Expanding Eysenck's toolbox: Beyond Correlational and Experimental Research

International Society for the Study of Individual Differences
The Han J. Eysenck Lecture

William Revelle

Department of Psychology
Northwestern University
Evanston, Illinois USA

July, 2013

Outline

Abstract

The study of individual differences integrates two traditional scientific approaches: the correlational techniques developed by Galton, Spearman and Pearson, and the experimental techniques of Wundt, Gossett and Fisher. Lee Cronbach (1957, 1975) and Hans Eysenck (1966, 1997) called for the unification of these two traditions. This is a challenge worth answering and many members of ISSID have attempted to do so.

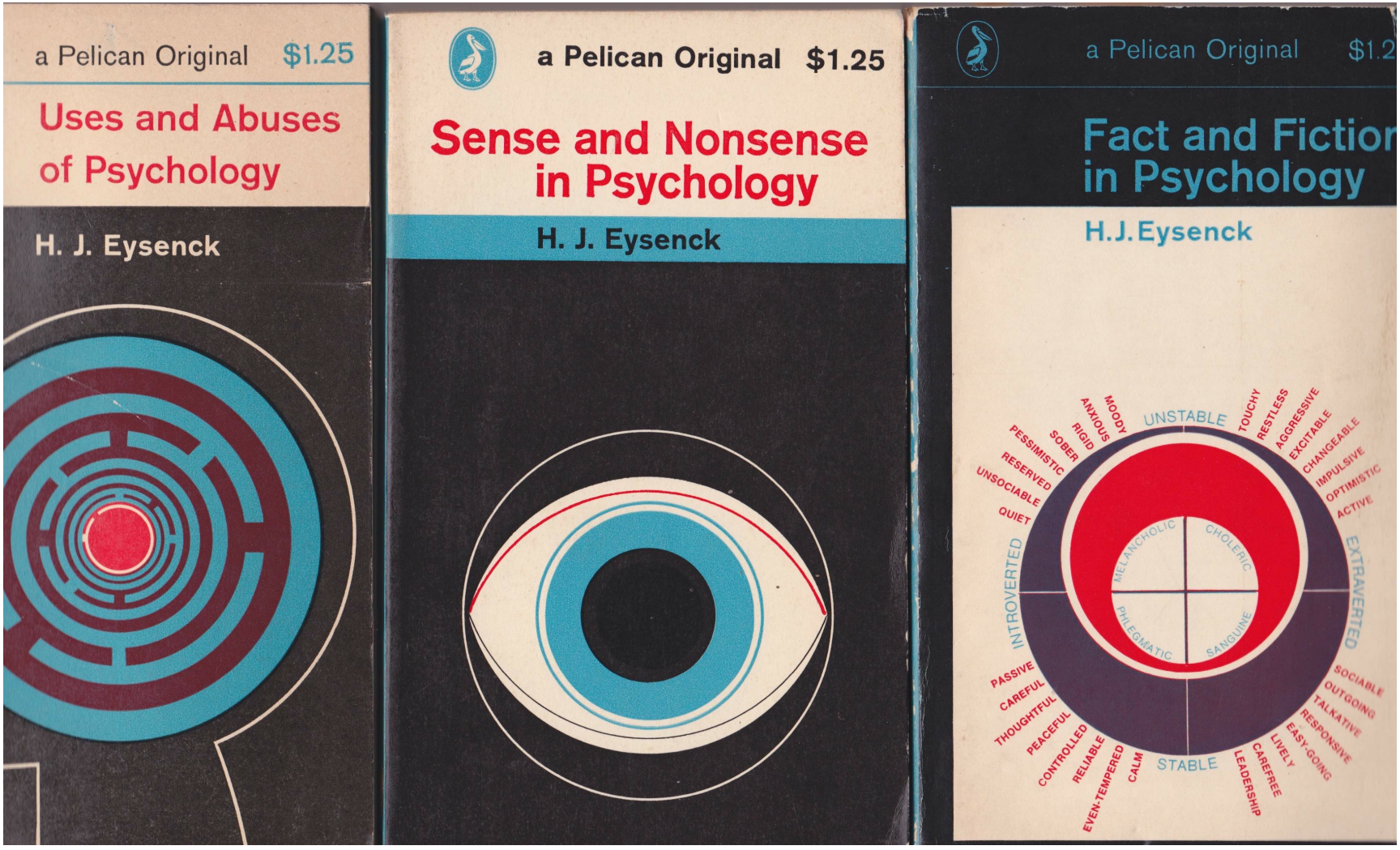
I review multiple ways to study how individual differences combine with situational and task demands to affect human behavior. These studies show the benefit and power of theory driven, programmatic experimental and correlational research.

Where I first learned about personality theory (and Hans Eysenck)

Figure : Nanga Medamit, ulu Limbang, Sarawak, Malaysia, 1965-1967

My first exposure to Hans Eysenck

The only psychology books in the Brunei bookstore (100 Km or 10 hours by boat downriver) were by Hans Eysenck



Who was this man?

published by Penguin Books

Psychology occupies a somewhat ambiguous place in the world today. Its findings are being widely applied in clinics, in industry, in education, and in the armed forces. At the same time, many intelligent people are critical of the alleged laws of human behaviour discovered by psychologists, psychiatrists, and psychoanalysts, and doubtful about the applicability of scientific methods to the study of human beings. In this book, a well-known psychologist has tried to strike a balance, to indicate to what extent the claims made for his science are justified, and to what extent they fail to have any factual basis. The discussion is very fully documented by references to the most important and relevant researches carried out in this country and abroad. Topics dealt with are the testing of intelligence, selection procedures in schools and universities, vocational guidance and occupational selection, psychotherapy and its effects, national differences, racial intolerance, Gallup surveys, industrial productivity, and many others. In each case, psychological findings are submitted to a searching criticism, and a clear distinction made between those uses of psychology where enough is known to support social action, and those abuses where personal opinions rather than experimentally demonstrated fact seem to be involved.

Cover design by Eric Kitson

published by Penguin Books

Here is the long awaited final volume of Professor Eysenck's Pelican trilogy: *Uses and Abuses of Psychology*, *Sense and Nonsense in Psychology* – and now *Fact and Fiction in Psychology*.

The author's style is as incisive and his wit as keen as ever, while the range of subjects that he deals with is, as always, provocatively wide. Of special interest in this volume is his application of behavioural therapy to the theory and practice of neurotic behaviour and especially to the severe clinical problem of the alcoholic. Also Professor Eysenck's most recent views on the criminal personality are set out with challenging authority.

Further chapters on the psychology of road traffic offenders and a hard look at the more exclusive claims of depth psychology complete a fascinating volume.

Cover design by Germano Facetti

The influence of Eysenck on personality and individual differences

1. Popular books
   - Uses and abuses of psychology (1953)
   - Sense and nonsense in psychology (1957)
   - Fact and fiction in psychology (1965)
2. Scholarly books (a small selection)
   - Dimensions of personality (1947)
   - The scientific study of personality (1952)
   - The structure of human personality (1953)
   - The dynamics of anxiety and hysteria (1957)
   - The biological basis of personality (1967)
   - Eysenck of extraversion (1973) (Edited reprints)
   - The measurement of personality (1976) (Ed.)
   - A model for intelligence (1982) (Ed.)
   - Personality and Individual differences (1985) (H.J. and M.W.)
   - A new look at intelligence (1998)

European personality research was a beacon of light in the "Dark Ages of personality"

- While personality was under attack in the US (Mischel, 1968; Endler & Magnusson, 1976) it was alive and well and living in Europe (Eysenck, 1967), Gray (1970, 1982, 1991), Strelau & Angleitner (1991)
  - It is hard to remember now in the second decade of the 21st century the attacks of the 60s-80s on the study of stable, biologically based, important personality traits.
  - These attacks had a perverse and long lasting influence on American personality research.
  - The scars of these debates persist in that a generation of American researchers avoided the field.
  - However, it is because of the contributions of (mainly) European personality researchers that we have such a vibrant field today.
- Whether we agree or disagree with Hans Eysenck's theoretical program, we all owe a great debt to his contribution in advancing the field.

Eysenck and the process of science

Prologue: two broad themes to be discussed and interwoven

1. The two disciplines of scientific psychology
    1. Two broad cultures of intellectual activity (Snow, 1959)
    2. Two broad cultures of psychology (Kimble, 1984)
    3. Two disciplines within scientific psychology (Cronbach, 1957, 1975) and (Eysenck, 1966, 1987a, 1997).
2. The process of theory construction and validation
    1. Science from hunch to law (Eysenck, 1976, 1985)
    2. Good theories as alive and generative: the example of theories of Extraversion.

I will emphasize the power of integrating psychometric and experimental techniques in a programmatic study of personality and individual differences.

The two cultures of intellectual inquiry

C.P. Snow (1959) considered two cultures of intellectual inquiry:

> *"I believe the intellectual life of the whole of western society is increasingly being split into two polar groups."*
> *.. "I felt I was moving among two groups–comparable in intelligence, identical in race, not grossly different in social origin, earning about the same incomes, who had almost ceased to communicate at all, who in intellectual, moral and psychological climate had so little in common ... one might have crossed an ocean."*

Kimble and the two cultures of psychology

Just as Snow considered the scientific versus humanistic cultures of English and American society, so did Kimble (1984) consider two cultures of psychology: the scientific and the humanistic.

> *"The remaining points of disagreement involve the items asking about most important values (scientific vs. human), source of basic knowledge (objectivism vs. intuitionism), and generality of laws (nomothetic vs. idiographic).*

Two competing tribes/paradigms within scientific psychology

But even within the culture of scientific psychology, we have two competing tribes who differ in their basic paradigmatic view of how to do science: the correlational vs. experimental paradigms discussed by Cronbach (1957, 1975) and Eysenck (1966, 1987a, 1997). Both pleaded for an integration of the two tribes. Neither was overly successful.

Others who have tried to reconcile these differences include Vale & Vale (1969), and Underwood (1975).

In a prior review Revelle & Oehlberg (2008) we reported that this dichotomy still continues. Today I will try to go beyond this dichotomy by showing how theory development and theory testing requires a mixture of the inductive power of correlations with the deductive power of experimental techniques. For we as individual differences psychologists are most able to unify the two disciplines.

The conventional dichotomy of research paradigms in psychology ala Cronbach (1957, 1975) and Eysenck (1966, 1987a, 1997)

Correlational

1. Influential founders
   1. Galton (1886)
   2. Pearson (1896)
   3. Spearman (1904)
2. Measurement of variances and covariances
   1. bivariate r, ϕ, $Yule_Q$
   2. multivariate R, factor analysis, principal components
   3. General Linear Model and its extension to multi-level modeling
3. Addresses threats to validity by statistical "control"

Experimental

1. Influential founders
   1. Wundt (1904)
   2. Gossett (Student, 1908)
   3. Fisher (1925)
2. Measurement of central tendencies
   1. bivariate t and F
   2. multivariate MANOVA
   3. General Linear Model and its extension to multi-level modeling
3. Addresses threats to validity by randomization

Two disciplines: two viewpoints

Table : The naive perspective from both sides–the other side is easy, why don't they just do it right? Our variables are complicated, well articulated, theirs are simple, just use any one.

Individual Differences	Experimental
Personality Ability	Task Performance

The experimentalist's challenge: what to measure

Measures

1. Giant 3
   - EPI
   - EPQ
2. Big 5
   - NEO-PI-R
   - IPIP B5
   - IPIP NEO
   - BFI
   - TIPI
3. Beyond the Big 5
   - HEXACO
   - IPIP HEXACO
   - BFAS
   - SAPA 3-6-12
   - ICAR-IQ
   - ...

Constructs

1. Extraversion
   - but which one? Costa vs. Goldberg
2. Neuroticism
3. Agreeableness
4. Conscientiousness
5. Openness-Intellect
   - but is it openness or is it intellect?
6. Honesty/Humility
7. Impulsivity
8. Sociability
9. Trust
10. ...

The challenge for individual difference researchers: what constructs to measure

Memory

1. Working memory
2. Iconic memory
3. Short Term memory
4. Long Term memory
5. Semantic memory
6. Episodic memory
7. Procedural memory
8. Autobiographical memory
9. False memory
10. Recall
11. Recognition

Attention

1. Sustained Attention
2. Allocation of Attention
3. Capturing Attention
4. Breadth of Attention
5. Local/Global Attention
6. Paying Attention

The experimentalist's challenge: how to analyze, what to report

Analysis

1. Dimension Reduction
   - Principal Components
   - EFA
   - CFA
2. Structure
   - Path Analysis
   - SEM
   - Latent Growth Curves
3. Reliability analysis
   - Internal Consistency
   - Alternate Form
   - Test-Retest
4. Item Response Theory

Statistics

1. Measures of association
   - Pearson r, Spearman ρ
   - ϕ or $Yule_Q$
   - $r_{tetrachoric}$, $r_{polychoric}$
2. Goodness of fit
   - χ^2 or χ^2 difference
   - RMSEA or RMSR
   - Tucker-Lewis
   - BIC or AIC
3. Reliability
   - α
   - β
   - ω_h
   - ω_t

The challenge for individual difference researchers: which paradigm to use

Memory

1. Reaction time
   - Sternberg Memory Scanning
   - Ratcliff choice
   - Jacoby identification
2. Accuracy
3. Serial anticipation
4. Free recall
5. Cued recognition

Attention

1. Posner letter search
2. Erickson flanker task
3. Vigilance
4. dot probe
5. emotional "Stroop"
6. Eye tracking
7. Reaction Time

The extra subtleties of design

Personality

1. Item wording
2. Response alternatives
3. Appropriate sample size
4. Subject selection
   - restriction of range
5. generalization of subject characteristics

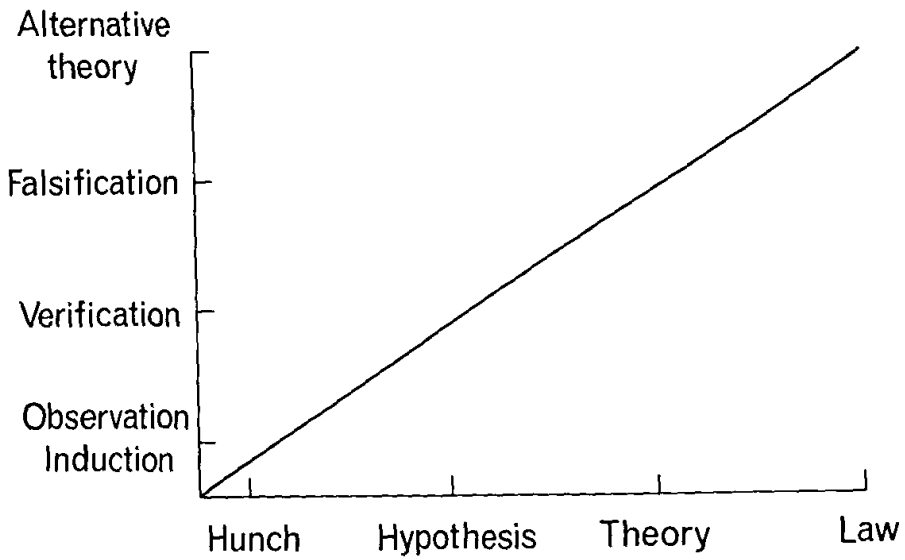
Experimental

1. number of practice trials
2. Inter Stimulus Interval
3. Stimulus Onset Asychrony
4. Type of randomization/counterbalancing
   - block randomization
   - complete randomization
   - counterbalancing
5. Data trimming procedures
6. Power/p-hacking

Scientific progress and levels of theory

Eysenck (1976, 1985); Eysenck & Eysenck (1985)

1. Hunch
   - observations
   - deduction
2. Hypothesis
   - hypothesis development
   - hypothesis verification
3. Theory
   - Weak theory – confirmation studies
   - Strong theory –disconfirmation studies
4. Law



Eysenck, Lakatos, Popper and Kuhn

Eysenck (1983, 1985, 1987b, 1988); Eysenck & Eysenck (1985) followed Lakatos (1968) in suggesting that disconfirmation studies did not lead to theory rejection until a better theory was supplied.

> *"Purely negative, destructive criticism, like 'refutation' or demonstration of an inconsistency does not eliminate a programme. Criticism of a programme is a long and often frustrating process and one must treat budding programmes leniently. One can, of course, undermine a research-programme but only with dogged patience. It is usually only constructive criticism which, with the help of rival research programmes can achieve major successes; but even so, dramatic, spectacular results become visible only with hindsight and rational reconstruction."*
> *(Lakatos, 1968, p 183)*

Eysenck's theory as an adaptive and changing theory of personality

Eysenck (1983) thought that the building of paradigmatic personality research required critical analysis of theory and welcomed the publications of some of his strongest critics (e.g., Gray, 1981).

> *"the existence of anomalies should be no bar to the acceptance of the paradigm; the existence of such anomalies should merely act as a spur for the puzzle-solving capacities of ordinary science."*

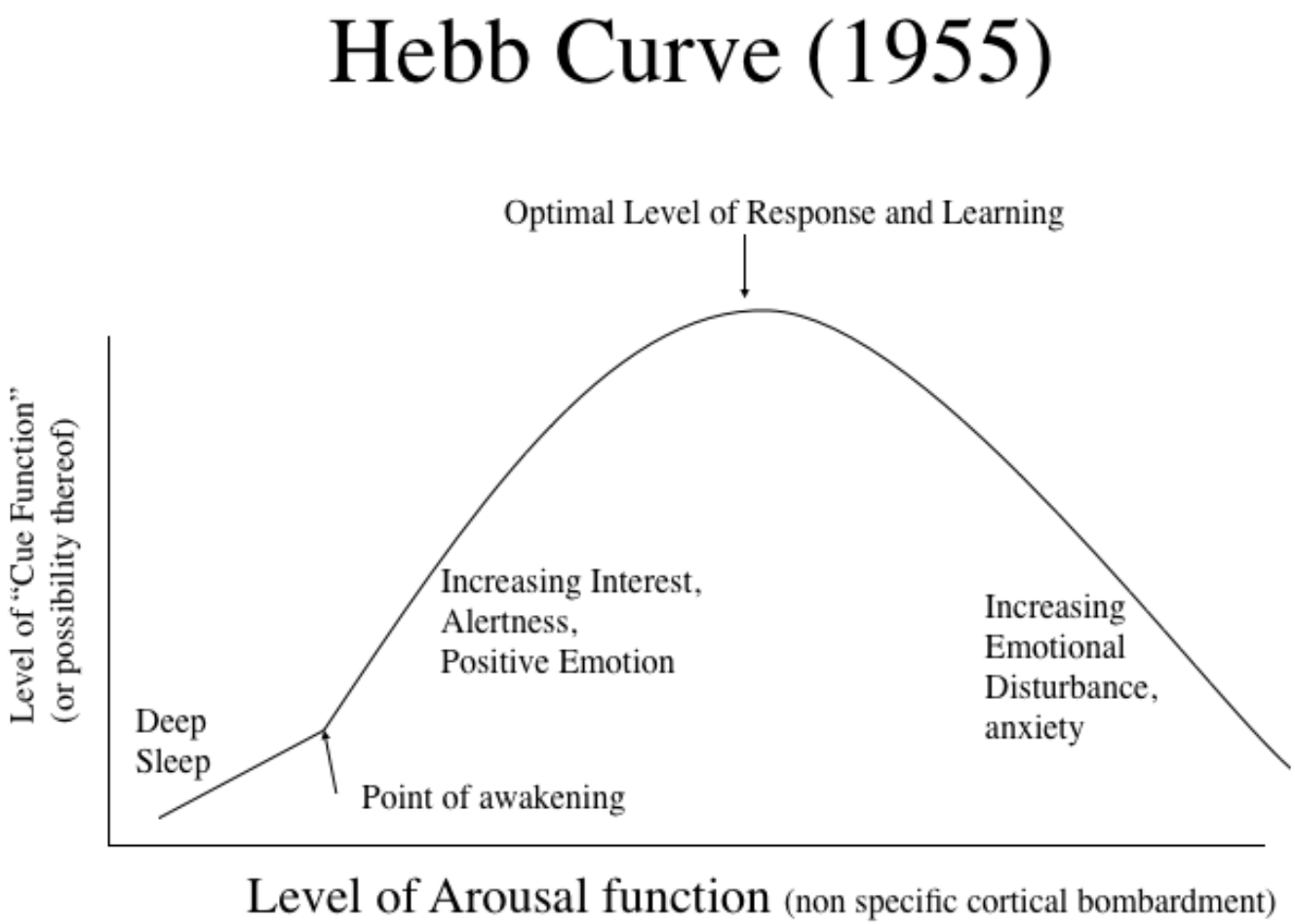
Indeed, in his presidential address to this society, Eysenck (1983) spent much of the time discussing Gray's criticisms and then cheerfully announced that Gray was going to replace him at the Maudsley!

Eysenck's theories as integration of individual differences with general laws

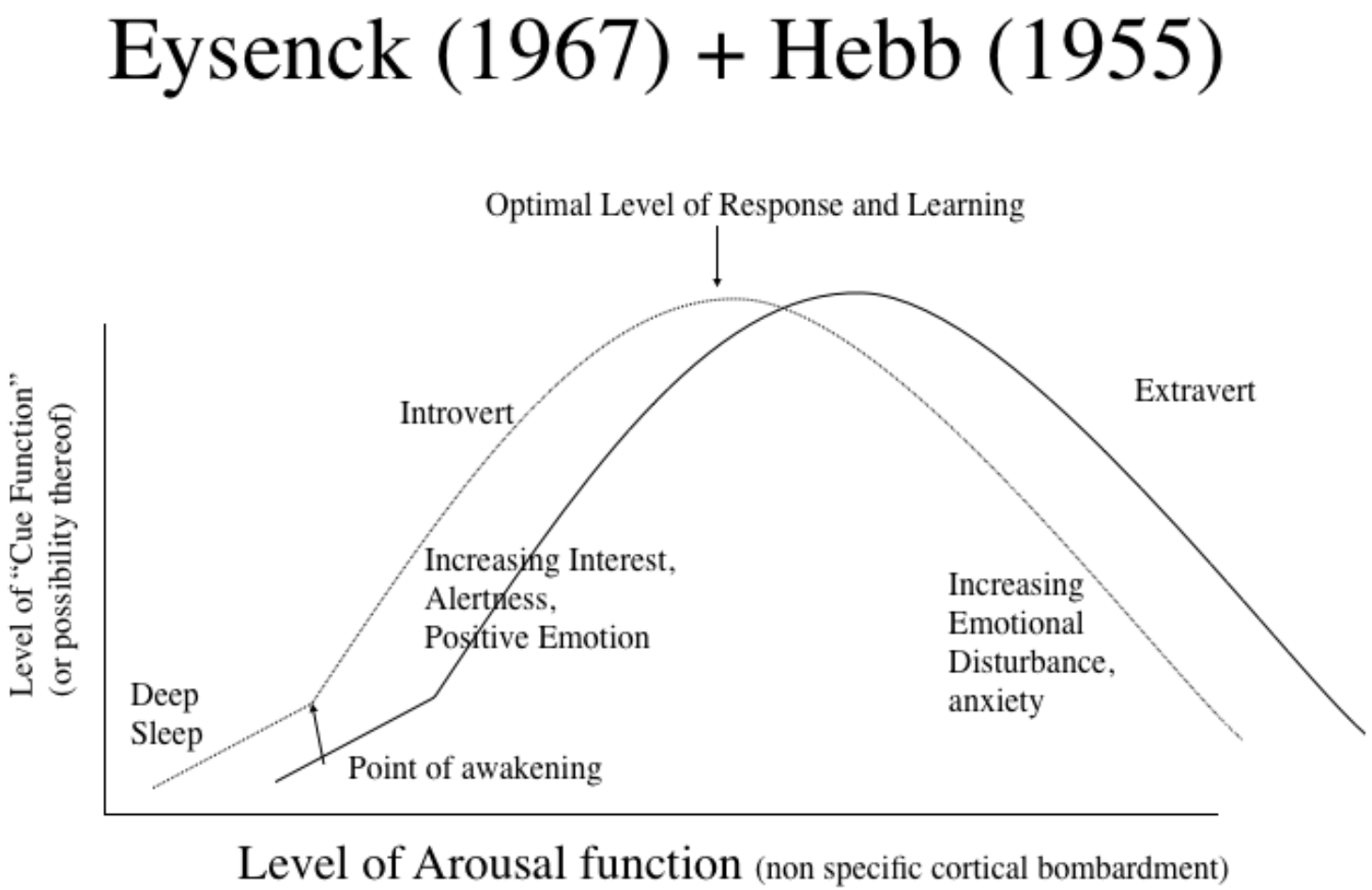
Eysenck always tried to integrate his taxometric study of individual differences with the best general psychological theories available at the time. That meant that the theory changed. (Although sometimes without comment.) Thus, to read Eysenck & Himmelweit (1947) or Eysenck (1952) is to read a completely different theoretical integration than proposed in Eysenck (1967) or Eysenck & Eysenck (1985) or finally, that of Eysenck (1997).

1. Personality and Learning Theory
   - Hull (1943, 1952)
   - Eysenck & Himmelweit (1947); Eysenck (1952)
2. Personality and Arousal Theory
   - Hebb (1955); Berlyne (1960); Berlyne & Madsen (1973); Broadbent (1971)
   - Eysenck (1967); Eysenck & Eysenck (1985)
3. Personality, genetics, structures, and neurotransmitters

State of the art theory in 1955–Hebb's Conceptual Nervous System



Predicting individual differences in performance under stress

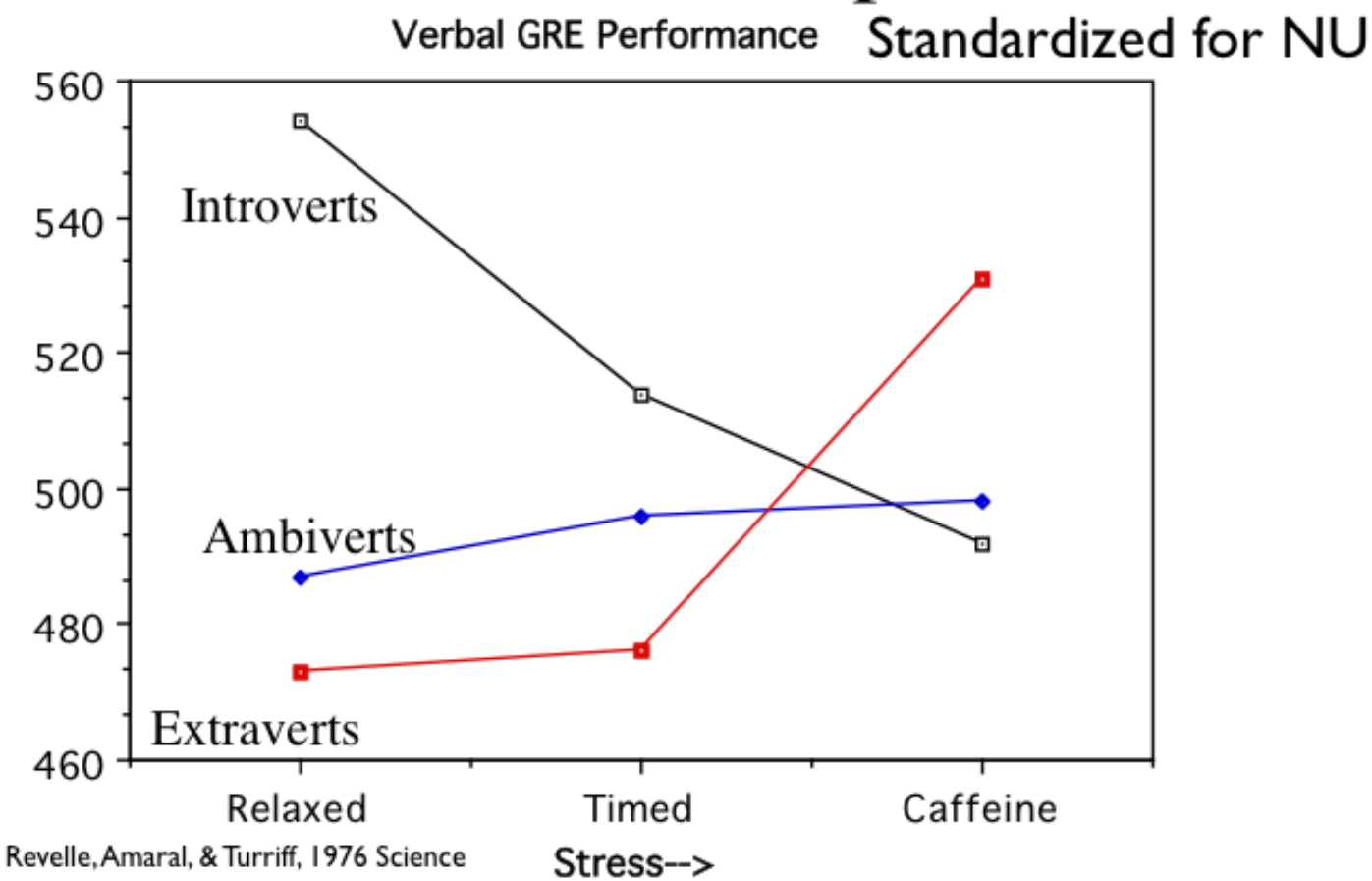


Confirmation experiment $\neq$ theory testing: The example of caffeine by extraversion

1. Basic hypothesis
   - Introverts are more aroused than extraverts Eysenck (1967)
   - Caffeine or time stress will increase arousal
   - Performance is a curvilinear function of arousal (Yerkes & Dodson, 1908; Hebb, 1955; Easterbrook, 1959; Broadbent, 1971)
2. Revelle, Amaral & Turriff (1976)
   - I-E measured with Eysenck Personality Inventory
   - caffeine given as placebo or 200 mg in capsule
   - Performance on practice Graduate Record Exams (GRE), reported in standardized scores
3. Predictions
   - Introverts $>$ extraverts in relaxed condition
   - Introverts $<$ extraverts with time pressure and caffeine

Caffeine and time stress on complex performance

Introversion, time pressure, and caffeine: effect on verbal performance



Failures to replicate lead to theory improvement: The discovery of the imp/soc distinction

Failures to replicate can lead to better science for they show the limits of an effect.

1. Kirby Gilliland (1976) failed to replicate the Revelle et al. (1976) effect
   - A better study, caffeine was dosed by body weight and had 3 levels of caffeine
   - Used the Eysenck Personality Questionnaire (EPQ) instead of Eysenck Personality Inventory (EPI)
   - Failed to find the same results
2. Did replicate the results when using the EPI (Gilliland, 1980)
3. What was the difference?

Gilliland's dissertation results did not replicate Revelle et al. (1976)

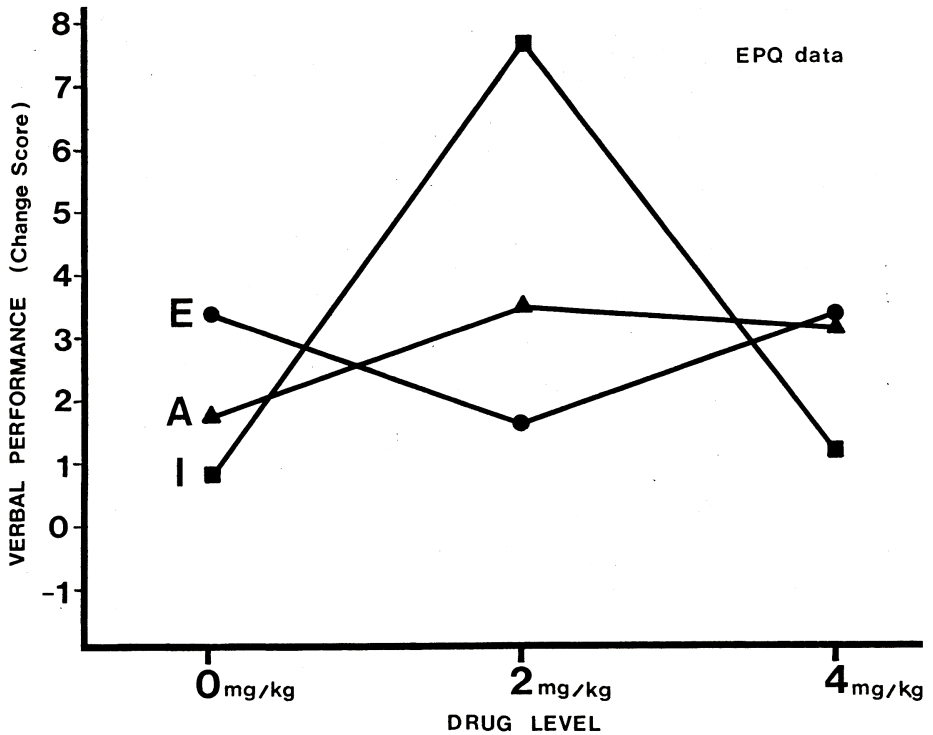


Figure 8. EPQ based group means for change in number of items correctly answered on GRE practice tests.

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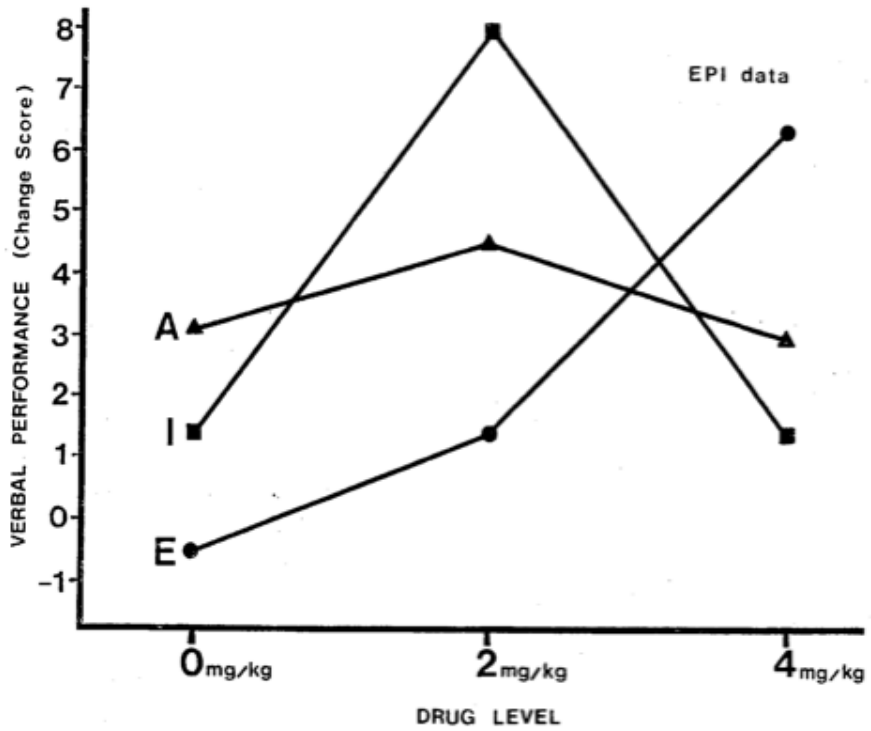
Figure : From Gilliland (1976)

Gilliland (1980) replicated (Revelle et al., 1976) when using EPI.

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.

Figure : From Gilliland, K. (1980). The interactive effect of introversion-extraversion with caffeine induced arousal on verbal performance. Journal of Research in Personality, 14(4), 482–492.

Using psychometrics to explain experimental results: Rocklin & Revelle (1981)

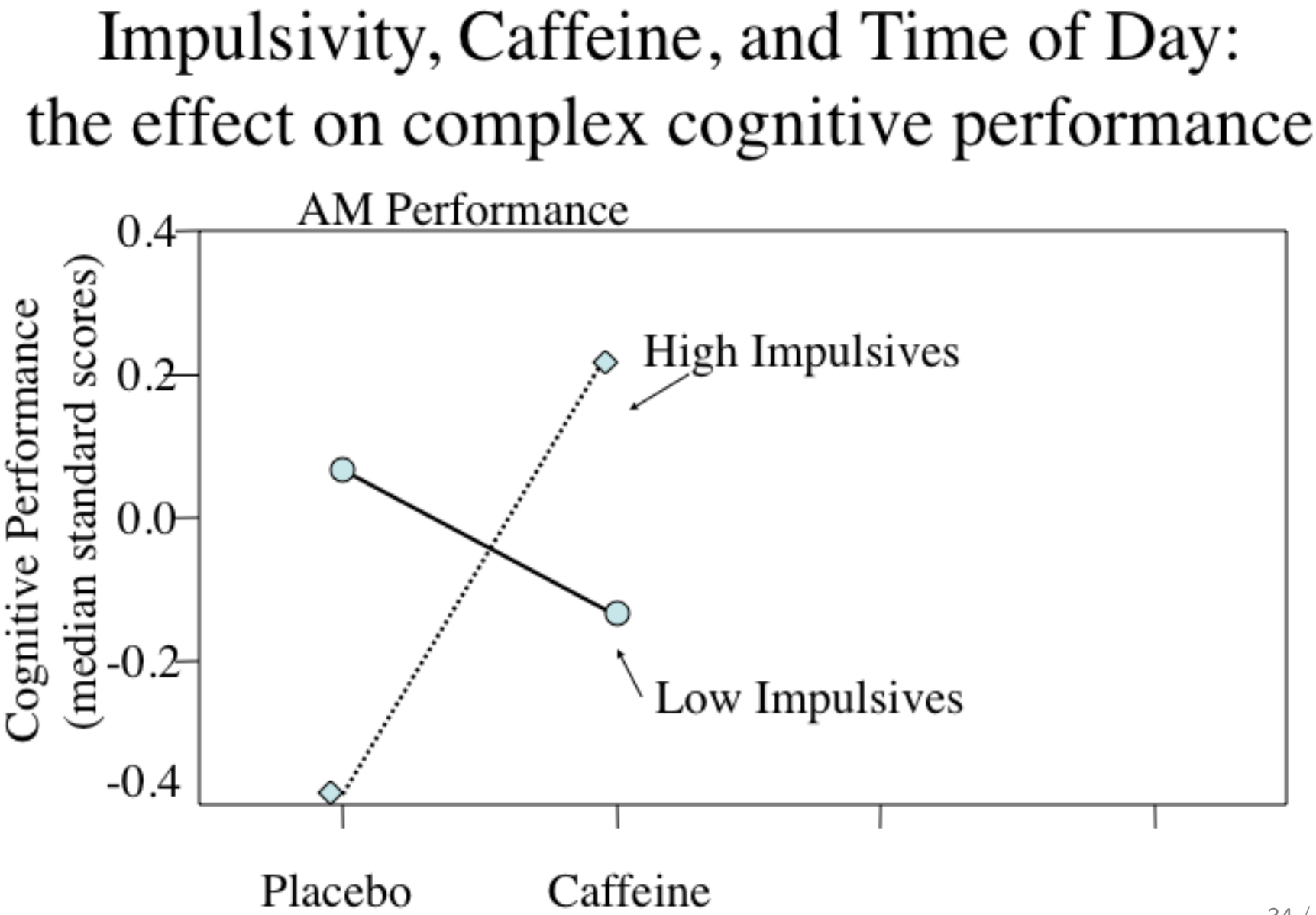
1. Eysenck Personality Inventory
   - Extraversion
   - Neuroticism
2. The new and improved Eysenck Personality Questionnaire
   - Extraversion
   - Neuroticism
   - Psychoticism
3. Cross form correlations were high for E (.74) and N (.83)
4. Structure was completely different for the two Extraversion scales
   - Number of factors determined by the Very Simple Structure criterion (Revelle & Rocklin, 1979)
   - 2 primary factors of EPI E (sociability and impulsivity)
   - one factor for EPQ E
5. This led to a small cottage industry of replications using EPI instead of EPQ (e.g., Campbell, 1983; Campbell & Heller, 1987).

Theory testing and rejecting by finding limiting cases

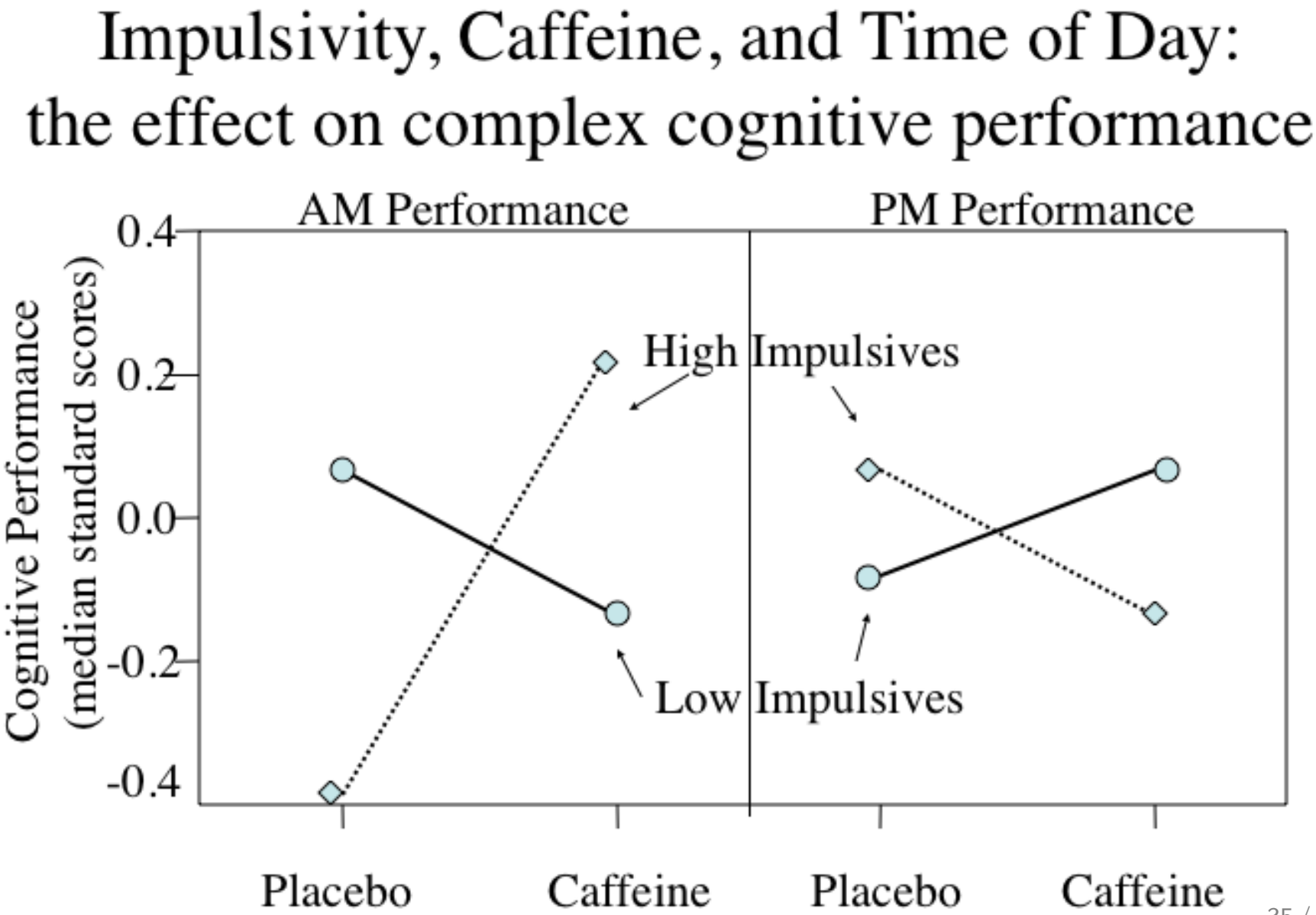
1. Over three years, we could replicate the Revelle et al. (1976) study about half the time.
   - We tested many different explanations, none worked.
   - Had varied time of day because we thought everyone would be more aroused later in the day. That is we hypothesized
     - $E < I$
     - $am < pm$
     - $placebo < caffeine$
2. Eventually we found a consistent interaction of Imp x drug x Time if we assumed an inverted U relationship of arousal and performance and
   - $E_{am} < I_{am}$
   - $I_{pm} < E_{pm}$
   - $placebo < caffeine$

Revelle, W., Humphreys, M. S., Simon, L., & Gilliland, K. (1980). Interactive effect of personality, time of day, and caffeine: A test of the arousal model. Journal of Experimental Psychology General, 109(1), 1–31.

Theory testing by rejection: The example of time of day x caffeine



Theory testing by rejection: The example of time of day x caffeine

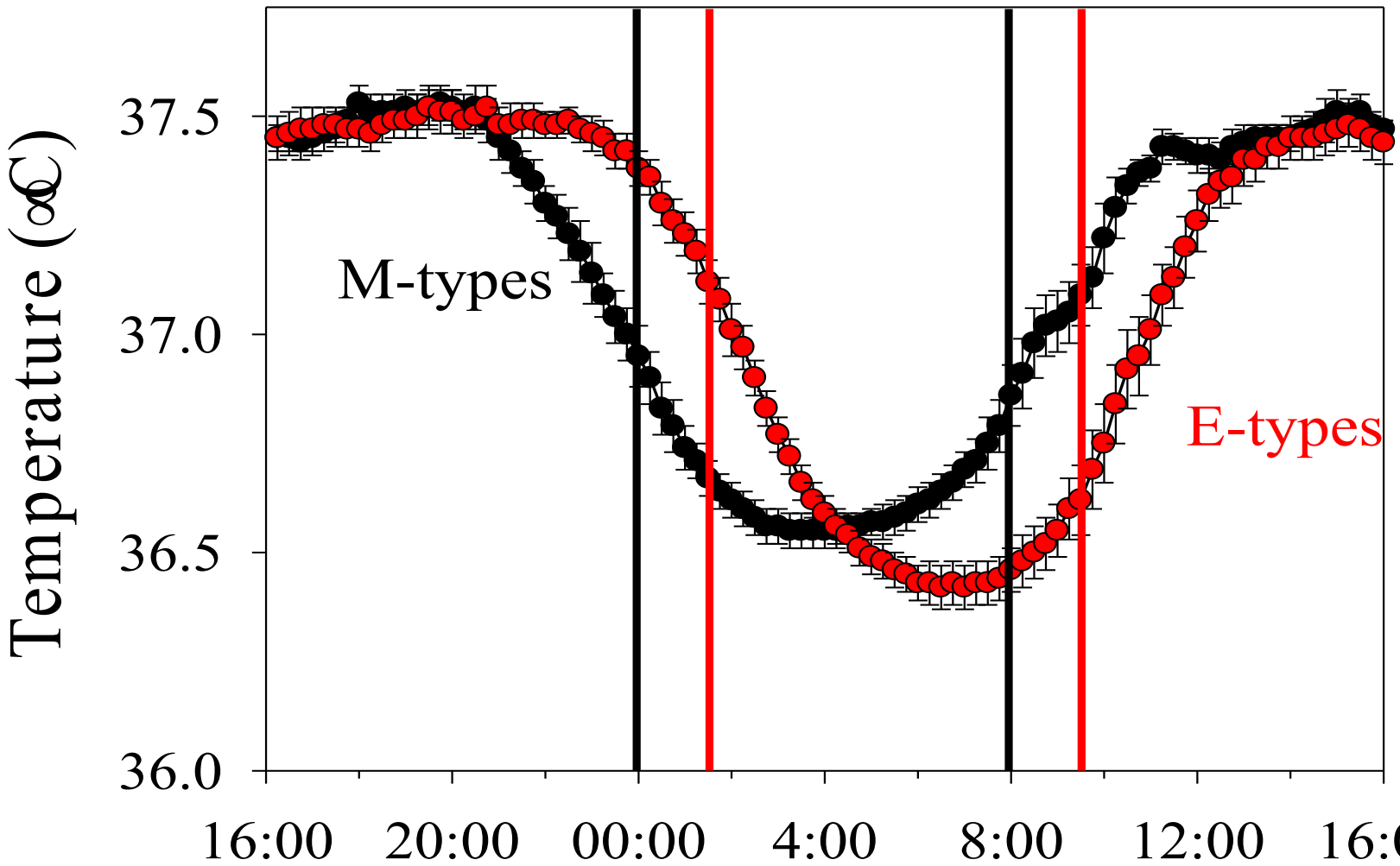


Using experimental data for correlational analysis: body temperature and personality

1. Charmane Eastman had examined core body temperature over two weeks to study the effects of shift work.
   - Multiple, small experimental studies
   - Each study had included measures (MMPI-2) that could be interpreted as impulsivity.
   - Each study included measures of morningness-eveningness.
2. Erin Baehr synthesized these studies to examine individual differences in body temperature.
   - We also measured average bed time and average rise time for all subjects.
   - Acrophase of Body Temperature differed more than differences in behavior (biology meets society)
3. Although we plot the data in terms of Morningness/Eveningness, somewhat weaker results were true for impulsivity (Baehr, Revelle & Eastman, 2000).

Baehr, E. K., Revelle, W., & Eastman, C. I. (2000). Individual differences in the phase and amplitude of the human circadian temperature rhythm: with an emphasis on morningness-eveningness. Journal of Sleep Research, 9(2), 117–127.

Biology meets society – time of day and morningness/eveningness



Theory development by integrating multiple alternative theories

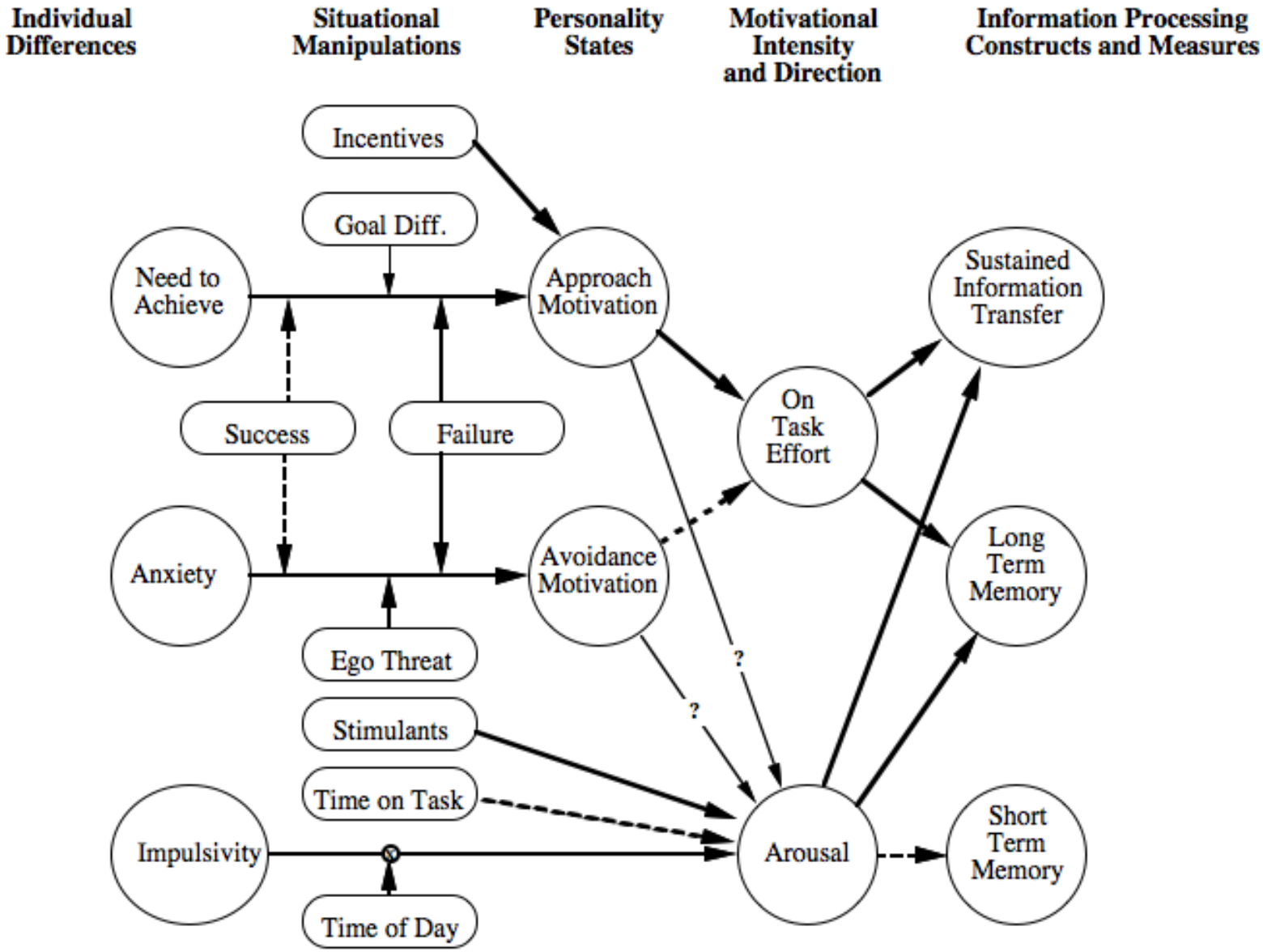
Multiple theories about personality and efficient performance

1. H.J. Eysenck (1967) and arousal theory
   - Introverts more aroused than Extraverts
   - Arousal has an inverted U relationship to performance
2. J.W. Atkinson (1957, 1974) and achievement motivation theory
   - High need achievement and low test anxiety lead to high motivation (Atkinson, 1957)
   - Motivation has inverted U relationship to performance (Atkinson, 1974)
   - Motivation has inertial properties (Atkinson & Birch, 1970; Revelle & Michaels, 1976; Revelle, 1986)
3. Theories of anxiety and cognitive performance
   - Anxiety and task difficulty (Spence, Farber & McFann, 1956)
   - Anxiety and working memory (Eysenck & Mathews, 1987; Eysenck, Derakshan, Santos & Calvo, 2007; Eysenck, 2000)
   - Anxiety and resource allocation (Wine, 1971)
4. Easterbrook (1959) and the Yerkes & Dodson (1908) "law"

Integrating multiple theories of performance: Humphreys & Revelle (1984)

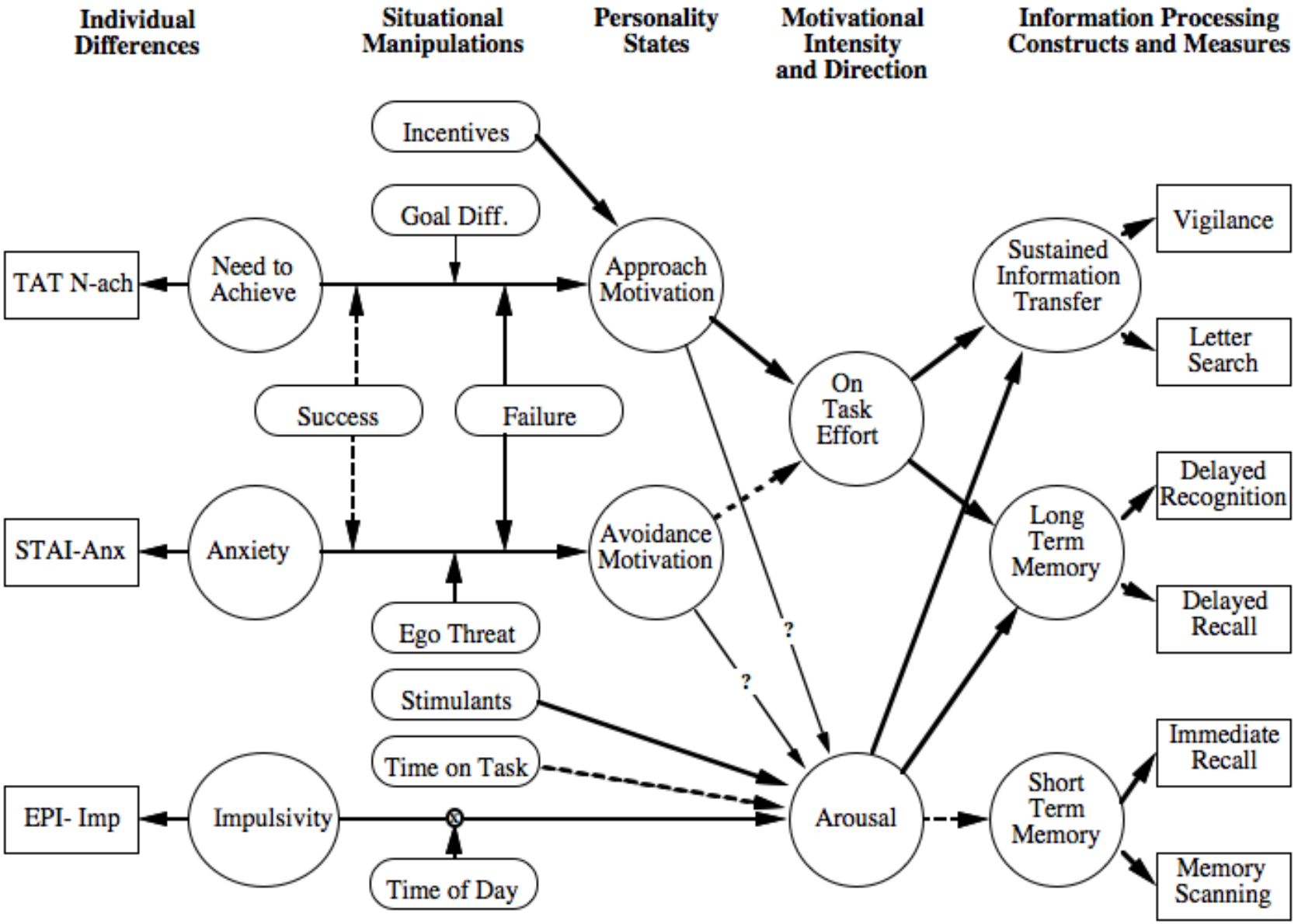
1. Multiple dimensions of personality relating to efficient cognitive performance
   - Introversion/Extraversion – Impulsivity
   - Anxiety (not just neuroticism)
   - Achievement motivation
2. Decomposing motivation
   - Arousal
   - Effort
3. Decomposing Performance
   - Attention tasks
   - Short term (working) memory tasks
   - Complex tasks that reflect some mixture of attention and memory

A "simple" model of personality and performance



Adapted from Humphreys & Revelle, 1984; Revelle, 1989

Personality, Motivation, and Cognitive Performance



Adapted from Humphreys & Revelle, 1984; Revelle, 1989

Theory testing by critical comparisons

1. Theories differ in breadth and depth
   - Many theories are silent for some phenomenon
   - Some sets of theories are mutually compatible, but with different range

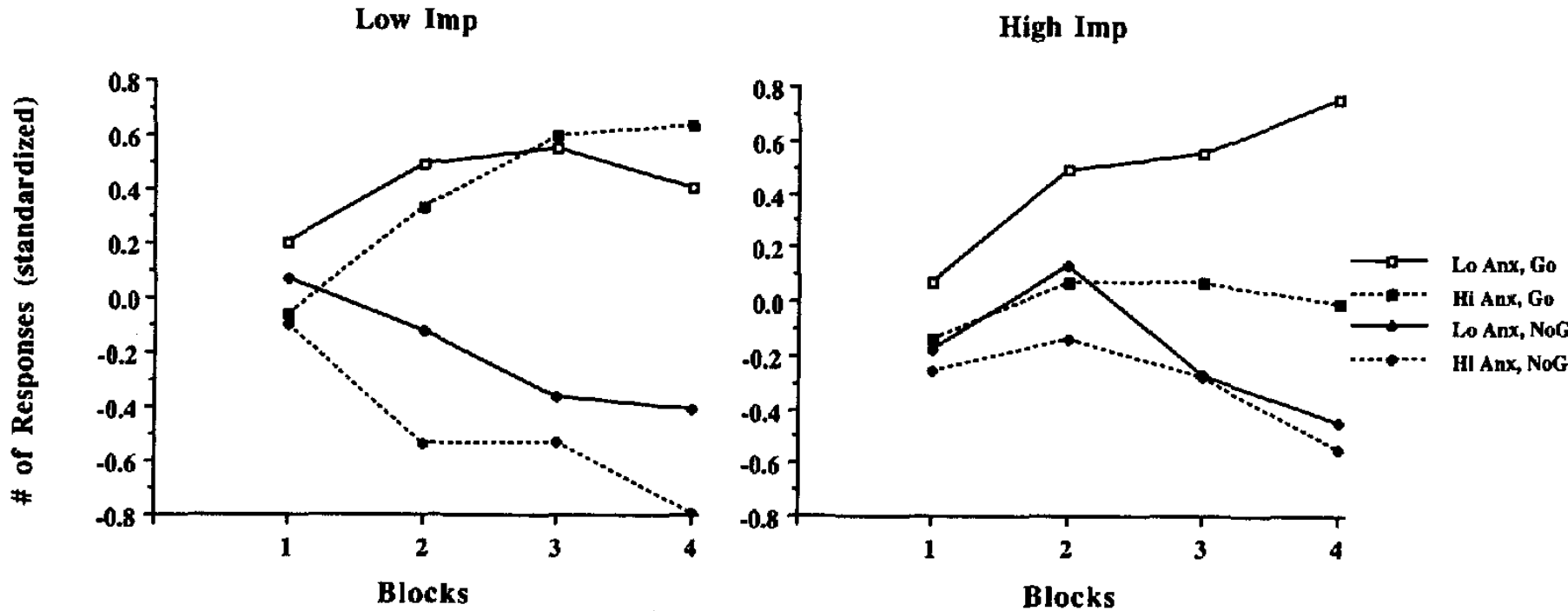
Phenomenon	Theory 1	Theory 2	Theory 3	Theory 4
A	+	+	+	+
B	+	+		+
C	+		+	+
D		+	+	
E	+	-	0	
F	0	+		

2. We test alternative theories by looking for where they make different predictions.
3. It is not enough to disconfirm a theory, we must show better alternatives.

Testing four models of conditioning: Zinbarg & Revelle (1989)

1. Drive Theory (Hull, 1943; Spence, 1964)
   - Anxiety and performance (Spence et al., 1956) but see Weiner & Schneider (1971)
2. Eysenck (1967); Eysenck & Eysenck (1985) specify the variables that affect conditioning:
   - Partial reinforcement
   - weak conditioned stimuli
   - discrimination learning
3. Impulsivity and cues for reward, anxiety and cues for punishment Gray (1981)
4. Extravert's focus on reward blinds them to punishment Newman, Widom & Nathan (1985); Patterson, Kosson & Newman (1987)

Zinbarg & Revelle (1989) used a go-nogo discrimination task



Reliable anxiety x impulsivity x Cue type interactions across four studies. Results not directly supportive of any of the four theories but suggested a revision of the Gray model. From Zinbarg, R. E. & Revelle, W. (1989). Personality and conditioning: A test of four models. Journal of Personality and Social Psychology, 57(2), 301-314.

Tests of competing theories of anxiety and information processing Leon & Revelle (1985)

How does anxiety affect performance?

1. Anxiety interacts with task difficulty Spence et al. (1956)
   - But see Weiner & Schneider (1971)
2. Anxiety limits working memory capacity Eysenck & Mathews (1987); Eysenck et al. (2007); Eysenck (2000)
3. Anxiety narrows the breadth of attention Easterbrook (1959)
4. Anxiety leads to off task thoughts Wine (1971)

Leon, M. R. & Revelle, W. (1985). Effects of anxiety on analogical reasoning: A test of three theoretical models. Journal of Personality and Social Psychology, 49(5), 1302-1315.

Geometric analogies differing in memory load (transformations) and complexity (number of elements)

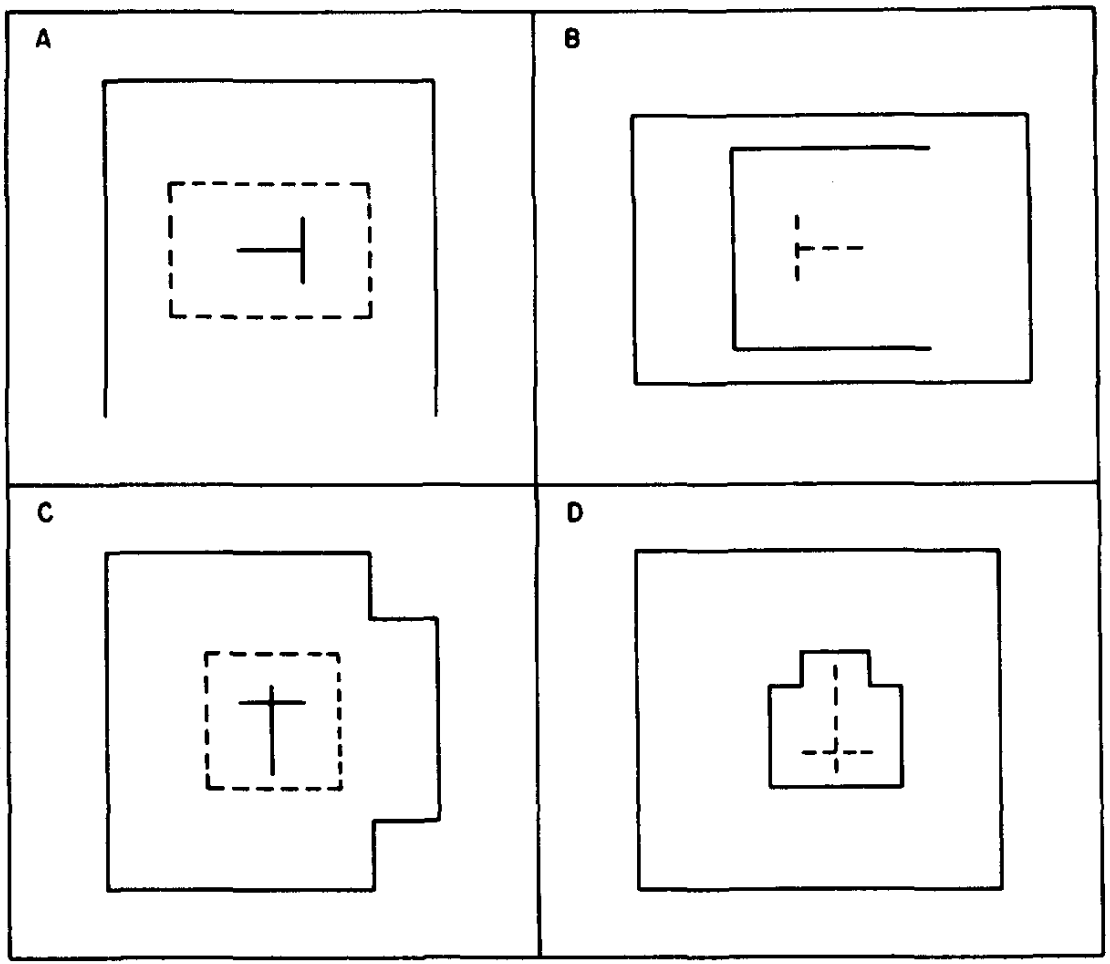


Figure 1. Sample 3-element two-transformation analogy problem.

Memory load, stress and anxiety Leon & Revelle (1985)

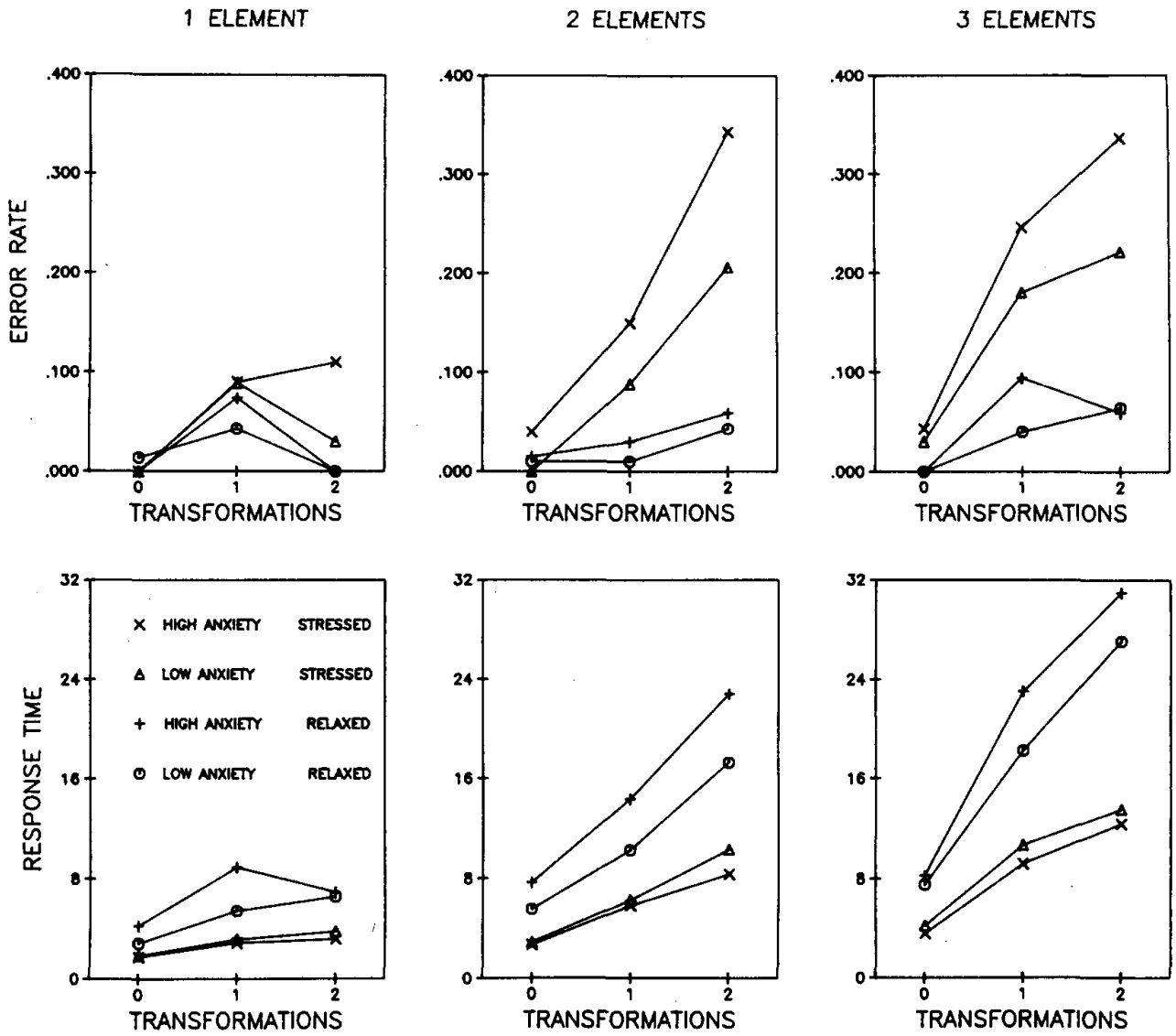


Figure 3. Error rates and response times for true analogies. (Error rates are calculated for all true analogies. Response times are calculated for true analogies that were solved correctly.)

Integrating cognitive theory with personality theory: Impulsivity, arousal and breadth of processing

1. Strong theories make testable predictions and theory develops by testing these predictions. Who is better able to test one's theories than oneself?

Integrating cognitive theory with personality theory: Impulsivity, arousal and breadth of processing

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2. Anderson & Revelle (1994) examined sustained performance on a recognition memory task to test the hypothesis that high trait impulsives were consistently faster to suffer from a decay in arousal than low trait impulsives.
3. We examined this effect at two times of day and unexpectedly found a time of day by impulsivity interaction.

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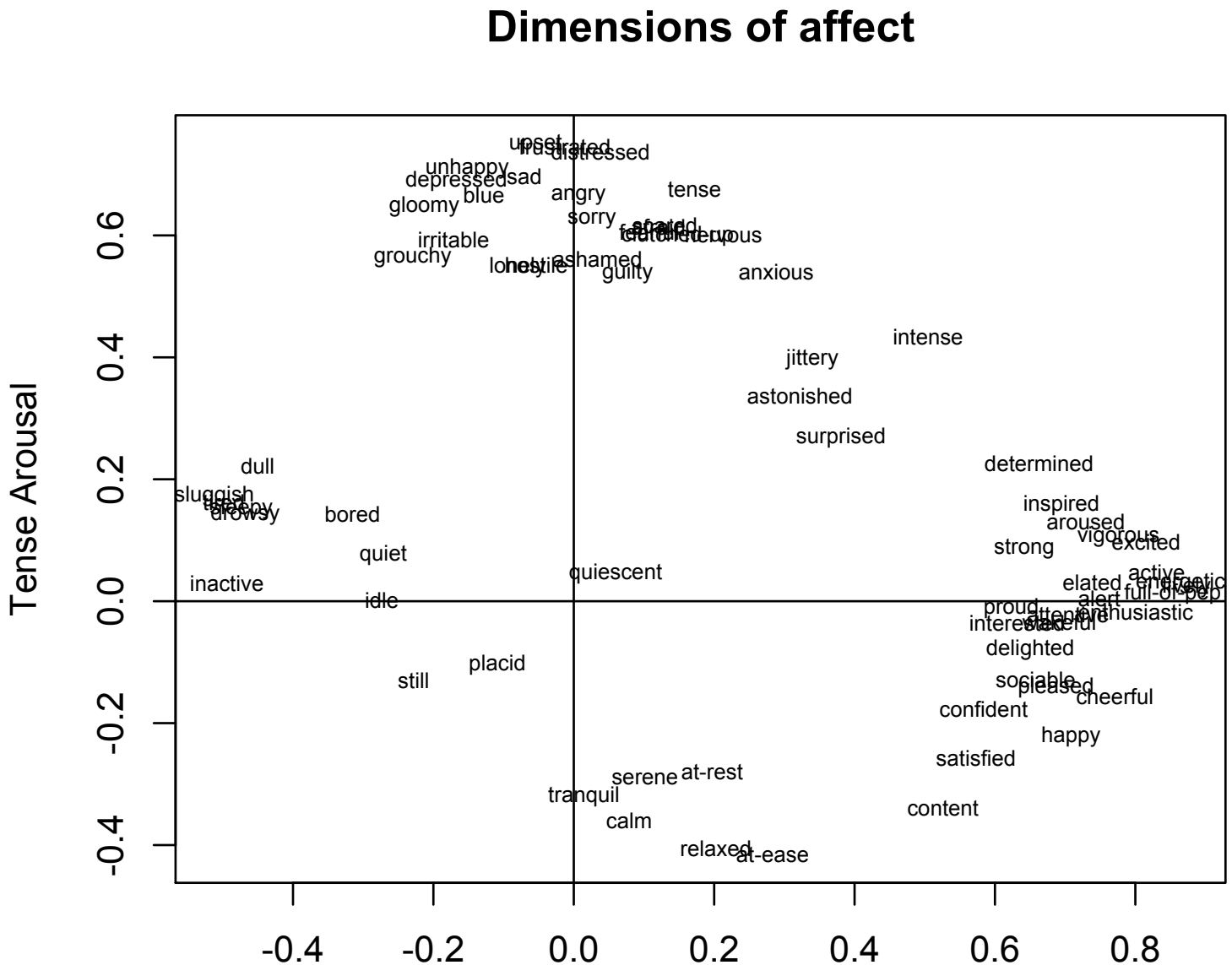
4. But science advances by disconfirmation as well:
   - "Two particular models deserve attention here. First, these data obviously contradict our own previous arguments (e.g., Revelle et al., 1987; Revelle & Anderson, 1992) that impulsivity is linked to stable differences in rate of change in arousal states." (Anderson & Revelle, 1994)

Integrating experimental and correlational data: Aggregating data across experimental studies for psychometric analysis

1. For about 10 years, we collected mood and arousal data as part of every experimental study we did.
   - Typical design was a mood pretest
   - Some arousal or motivation manipulation (e.g., caffeine, time stress, movies)
   - Then some post test
2. Motivational State Questionnaire (MSQ) was formed from items taken from Thayer's AD-ACL Thayer (1978), the PANAS (Watson, Clark & Tellegen, 1988) and various circumplex measures of emotion (Larsen & Diener, 1992)
3. Factor structure of the 72 items for 3896 subjects and their correlations with basic personality scales from the EPI is reported by Rafaeli & Revelle (2006)
4. The actual data are available as the `msq` data set in the *psych* package (Revelle, 2013) in R.

Dimensions of the Motivational State Questionnaire



Comments on experimental studies–Sample Size

1. Recent discussions of the need for replicability emphasize how most small studies are underpowered that observed effects in these studies are hard to replicate.
2. Although power is always an issue for replicability, studies do not have to be large if the effects are expected to be large.
    1. Shweder & D'Andrade (1980) proposed that personality structure was all in the eyes of the beholder.
    2. Using 8 subjects, Romer & Revelle (1984) showed that this was an artifact of the way Shweder collected his data.
        - When first submitted to JPSP, we had 4 subjects! A reviewer complained, so we doubled our cell size from 2 to 4.
        - The effects remained the same. This was really just a gedanken experiment and demonstration.
    3. A similar demonstration was done by Peter Borkenau (1986) who used an act frequency analysis of trait ratings but with 121 subjects.

Comments on experimental studies–the lack of a need for 'significance'

1. Effects don't have to be significant to be important.
   - In a test of the association between extraversion and positive affect (i.e., the "Larsen Effect" of Larsen & Ketelaar, 1989), we showed absolutely no differential effect of a positive mood induction using a humorous movie.
   - This complete lack of effect, in combination with positive effects in other (later) experiments, resulted in Smillie, Cooper, Wilt & Revelle (2012) showing how the association between extraversion and positive affect depends upon doing something to get reward, not just the reward itself.
   - Smillie et al. (2012), by doing multiple experiments, with predicted interactions in some, lack of effects in others, were able to define the limits of the relationship between extraversion and positive affect.

Correlational approach is not limited to psychology

1. A number of the physical sciences are observational rather than experimental
   - Astronomy, Geology, Oceanography, Climatology
2. Developments in science tend to follow developments in measurements and methodology
   - Astronomy: Galileo, the telescope and heliocentric theory.
   - Biology: Darwin & Russell, collecting data in new locations by using the scientific expedition
   - Oceanography: Echo sounders and the discovery of sea mounts and trenches leading to theory of plate tectonics
   - Climate Science: Observations of the change in atmospheric CO_2 have led to concerns about global climate change.

Developments in measurements and methodology in the study of personality

1. Galton, Spearman, & Thurstone: The measurement of cognitive ability
2. Galton, Pearson, & Spearman: The correlation coefficient
3. Spearman & Thurstone: Factor analysis
4. Structural Equation Modeling as a generalization of factor analysis
5. Longitudinal SEM
6. Multilevel modeling of within and between individual effects

Improvements in measurement of individual differences continues

1. Longitudinal studies (e.g., Terman, 1925; Terman & Oden, 1947; Block, 1971; Deary, Whiteman, Starr, Whalley & Fox, 2004; Hampson, Goldberg, Vogt & Dubanoski, 2006; Hampson & Goldberg, 2006) give amazing power to disconfirm alternative models.
2. Observational innovations: the Big EAR (Mehl & Pennebaker, 2003; Mehl, Vazire, Holleran & Clark, 2010), PDAs, cell phones (Wilt, Funkhouser & Revelle, 2011) for within subject analyses
3. General telemetric techniques can lead to very large samples (Wilt, Condon & Revelle, 2011)
4. Twin and family studies (Eysenck, 1990; Bouchard, 2004; Johnson, 2010) explore experiments of nature
5. Imagining: MRI, fMRI, PET, MEG: biological aspects of personality
6. Genome Wide Association (might not be as promising as we

The power of modeling

1. The study of climate change is a nice example of the combination of good data with experimental tests, not of the climate, but of computer models of the climate.
   - Theories are developed and tested as climate models
   - Models are evaluated in terms of the sensitivities of their parameters to known historical events.
2. Theories are predictions of how variables affect outcomes
   - As we acquire better theoretical models, we are able to express them in terms of parameter values of the models
   - Experiments can be done on the sensitivity of the parameter values
   - Model simulations are tests of the models
3. Examples of simulations of personality models include
   - Modeling as a test of the Dynamics of Action (Atkinson & Birch, 1970) and the CTA reparameterization (Revelle, 1986)
   - Fua, Horswill, Ortony & Revelle (2009); Fua, Revelle & Ortony (2010) applied the CTA model to simulations of behavior
   - Quek & Ortony (2012) applied the CTA model to simulations of the Implicit Attitudes Test

Conclusion

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Conclusion

1. The study of personality and individual differences has become even more exciting than it was 40 years ago.
2. More people are using more ways to study more problems than ever before.
3. Expanding our thinking beyond just experimental and correlational, and recognizing the power of interactions and the power of developing theory has made us a stronger science.
4. We all owe a great debt to the Hans Eysenck and to his many colleagues and students who have made our science richer.

Why I am glad to have learned about Hans Eysenck

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