26:010:557 / 26:620:557
Social Science Research Methods

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Overview

- Some Questions to Ponder
- Greek Philosophy of Science
- Medieval Philosophy of Science
- Saving the Appearances
- The Seventeenth Century
- Newton’s Axiomatic Method
- New Science and Scientific Method
- Inductivism

Some Questions to Ponder

- Is all research scientific?
  - The former President of the A.A.A. tells me so
    - Do you agree?
- Must non-scientific research be bad research?
- What makes some science “good” science?

Last Time . . .

- We considered what philosophy is . . .
- . . . and its separation from science . . .
- . . . and some of its branches
- We discussed big philosophical issues in
  - Metaphysics
  - Epistemology
- We considered Philosophy of Science as a second-order criteriology . . .
- . . . discussed why it is relevant to us . . .
- . . . and agreed to adopt both a historical and a topical approach to studying it

Some Questions to Ponder

- "Stubbing my toe causes me pain"
  - What does this mean?
- "Time pressure causes auditors to make more mistaken decisions"
  - What does this mean?
  - How is it similar?
  - How is it different?

Greek Philosophy of Science

- Aristotle's Inductive-Deductive Method
  - Observations
    - lead by induction to
  - Explanatory principles
    - which by deduction lead to
  - Statements about the observations
- Induction
  - By enumeration
  - By 'intuition'
- Deduction
  - Syllogism
- Genuine scientific knowledge has the status of necessary truth

Greek Philosophy of Science

- Extralogical requirements of scientific explanation
  - Premises must be true
  - Premises must be indemonstrable
  - Premises must be better known than the conclusion
  - Premises must be *causes* of the attribution in the conclusion
- Causes must be distinguished from accidental correlations
- A causal relation
  - Is true of every instance of the subject
  - Is true of the subject precisely
  - Is “essential” to the subject

Greek Philosophy of Science

- Aristotle's Four Causes
  - A prerequisite for scientific explanation
  - Formal cause
    - Nature, shape or design – general conditions
  - Efficient cause
    - What brought it about (closest to our modern term)
  - Material cause
    - Physical substance
  - Final cause
    - Purpose or intention (telos)

Greek Philosophy of Science

- Pythagorean philosophy
  - Mathematical harmony provides insight into the structure of reality
- "Saving the appearances"
  - Do mathematical relations that fit observed phenomena count as explanations?
  - Superimposing mathematical relations on phenomena "saves the appearance" but does not necessarily explain why the phenomena are as they are

Greek Philosophy of Science

- Deductive systematization (cf. Euclid, Archimedes)
  - The structure of a completed science should be a deductive system of statements
    - Axioms self-evidently true
    - Theorems deduced from axioms
    - Deductions make contact with reality

Atomism

- All that is real is the motion of atoms through the void
  - Entirely materialistic
    - No place for spiritual values, purposes, etc.
  - Ad hoc explanations
    - Unverifiable

Medieval Philosophy of Science

- Robert Grosseteste
  - Affirmed inductive-deductive pattern
  - Described as ‘resolution’ and ‘composition’
  - Hence subsequently known as the ‘Method of Resolution and Composition’
  - Developed inductive precursor to Mills’ ‘Joint Method of Agreement and Difference’
  - Method of Falsification (Modus [Tollendo] Tollens)
    - Used to eliminate all but one of competing explanations

Medieval Philosophy of Science

- Roger Bacon
  - Grosseteste's pupil
  - Emphasized accurate and extensive factual knowledge
  - 'First prerogative'
    - Principles induced by 'resolution' subjected to test of *further* experience
  - 'Second prerogative'
    - Data generated by active experimentation

Medieval Philosophy of Science

- Duns Scotus
  - Method of Agreement
    - ‘e’ *can be* the effect of a circumstance present in every instance
    - Establishes ‘aptitudinal unions’ only, not necessities
- William of Ockham
  - Method of Difference
    - A circumstance present when ‘e’ is present, and absent when not, *can be* the cause of ‘e’
  - Ockham’s Razor

Medieval Philosophy of Science

- Necessary Truth
  - Aristotle
    - First principles of science are necessary truths
  - Duns Scotus
    - Sense experience is sufficient to recognize truth of a first principle, but not to prove its necessity
    - A first principle is true in virtue of the meaning of its terms
    - Empirical generalizations are contingent
  - Nicholas of Autrecourt
    - Necessary truths satisfy the Principle of Non-Contradiction

Saving the Appearances

- Copernicus
  - A Pythagorean approach
    - The sun centered system was more than just a computational device
- Osiander
  - Took a contrary view of Copernicus' theory
- Galileo v. Cardinal Bellarmine
  - Despite disclaimers, Galileo took Copernicus' view
- Kepler
  - God as mathematician
  - Basically Pythagorean, but some suspect developments

Saving the Appearances

- Bode's Law

Planets:	Mercury	Venus	Earth	Mars	Asteroids	Jupiter	Saturn
Predicted:	4	7	10	16	28	52	100
Actual:	3.9	7.2	10	15.2	-	52	95.4

Saving the Appearances

- Bode's Law

Planets:	Mercury	Venus	Earth	Mars	Asteroids	Jupiter	Saturn	Uranus
Predicted:	4	7	10	16	28	52	100	196
Actual:	3.9	7.2	10	15.2	-	52	95.4	191.9

Confirmed? Real?

Saving the Appearances

- Bode's Law

Planets:	Mercury	Venus	Earth	Mars	Asteroids	Jupiter	Saturn	Uranus	Neptune
Predicted:	4	7	10	16	28	52	100	196	388
Actual:	3.9	7.2	10	15.2	-	52	95.4	191.9	300.7

Discredited?

Saving the Appearances

- Bode's Law

Planets:	Mercury	Venus	Earth	Mars	Asteroids	Jupiter	Saturn	Uranus	Neptune	Pluto
Predicted:	4	7	10	16	28	52	100	196	(388)	388
Actual:	3.9	7.2	10	15.2	-	52	95.4	191.9	(300.7)	395

Rehabilitated?

The Seventeenth Century

- Galileo
  - The book of nature is written in the language of mathematics
  - Physics restricted to statements about ‘primary qualities’
    - ‘Primary qualities’ are objective
    - ‘Secondary qualities’ are subjective
  - Excluded teleology
  - Anti-Aristotelian polemic not directed against inductive-deductive method, but against misapplication of it
  - Valued abstraction and idealization
  - Emphasized creative imagination in Method of Resolution
  - Applied Grosseteste and Bacon’s Method of Resolution
  - Ambivalent on experimental confirmation
  - Affirmed Archimedean ideal of Deductive Systematization

The Seventeenth Century

- Francis Bacon
  - Controversial role in the history of the philosophy of science
  - More successful as an expositor than as an innovator?
  - 'Novum Organum' claimed originality
    - Gradual, progressive inductions
    - Method of Exclusion (to eliminate accidental correlations)
    - 'Instances of the Fingerpost' to decide between competing explanations
  - Some criticisms of Aristotle misguided
  - Propagandist for organized scientific research
  - Moral imperative for man to recover domination over nature lost in the Fall

The Seventeenth Century

- Francis Bacon
  - The study of nature has been obscured by four classes of “Idols”
    - Idols of the Tribe
      - ➔ Human nature: postulates regularity, generalizes hastily, overemphasizes confirming instances
    - Idols of the Cave
      - ➔ Attitudes that arise from Individual upbringing and education
    - Idols of the Marketplace
      - ➔ Vulgar usage of words impedes scientific concept-formation
    - Idols of the Theater
      - ➔ Received dogmas and methods of various philosophies

The Seventeenth Century

- Descartes
  - Inverted Bacon's procedure to proceed from most general claims
  - Committed to Archimedean ideal of deductive hierarchy
  - Like Galileo, distinguished 'primary' and 'secondary' qualities
  - Combined Archimedean, Pythagorean and atomist perspectives
  - Derived several important physical principles
  - Observation and experiment
    - Knowledge of conditions for events occurring
    - Suggest hypotheses specifying mechanisms consistent with fundamental laws
  - Recognized the value of experimental confirmation

Newton's Axiomatic Method

- Opposed theorizing about nature from metaphysical principles
- Method of Analysis and Synthesis
- Stressed experimental confirmation
- Emphasized the value of deducing consequences that go beyond the original inductive evidence
- Absolute Space and Absolute Time distinct from 'sensible measures'
- The bucket experiment

Newton's Axiomatic Method

- Formulation of an axiom system
- Specification of a procedures for correlating theorems of the axiom system with observations
- Confirmation of the deductive consequences of the empirically interpreted axiom system
- Sought to exclude 'hypotheses' from experimental philosophy
- For Newton
  - 'Theory' meant invariant relations among terms designating manifest qualities
  - 'Hypotheses' meant statements about terms designating 'occult qualities' for which no measuring procedures are known

Newton's Axiomatic Method

- Fruitful explanatory hypotheses
  - Admit no more causes than are sufficient to explain appearances
  - Assign the same causes to same effects
  - Qualities of bodies, which admit neither intensification or remittance of degrees, to be esteemed universal qualities (e.g., extension,hardness)
  - Propositions inferred by general induction 'nearly' true
- Scientific laws are contingent

New Science and Scientific Method

- John Locke
  - Like Newton, committed to atomism
  - Ignorance of atoms a contingent matter
  - Science consists of generalizations that are at best probable
  - Necessary connections do exist in nature
  - ‘Ideas’ are the effect of atoms in the real world

New Science and Scientific Method

- Gottfried Leibnitz
  - Successful practicing scientist
  - Two-way commerce between scientific theories and metaphysical principles
    - E.g., principle of continuity
  - Interpreted the universe using teleological considerations
  - Scientists reach only ‘moral certainty’
  - General metaphysical principles are necessary truths

New Science and Scientific Method

- David Hume
  - Extended and made consistent Locke's skeptical approach to the possibility of necessary knowledge of nature
  - All we can learn is constant conjunctions
    - All knowledge is subdivided into 'relations of idea' and 'matters of fact'
    - Knowledge of 'matters of fact' is given in and arises from sense impressions
    - Necessary knowledge of nature presupposes knowledge of the necessary connectedness of events

New Science and Scientific Method

- David Hume
  - Certain statements about the relations of ideas are necessary truths, established independently of any appeal to empirical evidence
  - Statements about matters of fact are never more than contingently true, and must be established by appeal to empirical evidence
  - Sense impressions are the sole knowledge of matters of fact

New Science and Scientific Method

- David Hume
  - If by ‘causal relation’ we mean both ‘constant conjunction’ and ‘necessary connection’ we can achieve no causal knowledge at all
  - Our impression of necessity is derived from custom and habit of mind
  - Eight Rules by which to judge of Causes and Effects

New Science and Scientific Method

- Immanuel Kant
  - Greatly disturbed by Hume's analysis of causation
  - Distinguished between the matter and the form of cognitive experience
  - Three stages in the cognitive organization of experience
    - Unstructured 'sensations' are organized with respect to Space and Time
    - Ordered 'perceptions' are related by means of concepts such as Unity, Substantiality, Causality and Contingency ('Categories of the Understanding')
    - 'Judgments of Experience' are organized into a single system of knowledge through 'Regulative Principles of Reason'

New Science and Scientific Method

- Immanuel Kant
  - With respect to theories, he valued predictive power and testability
  - Three ‘analogies of experience’ (necessary conditions for objective empirical knowledge)
    - E.g. “For every event there is some set of circumstances from which the event follows according to a rule”
  - We must systematize our knowledge *as if* nature were purposively organized
  - He defended the use of idealizations in scientific theories

Sidebar

- Rationalists
  - Descartes
  - Leibnitz
- Empiricists
  - Locke
  - Berkeley (Anti-realism, Idealism)
  - Hume (Skepticism)
- Transcendental Idealist
  - Kant
    - Categories
    - Synthetic a priori

New Science and Scientific Method

- John Herschel
  - Distinguished the ‘context of discovery’ from the ‘context of justification’
    - Context of discovery
      - ➔ Inductive schema
      - ➔ Formulation of hypotheses
    - Context of justification
      - ➔ Extension to extreme cases
      - ➔ Unexpected results
      - ➔ ‘Crucial experiments’

New Science and Scientific Method

- John Whewell
  - Sought to base a philosophy of science on a history of science
    - Facts are any pieces of knowledge
    - Ideas are rational principles that bind facts together
    - Pattern of scientific discovery
      - ➔ Collection and decomposition of facts, and clarification of concepts
      - ➔ ‘Colligation of facts’ – a particular conceptual pattern is superinduced on facts
      - ➔ Consolidation and extension

New Science and Scientific Method

- John Whewell
  - Consilience of Inductions
    - Successive incorporation of laws into theories
    - An Inductive Table in the form of an inverted pyramid
    - Inductive generalization in which observations and descriptive generalizations are subsumed under theories of increasing scope
  - Fundamental laws of nature have necessary status

New Science and Scientific Method

- Emile Myerson
  - Distinguished ‘empirical laws’ and ‘causal laws’
  - ‘Empirical laws’ allow prediction
  - ‘Causal laws’ permit understanding

New Science and Scientific Method

- Pierre Duhem
  - Scientific theories ‘represent’ but do not ‘explain’ experimental laws
  - A scientific theory consists of
    - An axiom system
    - Rules of correspondence which correlate some terms of the axiom system with experimentally determined magnitudes

New Science and Scientific Method

- Norman Campbell
  - Distinguished between an axiom system and its application to experience
  - A physical theory comprises
    - A hypothesis (a collection of statements the truths of which cannot be determined empirically)
    - A dictionary (relating the terms of the hypothesis to statements whose empirical truth can be determined)
    - In addition, a theory must be associated with an analogy to a system governed by previously established laws

New Science and Scientific Method

- Mary Hesse
  - The use of analogy in science claims two types of relations between the analogue and the system to be explained
    - Similarity relations between properties of the analogue and properties of the system to be explained
    - Causal relations which hold both for the analogue and for the system to be explained

New Science and Scientific Method

- Rom Harre
  - Argues for the centrality of models as being more consistent with the intuitions of scientists than, say, Duhem's approach:
    - Statements about a model
    - Empirical laws
    - Transformation rules

Inductivism

- John Stuart Mill
  - Context of Discovery
    - Method of Agreement
    - Method of Difference
    - Method of Concomitant Variation
    - Method of Residues
    - (Joint Method of Agreement and Difference)
    - Multiple causation greatly restricted applicability (especially in the case of composition of causes)

Inductivism

- John Stuart Mill
  - Context of Justification
    - Causal relations and accidental relations
      - ➔ Some invariable sequences are causal and others not
      - ➔ A casual relation is both invariable and unconditional
      - ➔ Ultimate laws of nature might be used to determine what is unconditional . . .
      - ➔ . . . But Mill failed to specify these
    - Mill's attempt to *justify* induction is circular