Measurement

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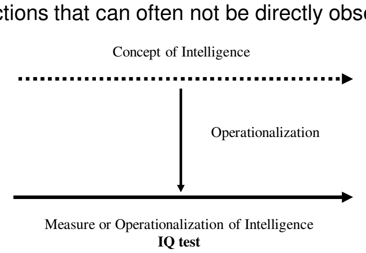
Measurement

- In much scientific work we are interested in either describing the distributions of and/or relationships among abstract constructs: e.g.,
  - Political conservatism
  - Intelligence
  - Neuroticism
  - Aggression

Measurement

- However, in most cases these constructs are abstractions that can often not be directly observed.



Measurement

- Note that the degree to which the operationalization of the abstract concept actually reflects or mirrors the construct is the degree to which the operationalization can be said to be **valid**.
- The value of scientific research is completely dependent upon the degree to which the operationalizations are successful or valid.

Concepts and Constructs

- Concept:
  - “An abstraction formed by generalization from particulars”
  - Abstract hard to define
  - E.g. intelligence
- Construct:
  - A concept with scientific purpose
  - Can be measured and studied.
  - E.g. IQ

Measurement

- Statistical analyses depend upon the measurement characteristics of the data.
- **Measurement** is a process of assigning numbers to constructs following a set of rules.
- We normally measure variables into one of four different levels of measurement:
  - **Nominal**
  - **Ordinal**
  - **Interval**
  - **Ratio**

Measurement

- **Nominal Measurement:**
  - This refers to the simple act of assigning different labels to different categories of a variable
  - Nominal → Naming
  - Only supplies one piece of information
  - E.g., an ethnicity variable
    - 1= White
    - 2= Asian
    - 3= Middle-eastern
    - 4= Latino
    - 5= Black

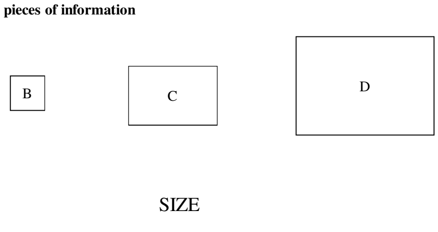
Measurement

- **Ordinal measurement**
  - Here numbers not only imply different categories of a variable, but also information concerning the “more-ness or less-ness” of that variable.
  - Ordinal
  - Consider the variable “subjective temperature”
    - 1 = Cold
    - 2 = Comfortable
    - 3 = Hot

Ordinal Measurement

- Where Numbers Representative Relative Size Only

Contains 2 pieces of information

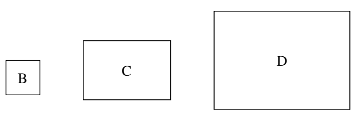


Measurement

- **Interval Scale Measurement**
  - In interval scale measurement there are **three** kinds of information conveyed by the numbers assigned to represent a variable:
    1) Different numbers which represent different categories or values of that variable
    2) Numbers also represent “more or less-ness” of that variable
    3) Where equal intervals with respect to the operationalization correspond to equal intervals with respect to the abstraction being measured.

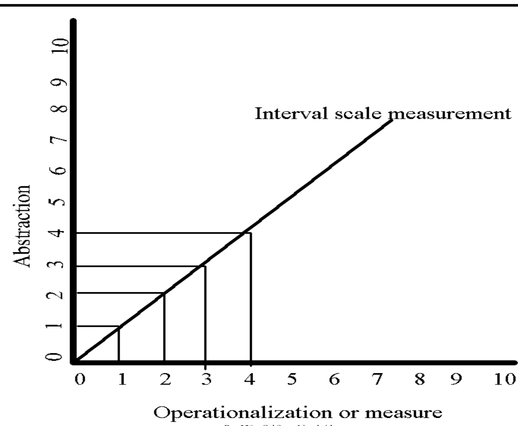
Interval Measurement:

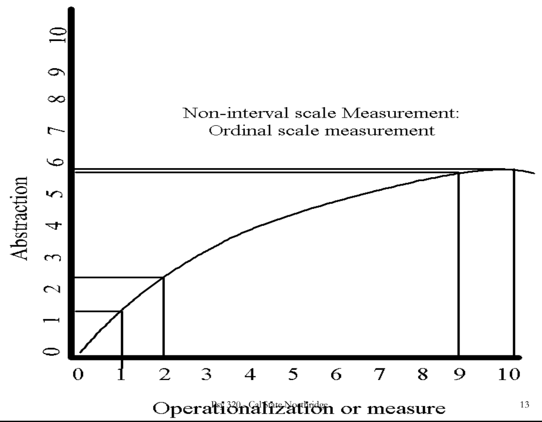
- Where Equal Differences Between Numbers Represent Equal Differences in Size



Numbers representing Size	**1**	**2**	**3**
Diff in numbers		**2-1=1**	**3-2=1**
Diff in size		**Size C – Size B =Size X**	**Size D – Size C = Size X**

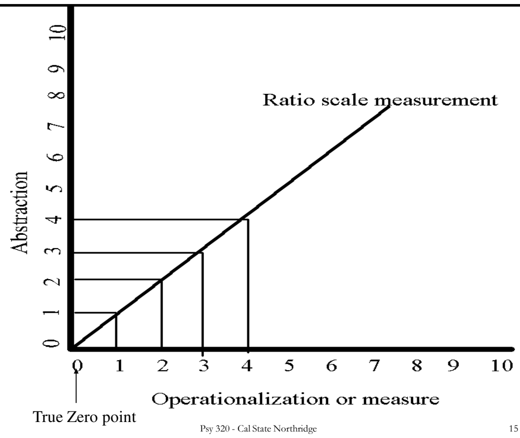
SIZE →





Measurement

- **Ratio Scale Measurement**
  - In ratio scale measurement there are **four** kinds of information conveyed by the numbers assigned to represent a variable:
    - Different numbers which represent different categories or values of that variable
    - Numbers which represent “more or less-ness” of that variable
    - Where equal intervals which respect to the operationalization correspond to equal intervals with respect to the abstraction being measured.
    - Where there is a meaningful 0-point and therefore meaningful ratios among measurements.



Measurement

- Ratio Scale Measurement
  - If we have a true ratio scale, where 0 represents an a complete absence of the variable in question, then we form a meaningful ratio among the scale values such as:

$$4/2 = 2$$

  - However, if 0 is not a true absence of the variable, then the ratio 4/2 = 2 is not meaningful.

Variables and Constants

- Variable: any condition, event, characteristic or attribute that can take on different values at different times or with different people.
  - Age of people
  - Temperature
  - Intelligence
  - Xenophobia
- Constant:
  - One value in a given context.
  - Does not change or vary.

Independent and Dependent Variables

- Independent variable
  - we are referring to a variable that the experimenter has some direct control over and can manipulate
  - In Experiments IVs are the "cause"
  - In non-experiments IVs are the "influence
  - i.e., $X \rightarrow Y$
- Dependent Variables
  - The variable being influenced/predicted
  - The outcome variable

Discrete & Continuous Variables

- Discrete variables: can only take on a finite or restricted set of values.
  - Can only take on whole values (think digital)
  - E.g., number of children per family, Number of students taking 100A
- Continuous variables: can take an infinite number of values
  - E.g., Temperature (10.3 C, 10.24 C, 15.212 C), Weight (102.2lbs., 116.56 lbs.)
- The difference often limited only by precision

Random Sampling

- Random Selection
  - Participants are chosen into the study at random
- Random Assignment
  - Once selected, participants are randomly placed into treatment groups

Intro to Notation

- It's all greek (well mostly), get used to it!
- Capital letters refer to variables (e.g. X, Y)
- Lower Case Letters with subscripts – are individual values (e.g. x_1)
- Σ - summation e.g. $\sum X, \sum X_i, \sum_{i=1}^{N} X_i$
- $(\Sigma X)^2$ vs. ΣX^2
- Rules
  1. $\Sigma(X - Y) = \Sigma X - \Sigma Y$
  2. $\Sigma CX = C\Sigma X$
  3. $\Sigma(X + C) = \Sigma X + NC$