FACTOR ANALYSIS

Initially developed by psychometrician Charles Spearman (1904) as a method to uncover the structure of mental abilities (Spearman's G)
The method is widely used in psychometrics, psychopathology, occupational & educational psychology & individual differences research

Factor Analysis (FA): Umbrella term that refers to a number of advanced multivariate statistical techniques that are used to un-recover the hidden (latent) structure/construct (dimensions) from a set of observed attributes
Used to condense a large number of observed attributes into a much smaller, yet meaningful, set of constructs

EXAMPLE (THE EPQ-R-S)
Answer each question with a *yes* or *no*:

1) Does your mood often go up or down?
2) Do you ever feel 'just miserable' for no reason?
3) Are your feelings easily hurt?
4) Are you a worries?
5) Are you often troubled about feelings of guilt?

Can present the relations between these items in a correlation matrix or visualise them in a conceptual (uni-dimensional) psychological space

FACTORIAL DIMENSIONALITY

The dimensions (factors or components) (constructs or sub-constructs) are linear combinations of observed attributes (although modern developments of the technique allow for non-linear combinations)
Therefore the observed attributes need to be numerical or at least possess an underlying continuous structure
Since FA is not assessing causal relationships, there is no need to define dependent or independent variables
In FA are trying to maximise the attributes' explanatory rather than predictive power

MAJOR FA TYPES

Exploratory Factor Analysis (EFA)	Used when one is interested in identifying a (potentially) hidden construct/structure <u>Principal Components Analysis (PCA)</u> – assumes that all the variance common (true score) & unique (systematic/random error) in the items can be explained by some hidden construct ⇒ Most commonly used in psychology, Hotelling 1933
Confirmatory Factor Analysis (CFA)	Joreskog 1973 Is used when one is looking to confirm an already hypothesised, theorised or empirically identified construct

KEY CONCEPTS

Item: An observed (manifest) element of an attribute (e.g. response to single task or question in questionnaire)
Factorability: The suitability of an item (or a psychometric test dataset) to be included in a FA model
N.B. In practise factorability depends on the degree of numerical association between items

- Items with very low (below |0.5|) or very high (above |0.9|) correlations need to be carefully considered for inclusion/exclusion
- <u>Bartlett's test of Sphericity:</u> Tests whether the item correlation matrix is significantly different from a matrix with zero correlations (assesses the factorability of a dataset)

Simple structure: In a basic sense it refers to the situation where items form distinct groups based on the degree of their associations (i.e. exhibit high within-group correlations & low to none between-group correlations)
In a simple structure, items form highly independent dimension
Factor/Component: A latent dimension (construct) that is made up by a group of related items, for the factor to be meaningful the items need to be related both in a qualitative (conceptual) & quantitative (numerical) sense

- <u>Orthogonal Factors</u> – dimensions that are considerable to be independent from each other
- <u>Oblique Factors</u> – dimensions that are considered to be related to a degree to each other

Factor Loading: The correlation between an item & a factor

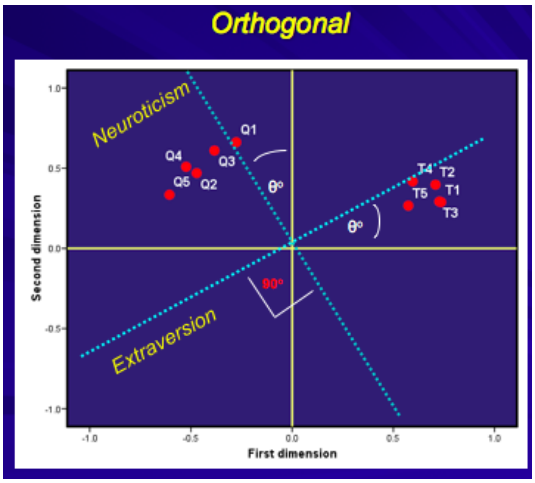
⇒ When an item has a loading on a factor of >|0.4| is considered to belong to that factor

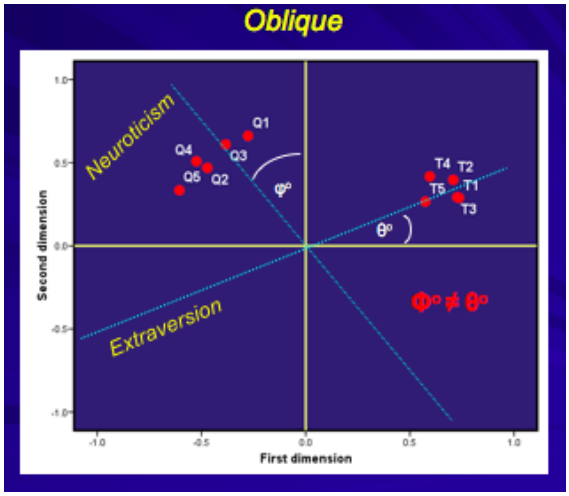
ROTATION

Rotation: The geometric transformation of the factors (latent space) in order to generate a model that contains a simple structure

- Varimax Rotation (orthogonal) – used to rotate orthogonal (unrelated) factors in such a way that maximises the variance each of them explains, most common in psychology
- (Direct) Oblimin Rotation (oblique) – rotation that is used for oblique (related) factors

Can choose between an orthogonal or an oblique rotation





Oblique may give a better picture of the underlying constructs, however it distorts the conceptual space

HOW MANY FACTORS TO KEEP

Kaiser Criterion: Retain any factor that has an eigenvalue greater or equal to one, can explain the variance in at least a single item in the model (Little Jiffy)

Eigenvalue (λ): (Characteristic Roots) The standardised variance of all the items that is explained by a single factor

Cattell's (1958) scree plot rule

Variance-explained rule – retain all factors that collectively account for 80-90% of the total variance

The Joliffe criterion – retain all factors with eigenvalues greater or equal to 0.7

Comprehensibility – retain all factors that are meaningful & clearly interpretable within the context of a given study

⇒ The final assessment rests on psychological knowledge (FA cannot 'name' the factors for us)