

# The Theory of Measurement

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# Measurement: what is it?

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- ❑ Measurement ≠ just assigning values/ numbers
  - ❑ Measurement = assigning values in a systematic and grounded way.
  - ❑ This involves
    - **Ontology**: a definition of the quantity or category that identifies its boundaries, fixing what belongs to it and what does not.
    - **Representation**: a metrical system that appropriately represents the quantity or category.
    - **Procedures**: rules for applying the metrical system to produce the measurement results.
  - ❑ All three must mesh properly.
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# Ontology

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- Two kinds of concepts (cf Weber, Neurath)
    - Concepts referring to specific features: age, minimum wage, ...
    - 'Ballungen' concepts: happiness, race, social exclusion.
  - The difference is
    - Not facts vs values;
    - Not 'natural' vs socially constructed;
    - Not 'real' vs nominal or made up;
    - Not observable vs unobservable.
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# Ontology: characterizing a feature

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- Ways to characterize concepts
    - Via explicit definition
    - Via implicit definition
    - Via operational definition.
  - Usual trade-off wrt common metrics
    - Accuracy of characterization relative to purpose
    - versus
    - Breadth of applicability.
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# Representation: showing it has the right characteristics (1)

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**Concepts for specific features:** the 'theory of measurement' (Suppes et al.)

- Construct a representation.
- (In the ideal) prove a **representation theorem**: show that characteristics of the concept match those of the representation.

## Examples

- If adding an option to 2 equivalent sets results in equivalent sets (plus 2 other axioms), the measure for economic freedom must be a sheer cardinality measure.
  - A scale of 1 -10 must be treated as a pure ordering if 9 units  $\neq$  3 times the amount of the quantity possessed by individuals with 3 units.
  - Poverty: cardinality measures do not represent depth of poverty.
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# Representation

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- Different types of representation suit different types of concept.
    - Ballungen concepts: tables of indicators (e.g. EU measure for social exclusion).
    - Concepts referring to specific features: single-valued functions from items measured to values (e.g. age).
  - Stevens: Measures may
    - Enumerate instances of a concept, e.g. proportion of a population that is male;
    - Order instances of the concept, e.g. rank colleges on the quality of their students;
    - Order instances of the concept on a scale with equal intervals, e.g. GDP;
    - Order instances of the concept on a scale with equal ratios and a true zero point, e.g. perceptual scales of loudness.
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# Representation: showing it has the right characteristics (2)

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## **Ballungen Concepts**

- Refine them, thereby losing
    - Much of the original sense and associations; e.g. poverty
    - Comparability across uses. (Beware of punning!)
  - Use tables of indicators, thereby losing
    - Ability to rank across time and individual units
    - Chance of precise prediction/explanation.
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# Procedures

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- Accuracy = getting the true values.  
Precision = getting narrow values.
  - The problem of 'nomic measurement':  
Ex: thermometer.
  - Solutions
    - Check via other procedures.
    - Derive the requisite regularity from theory.
    - Resort to operational definition.
    - Use uncontroversial regularities.
    - **COHERENCE** along all these dimensions.
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# Procedures (Cont'd)

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- ❑ Should mesh with ontology and representation  
—and shown to be
  - ❑ Empirical regularities are central to this job
  - ❑ May be different for different kinds of systems  
or in different contexts or given different  
available instruments
  - ❑ Empirical regularities should ensure that  
different procedures measure the same thing
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# Getting the procedures right

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- ❑ Procedures to measure concept may violate common sense understanding of concept, e.g. unemployment
  - ❑ Measurement procedures may combine variables with different underlying relations for other concepts, e.g. "happiness" and "satisfaction"
  - ❑ Same nominal concept may be measured by different procedures when used for different purposes, e.g. QOL.
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# Value-laden concepts/ measures

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- ❑ The intrusion of values and the value implications of a measure can require real expertise to spot (cf. AB Atkinson on poverty measures).
  - ❑ Values and value implications are hard to eliminate. Choices must be made that advantage one group over another with no scientific basis for choice (cf, CPI, poverty measures).
  - ❑ It is often inappropriate to eliminate values (cf. the Stern report on the economics of climate change).
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# Implications

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- ❑ If ontology, representation, and procedures are well specified, common measures are possible
  - ❑ Use of concepts for different purposes often leads to changes in ontology, representation and/or procedures that disrupt the possibility of common measures. This is especially likely for ballungen concepts.
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# Implications (Cont'd)

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- Many policy related social science concepts lack a firm scientific basis for their definition and often their definitions depend on values. The varying purposes for which they are used makes common measures very difficult, if not impossible.
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