Psychology 371: Personality Research
Introversion-Extraversion

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April, 2018
Outline

Descriptive versus casual models
  Descriptions of Introversion-Extraversion

A personal digression
  Eysenck’s world wide influence
  Eysenck’s influence on personality theory

Eysenck, the development of theory
  Original work
  Eysenck’s arousal theory as a theory of performance

Theory comparison and development

References
1. Simple descriptive basis
   - Self reports
   - Sociable
   - Active
   - Impulsive
   - Spontaneous

2. Peer ratings

3. People who describe themselves as outgoing are more known to others.
1. While most US researchers were studying the dimensionality of self reports, Europeans were developing casual models.
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
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.)
   - Personality and Individual differences (1985) (H.J. and M.W.)
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’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
### The original Eysenck factors (of behavior)

**Table:** The original Eysenck matrix

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<tbody>
<tr>
<td>Age above 30</td>
<td>0.08</td>
<td>0.14</td>
<td>-0.27</td>
<td>-0.22</td>
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<tr>
<td>Unskilled</td>
<td>0.22</td>
<td>-0.45</td>
<td>0.12</td>
<td>-0.48</td>
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<td>Unemployment</td>
<td>0.55</td>
<td>-0.23</td>
<td>-0.12</td>
<td>-0.36</td>
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<td>Degraded work-history</td>
<td>0.16</td>
<td>-0.29</td>
<td>0.16</td>
<td>-0.29</td>
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<tr>
<td>Abnormality in parents</td>
<td>0.47</td>
<td>0.21</td>
<td>0.35</td>
<td>0.31</td>
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<tr>
<td>Unsatisfactory home</td>
<td>0.43</td>
<td>0.06</td>
<td>0.45</td>
<td>0.00</td>
</tr>
<tr>
<td>Married</td>
<td>0.21</td>
<td>0.39</td>
<td>-0.12</td>
<td>-0.19</td>
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<tr>
<td>No group membership</td>
<td>0.46</td>
<td>-0.40</td>
<td>-0.16</td>
<td>-0.32</td>
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<tr>
<td>Narrow interests</td>
<td>0.55</td>
<td>-0.57</td>
<td>0.04</td>
<td>-0.10</td>
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<tr>
<td>Alcohol</td>
<td>0.07</td>
<td>0.00</td>
<td>0.17</td>
<td>-0.36</td>
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<tr>
<td>Abnormal before illness</td>
<td>0.61</td>
<td>-0.09</td>
<td>0.24</td>
<td>0.33</td>
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<tr>
<td>Badly organized personality</td>
<td>0.92</td>
<td>-0.12</td>
<td>0.35</td>
<td>0.15</td>
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<tr>
<td>Dependent</td>
<td>0.65</td>
<td>-0.22</td>
<td>0.06</td>
<td>0.24</td>
</tr>
<tr>
<td>Little energy</td>
<td>0.53</td>
<td>-0.69</td>
<td>0.06</td>
<td>-0.24</td>
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<tr>
<td>Cyclothymic</td>
<td>0.46</td>
<td>0.31</td>
<td>0.00</td>
<td>0.37</td>
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<tr>
<td>Schizoid</td>
<td>0.52</td>
<td>-0.07</td>
<td>0.26</td>
<td>0.29</td>
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<tr>
<td>Hypochondriacal personality</td>
<td>0.31</td>
<td>-0.22</td>
<td>-0.41</td>
<td>0.07</td>
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<tr>
<td>Obsessional</td>
<td>0.00</td>
<td>0.51</td>
<td>0.07</td>
<td>0.25</td>
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<tr>
<td>Somatic anxiety</td>
<td>0.05</td>
<td>0.25</td>
<td>-0.37</td>
<td>0.12</td>
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<tr>
<td>Effort intolerance</td>
<td>0.23</td>
<td>0.13</td>
<td>-0.63</td>
<td>0.26</td>
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<tr>
<td>Dyspepsia</td>
<td>0.54</td>
<td>0.17</td>
<td>-0.36</td>
<td>-0.01</td>
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<td>Fainting, fits</td>
<td>0.23</td>
<td>-0.23</td>
<td>-0.42</td>
<td>0.23</td>
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<tr>
<td>Pain</td>
<td>0.12</td>
<td>0.00</td>
<td>-0.39</td>
<td>0.03</td>
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<td>Tremor</td>
<td>0.30</td>
<td>0.34</td>
<td>0.17</td>
<td>0.10</td>
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<tr>
<td>Sex anomalies</td>
<td>0.14</td>
<td>-0.50</td>
<td>0.54</td>
<td>-0.01</td>
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<tr>
<td>Irritability</td>
<td>0.18</td>
<td>0.41</td>
<td>0.13</td>
<td>-0.10</td>
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<tr>
<td>Apathy</td>
<td>0.18</td>
<td>0.48</td>
<td>-0.02</td>
<td>-0.46</td>
</tr>
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</table>
The first two unrotated factors from the Eysenck correlation matrix
Learning theory

1. In the late 1940s to the late 1950’s, theories of learning were the major theoretical approach

2. Eysenck (and Spence) tried to integrate individual differences into these approaches by examining differential rates of learning

3. To eysenck introverts condition more rapidly than extraverts

4. Thus, introverts learned to be rule followers, Extraverts not so much
State of the art theory in 1955—Hebb’s Conceptual Nervous System

Hebb Curve (1955)

Optimal Level of Response and Learning

Level of “Cue Function” (or possibility thereof)

Deep Sleep

Increasing Interest, Alertness, Positive Emotion

Point of awakening

Increasing Emotional Disturbance, anxiety

Level of Arousal function (non specific cortical bombardment)
Predicting individual differences in performance under stress

Eysenck (1967) + Hebb (1955)

Optimal Level of Response and Learning

Level of Arousal function (non-specific cortical bombardment)

Level of “Cue Function” (or possibility thereof)

Deep Sleep

Point of awakening

Introvert

Increasing Interest, Alertness, Positive Emotion

Extravert

Increasing Emotional Disturbance, anxiety
Confirmation experiment ≠ 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

Verbal GRE Performance

Standardized for NU

Revelle, Amaral, & Turriff, 1976 Science
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)
Gilliland (1980) replicated (Revelle et al., 1976) when using EPI.
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
   - $E_{am} < I_{am}$
   - $I_{pm} < E_{pm}$
   - $placebo < caffeine$

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

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

Diagram showing the effect of caffeine on cognitive performance for high and low impulsives during the morning (AM) and placebo conditions.
Theory testing by rejection: The example of time of day x caffeine

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

Biology meets society – time of day and morningness/eveningness

![Core body temperature from 171 volunteers averaged over a week. (Baehr et al., 2000)](C:\SPW32\MEQT\figA)

- **M-types**
- **E-types**

**Figure**

- Time (hours)
  - 16:00
  - 20:00
  - 00:00
  - 04:00
  - 08:00
  - 12:00
  - 16:00

- Temperature (°C)
  - 36.0
  - 36.5
  - 37.0
  - 37.5

- **= Average Sleep**
- **= Average T_MIN**
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”

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

<table>
<thead>
<tr>
<th>Phenomenon</th>
<th>Theory 1</th>
<th>Theory 2</th>
<th>Theory 3</th>
<th>Theory 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>B</td>
<td>+</td>
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<tr>
<td>D</td>
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</tr>
<tr>
<td>F</td>
<td>0</td>
<td>+</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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


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

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)

Geometric analogies differing in memory load (transformations) and complexity (number of elements)
Memory load, stress and anxiety Leon & Revelle (1985)
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.
Integrating cognitive theory with personality theory: Impulsivity, arousal and breadth of processing

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**Integrating cognitive theory with personality theory:**

**Impulsivity, arousal and breadth of processing**

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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 (?)

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, 2018) in R.
Dimensions of the Motivational State Questionnaire


Rocklin, T. & Revelle, W. (1981). The measurement of


