Human Brains and Human Life 2
Heterarchy and Self Identity

Mechanisms and Control Mechanisms

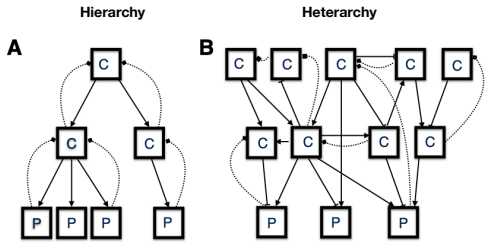
- Mechanisms produce a phenomenon as a result of
  - their component parts each performing activities
  - and these being organized to generate the overall phenomenon
- As characterized, mechanisms will continually produce a phenomenon
  - until materials, including free energy, are exhausted
- Often it is not useful to allow a mechanism to operate all the time
  - one needs some way to turn it off
  or always to operate in the same way
  - one needs some way to modulate its operation
- Control mechanisms
  - operate on the parts of other mechanisms, changing how they behave and hence how the mechanism as a whole acts

Clicker Question

Which feature is characteristic of a hierarchy rather than a heterarchy

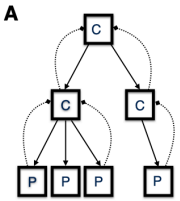
A. Individual mechanisms are often controlled by multiple independent controllers
B. There is a top level controller overseeing all the other controllers
C. There is no strict layering of controllers—controllers can be added to act on any other component

Two Organizational Schemes



Hierarchy

- In a hierarchy, each component, except the one at the top, is subordinate to those above it
  - subordinate components supply information to the component above it
  - and execute the commands given to them by their superior
- Many social organizations employ (at least in theory) a hierarchical organization
  - businesses
  - military
  - governments
  - universities

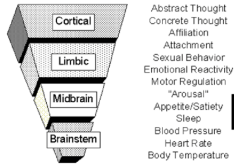


Motivating Hierarchy

- Hierarchy seems to be required to prevent chaos
  - If subordinates are allowed to make their own choices, they may make ones that conflict with those made by others
  - And that undermines the smooth functioning of the whole system
- A central authority (executive) is thought to be needed to
  - Set objectives/goals
  - Respond to conflicting information/goals
  - Keep everything on track

Hierarchy in the Brain

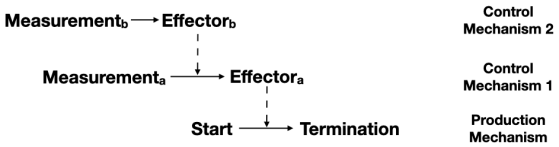
- It is common to think of the brain as organized hierarchically
  - Subcortical areas are subordinate the to neocortex
  - Other cortical areas are subordinate to the prefrontal cortex—the central executive



Abstract Thought
Concrete Thought
Affiliation
Attachment
Sexual Behavior
Emotional Reactivity
Motor Regulation
"Arousal"
Appetite/Satiety
Sleep
Blood Pressure
Heart Rate
Body Temperature

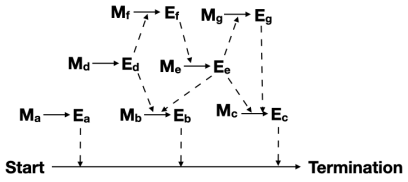
Multiple Control Mechanisms

- One control mechanism can operate on another, suggesting a hierarchy



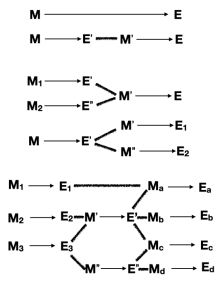
The Breakdown of Hierarchy

- Multiple different control mechanisms can operate independently on the same controlled mechanism
  - It is the controlled mechanism that determines a response to multiple controllers
- A control mechanism can operate on multiple other control mechanisms



Signaling Within Control

- The measurement component of a control mechanism can
  - directly act on the effector
  - or via intermediates
    - signals produced by one component may be responded to by another
- One component can respond to or produce multiple signals
- Control components can be added opportunistically, resulting in networks of control processes
  - Without requiring a hierarchy



Who Would Design A Heterarchical Control Network?

- Seemingly not a rational designer who builds the control system from scratch!
- But what about the person who must intervene when the original design fails?
  - It doesn't make sense to start all over again
  - But rather, to figure out a patch that will address the problem but not alter much else
  - In computer programs, these are called *kludges*
- What about organisms?
  - Evolution is conservative
  - Evolution is opportunistic
    - If a new component, wherever in the organism it is introduced, improves performance (or doesn't much impair it), it may get retained

Won't Heterarchy Just Result in Chaos?

- It certainly can
  - and does—all organisms die, and many die early in life
    - leaving no successors with their genome
  - there are plenty of examples of pathology in which people act against their own preservation/success
  - in cancer individual cells throw off the yoke of the whole organism and seek their own fortune—replicating, securing resources, defeating defense mechanisms of the rest of the organism
- But there are lots of examples of kludged systems that work reasonably well
  - the operating system on your computer has been patched (kludged) many times
  - existing organizations have undergone many changes to address problems and continue to function

Evolving Heterarchical Designs

- Evolution on earth has had approximate 4 billion years to work out designs that work reasonably well
  - for nearly 3 billion years all life was single-cell
    - with short lifespans with mutations in each organism, that provided a lot of opportunities to try out many designs for a cell
    - most of that exploration involved adding or deleting control connections
      - many of which are retained in cells today (including those in multicellular organisms)
- Evolution doesn't optimize—it satisfices
  - to be maintained, the design just needs to meet the need
    - to work well enough to allow the organism to leave offspring

Discussion Question

You and three friends are stranded on a relatively well-provisioned island. How would you organized yourselves?

A. Elect one of you as ruler
B. Each set out on your own, sometimes trading with each other
C. Divide up the tasks among yourselves, each doing what he/she is pretty good at
D. Discuss all issues on which decisions are needed together until you reach a consensus and then act on it
E. Argue and bicker among yourselves, cooperating just enough to stay alive (or not)

What Maintains Unity in an Organism?

- If no agent is maintaining order, won't the components simply go in different directions?
  - think of social organizations that break up because the individuals go their own ways and refuse to stay unified
- For a different perspective, consider a group that has to stay together to survive
  - the context in which they find themselves provides a common reference
- An organism has a boundary (which it creates) at which it interacts with the world outside
  - all components inside operate in the same (internal and external) environment
- Individual organisms often live in social networks with members of the same and other species
  - evolution has come up with communal organizations in which individuals have specific roles
- Unity arises as the different components all confront the same challenges, not from a central authority

Isn't nature "red in tooth and claw"?

- Tennyson's phrase has often been taken to characterize natural selection
  - Organisms/species compete and only the victors leave offspring
  - This is, supposedly, Darwin's view
- But a closer look at nature finds many, many examples of successful symbiotic relationships (Darwin discusses several of these)
  - Consider how many organisms live within your skin
    - they depend on you, and you on them
    - and no one is in charge

Knowing One's Self

- Echoing the Oracle at Delphi, Socrates enjoined us to know ourselves
- What is a self?
  - Is the self a specific part of us? A part that leads us to live a particular kind of life?
- Consider Descartes's dualism
  - He argued for an immaterial mind as required for thinking and language
  - But the mind just carried out thinking. It had no memories, no feelings, etc.
  - Is a Cartesian mind a self?
- The memories, feelings, etc., that make each of us distinct are dispersed through our brains
  - And many of our capabilities depend upon the rest of our physical body
    - With their manifestation in part determined by the environment in which we function
- Where is the self that we are supposed to know?

A Different Perspective

- A self is not something within us that defines who we are
  - But something (or somethings) each of us constructs and uses in controlling what we do
    - Who is this "us"?
      - Don't fall for the trap. We are not something additional to the rest of our brain/body/environment, but a composite
- Organisms are autopoetic (Varela and Maturana)
  - (given whatever materials are in them at birth) they make themselves from resources taken from their environment
    - Note: this is not a gene-centric perspective: organisms "decide" which genes to express
      - the genome is just a set of recipes that the organism can use to make proteins

Sellars' Myth of Jones

- Sellars constructed a myth in which no one in a given human community had learned about "thoughts"
  - Yet the individuals constructed a sophisticated science that could explain and predict what happened in their world
    - including the behavior of other humans (among them were good behaviorist psychologists)
- Jones developed a new explanation (folk psychology) that ***posited*** that people had thoughts and employed them in determining their behavior
  - He was more successful than the behaviorist psychologists
    - His account was just a theory
      - the evidence for thoughts was that by appealing to thoughts one could develop better predictions of behavior
        - and can tell good stories about why people behave as they do
- As a comparison, think of Tolman's cognitive maps
    - He posited them to predict and explain rodent behavior

Sellars' Myth of Jones

- One day Jones decided to train Dick to report on his own thoughts
  - When Dick reported thoughts Jones claimed he had, Jones rewarded him (see, Jones is still a good behaviorist!)
  - Dick became very good at using the mentalistic vocabulary to describe himself, although he had no idea how he did so
    - There must be some basis on which he does so but neither Jones nor Dick knows what it is
- Are we like Jones?
  - When we report our thinking (including our hopes, our desires, etc.), do we know how we do so?

A Constructivist Account of the Self

- Extending Sellars' myth: Just as neither Jones nor Dick know how Dick is able to report his thoughts, neither can explain their efficacy. But they prove to be effective in regulating behavior
  - When Dick reports a given desire, he is more likely to act upon it
  - When he combines his thoughts (his desire for water and his belief that there is water in the refrigerator),
    - he comes up with new thoughts: I should go to the refrigerator
      - and miraculously, after having the thought, he goes to the refrigerator
- Folk psychology is not just good at explaining and predicting behavior, it can be used to guide behavior

A Constructivist Account of the Self

- As Dick reflects on himself using his new tool to describe his beliefs, desires, etc., he theorizes further about his behavior
  - He notices that he, like some others, does things like push other people aside to get to food
    - He coins the term *selfish* for such individuals
  - He notices that some other people step aside and actually help others get to the food
    - He calls these people *kind* and *generous*
  - He finds that he likes these kind and generous people and wishes to be like them
    - Of course he has no idea why we wants to be that way!

Using One's Constructed Self to Regulate One's Behavior

- How can Dick go about making himself be kind and generous?
  - How would he go about making other people kind and generous?
    - If he is a behaviorist like Jones, he can reward them when they are kind and generous
    - He may also employ stimuli: post signs saying "Be Kind to Others"
  - Can he do the same for himself?
    - He repeats to himself at crucial times "I want to be kind and generous"
    - When he catches himself relapsing, he impose penalties on himself
      - And rewards when he is kind and generous

The Constructed Self and Episodic Memory

- Dick goes on to construct a whole story about himself
- Constructing a self relies on resources made available by our brains
  - Importantly, an ability to remember one's past
    - Tulving coined the term *episodic memory* for the ability of humans to relive events in their past (he thought only humans could do this)
      - This involves more than knowing that the event happened
        - one can "relive" the previous experience
      - Tulving referred to episodic memory as a kind of time travel
    - He further proposed that the same processes enable humans to project themselves into the future
      - Envisaging oneself as living a particular life
- Constructing a self may involve both
  - selectively remembering episodes in our past
  - imaginatively projecting oneself into episodes in the future
- The self one constructs then has consequences for how one behaves

Discussion Question

On the story just told, where is the constructed self in the brain?

A. No where. It is just a construct
B. Everywhere, including outside the brain
C. It moves around as different brain areas become active in controlling one's activities
D. Other

Modifying the Oracle's Message

- The injection of the Delphic Oracle assumed that we already have a self that we can set about knowing
- The alternative message would be: "Construct oneself."
  - Recognizing that you are the one choosing which self to construct
  - And what you choose will significant affect who you become