Chapter 1.1

The advent of mechanism

In the 17th century, Descartes produced detailed arguments that many aspects of cognition, such as memory and perception, could be fully accounted for in terms of physical mechanisms. At that time, most scholars were not so much interested in discovering new knowledge as they were intent on combining the ideas of Aristotle with Christian belief. Skepticism and independence, valuable attributes today, were considered character defects in the Middle Ages. In the 14th century, for example, students at Oxford University were fined for expressing any ideas that departed from Aristotle's philosophy (five shillings for every point of divergence, a substantial amount in those days). At the same time, what counted as scientific knowledge when Descartes was a young man in the early part of the 17th century, consisted of a mixture of both reason and bizarre superstition. For example, according to Aristotle, the European bison regularly hunted for its meat, and defended itself by discharging excrement over a distance of eight yards, and this discharge was so toxic it burnt the hair of pursuing animals.
The colour red is

a) a simple idea according to Locke.

b) a clear and distinct idea according to Descartes.

c) both of the above.

d) neither of the above.

Locke is in fact deliberately blurring the distinction between percepts and concepts; the experience of seeing the color red is as much a kind of idea (a simple idea, in fact) as is the thought "I am now experiencing a particular kind of color" or for that matter "Apples are red and sometimes green."
The Greek notion of Psuché was very different from our current view of a soul or even a mind.
Plants had a Psuché as did animals.
Psuché is what animates or sustains living things so the word ‘soul’ as a translation isn’t really adequate. These animators are sets of capacities or faculties; skill.
Teleological Explanations

A teleological explanation is one that accounts for an event or object by assuming in advance that there must be some ultimate purpose or final cause responsible for its design.
Examples

I gave you a gift in order to make you feel good.

I studied to do well in the exam.

Fish developed fins so that they could swim well.
Aristotle’s theories of natural phenomena were full of teleological explanations.

Nature was directed by goals or purposeful outcomes.
Ducks evolved webbed feet *in order to* allow them to swim better.

**Teleological**

Human beings have hands **because** they are intelligent.
The concept of shape is so simple, wrote Descartes, that it is involved in everything perceivable by the senses. For example, whatever you may suppose colour to be, you will not deny that it is extended and so has shape.

How did Descartes arrive at this idea?

If you find it strange that I make no use of the qualities one calls heat, cold, moistness, and dryness..., as the philosophers [of the schools] do, I tell you that these qualities appear to me to be in need of explanation, and if I am not mistaken, not only these four qualities, but also all the others, and even all of the forms of inanimate bodies can be explained without having to assume anything else for this in their matter but motion, size, shape, and the arrangement of their parts (AT XI 25–26).
(i) The image on the retina is a two-dimensional geometrical object, and the best way to mathematically represent a two-dimensional image is in terms of lines and their lengths.

(ii) Lines and their length (or in other words, their physical magnitude) are both clear and distinct ideas.

(iii) Finally, perception is the result of a physical mechanism in the brain, and this mechanism actually functions by representing three dimensional objects in terms of line lengths.
A mechanistic theory of perception

In his treatise, entitled "L’Homme" (the Human Being), Descartes imagined a world populated by animated human-oid statues that are built to see and respond to objects (as well as to engage in a host of other activities like sleeping, eating and digesting food and breathing). His aim was to prove that if we compare these imaginary creatures to ourselves, we will find that both function in the same way. Indeed, Descartes wrote in a letter to an influential colleague, his extensive neuroanatomical research encouraged him to assume that what previously was explained by assuming the existence of animal and vegetable souls, could instead be accounted for strictly in terms of physical mechanisms.

The neurophysiological theory of perception that Descartes proposed is hopelessly wrong, of course, in many ways. Yet we can still say that his approach to the problem closely resembled the methodology used by modern researchers interested in the very difficult question of how the electrochemical changes in the retina end up as an organized percept in the brain.

We already have noted (in Case Study 1) that Descartes conceived of the problem in terms of abstract geometry and optics, and in fact, Descartes had previously made fundamental contributions to both these domains. The task of the visual system was correctly understood as follows: there is a physical image of a shape with geometric properties on the retina, and the visual system must reconstruct an internal description of the object that has produced this image. You can see the general idea expressed in the diagram labeled Descartes’ drawing of the visual system. The object -- an arrow -- produces activation of the nerves in the retina, and the neural activity of the brain reconstructs that image to yield the perception of an upright arrow.

Descartes did not have any notion that neurons produce electrical activity and his ideas were driven more by the preconception in that era that the body carries a very refined kind of fluid termed "animal spirits", which is separated from the blood and enters the brain through the pineal gland. The external object (the arrow in the drawing) emits light energy that displaces the ends of the nerve fibers, and the optic nerves carry the signal by means of the flow of animal spirits to the brain. This signal in turn changes the pattern of animal spirits in the pineal gland to produce a representation of the external object.

It’s important to note that Descartes did not argue that the neural "image" of the arrow actually should be thought of as a literal copy of the object inside the brain, even though we can see the figure on this page showing the outline of a miniature arrow in the pineal gland.
The homunculus argument is a fallacy arising most commonly in the theory of vision.

One may explain (human) vision by noting that light from the outside world forms an image on the retinas in the eyes and something (or someone) in the brain looks at these images as if they are images on a movie screen.

The question arises as to the nature of this internal viewer. The assumption here is that there is a 'little man' or 'homunculus' inside the brain 'looking at' the movie.
“Now, when this picture [originating in the eyes] thus passes to the inside of our head, it still bears some resemblance to the objects from which it proceeds.

As I have amply shown already, however, we must not think that it is by means of this resemblance that the picture... (directly)....causes our sensory perception of these objects—as if there were yet other eyes within our brain with which we could perceive it.

Instead we must hold that it is the movements composing this picture which, acting directly upon our soul in so far as it is united to our body, are ordained by nature to make it have such sensations.”
Descartes believed (incorrectly) that neurons were etching patterns made up of simple line segments on the pineal gland. The covariation between different patterns was responsible for representing differently shaped objects, or different colours, etc.
Descartes argued that the functioning of animals could be accounted for completely in mechanical terms. In this sense, animals were automata, but they were not like clockwork machines, given their level of complexity. Animals have two different ways of moving. In the first, perception leads directly to an automatic action with no recognition of the stimulus, very much in the same way that modern physiology considers some responses to be spinal reflexes that can occur even before there is enough time for sensation to reach the cortex.

For example, the rapid withdrawal of a limb from a flame can occur a split second before we actually experience any pain. In the figure showing a "human-machine" withdrawing a foot from the heat of a fire, the sequence of events was construed by Descartes as follows: The fire in contact with the skin is moving very swiftly and displaces the area of the skin it touches, pulling on nerve fibers. This event immediately results in pores opening in the brain to which the nerve fibers are attached. This releases animal spirits from the cortical cavity marked F in the diagram, which then enter 'part into the muscles that serve to withdraw this foot from the fire, part into those that serve to turn the eyes and head to look at it, and part into those that serve to advance the hands and bend the whole body to protect it'.

Automatic movements, on this account, can be an orchestrated sequence of actions designed to serve a particular function, without first requiring stimulus identification. A further clue to interpreting Descartes' argument is that F in the brain is not the pineal gland and in fact he tells us explicitly that F is a cavity. Since the pineal gland is the seat of ideas, we should infer that the response to a flame (depicted in the figure) is immediate, automatic and does not require a mental representation of any sensory event before the orchestrated action occurs. So we can refer to this kind of movement as an action that occurs without cognition (note the figure caption), in the sense that the foot moves without the brain working to first classify or interpret the sensation.

A second way of generating a movement is by responding to a perceived object or event. Now we have the problem of how an animal or man-machine recognizes an external object before engaging in an action. I have already described in Case Study 1 that Descartes struggled to develop the assumption that visual objects were abstracted in the brain as mathematical quantities, and that such quantities could be represented in terms of lines and their lengths, an argument that if correct, he thought, would be based on a clear and simple idea. He later turned to another hypothesis.

Descartes was interested in the following question, one that continues to lie at the heart of modern research on visual cognition. How does the brain relate its own internal events to objects in the real world that we perceive? (Be sure you understand this question; read it a few times if necessary). Let me put...
This type of movement takes place *without* the pineal gland.

Figures traced on the pineal gland represent ideas.

“figures traced in the spirits on the pineal gland, where the seat of imagination and common sense is, should be taken to be ideas” (page 9).

Therefore — this form of movement involves action *without* cognition.
The interpretation that Descartes offered is very close to the modern concept of a reflex arc.

This idea came close to the modern view of a reflex developed by Sherrington, awarded the Nobel prize in neurophysiology in 1932. Sherrington conclusively demonstrated the existence of sensory-motor neural pathways that bypass the cortex. These are reflex arcs--direct connections between a stimulus and a response via the spinal cord. For example, Sherrington observed that in a decorticated dog (i.e. the spinal cord was surgically isolated from the cortex), ‘...a feeble electric current on the shoulder brings the hind paw of that side to the place, and performs a rhythmic grooming of the hairy coat there. If a foot treads on a thorn that foot is held up from the ground while the other legs limp away. Milk placed in the mouth is swallowed; acid solution is rejected. The dog shakes its coat dry after immersion in water”.
What is noteworthy about spinal reflexes is that they are limited in important ways. As Sherrington pointed out in his classic textbook published in 1906 (The Integrative Action of the Nervous System):

...when all is said, if we compare such a list (of spinal reflexes) with the range of situations to which the normal dog or cat reacts appropriately, it is extremely poverty stricken. It (the dog or cat) contains no social reactions, it fails to recognize food as food. It shows no memory, it cannot be trained or learn, it cannot be taught its name. The mindless body reacts with the fatality of a penny-in-the slot machine.

Thus, spinal reflexes are: (i) relatively inflexible, (ii) not based on conscious recognition of a stimulus (for example, some reflexes can be triggered even in comatose patients), (iii) not altered by learning; and (iv) are too simple to enable social interactions.
Animals and Human beings
A second way of moving

Responding to an object or event after it is recognized and interpreted. For example, a dog wags his tail when you show him a ball that he has played with in the past.
Perceptual representations leading to action have the form of etched lines on a two-dimensional surface (the pineal gland).

But how do very similar objects (say, a grape and a marble) lead to very different actions?

Descartes’ sign theory.

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These associations are innate; we possess them at birth.

the sensation blue  the sensation red  the sensation green

Fig. 5.6
Humans have a third way of moving

We have the ability to reflect on our own mental representations.

What does this mean?
The Importance of Language

In fact, none of our external actions can show anyone who examines them that our body is not just a self-moving machine but contains a soul with thoughts, with the exception of words, or other signs that are relevant to particular topics without expressing any passion.
I say words or other signs, because deaf-mutes use signs as we use spoken words

I say that these signs must be relevant, to exclude the speech of parrots, without excluding the speech of madmen, which is relevant to particular topics even though it does not follow reason.

I add also that these words or signs must not express any passion, to rule out not only cries of joy or sadness and the like, but also whatever can be taught by training to animals.
In the 17th century, the meaning of *passion* was quite different than the meaning of *emotion*.

*A passion* was *passively* experienced. It was always caused by an object external to the person or animal that was experiencing the feeling.

An *emotion*, by contrast, can be generated spontaneously, without any external cause.
The Cartesian theory of language production (Chomsky).

“...one fundamental contribution of what we have been calling 'Cartesian linguistics' is the observation that human language, in its normal use, is free from the control of independently identifiable external stimuli ..... and is not restricted to any practical communicative function, in contrast, for example, to the pseudo language of animals".

"In short, animal 'language' remains completely within the bounds of mechanical explanation as this was conceived by Descartes.... and the creative aspect of language is what separates humans and animals."
Animals have no thoughts!

yet, animals have a pineal gland.

“figures traced in the spirits on the pineal gland, where the seat of imagination and common sense is, should be taken to be ideas”. (page 9)
Animal are capable of some form of cognition but only driven by external or internal stimuli.

Examples: Pain, the sight of food, the desire for food (hunger), the sight of a threat, a stimulus that generates anticipation of a good or bad outcome, etc.
Human thoughts (and language that expresses them) are free from the control of independently identifiable stimuli.

Examples:
What a nice cat you have.
I doubt that your cat is nice.
I believe that you have a nice cat.
I was thinking about that nice cat of yours.
Passions and the embodied mind

It is often assumed that Descartes wished to argue that our thinking has little to do with our bodies.

Descartes' error, Antonio Damasio tells us, was his belief in "the abyssal separation between body and mind . . . "
Nature teaches me through the sensations of hunger and thirst that I am not merely present in my body as a sailor is present in a ship, but that I am very closely joined and as it were intermingled with it, so that I and my body form a unity.

If this were not so, then I who am nothing but a thinking thing would not feel pain when the body was hurt, but rather the intellect would simply perceive the damage, just as a sailor perceives by sight when anything in his boat is broken.
Passions and the embodied mind.

Emotional conflict

Passions can arise from external objects or events acting on our senses, or they can be felt as occurring spontaneously within the mind itself, in which case they are “passions of the soul”.

These are triggered by the brain (‘caused, maintained and strengthened by the movement of the spirits’) and so unlike willed or voluntary thoughts or feelings, they do not have their origin in the soul, even though they are referred to as passions of the soul.
Conflict occurs in two ways:

(i) The spirits in the *brain* will move the pineal gland in a particular way, exciting a desire for something, and the will might oppose this feeling so that the *mind* can be impelled almost at the same time to desire and not desire something.

The phrase “almost at the same time” is important because the desire is occurring in spite of one’s conscious will which can represent an intention strongly enough to gradually halt the movement of the spirits.
(ii) A second way of experiencing conflict occurs in the body when passions force the limbs to behave in a certain way and the rational soul (mind) attempts to stop this action.
Despite common misconceptions that Descartes believed in the virtues of a passionless, analytic mind and that he considered emotions to be a disruptive influence on rational thought, he in fact argued that emotions played an important role in sustained acts of will and that certain passions, for example a feeling of wonder, were essential for intellectual development.
The **Cartesian** Theater

At some point during the processing of a stimulus or event, the inputs from many unconscious processing systems come together to enable consciousness.
Baars’ Global Workspace Model of Consciousness

Context operators behind the scenes
Director | Spotlight Controller | Local Contexts

- Competing for access to consciousness:
  - Outer Senses
    - Seeing
    - Hearing
    - Feeling
    - Tasting
    - Smelling
    - Submodalities
    - Heat
    - Vibration
  - Inner Senses
    - Visual Imagery
    - Inner Speech
    - Dreams
    - Imagined Feelings
  - Ideas
    - Imagible Ideas
    - Verbalized Ideas
    - Fringe Conscious Intuitions

- the players ...
- the spotlight of attention shining on the stage of working memory ...

- Working memory receives conscious input, controls inner speech, uses imagery for spatial tasks, all under voluntary control.

- the unconscious audience...
  - Memory systems:
    - Lexicon
    - Semantic networks
    - Autobiographical & declarative memory
    - Beliefs, knowledge of the world, of oneself and others.

  - Interpreting conscious contents:
    - Recognizing objects, faces, speech, events, Syntactic analysis, Spatial relationships, Social inferences.

  - Motivational systems:
    - Is the conscious event relevant to my goals? Emotional responses, facial expressions, preparing the body for action, Managing goal conflicts.
The theatre has a powerful spotlight of attention, and only events in the bright spot on stage are strictly conscious.
Psychologists have become convinced that the real work in navigating through the problem spaces of our lives is done unconsciously for most of us most of the time.