Measurement and Meaning

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What do these statements mean?

The box weighs 22 lbs

The box has a mass of 10 kilograms

Gus likes blue better than black

Gus likes blue twice as much as black

Kim thinks there is a 30% chance of rain tomorrow

Kim remembers when it rained on the 4^{th} of July

Sally is very intelligent

Sally has an IQ of 140

“Epochs” in the study of mental life

Introspectionism (Wundt, Titchener)

~1880s-~1920s

Behaviorism (J.B. Watson, Skinner)

~1910s-~1960s

Cognitivism (G. Miller, Chomsky)

~1950s-???

Post-cognitivism?

~1980s-present

A brief history of psychological measurement

Phenomenalism (Kant, Mach) – ~19th Century

Logical positivism and the Vienna Circle (Carnap, Reichenbach, Schlick) - ~1930s

- Verificationism

Norman R. Campbell and the Ferguson Committee's challenge to psychology (~1920-~1940s)

Measurement theory (1950s-present)

A model of science underlying MT

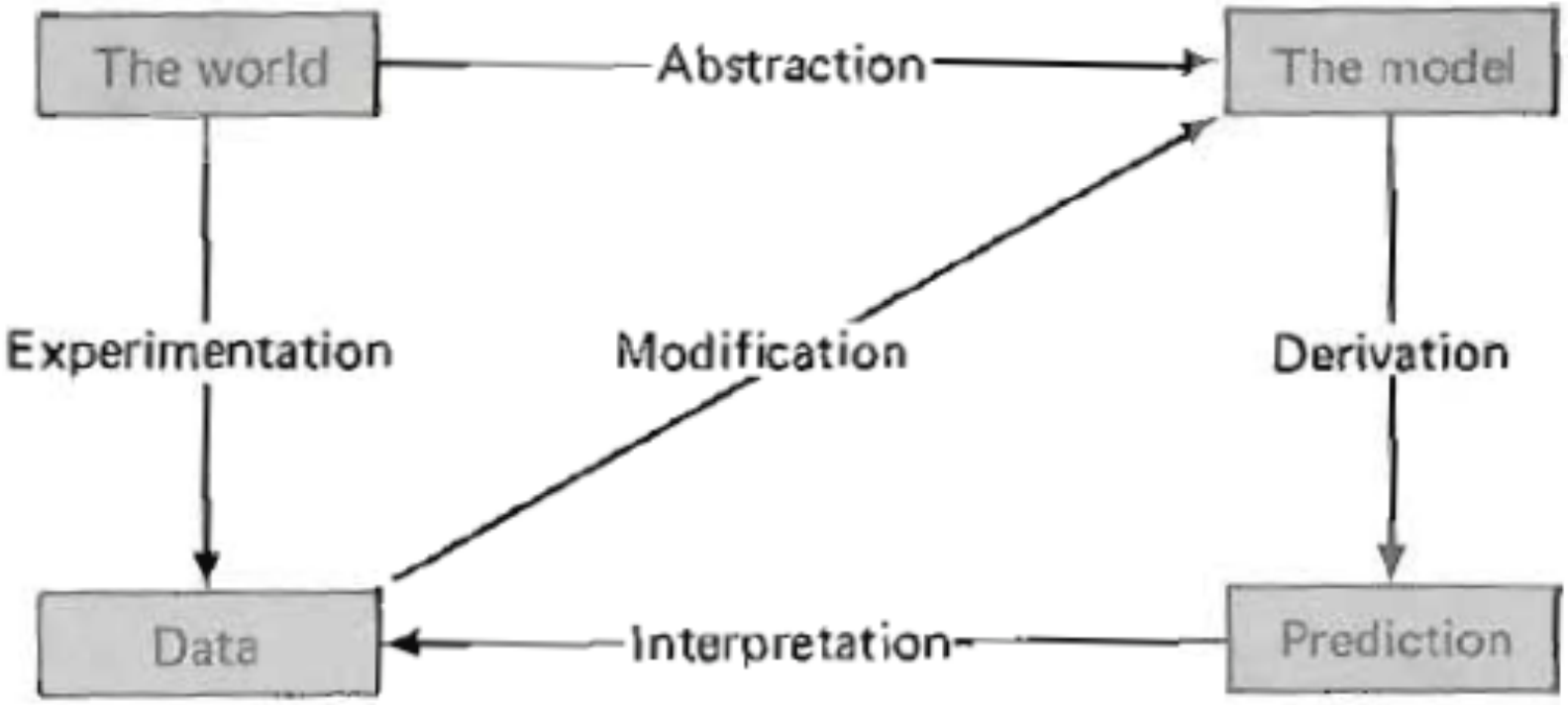

Fig. 1.1 Schematic illustration of a scientific investigation.

Elemental problems of measurement theory

The representation problem

The uniqueness problem

The meaningfulness problem

The scaling problem

Representation theorems

Given an empirical relational system

- <Set-of-boxes,Heavier-than>

And a formal relational system

- <X,R>

<Set-of-boxes,Heavier-than> is represented by <X,R> if there is a function f:X->Re+ such that for all x,y in X, Box-x Heavier than Box-y implies f(x) R f(y).

Representation theorems can be

Constructive (defining a scale)

Empirically verified through experiments

Uniqueness – scale types [admissable transformations] (Stevens' classification, 1951)

Nominal [x->y uniqueness preserving]

Ordinal [x->f(x) strictly increasing]

Interval [x->rx+s]

Ratio [x->rx]

Absolute [x->x]

Meaningfulness

A statement involving numerical values is meaningful only if its truth or falsity is invariant under all admissable transformations of the scale values

Probability elicitation methods

Direct response

Choice then confidence procedure

Indifference method

Proper scoring rules (e.g. Brier score

$$B(\mathbf{r}, i) = \sum_{j=1}^{C} (y_j - r_j)^2$$

Utility measurement

Certainty equvalent – What amount for certain would make you indifferent to a gamble or receiving X with probability p?