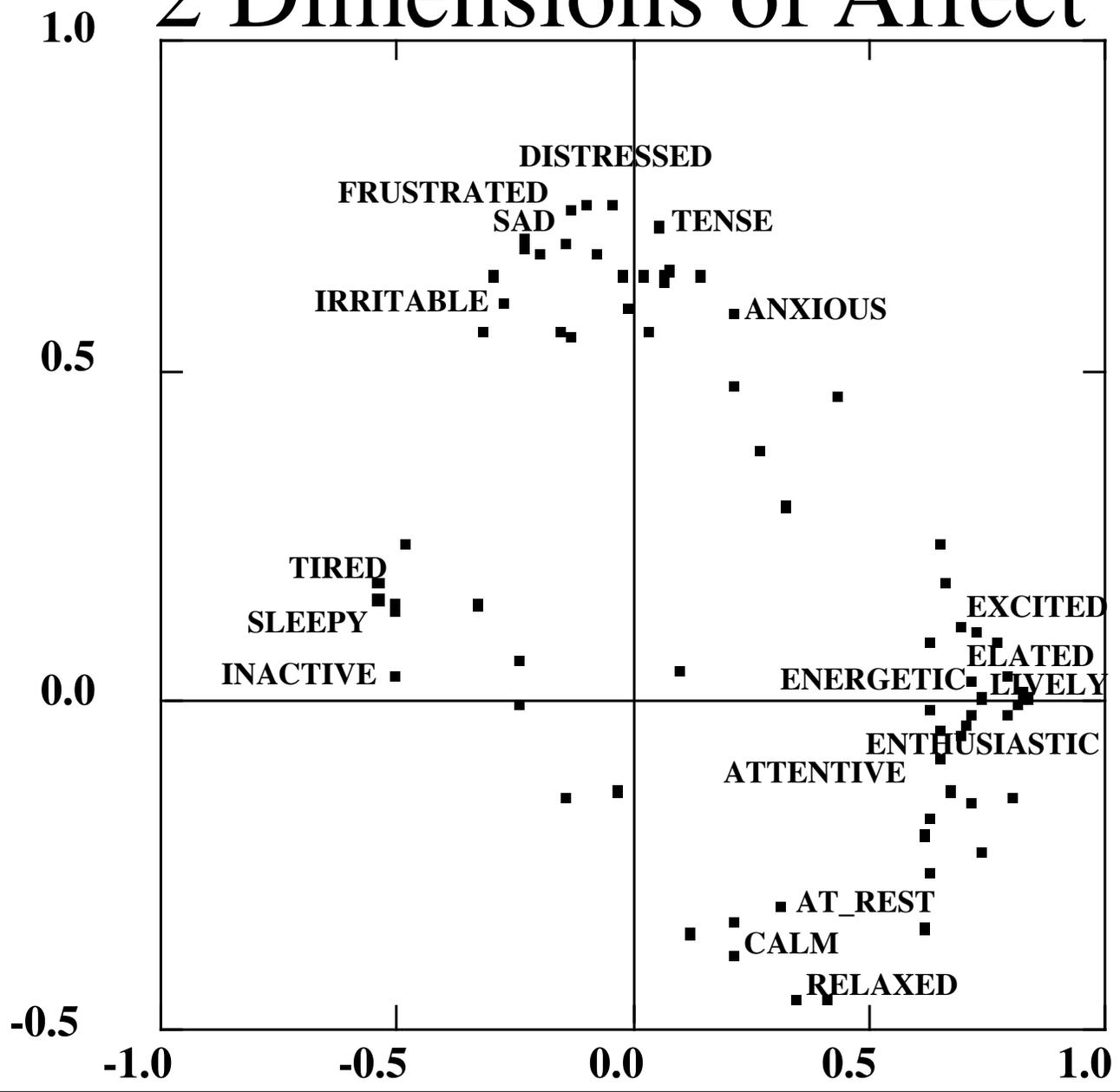
# Gray's original hypothesis



# 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
<b>energetic</b>	<b>0.8</b>	0.0	1
elated	<b>0.7</b>	0.0	2
excited	<b>0.8</b>	0.1	6
anxious	0.2	<b>0.6</b>	70
<b>tense</b>	0.1	<b>0.7</b>	85
distressed	0.0	<b>0.8</b>	93
<b>frustrated</b>	-0.1	<b>0.8</b>	98
sad	-0.1	<b>0.7</b>	101
irritable	-0.3	<b>0.6</b>	114
<b>sleepy</b>	<b>-0.5</b>	0.1	164
<b>tired</b>	<b>-0.5</b>	0.2	164
inactive	<b>-0.5</b>	0.0	177
<b>calm</b>	0.2	<b>-0.4</b>	298
<b>relaxed</b>	0.4	<b>-0.5</b>	307
at ease	0.4	<b>-0.5</b>	312
attentive	<b>0.7</b>	0.0	357
enthusiastic	<b>0.8</b>	0.0	358
<b>lively</b>	<b>0.9</b>	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 (1955), Claridge et al. (1981)
- Skin Conductance
  - Revelle (1973)
  - Wilson (1989)
- Spontaneous GSR
  - Crider and Lunn (1971)
- Photic Driving
  - Robinson (1982)

# Sedation Threshold

## C. Shagass (1955)

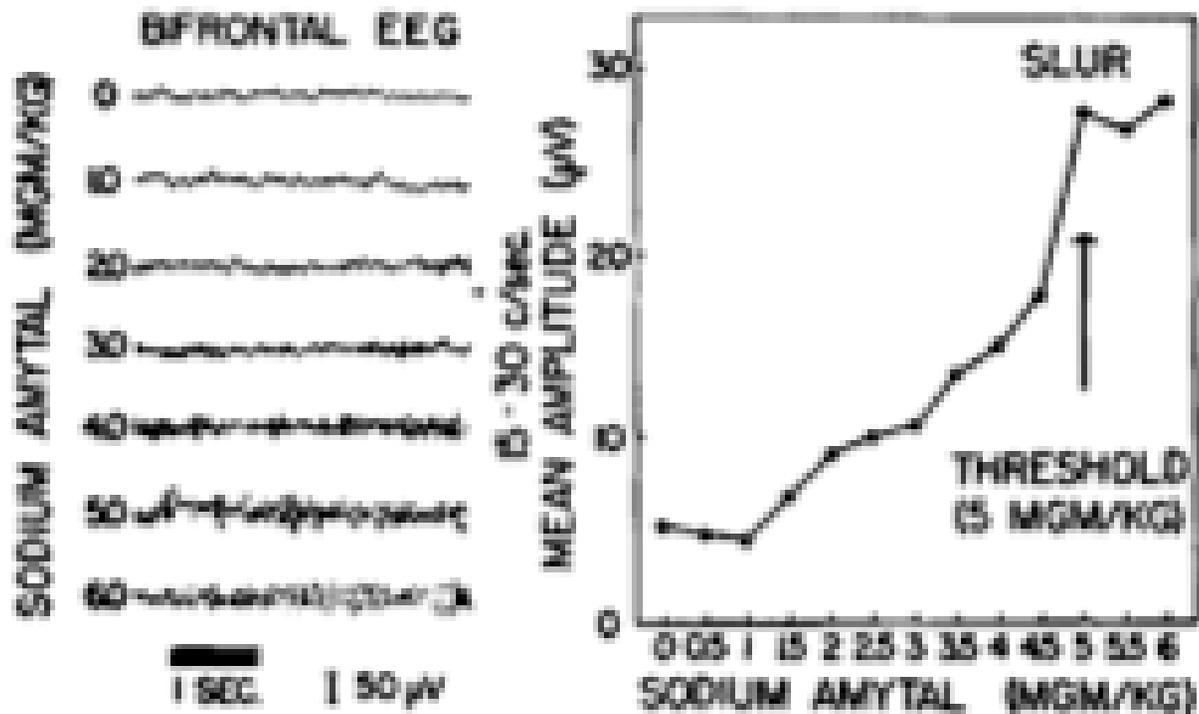


Fig. 1. Illustrates effect of Sodium Amytal on bifrontal EEG. Note progressive increase of the low-frequency amplitude. Arrow points to inflection point in the amplitude curve which indicates sedation threshold.

# Threshold differences detected by psychophysical methods

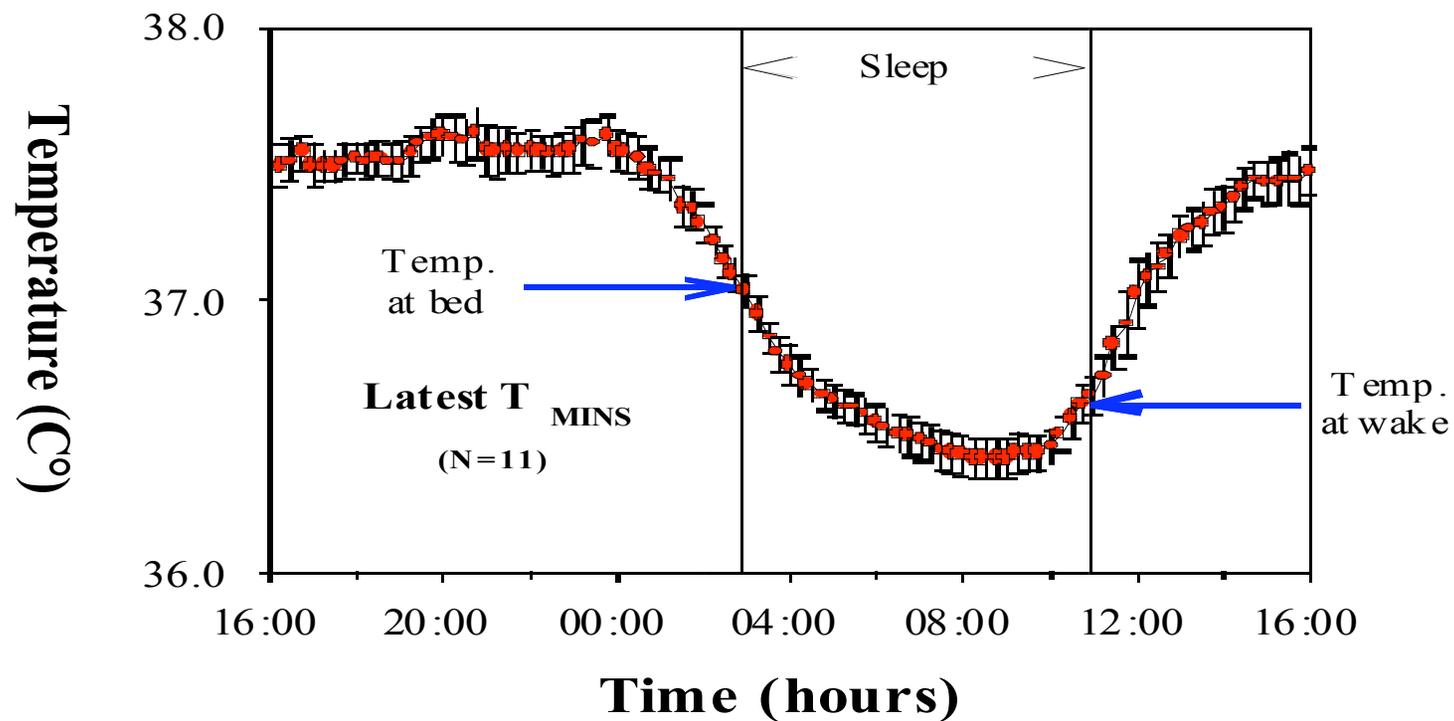
- Light Sensitivity (threshold)
  - Siddle (1967) staircase method
- Sound sensitivity
  - Smith (1968) forced choice
- Pain sensitivity
  - Haslam (1967)
  - Petrie (1960)
- Bi-modal sensitivity
  - Shigehisa and Symons (1973)
- Reaction to lemon juice
  - Eysenck, 1967

# Body temperature and time of day

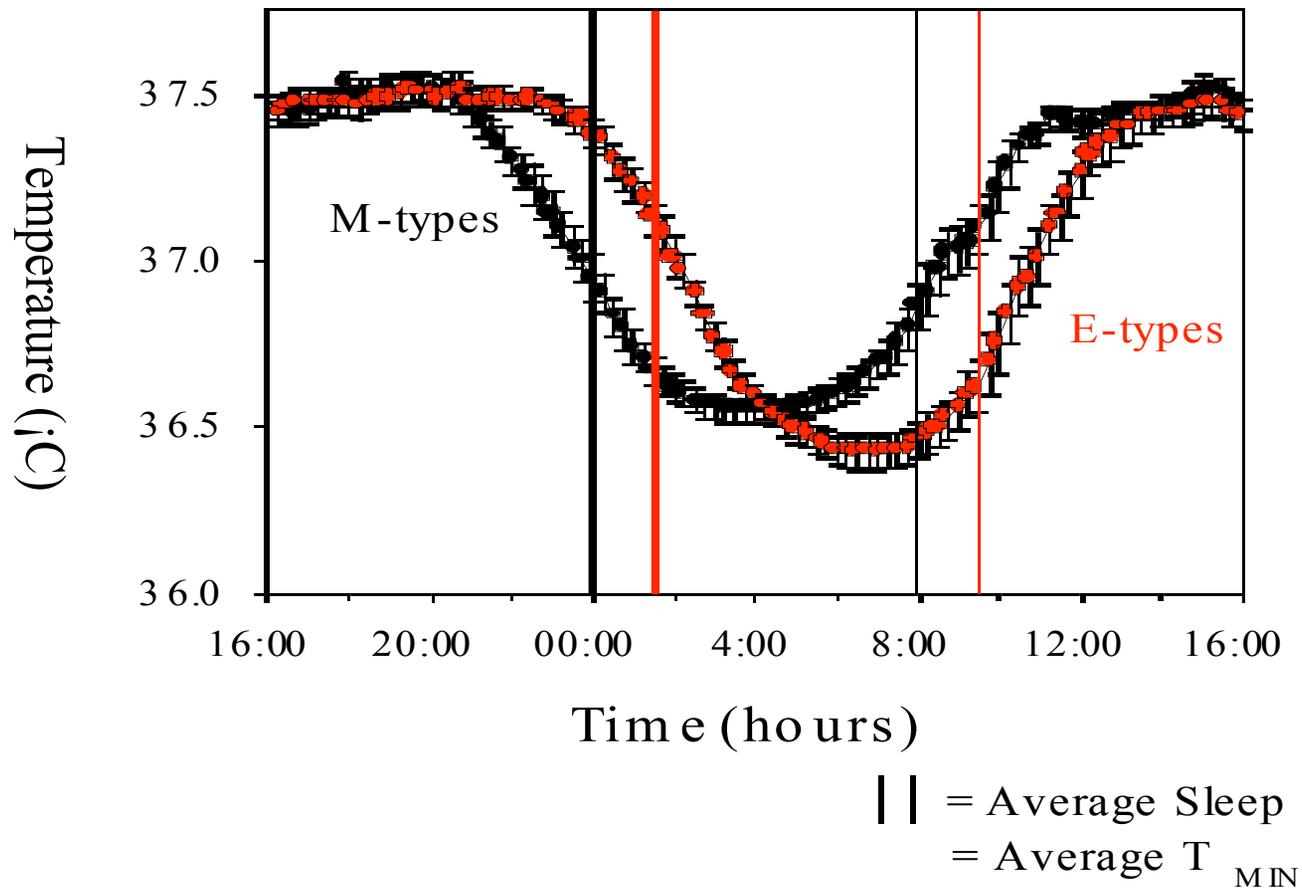
- Blake (1967) was cited as showing biological differences related to arousal but how relevant is this to basic theory?
- Folkard (1976)
- Eysenck and Folkard (1980)
- Wilson (1990)

# Body Temperature as $f(\text{time of day})$

(Baehr, Revelle & Eastman, 2000)



# Morningness/Eveningness and BT



# Is it level, or rates of change?

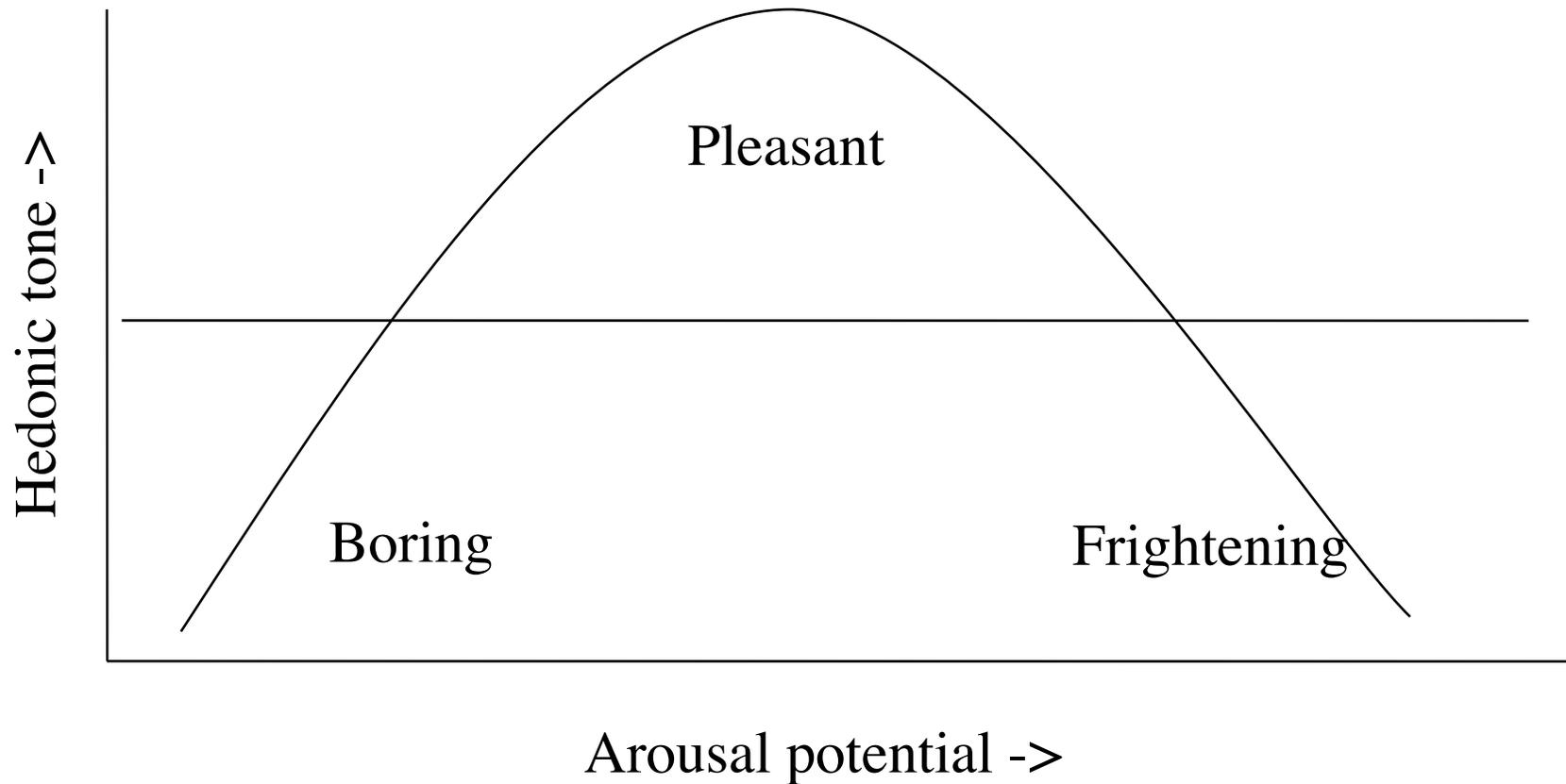
- Vigilance decrements from sleep deprivation similar to that of extraverts
- Do stimuli lose arousing properties faster for extraverts/high impulsives?
- Habituation of orienting response
- Bowyer, Humphreys and Revelle suggested that the effect was a decay rate in arousal
- But Anderson and Revelle 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

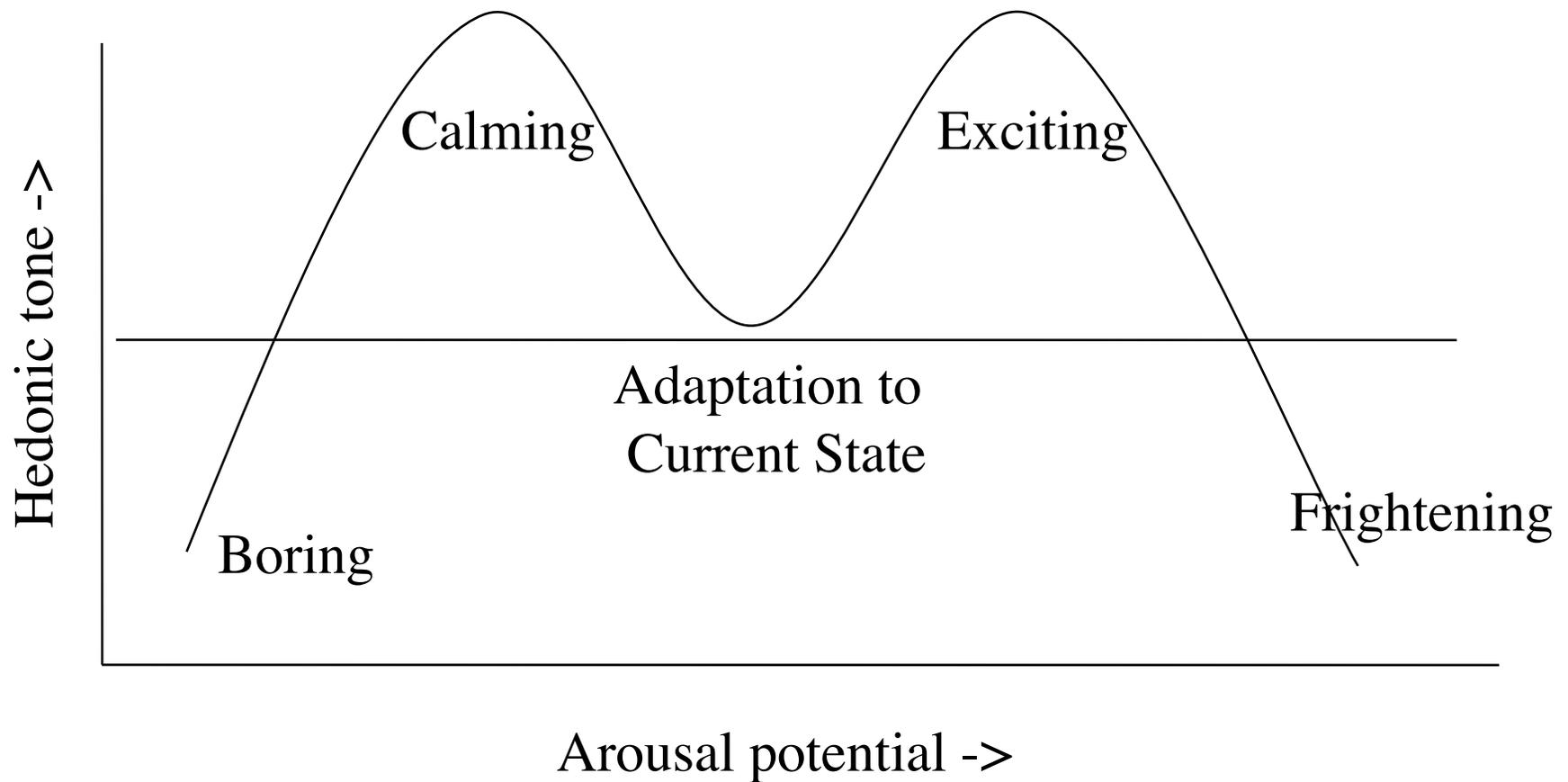
# Wundt's hedonic curve

(adapted from Berlyne)



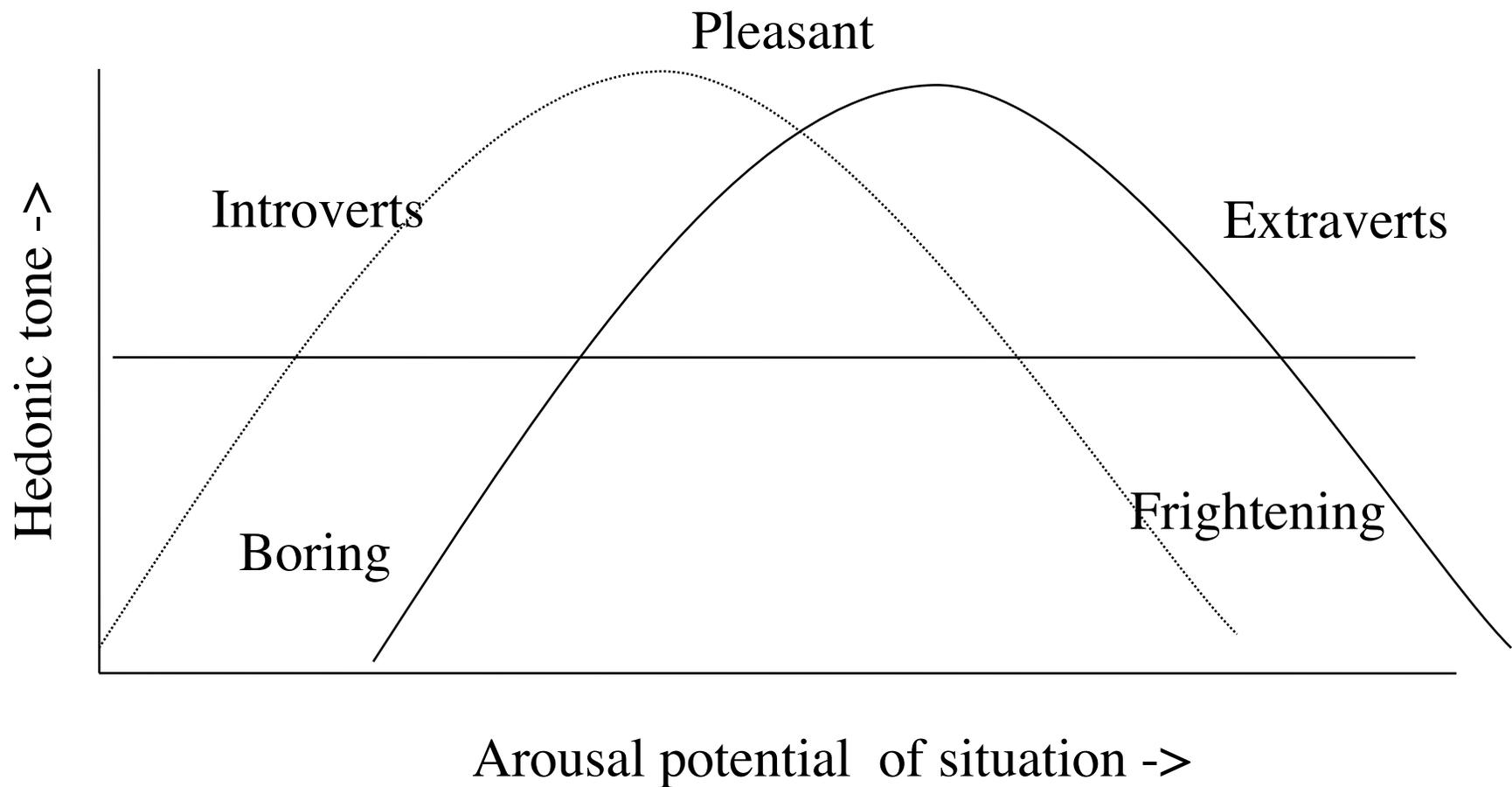
# Berlyne's hedonic curve

(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

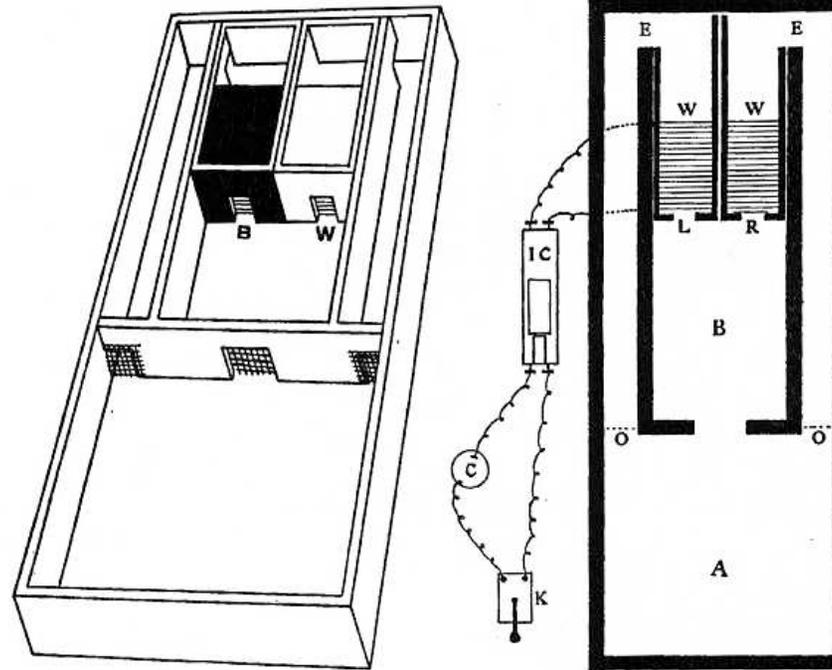


FIG. 1.

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

FIG. 2.

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

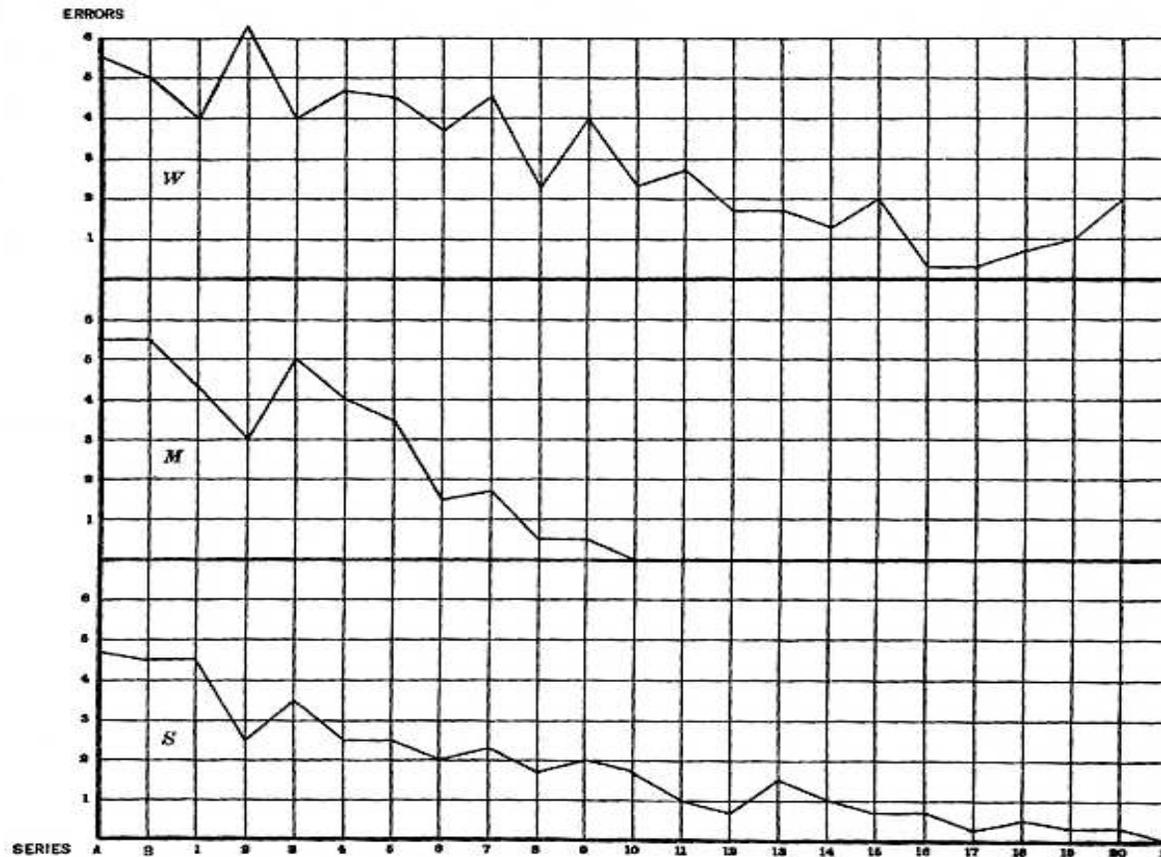


FIG. 4. Curves of learning. Ordinates represent series of ten tests each, and abscissæ represent the average number of errors for four mice in each series. *W*, designates the error curve for the individuals which were trained under the condition of *weak* electrical stimulation; *M*, designates the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

# Yerkes and Dodson, 1908

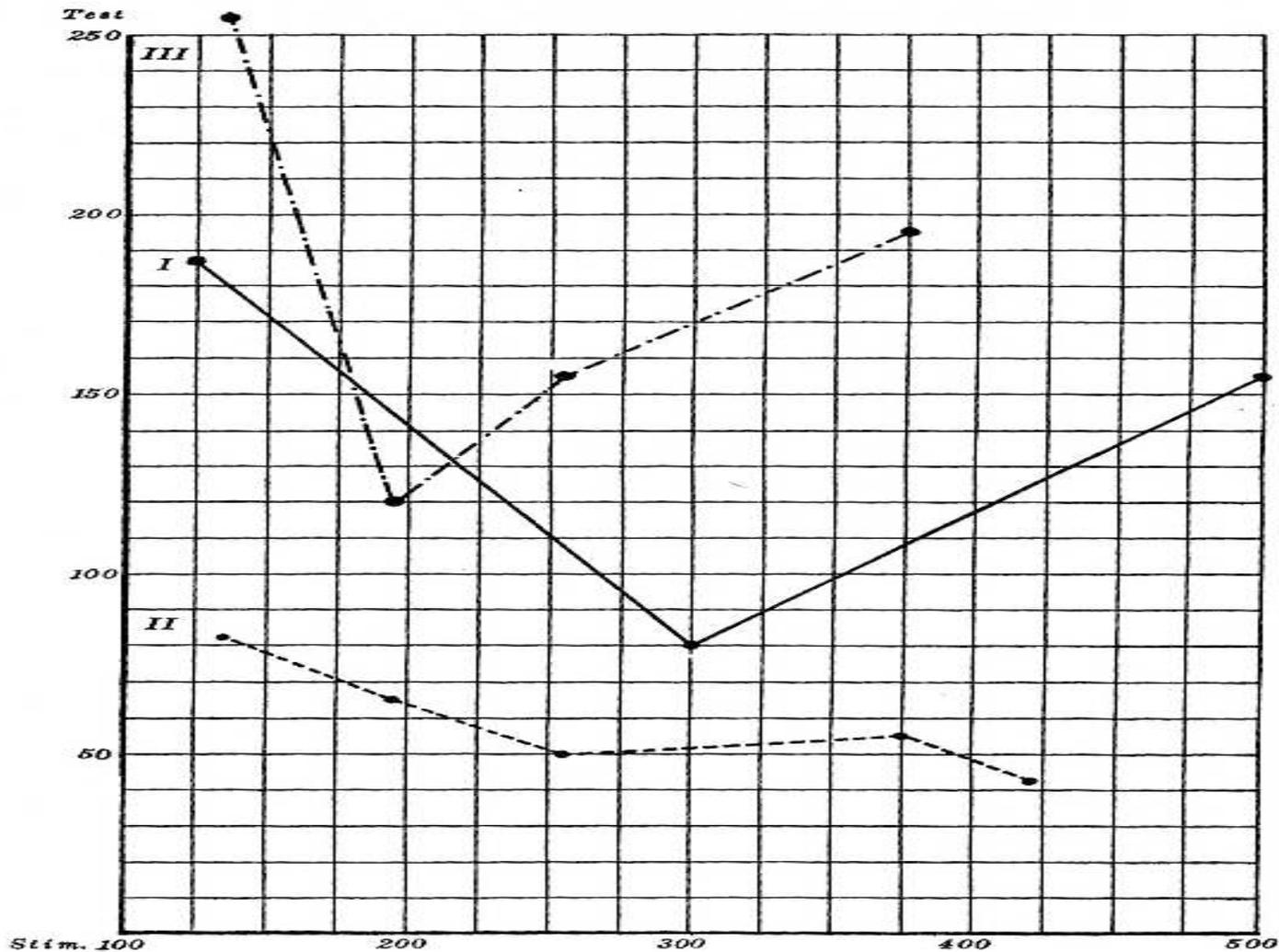


FIG. 5. A graphic representation of the relation of strength of electrical stimulus to condition of visual discrimination and rapidity of learning. Ordinates represent value of electric stimulus in units of stimulation; abscissæ represent the number of tests given. Curve I represents the results of the 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 gave a perfect habit, in the case of the four individuals trained, with 187 tests; the second dot, that for the stimulus value of 300 units 80 tests were necessary; and the third that for the stimulus value of 500, 155 tests. Curves II and III similarly represent the results of the experiments of sets II and III, respectively.

# Yerkes and Dodson, 1908

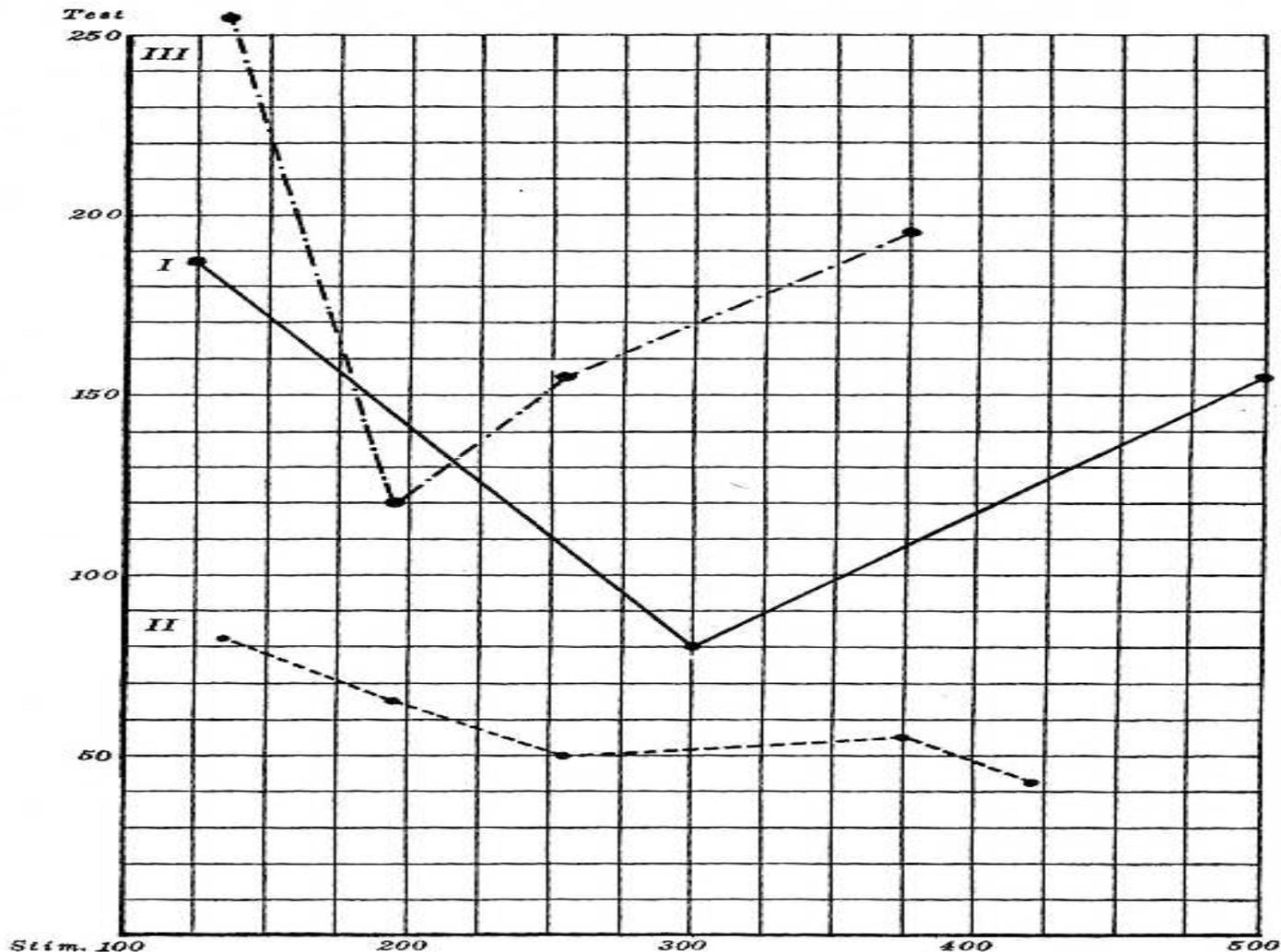
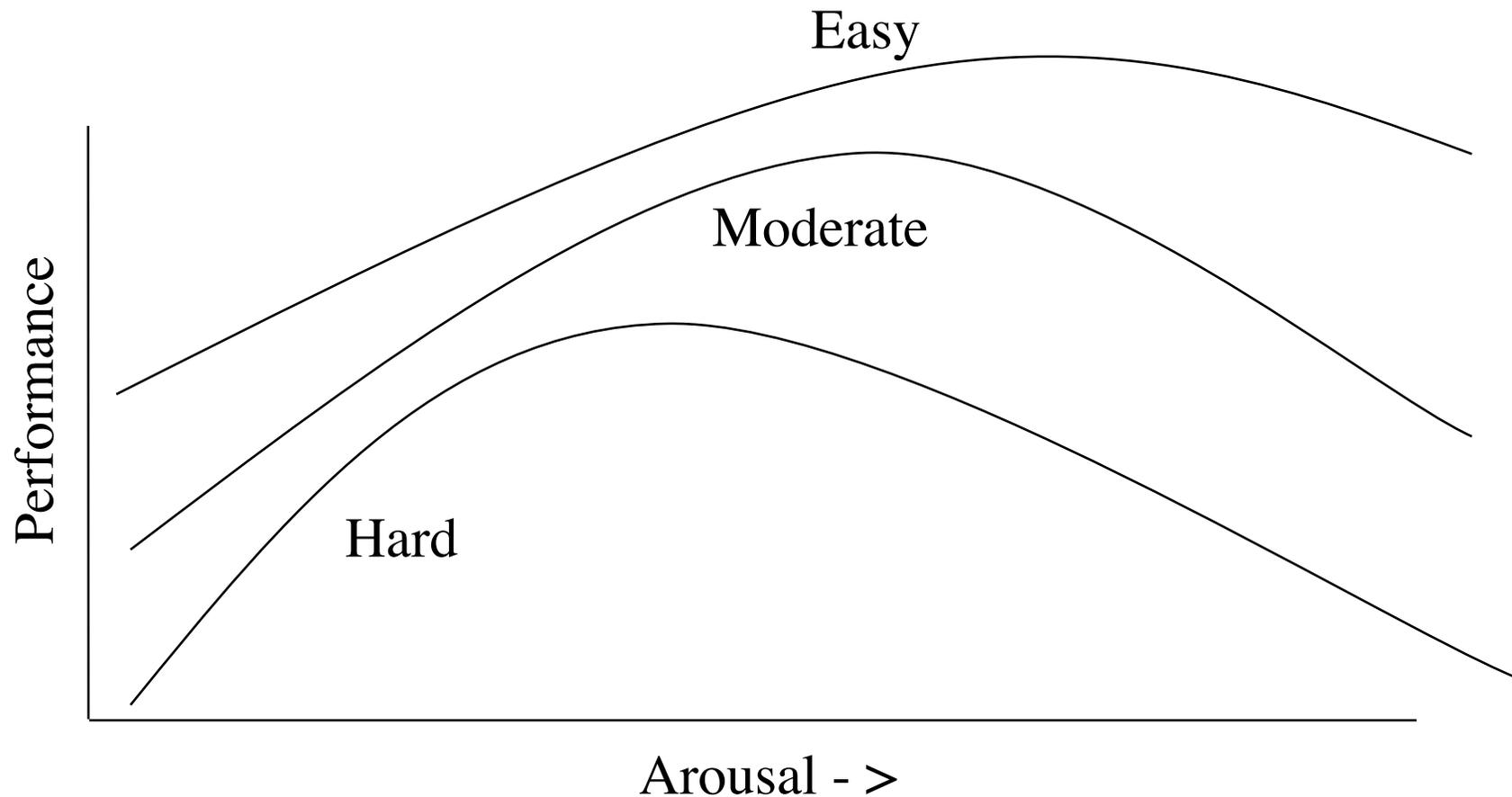


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# Yerkes and Dodson curve in terms of arousal and task difficulty



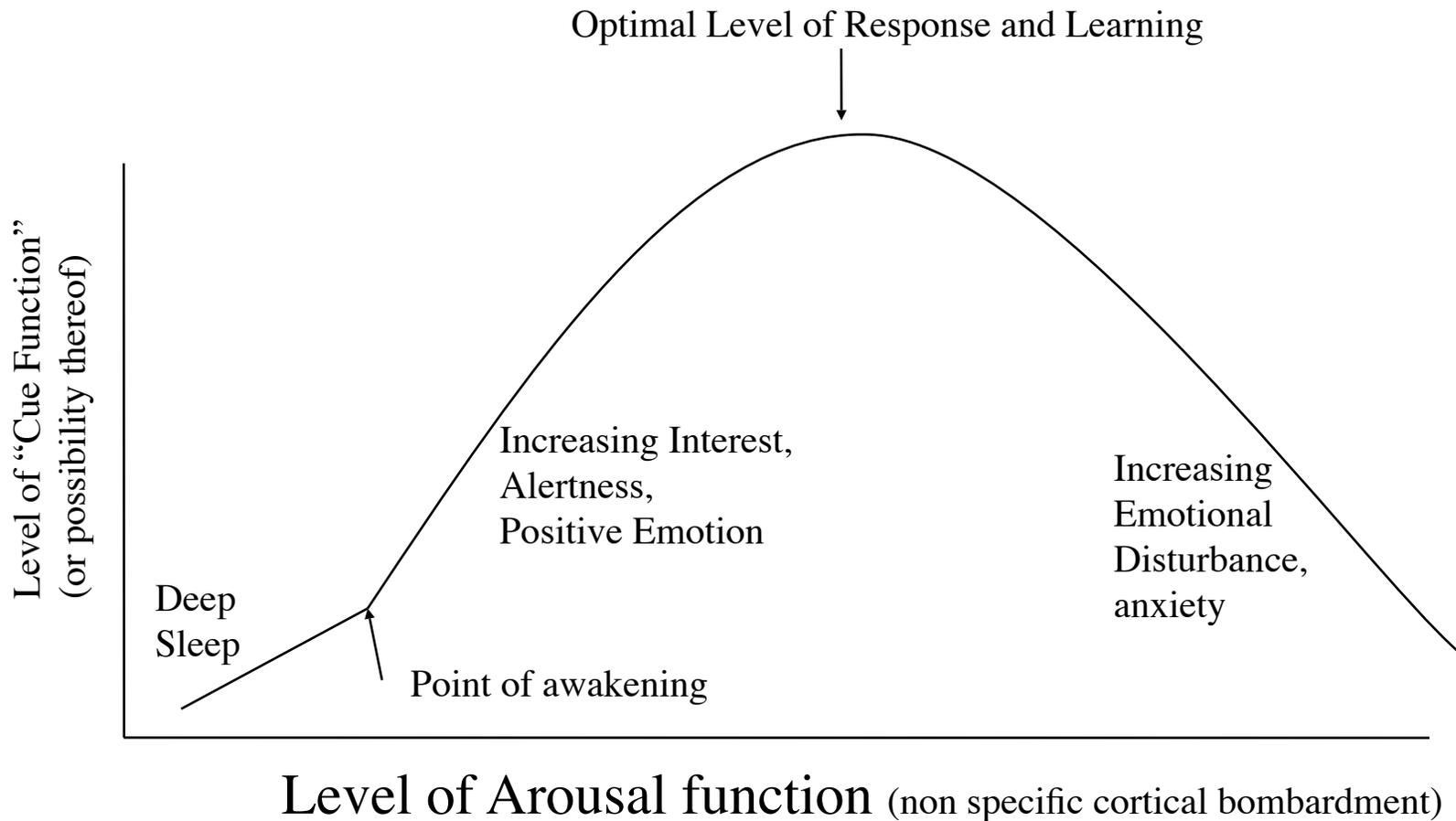
# Yerkes and Dodson revisited

- 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

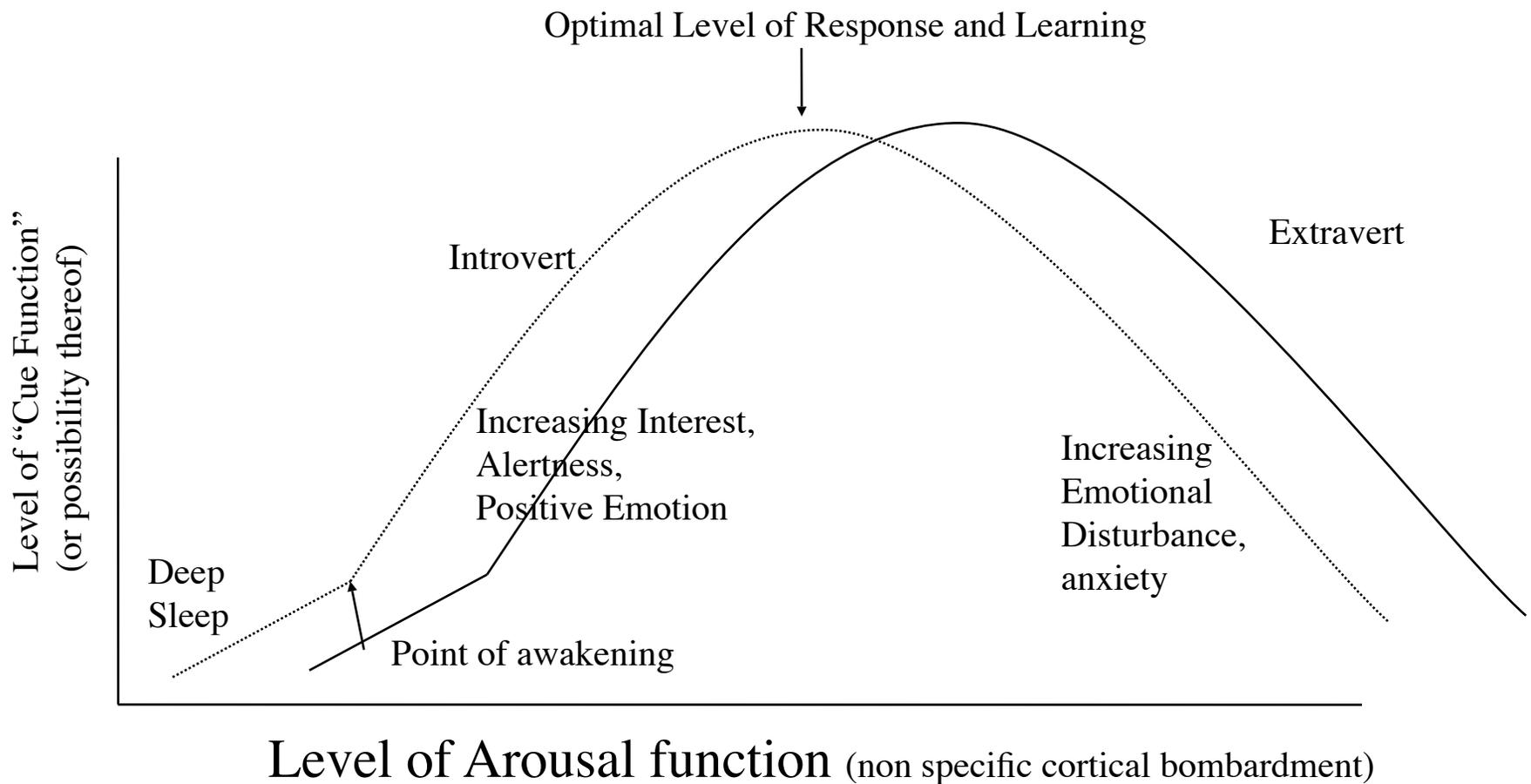
# Hebb Curve (1955)



# 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

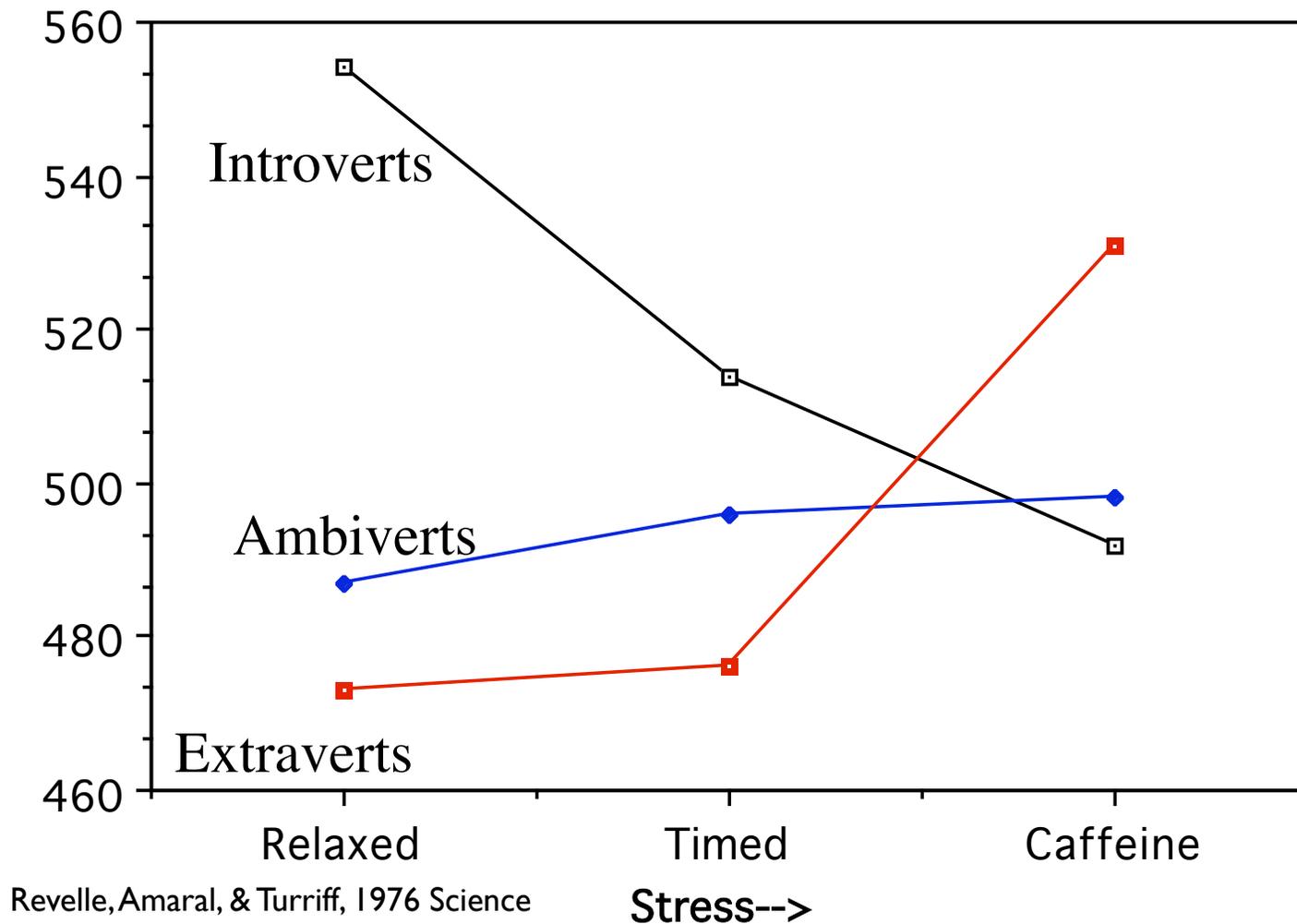
- Gupta 1977: IQ tests
  - 0, 5, 10, 15 mg of amphetamine
  - Extraverts versus introverts
  - But later work from their lab was plagiarized from Anderson leading one to question any findings from their lab

# 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

Verbal GRE Performance Standardized for NU



# 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

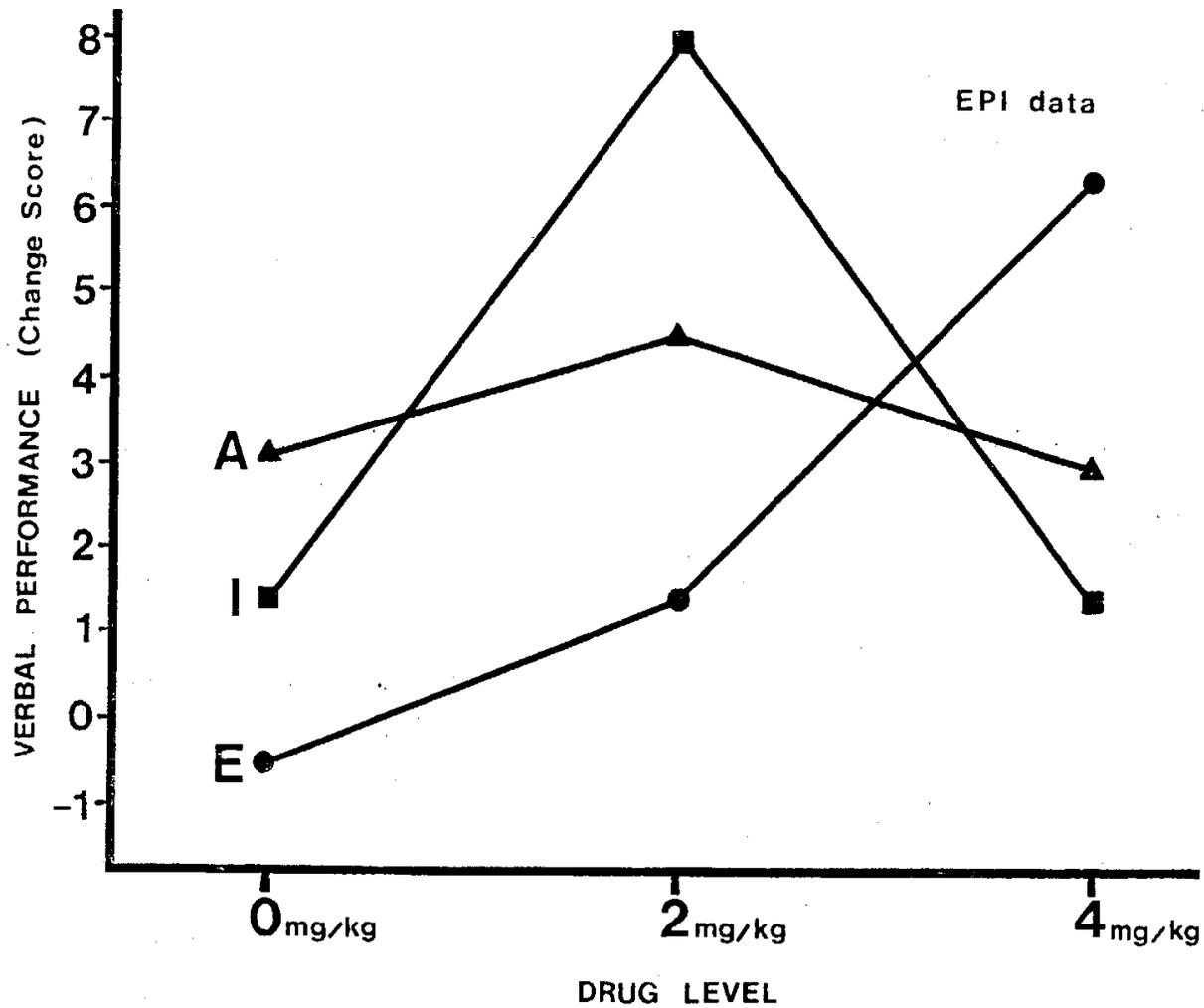
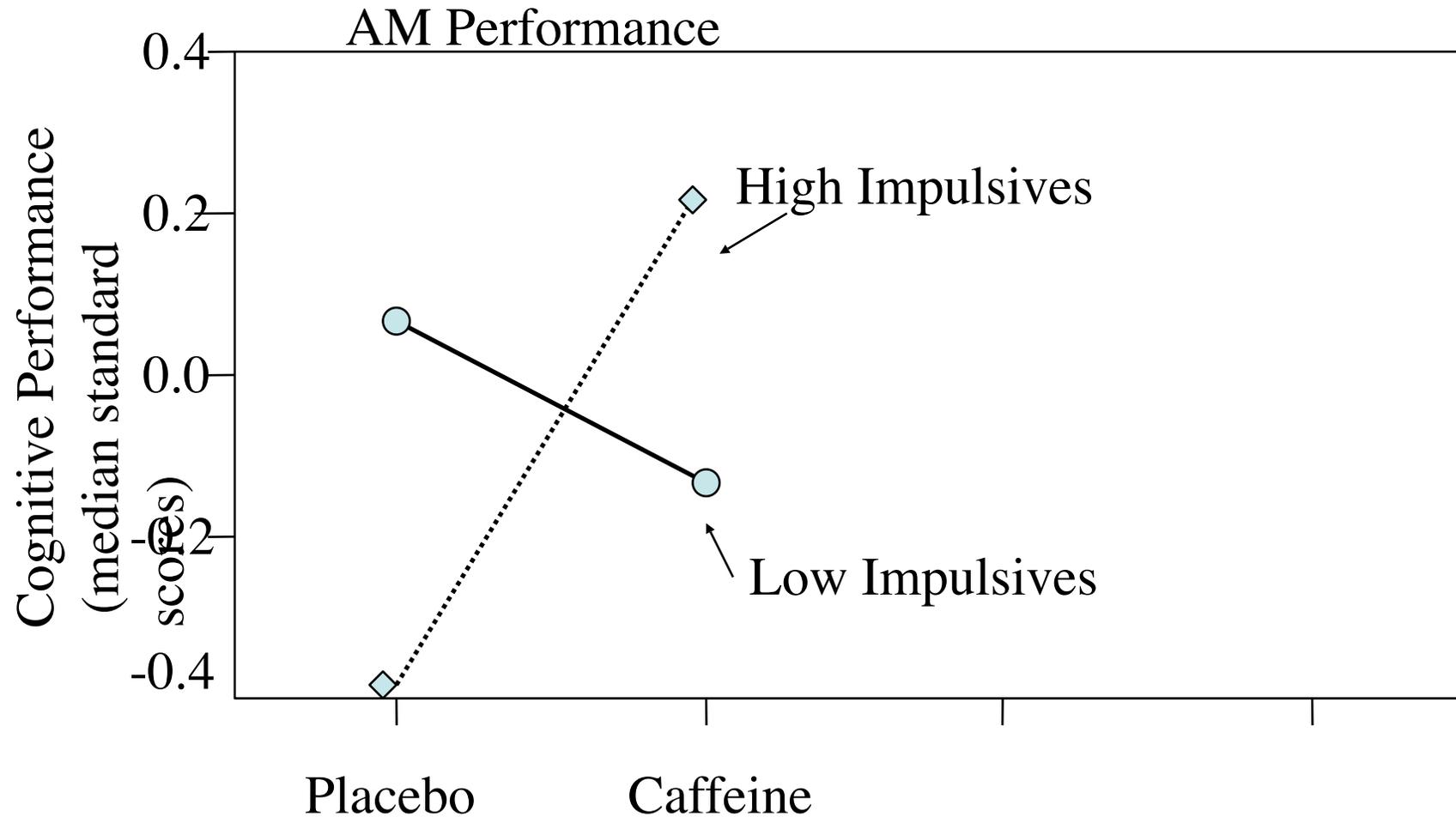
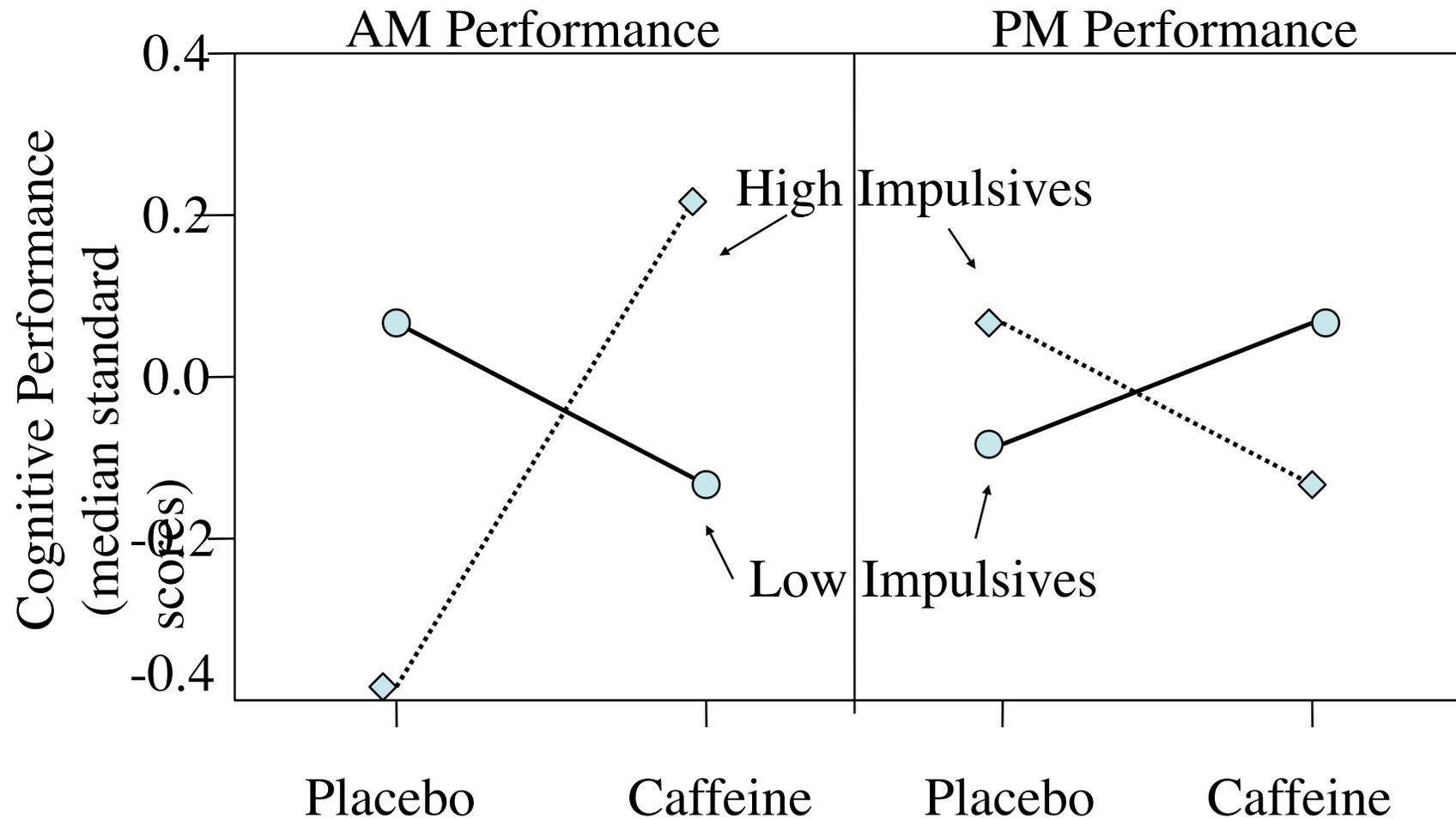


Figure 9. EPI based group means for change in number of items correctly answered on GRE practice tests.

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



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



# 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

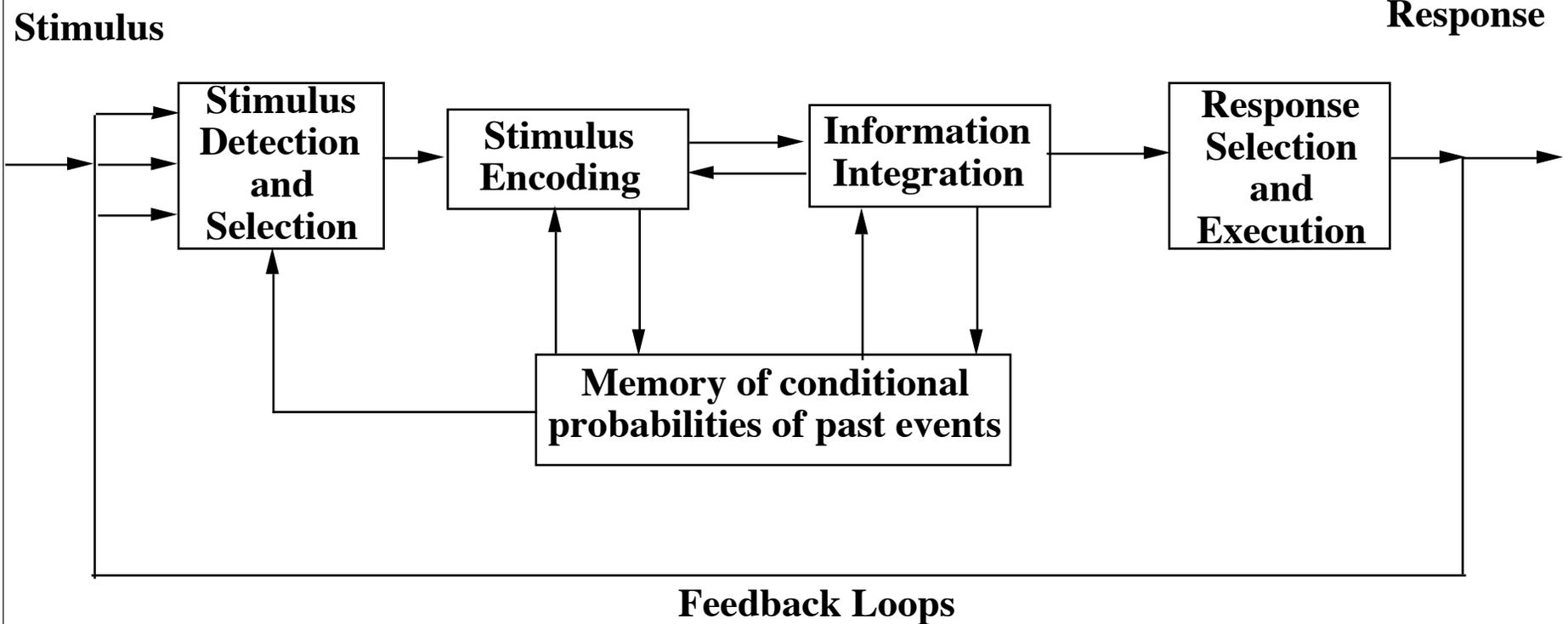
- Relationship of impulsivity to extraversion
  - Old Eysenck scales were Impulsivity + Sociability
  - Newer scales (including Big 5 markers) are more sociability and ambition
- Theories of extraversion and arousal - were they theories of impulsivity?

# 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

## Conceptual Stages of Information Processing

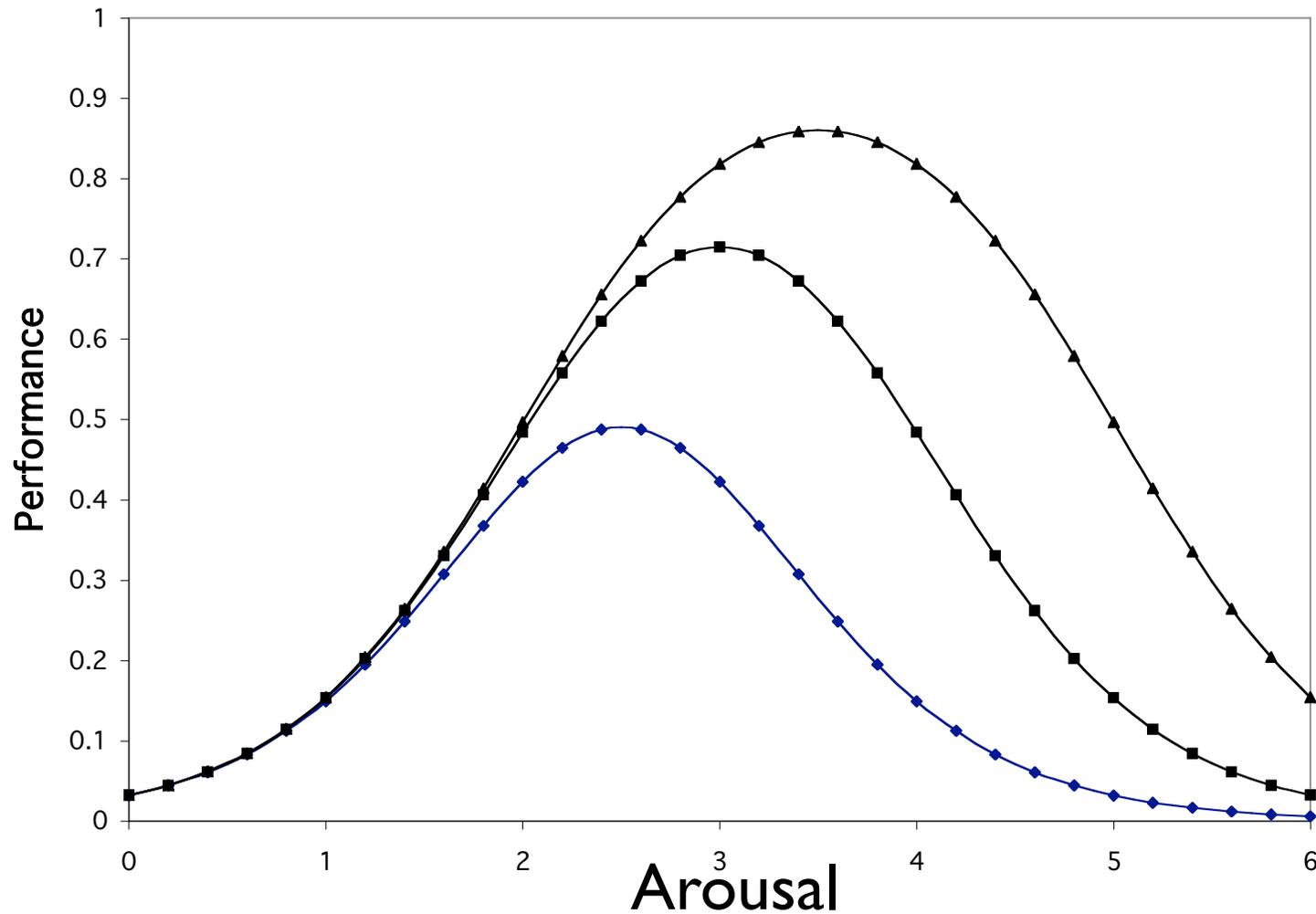


# Personality affects each stage of processing

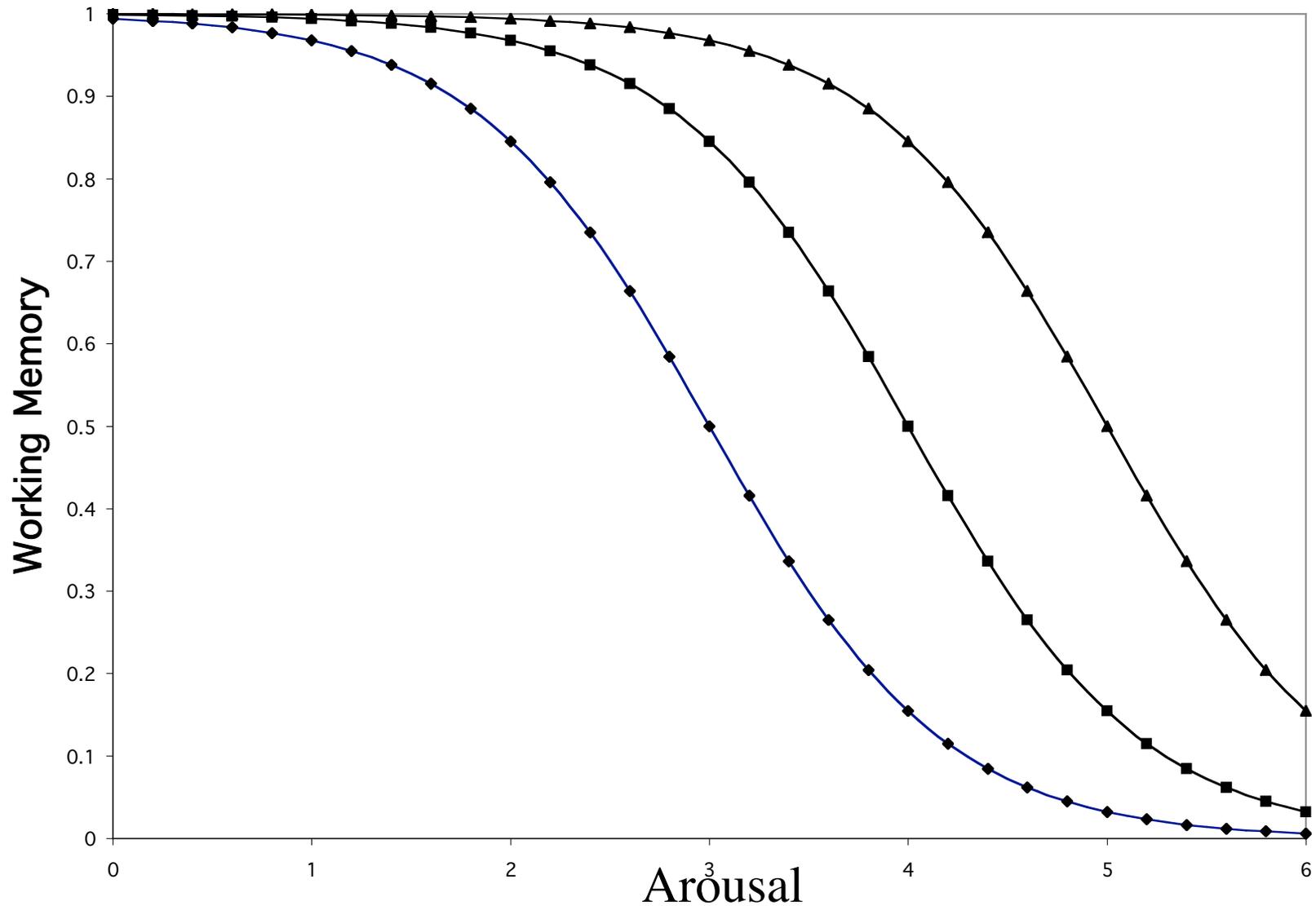
- Introversions facilitates detection in vigilance tasks
- Anxiety facilitates detection of threat terms
- Depression facilitates memory for negative events
- Intelligence facilitates processing speed

# Arousal and Performance

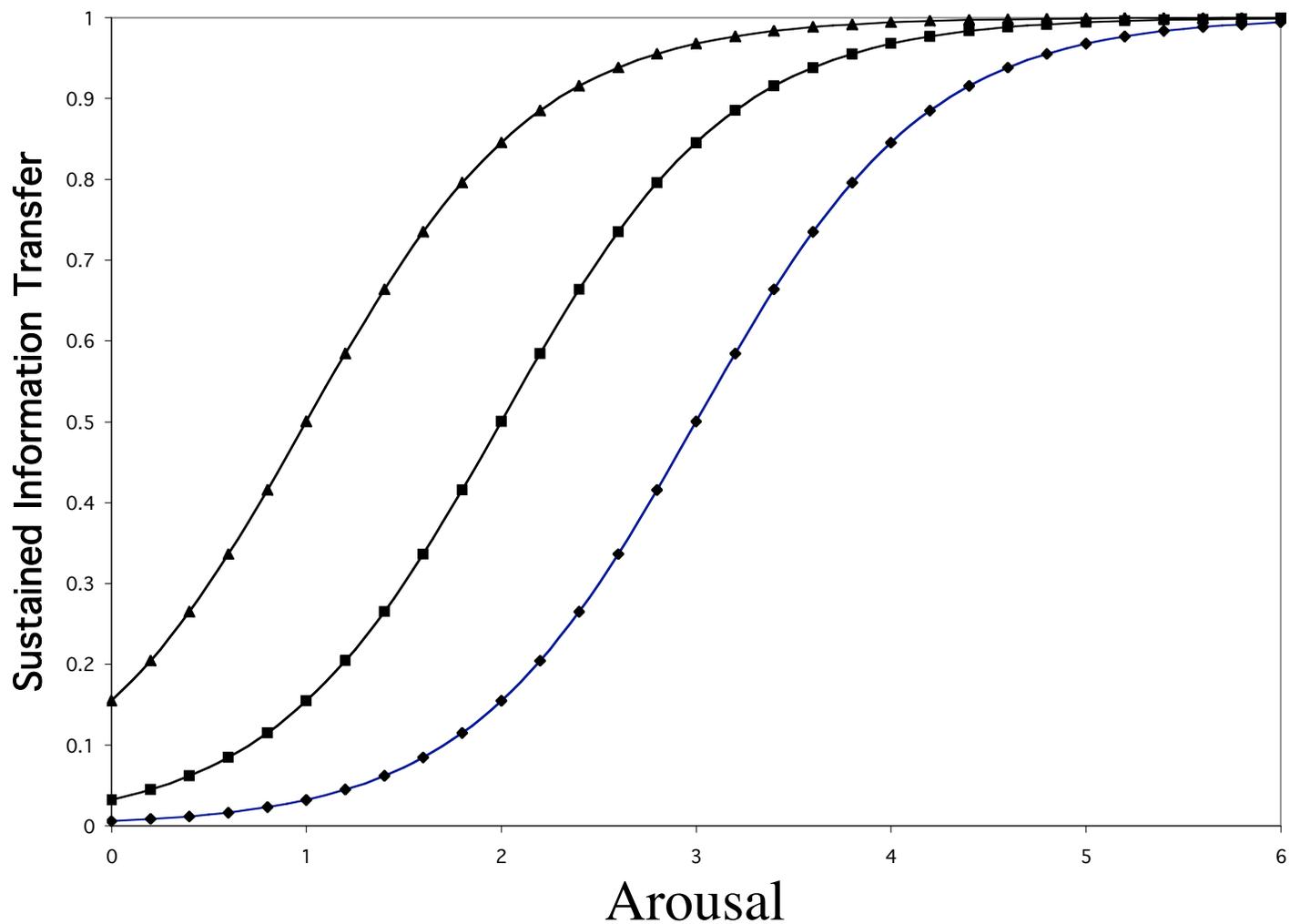
(Hypothetical description of Yerkes and Dodson Effect)



# Arousal and Working Memory

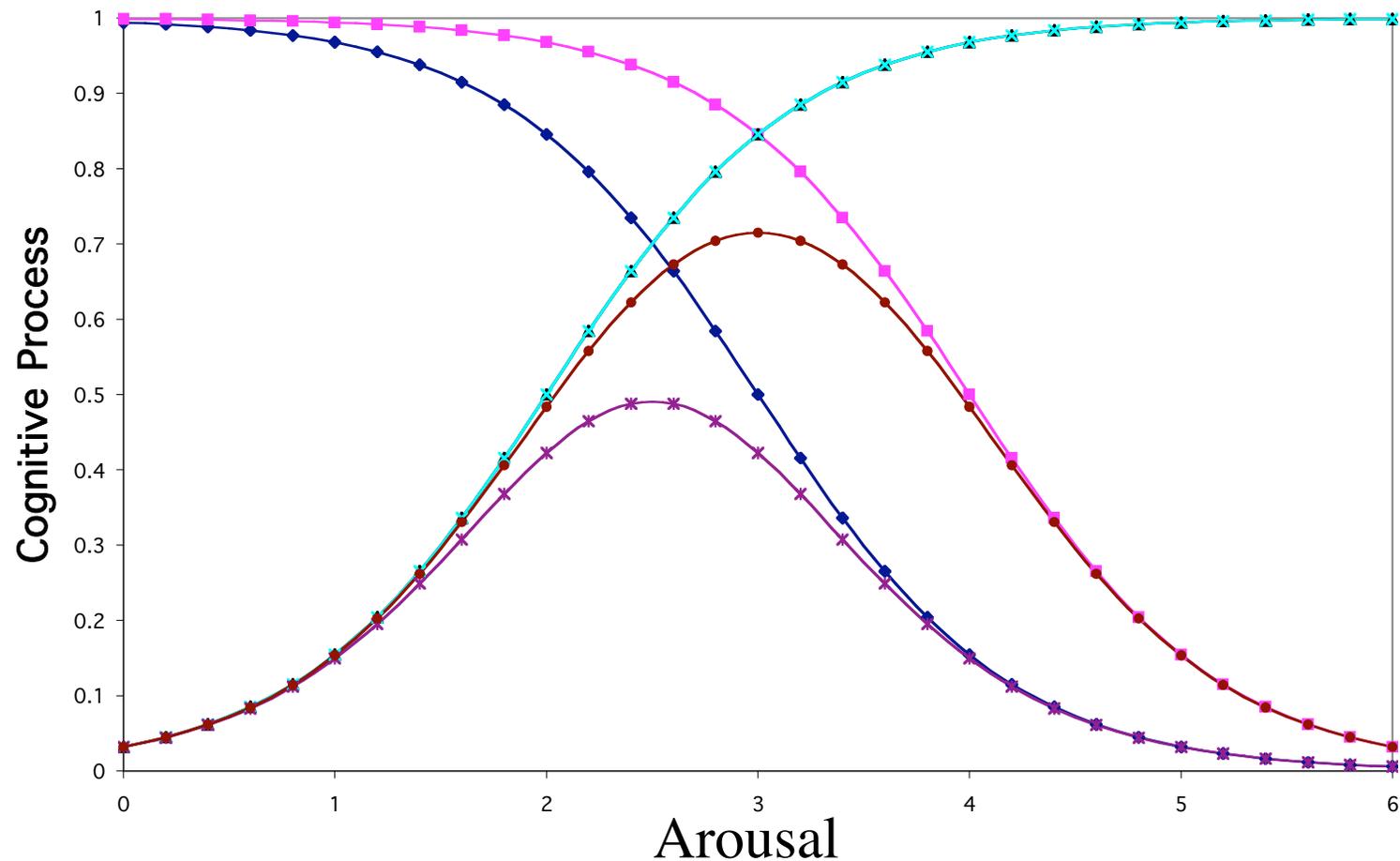


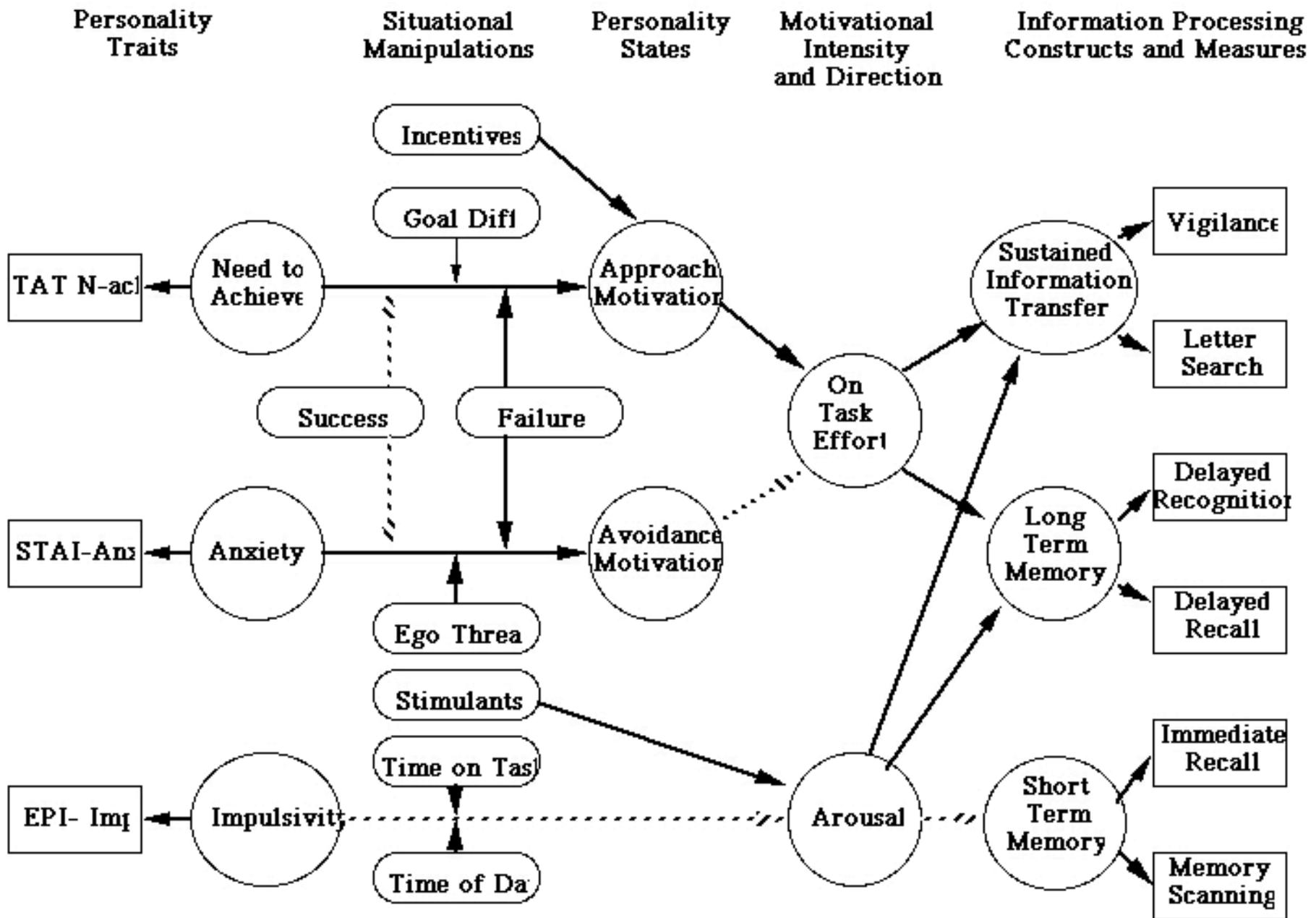
# Arousal and Information Transfer



# Arousal and Performance:

## Arousal, Working Memory and Information Transfer





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

