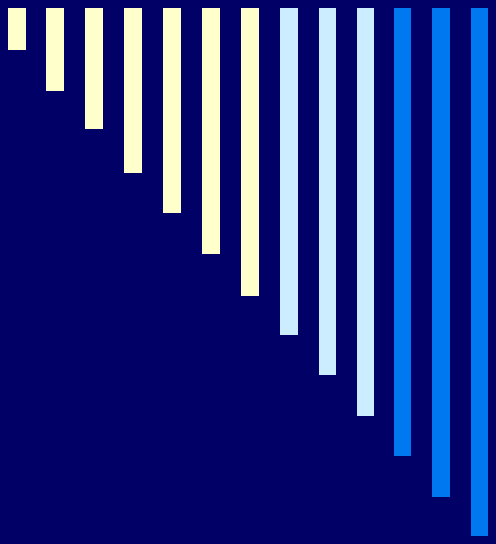


Quantitative Research Design & Methods

Topics

- Types of quantitative research
- Measurement Fundamentals
- Concepts and construct validity
- Levels of measurement
- Research Validity

Quantitative Research

1. Exploratory -- It is a good starting point to get familiarized with some insights and ideas (e.g. identify the dependent and independent variables)
2. Descriptive – "The mapping out of a circumstance, situation, or set of events" (McNabb)
3. Causal—experimenting (statistically speaking) to asses cause and effect. For example, whether or not a P.A. program is achieving its objectives. Experiments in the social science take place "naturally" (e.g. The effectiveness of Homeland Security to respond to natural or anthropogenic hazards).

Measurement Fundamentals

- A key difference is that normal science deals with concepts that are well defined and to great extent standardized measures (e.g. speed, distance, volume, weight, size, etc.)

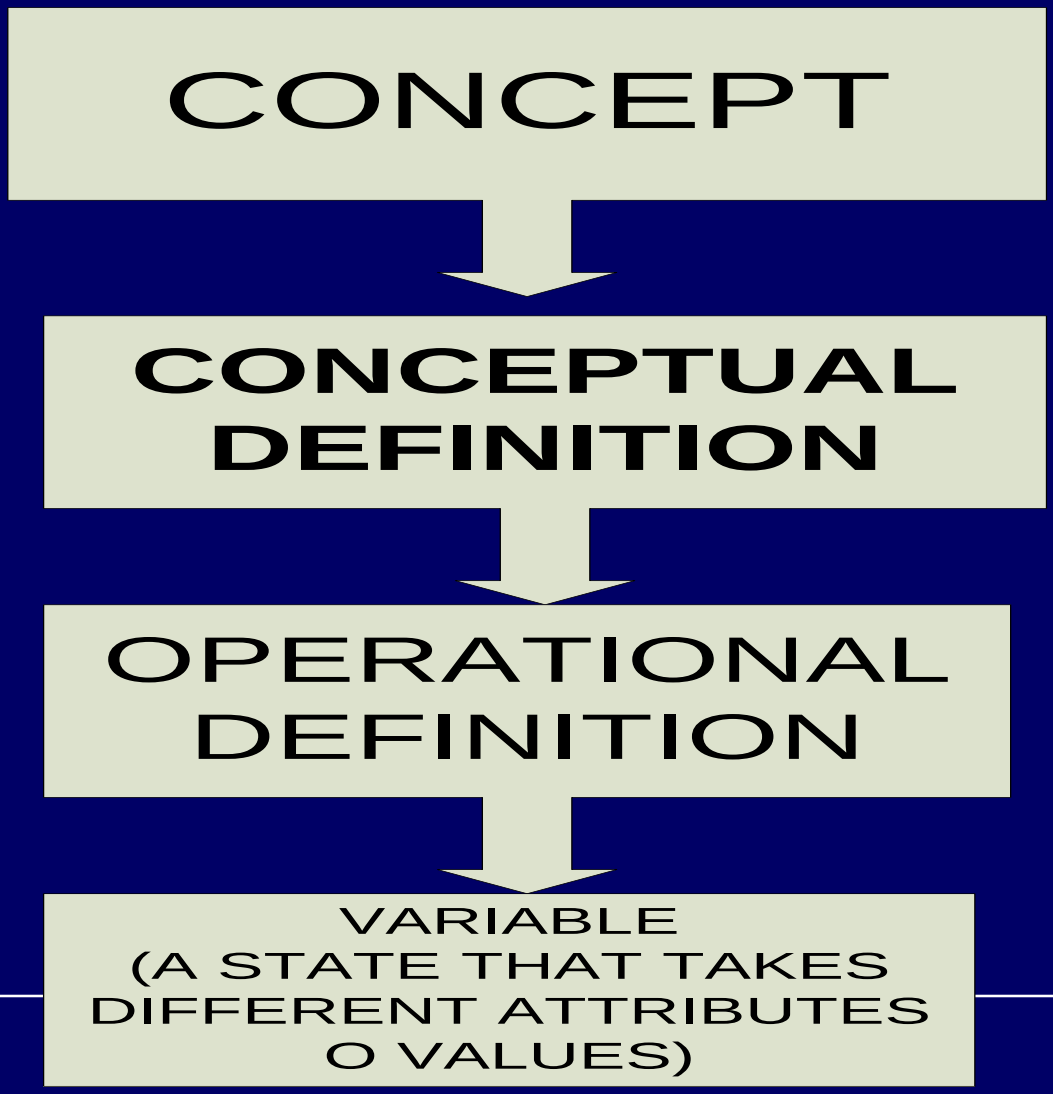
- **On the contrary the social science often uses concepts that are ill defined and therefore the standardization in terms of how it is measured varies or there is little agreement (e.g. social class, development, poverty, etc.)**
- **Statistics cannot be used until we understand the "the fundamental nature" of measurement (McNabb)**

Measurement Fundamentals

- Thus, our goal is that our measurements of the different concepts are valid or *match* as much as possible the "real" world

- **What is a concept?**
  - "A mental construct that represents phenomena in the real world". (Pollock 2005:7)
- The challenge is to transform concepts into concrete terms (preferable that can be measured).

Pollock's model



Units of Analysis

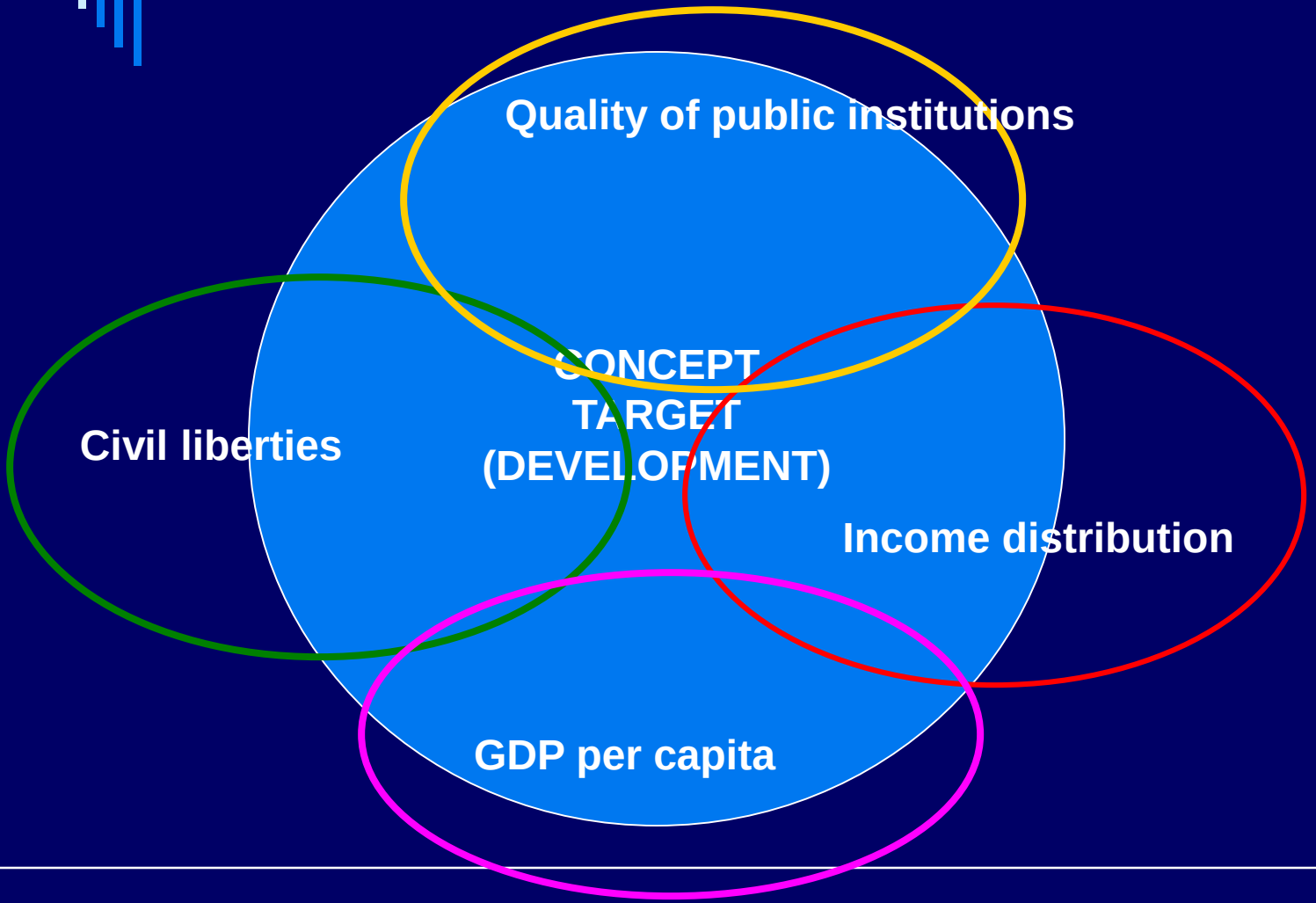
- Individuals
- People
- Places
- Groups
- Institutions
- Nations
- Programs

The case of development

- According to Michael Todaro (1994:18) development is both a physical reality and a state of mind in which society has, through some combination of social, economic, and institutional processes, secured the means for obtaining a better life, development in all societies must have a least the following three objectives:

1. To increase the availability and widen the distribution of basic life sustaining goods
2. To raise levels of living
3. To expand the range of economic and social choices

Concept, conceptualization, operationalization, variables & construct validity



Concept, conceptualization, operationalization & construct validity

- Construct validity is the match between the land of theory and the land of observation
- How effectively do the variable(s) we use represent the mental image of the concept and its manifestation in the real world?
- This is the fundamental question of construct validity!

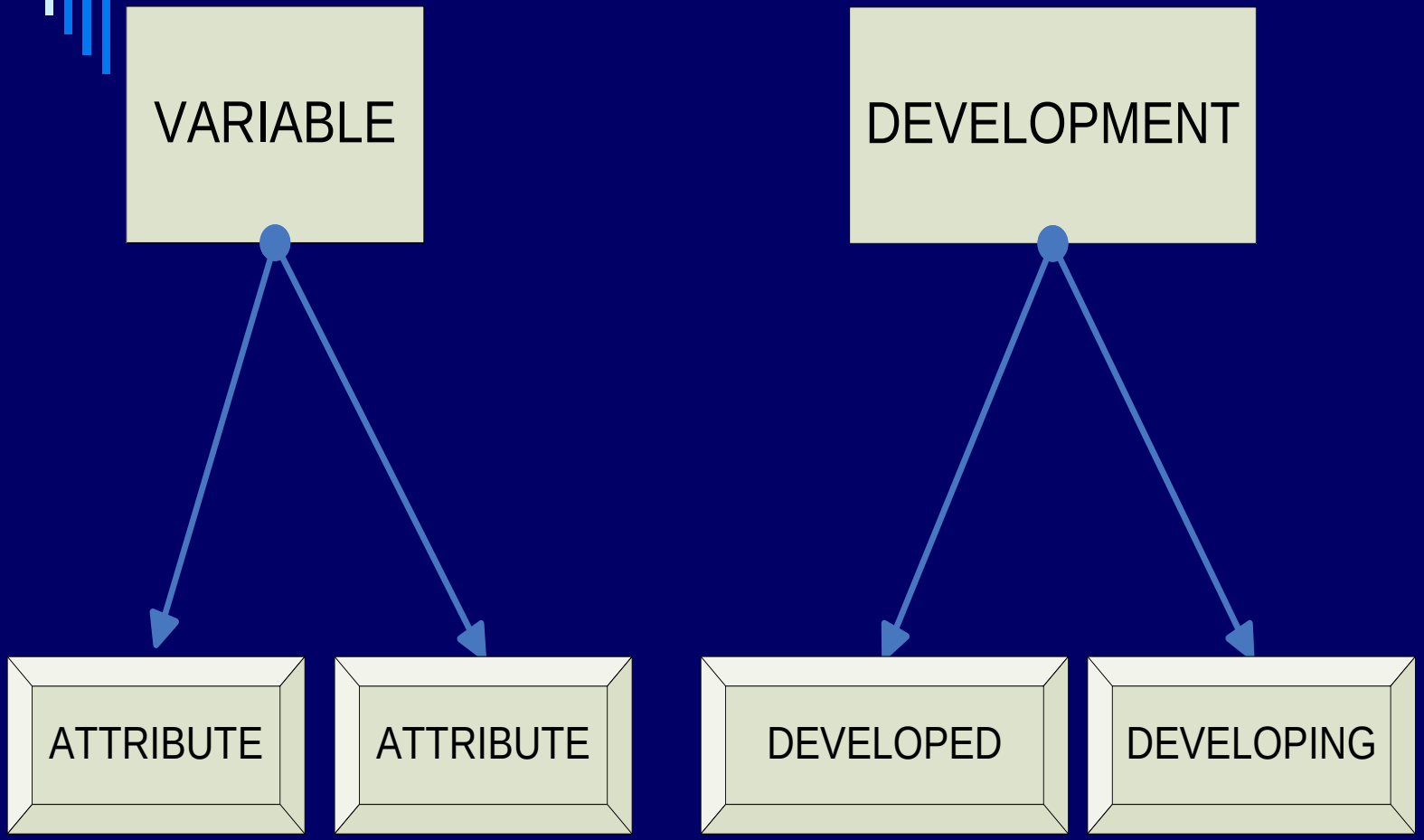
Measurement

- If our studies do not allow us to measure variation in the dependent variable (Y) as related to variation in our X variables, then we cannot do any scientific testing.
  1. We measure whether certain variables are meaningful – individually significant.
  2. We measure the variation in our variables.
  3. We also measure the significance and explanatory power of our models and the relationships between variables.
  4. If it can be quantified, then you should do so.

Qualities of Variables

- Exhaustive -- Should include all possible answerable responses. (Schooling: No Schooling, Elementary, Middle, HS, College)
- Mutually exclusive -- No respondent should be able to have two attributes simultaneously (e.g. Female Male).

Some Definitions



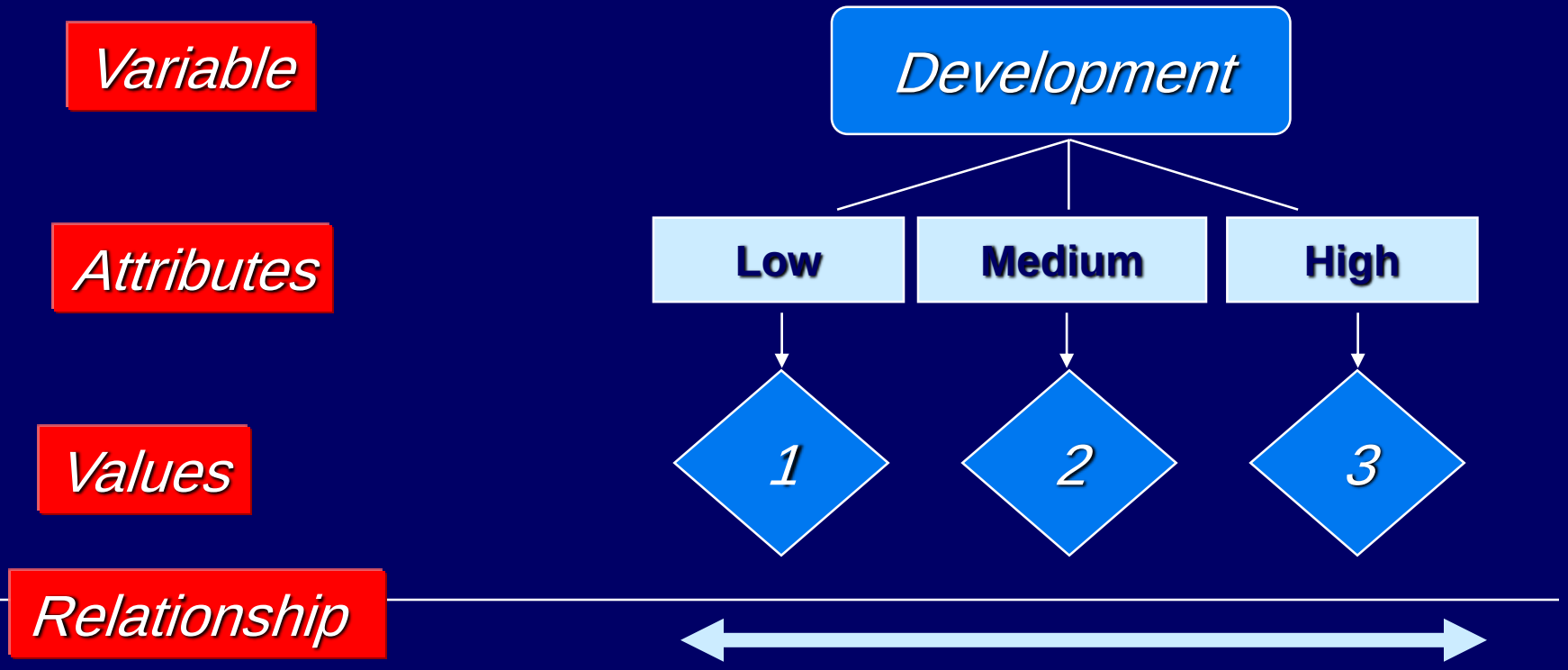
How do we construct variables?

- In order to “Operationalize” our variables we must first define them and then select a means to construct them. We do this by connecting concepts to observations.

- This requires choosing a level of measurement.

What Is Level of Measurement?

The relationship of the values that are assigned to the attributes for a variable



The Levels of Measurement

- Nominal
- Ordinal
- Interval
- Ratio

Nominal Measurement

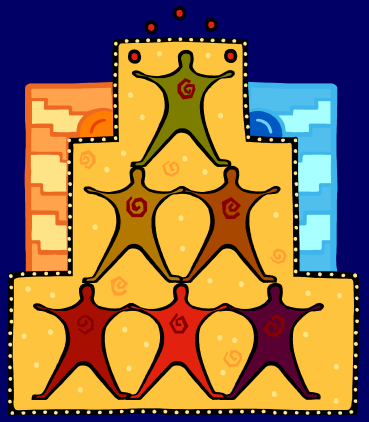
- The values “name” the attribute uniquely (classification).
- The value does not imply any ordering of the cases, for example, jersey numbers in football and dates in a calendar.

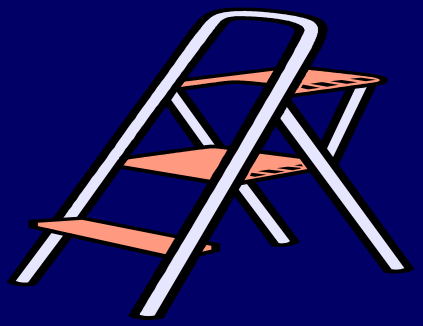
Nominal continued

- Nominal: These variables consist of categories that are non-ordered. For example, race or ethnicity is one variable used to classify people.
  - A simple categorical variable is binary or dichotomous (1/0 or yes/no). For example, did a councilwomen vote for the ordinance change or not?
  - When used as an independent variable, it is often referred to as a “dummy” variable.
  - When used as a dependent variable, the outcome of some phenomenon is either present or not.

Ordinal

- Ordinal: These variables are also categorical, but we can say that some categories are higher than others. For example, income tax brackets, social class, levels of education etc.
  - However, we cannot measure the distance between categories, only which is higher or lower.
  - Hence, we cannot say that someone is twice as educated as someone else.
  - Can also be used as a dependent variable.





Ordinal Measurement

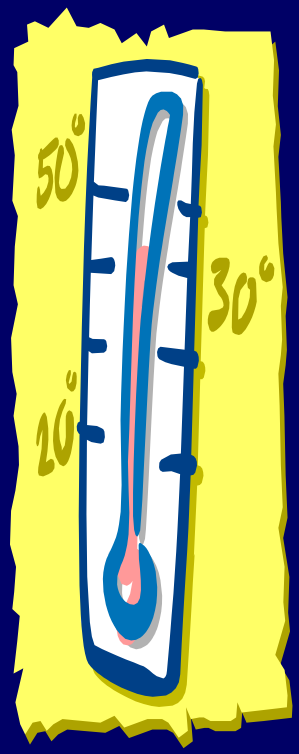
When attributes can be rank-ordered…

- Distances between attributes do not have any meaning, for example, code Educational Attainment as
  - 0=less than H.S.
  - 1=some H.S.
  - 2=H.S. degree
  - 3=some college
  - 4=college degree
  - 5=post college

Is the distance from 0 to 1 the same as 3 to 4?

Interval

- Interval: Variables of this type are called scalar or index variables in the sense they provide a scale or index that allows us to measure between levels. We can not only measure which is higher or lower, but how much so.
  - Distance is measured between points on a scale with even units.
  - Good example is temperature based on Fahrenheit or Celsius.



Interval Measurement

When distance between attributes has meaning, for example, temperature (in Fahrenheit) -- distance from 30-40 is same as distance from 70-80

- Note that ratios don't make any sense -- 80 degrees is not twice as hot as 40 degrees (although the attribute values are).

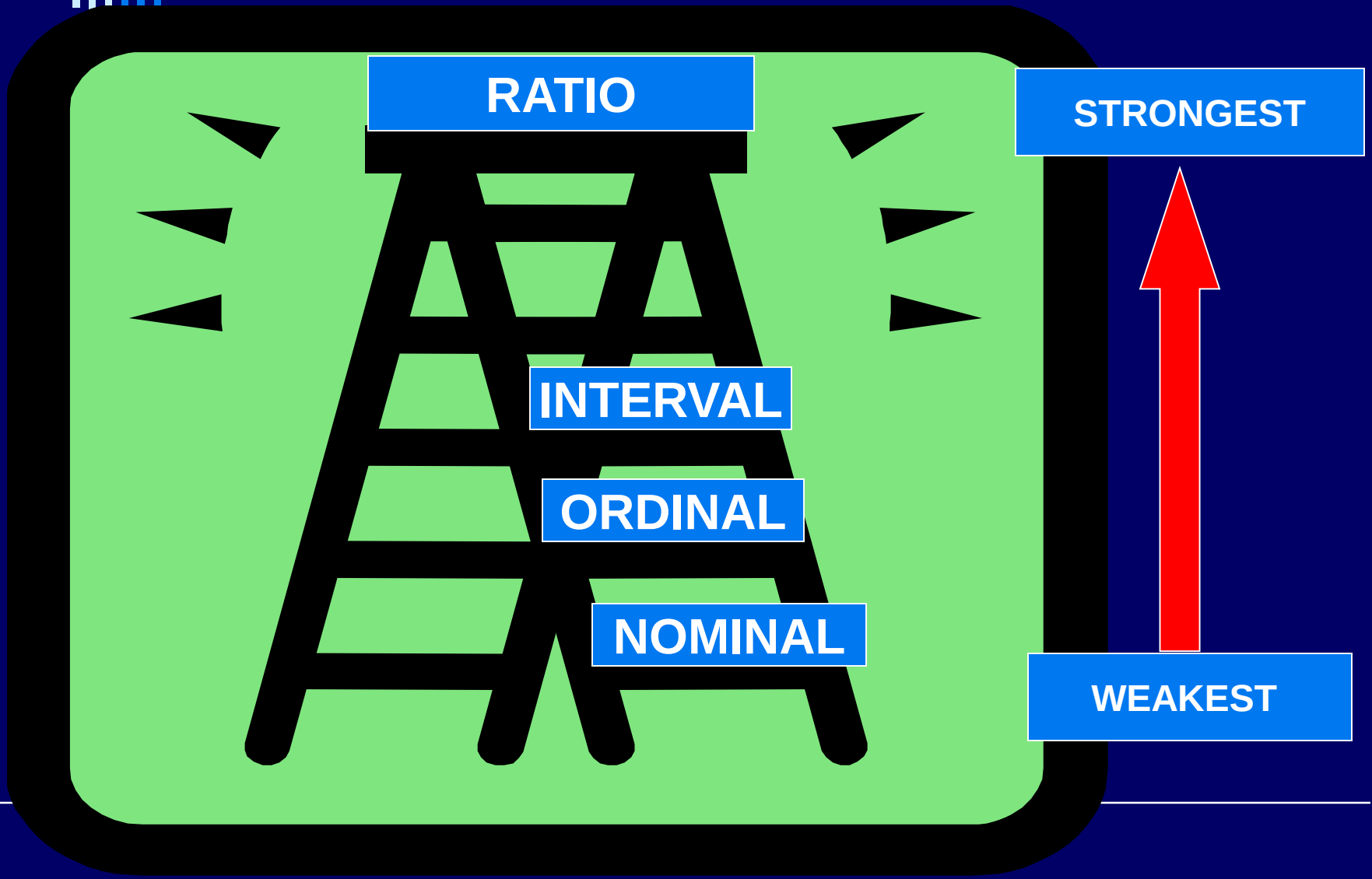
Ratio

- Ratio: Similar to interval level variables in that it can measure the distance between two points, but can do so in absolute terms.
  - Ratio measures have a true zero, unlike interval measures.
  - For example, one can say that someone is twice as rich as someone else based on the value of their assets since to have no money is based on a starting point of zero.

Ratio

- Has an absolute zero that is meaningful
- Can construct a meaningful ratio (fraction), for example, number of clients in past six months
- It is meaningful to say that “...we had twice as many clients in this period as we did in the previous six months.

Measurement Hierarchy



Research Validity

- Construct * (Already explained)
- Internal
- External
- Statistical

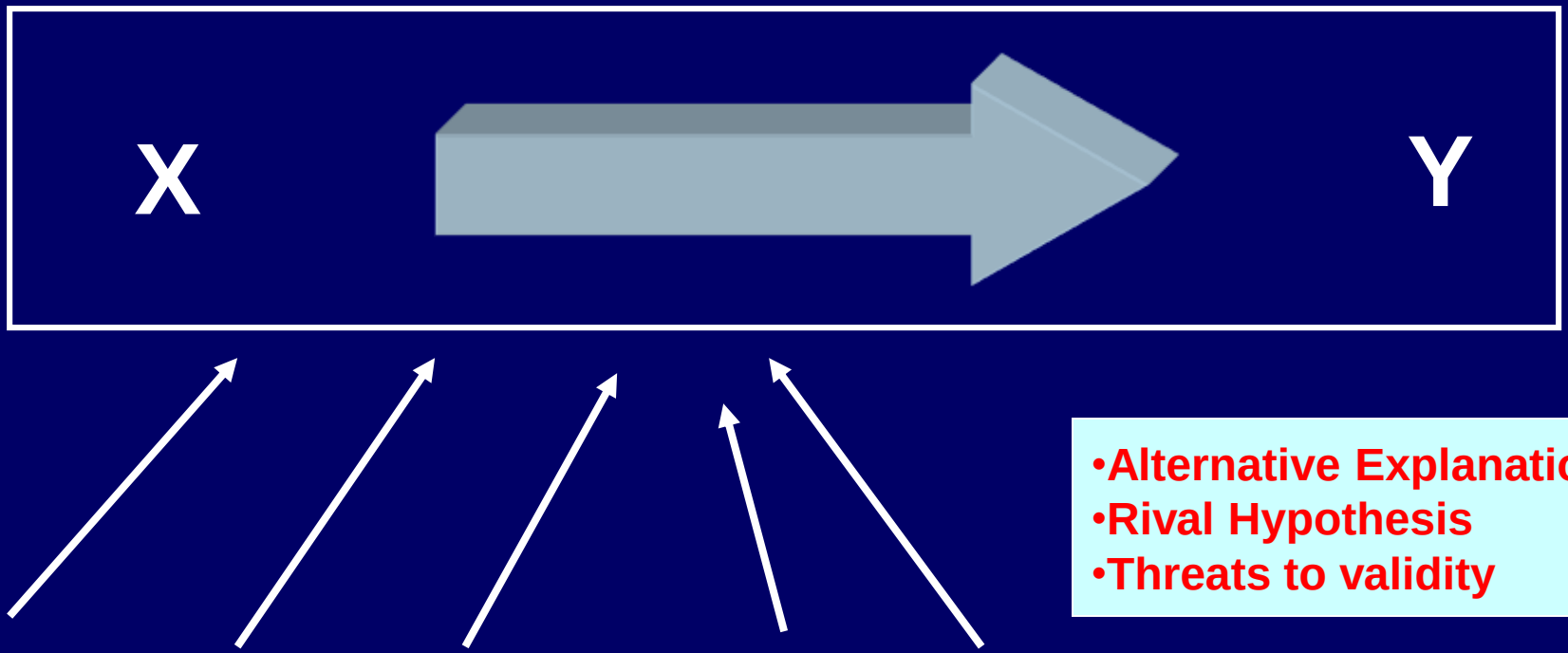
Internal Validity

- **Are there other causes for what I am observing?**
- If so, a study will lack internal validity if it cannot rule out plausible alternative explanations.
- Can the outcome (diminished corruption) be fully attributed to the program in place (tougher sanctions)?

Internal Validity

Our Cause (s)

The outcome
Results



- Alternative Explanations
- Rival Hypothesis
- Threats to validity

History, Maturation, Testing, Instrumentation, selection, mortality, etc.

External Validity

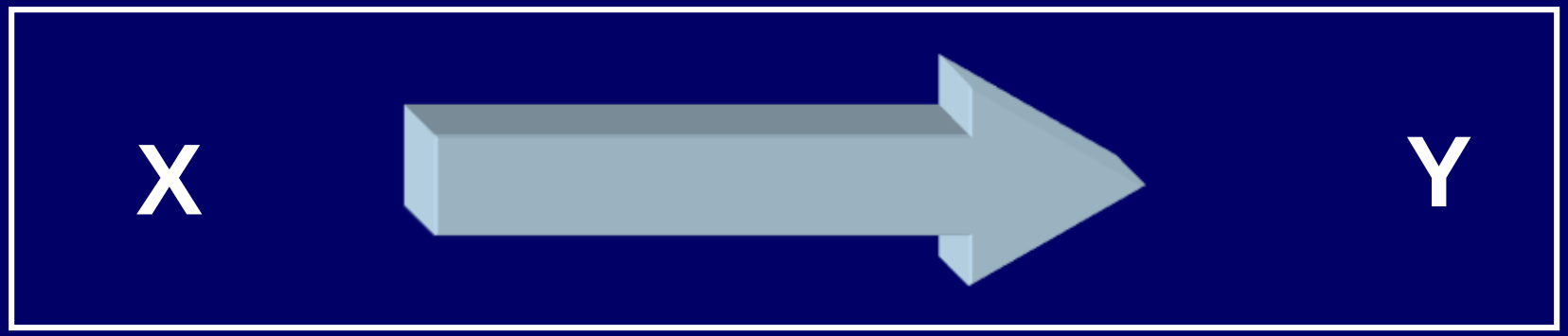
- How well does my study or sample relate to the general population?

  In other words, am I able to generalize to other population, places, across time?

External Validity

Our Cause (s)

The outcome
Results



- Alternative Explanations
- Rival Hypothesis
- Threats to validity

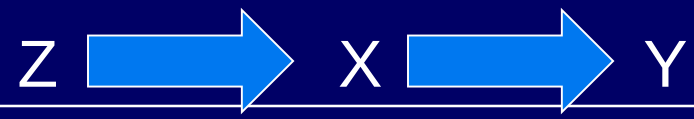
Selection * treatment

History * Treatment

Settings & Treatment

Model Misspecification and Spuriousness

- Antecedent variable: A variable that indirectly affects the relationship between two other variables.
- For example, College education increases income. (X → Y)
  - However, parents wealth and education (Z) plays a key role. Thus, income of college graduates may not be random.

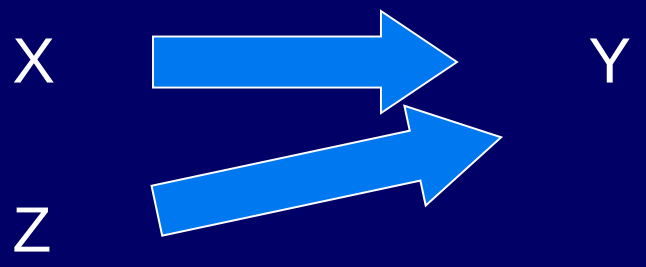


Model Misspecification and Spuriousness

- Intervening Variable: These may be spuriously related to another relationship.
  - **Drinking coffee causes cancer.**
  - Drinking coffee may not be the cause of cancer, but rather the fact that smokers are also coffee drinkers.

Model Misspecification and Spuriousness

- Alternative Variables: We also want to control for variables that would bias our results if omitted.
- In this case, the X variables in a model would produce biased estimates, undermining their validity and producing error that leads to inaccurate inferences.
- To forecast correctly the number of medals we need to know something about institutions and sports culture of a country.



Statistical Validity

- The level of measurement used to some extent determines the type of statistical test used (Chi squared is more appropriate to test association between nominal variables)
- We use statistics to test the likelihood or probability of being wrong in our conclusions
- The selection of an adequate statistical test is important to quantitative research
- How do we know if the relationship that we found is due to chance?

Research types and validity priorities

VALIDITY

RESEARCH TYPE	INTERNAL	EXTERNAL	CONSTRUCT	STATISTICAL
DESCRIPTIVE				
EXPLORATORY				
EXPLANATORY				
EVALUATION				
PUBLIC OPINION				