The Scientific Revolution

Foundation of Modernity 1600-1700

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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

Video

- http://www.youtube.com/watch?v=9hodYUDDfsY

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

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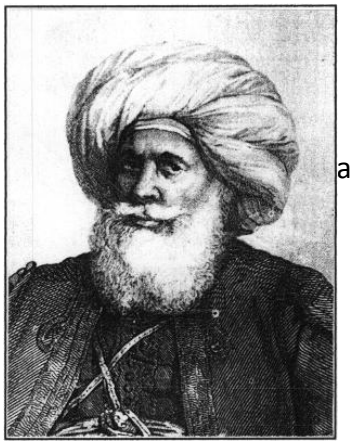


Creation of Universities

- 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

Europe

- God created the world
- Gave objects the power to affect other objects
- Hit tennis ball with racquet
- Racquet causes ball to move

Islam

- God destroys and recreates the universe in every instant of time (occasionalism)
- Racquet hits tennis ball
- God causes tennis ball to move, not the racquet

Revolution VS. Continuity

Interalism

- History of how scientists think about technical problems
  - Study of motion
- Revolution: abrupt break between ancient and modern sciences

Externalism

- History of social contexts that influence scientific thought
  - Science influenced by society
- Continuity – continuous development from ancient to modern science

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

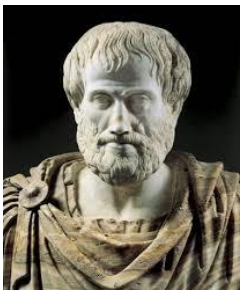
"My aim is to show that the machine of the universe is not similar to a divine, animated being, but similar to a clock" (Kepler; pg. 132)

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

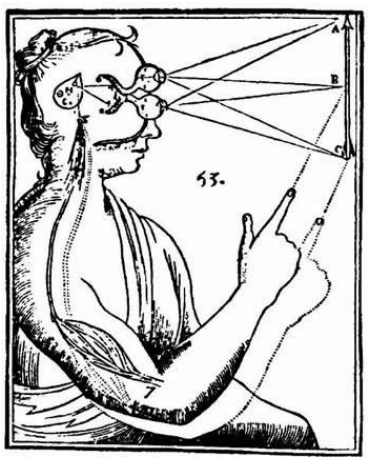
Aristotle's realist theory of perception

- 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



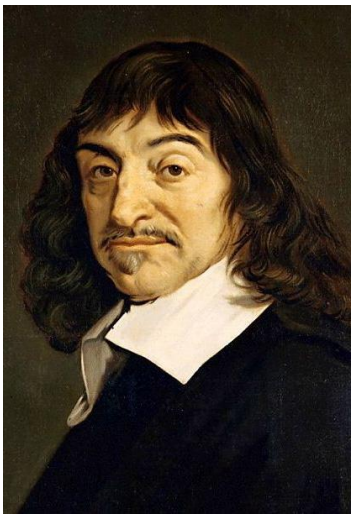
Cartesian theory of perception

- 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

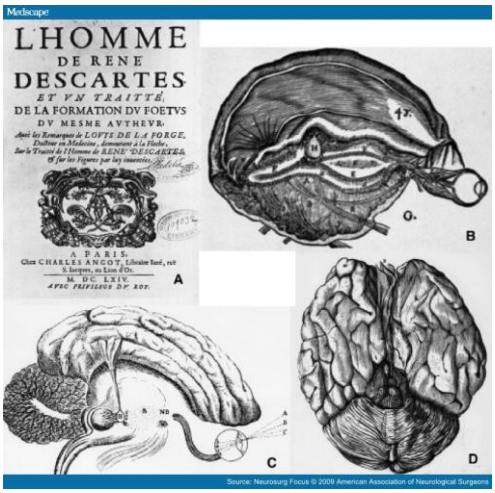
- Thought makes human behaviour more flexible
- Humans respond by thinking
- Animals require preset reflexes/habits

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

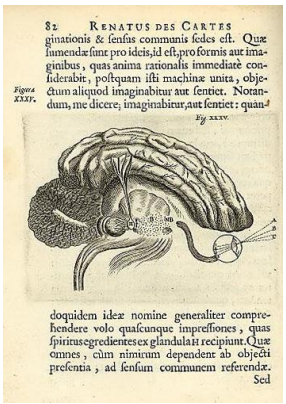
Phase 2

- 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)


82 RENATUS DES CARTES

ginationis & sensus communis sedes est. Quæ sumendæ sunt pro ideis, id est, pro formis aut imaginibus, quas anima rationalis immediatè considerabit, postquam ista machinæ unita, objectum aliquod imaginabitur aut sentiet. Notandum, me dicere, imaginabitur, aut sentiet: quan-

Figura XXXV.

Fig. XXXV.

doquidem ideæ nomine generaliter comprehendere volo quascunque impressiones, quas spiritus egredientes ex glandula H recipiunt. Quæ omnes, cùm nimirum dependent ab objecti presentia, ad sensum communem referendæ. Sed

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?

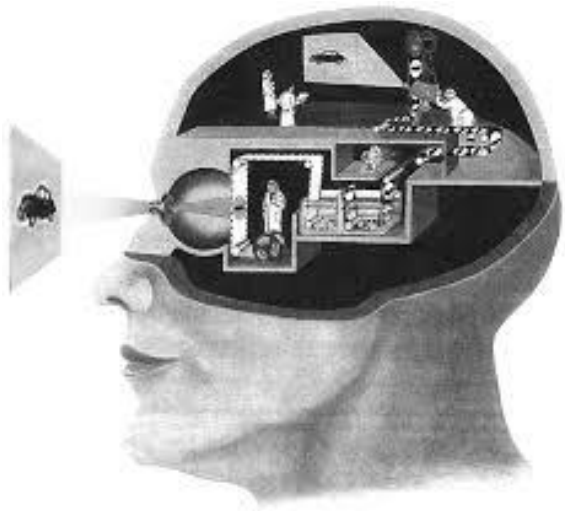
Point-Like Self

- 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

Cartesian theatre



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
  - Animas 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

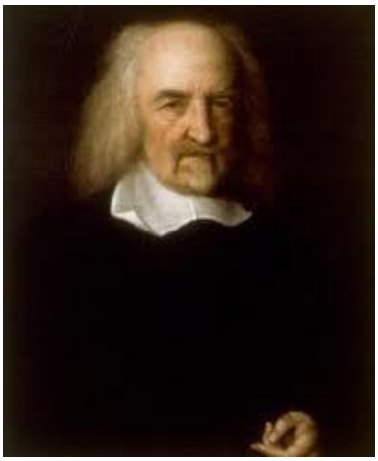
- Focusing on single stimulus
- Listening to just one person at a party

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

Classical Sciences

- Mathematical science
- Carried out demonstrations of what was already known to be true
- Not true investigations
- Nature was observed, not manipulated
- Theory precedes data

Baconian Sciences

- Experimental sciences
- Little/no theoretical expectations
- Lacked mathematical theories
- Nature was manipulated
- Quest for new facts about nature

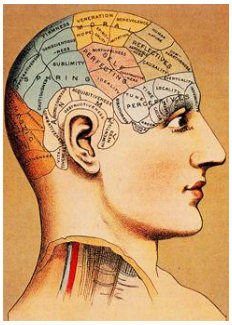
IS SCIENCE TODAY INFLUENCED BY CLASSICAL OR BACONIAN SCIENCES?

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?