The Scientific Revolution

Foundation of Modernity 1600-1700

Presented By: Tiffany Forward, Melissa Lye, and Nadine Rockwood

overview

• Before the scientific revolution
  • World view was profoundly spiritual
  • Matter and soul not sharply divided

• The seventeenth century
  • Traditional ideas were replaced with scientific and mechanical views
  • Scientific method extended to the study of humans
What is the scientific revolution?

• Started in Europe
• Movement from religion to science
  • Search for mathematical patterns
• Understand life using reason and experiment
• Created modern consciousness, cognition, and psychology
• Influenced all areas of science
The scientific revolution

• Historians today would have suspected the scientific revolution to occur in Islamic or Chinese regions
  • Had vast knowledge and culture compared to Europe
• Europeans were considered ignorant

WHY EUROPE?
Because...

- European social structure
- Differences in religion (Islam versus Christianity)
  - How religion spread
  - Separation of Church and state
  - Creation of autonomous universities (neutral spaces)
  - Authority of the book
  - Reception of Aristotelian natural philosophy
  - Public knowledge
  - Secondary causation

How religion spread

- Christianity – spread slowly through Roman world
  - pagans had to be convinced
- Islam – spread quickly via military conquest
Separation of church and state

Europe

• Separation between church and government (state)
• Roman Corpus of Civil Law became the basis of non-religious European law

Separation of church and state

Islam

•
•
Creation of Universities

• European universities were self-governed corporations
• Independent of religious and secular power
• Could establish own curriculum
  • Free from repression

• Islam did not recognize corporate bodies
• Colleges only taught religious material
  • Teachings of Sharia
  • Memorization of the Koran

Authority of the Book

• Europe – Bible had limited authority
  • Still held in high esteem

  “... it is not the Bible’s role to teach you the nature of things; that is the domain of [natural] philosophy” (William of Conches; pg. 129)

• Islamic laws derived from the Koran and hadiths (oral teachings of Muhammad)
  • Sharia

• Final authority
Aristotelian Natural Philosophy

- European philosophers embraced Greek natural philosophy
  - Centerpiece of the university curriculum
- Combined theology and natural philosophy into a congruent view of the universe

- Islam took what they could use from Greek natural philosophy
  - Geometry
  - Trigonometry

Public knowledge

- Europe – knowledge is public
  - Passed on to all
  - Ideas openly spread, debated, and practiced
- Cumulative knowledge makes breakthroughs possible

- Islam – teaching philosophy was a secret affair
  - Between master and student
    - Ideas died with the professor
- Emperor determined what would be researched and supported
- No guarantee these ideas would be preserved and passed on
## Secondary causation

<table>
<thead>
<tr>
<th>Europe</th>
<th>Islam</th>
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</thead>
<tbody>
<tr>
<td>• God created the world</td>
<td>• God destroys and recreates the universe in every instant</td>
</tr>
<tr>
<td>• Gave objects the power to affect other</td>
<td>of time (occasionalism)</td>
</tr>
<tr>
<td>objects</td>
<td>• Racquet hits tennis ball</td>
</tr>
<tr>
<td>• Hit tennis ball with racquet</td>
<td>• God causes tennis ball to move, not the racquet</td>
</tr>
<tr>
<td>• Racquet causes ball to move</td>
<td></td>
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## Revolution VS. Continuity

<table>
<thead>
<tr>
<th>Internalism</th>
<th>Externalism</th>
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</thead>
<tbody>
<tr>
<td>• History of how scientists think about</td>
<td>• History of social contexts that influence scientific</td>
</tr>
<tr>
<td>technical problems</td>
<td>thought</td>
</tr>
<tr>
<td>• Study of motion</td>
<td>• Science influenced by society</td>
</tr>
<tr>
<td>• Revolution: abrupt break between ancient</td>
<td>• Continuity – continuous development from ancient</td>
</tr>
<tr>
<td>and modern sciences</td>
<td>to modern science</td>
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What we’ve learned thus far

• Christian philosophers accepted merging faith and reason
• Islam followers did not
  • Religion and state were not separated
  • Emperors ruled based on the command of heaven

Religious views

• Christian view being reshaped by the scientific revolution
• Protestant Churches and Catholic Churches demanded internal submission to God
  • The right Christian belief
  • Magical practices and rituals were condemned
• Christian God became a hostile and distant figure
Renaissance Naturalism

- Renaissance naturalism - a perspective including both religion and modern science, accompanied by the concept of “natural magic”
- Explained the world without referencing supernatural powers
  - Attributed supernatural powers to matter
- To counteract this, Mersenne, Descartes, and others taught a clockwork universe

Mechanization of the World Picture

- Revolution triggered by Copernicus’s *Revolution of the Heavenly Orbs*
  - Change from the Earth to the sun as the center of the universe
- Galileo supported this through his physics and found telescopic evidence
- Moon and celestial bodies were no more heavenly than the Earth
Mechanization of the World Picture

• Humans had no soul and behaved as if they had a purpose (teleology)
  • Were complex machines moved only by physical causes
• Belief in a ‘soul’ became less sustainable
• Idea led by the clockwork conception

Clockwork Conception

• The idea that the universe is a machine
  • Celestial clockwork
• Proposed by Kepler, Galileo, and Descartes
• Popular view of universe
Clockwork Conception

“My aim is to show that the machine of the universe is not similar to a divine, animated being, but similar to a clock” (Kepler; pg. 132)

Clockwork conception

• Separated God (a living being) from the universe (a physical thing that He made)
• No need for intervention after the universe was made
• Clockmaker makes a clock, and the purpose behind the clock rests in the maker; the clock itself has no purpose, moving only by the physical causes
• Important implications for psychology
Aristotle’s realist theory of perception

- Sense organ receives the form of the object but not the matter of the object
  - We see the whole statue and not what its made of
- Fell apart due to logic and math

Cartesian theory of perception

- Developed to solve the conflict between calculations of the universe and messy appearance of experience
- Discrepancy between real world and perceived world
Cartesian theory of perception

• Distinction between primary and secondary properties
  • Primary – physically objective properties (wavelength)
  • Secondary – subjective sense properties (color)

• Created the New World – inner world of consciousness
  • Psychology
  • People asked how and why these secondary properties originate

Descartes (1596 – 1650)

• Created a religious-scientific framework of mind and body
• Had two phases of work
  1) Based in mathematical and scientific concepts
  2) Based in philosophy and philosophical justification
Phase 1 outline

- Physiological psychologist
- Had to avoid temptations
- Differences between humans and animals
  - Experience
  - Behaviour
  - Language

Phase 1

- Physiological psychologist
- Goal was to provide physiological accounts of mental processes
  - Dissected animal brains
- Explained behaviour of animals and humans as a result of inner machinery
- Simplified mental functioning to physiologically functioning
Temptations

• Averroism – splitting Aristotle’s human mind from body and associating it with the Christian soul
  – Mind contained general knowledge
  • Christian soul was immortal and the essence of personality
• Alexandrism – brain matter possessed the power of perceiving, remembering, and thinking
  • Denied immortality of the human soul

Power of thought

• Thinking was unique to the human soul
  • Separates humans from animals
• Three aspects of human thought
  • Experience
  • Behaviour
  • Language
Experience

• Human experience differed from animal experience
• Animals lack reflective thought
  • Awareness of own awareness
• Difference between simple awareness (surroundings) and self-awareness
• Animals only have simple awareness

Behaviour

• Thought makes human behaviour more flexible
• Humans respond by thinking
• Animals require preset reflexes/habits
Language

- Unique to humans
- Innate human language of the mind translates to speech
- Animals cannot think with *mentalese* (universal inner language)

L’Homme

- Descartes began writing a book, *L’homme*, on physiology
- Never finished it because he feared being condemned like Galileo
- Did not want to publish a book the Church did not agree with
Phase 2 Outline

- Descartes engaged in philosophy
- Main ideas
  - Dualism
  - Point-like self
  - Cartesian Theater

Phase 2

- Descartes engaged in philosophy
- Investigated his own mind to develop a foundational philosophy
- Doubted every belief until he found something he could not doubt – his own existence
- Doubting is an act of thinking
First truth

“Cogito, ergo sum” (Decartes; pg.143)
(I think, therefore I am)

Dualism

• Soul and body are completely separate
• Subjective world – mind and consciousness
  • Known through introspection
• Mechanical-material world – objective and scientific
  • World as it really is
• Explained primary and secondary sense properties
WHAT ARE THE PRIMARY AND SECONDARY SENSE PROPERTIES?

Point-Like Self

• Soul is a mathematical point
• Does not take up space
• Used for thinking
• Used to control, observe, and report experience
Cartesian Theater

• Developed by Dennis Dennett to explain Descartes model of mind
• See projected images
• Need to inspect image without reference to the actual object
• Consciousness is the collection of sensations the mind examines
Problems with the Cartesian Theater

1) Interaction of the mind and body at the pineal gland
   • How could a spiritual substance act on a material substance?
   • Implausible

2) Problem of other minds
   • How do we know that other people have minds/souls?
     • Language and self-awareness
     • Disproved by evolution
     • Anima can learn language

Other Important figures

• Descartes was an important figure in the Scientific Revolution
• Also other important thinkers that redefined the way the world was viewed

• Leibniz – Consciousness Quantified
• Hobbes – Laws of Social Life
• Spinoza – Determinism Extended
• Pascal – Wagering on God
Gottfried Leibniz (1646-1716)

- Invented calculus
- Universe is composed of an infinity of monads (unit)
  - Somewhat living
  - Some degree of consciousness
- Humans and animals are most dominant monad
  - Most conscious
- Conscious experience could be measured
- Innate dispositions activated by experience or reflection

Leibniz & Parallelism

- Proposed parallelism – mental and physical events are coordinated by God in advance
- Body and mind
  - Do not interact, just run alongside each other
  - Stay coordinated because of God’s perfect harmony
  - Correlated but neither cause the other
**Perception & Sensation**

- Petite perception – stimulus so weak it is not perceived
  - Creation of perceptions
  - Drop of water in the ocean is not perceived – we hear the waves
- Conscious experience is made up of many petite perceptions

- Apperception – perceptions are raw ideas that we become aware of in consciousness and become sensations
  - Creation of sensations

**Leibniz & Attention**

- Attention played a big role in apperception
  1) Active Attention
  - Focusing on single stimulus
  - Listening to just one person at a party
  2) Passive Attention
  - Stimulus grows stronger until we notice it
  - Engaged in another activity and do not notice a person talking to us until it passes a threshold
Thomas Hobbes (1588 – 1679)

• Spiritual substance is a meaningless idea
• Matter exists and determines the actions of people and animals
• Separated rational and meaningful philosophy from irrational and meaningless theology
• First to link right thinking to right use of language

Hobbes & Government

• First to ask “what would people be like in a state of nature without government?”
• His solution was for all members of society to give rights to a government
• Government will rule and protect
Hobbes & Natural Laws

- How rational people act to survive and prosper
- Believed Natural Laws apply to all people
- Follow laws during times when there is security
- Laws are broken during times of ruin
- Important to psychology
  - Social psychology

Baruch Spinoza (1632 – 1677)

- Philosophy that identified God with nature
- Rejected by others, work was repressed
- God (nature) is supporter and creator of all things
- God is no more than the totality of the universe
- Deterministic causes not final causes
Spinoza & the human mind

• Mind not separate from the body
  • Produced by brain processes
  • Rejected dualism

• Human behaviour is not free
  • Cannot blame a fire that burns a house
  • Cannot attach blame to a murderer

Spinoza & Self-control

• Right action and and thinking depend on control of emotions
• Wise person follows reason, not passion
  • Enlightened self-interest
  • Not effort to control God or nature

• Physical universe is beyond our control, passions are not

• Governments should allow freedom of thought, consciousness, and speech
Blaise Pascal (1623 – 1662)

- Studied the vacuum
- Created the mechanical calculator
- Human mind could be an information processor capable of being mimicked by a machine
- Thought and reason might be material calculation in both machine and brain
- Human uniqueness was free will
- Animals may be able to reason

Pascal & Faith

- Struggled with doubting faith in God
- Will and capacity for faith essential for humans
- Created general framework for decision making or judgment under uncertainty
  - Calculating probabilities to gamble rationally
- Convinced nonbelievers to accept God’s existence
  - Can’t hurt to believe but it may hurt (in the after life) not to believe
What We’ve Learned Thus Far

- Ideas of thinking, sensation, perception, and attention were developed
- The laws that govern society were examined
- God was totality of nature
- Based on probabilities, it was better to believe in God

Mathematical vs Experimental Sciences

<table>
<thead>
<tr>
<th>Classical Sciences</th>
<th>Baconian Sciences</th>
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<tbody>
<tr>
<td>Mathematical science</td>
<td>Experimental sciences</td>
</tr>
<tr>
<td>Carried out demonstrations</td>
<td>Little/no theoretical expectations</td>
</tr>
<tr>
<td>of what was already known</td>
<td>Lacked mathematical theories</td>
</tr>
<tr>
<td>to be true</td>
<td>Nature was manipulated</td>
</tr>
<tr>
<td>Not true investigations</td>
<td>Quest for new facts about nature</td>
</tr>
<tr>
<td>Nature was observed, not</td>
<td></td>
</tr>
<tr>
<td>manipulated</td>
<td></td>
</tr>
<tr>
<td>Theory precedes data</td>
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IS SCIENCE TODAY INFLUENCED BY CLASSICAL OR BACONIAN SCIENCES?

Modern Day Science

- Today’s science combines both classical and Baconian sciences
- Classical sciences
  - Development of precise mathematical theories
  - What is an example?
- Experimental sciences
  - Active manipulation of nature to discover new ideas
  - What is an example?
  - Science should be useful
The invention of psychology

• Idea of consciousness
• Objective connection between the order of the universe and the experience of it

Summary

• Scientific Revolution occurred in Europe
• Beginning of movement from religion to science
• Development of science hindered by religion
• Descartes played a large role
• Development of consciousness led to modern day psychology
• Scientific Revolution profoundly and permanently altered life and human self-understanding
Quiz Questions

• Describe the impact religion had on the Scientific Revolution.
• What concepts from 17th century philosophy and physiology are still present today? How have they been further developed?
• Throughout history, how have the proposed differences between animals and humans changed?

Questions?