Introduction to the Philosophy of Cognitive Science

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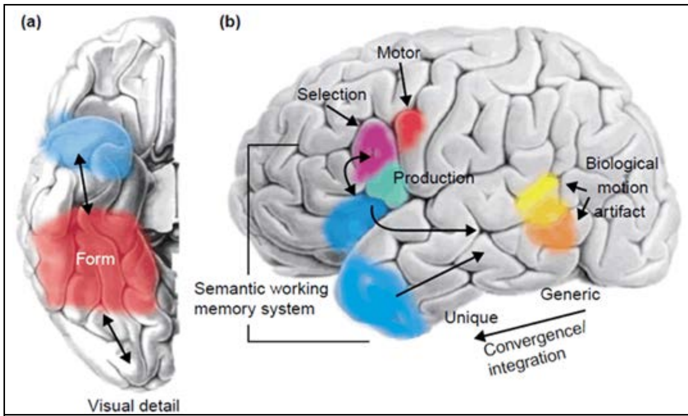
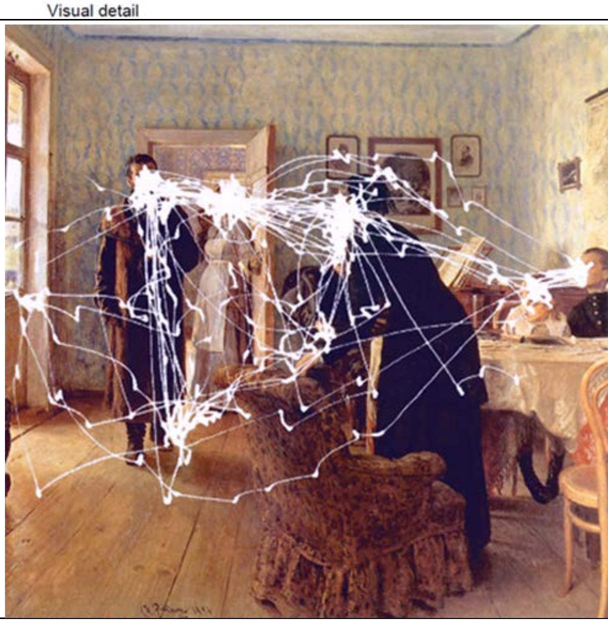
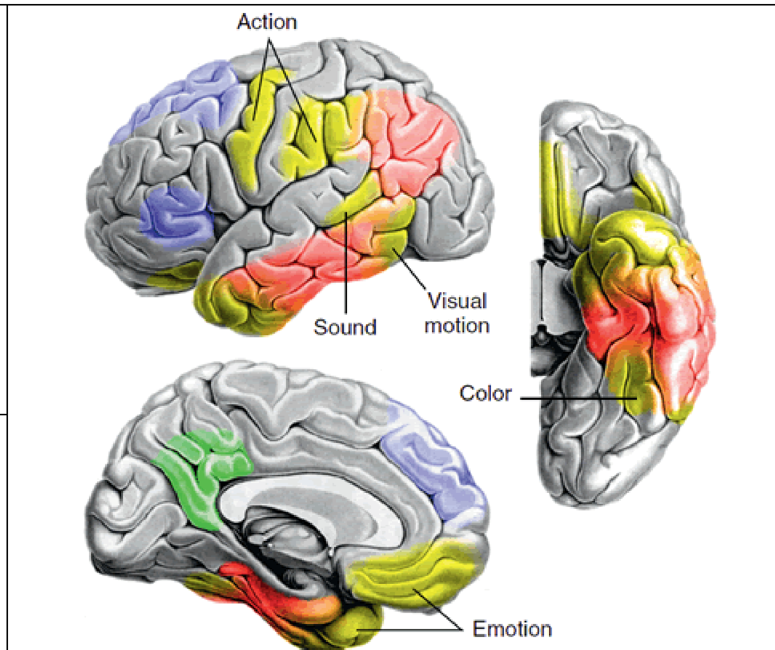
Chapter 1
Ontological Frameworks

1.1 Introduction

Humans naturally differentiate objects and phenomena in the world into the categories of living from non-living entities and related phenomena. Indeed, people can develop a deficit for naming non-living things, while remaining relatively unimpaired in naming living things. Indeed, the very structure of the brain's semantic memory provides the basis for some of this asymmetry.[1-4] Likewise, humans appear to manifest an







(**Top left**) A diagram from Martin and Chao depicting the approximate brain regions associated with semantic memory storage and retrieval for object form, motion and object-use-associated motor patterns. (**Above**) Diagram from Binder and Desai depicting one model of semantic processing. Yellow indicates modality-specific systems providing input into higher-level convergence areas (in red) responsible for abstract representations events and entities. Blue areas depict brain areas assocaited with the goal-directed activation of stored information. Finally, green areas indicate brain region hypothesized to to mediate semantic storage areas and the hippocampal memory system, possibly facilitating the creation of episodic memories. (**Bottom Left**)The visual saccade path during "free" or undirected scanning imposed upon the painting. Sasha Archibald, after Alfred Yarbus, after Ilya Repin, They Did Not Expect Him (aka An Unexpected Visitor, 1884) Notice that the faces receive the greatest number of saccades during the viewing period. From: Observations on Film Art .

innate disposition to categorize objects and phenomena into mental and non-mental entities and phenomena.[5-20] This disposition to think about the world in terms of mental and non-mental entities occurs in even in early, automatic, unconscious perceptual processing. It likewise drives behavior and manifests itself early in development. For instance, faces strongly attract visual attention (saccades). The human visual system's preference for faces occurs at the very earliest stages of scene perception when the brain selects objects to which to attend. This preference for faces manifests itself by 3 months in human infants—

suggesting an innate disposition to find faces visually salient.[21-24] Likewise, humans automatically and unconsciously process information regarding the emotional states and motor intentions of other people during vision. Indeed, "mind blindness" is one of the most significant pathologies associated with autistic spectrum disorder.[5-17] We likewise monitor and interact with other people using a vast array of automatic and unconscious processes.[20, 25-27] In short, the human disposition to categorize the world into mental and non-mental results—at least partially--from a variety of innate, automatic, and unconscious cognitive processes.

Philosophical and scientific theories of the mind throughout history attempt to understand and to either affirm or deny the real world basis of these innate tendencies of human categorization. Do the categories of mental and non-mental cut the world at a joint? That is, does the distinction marked by the mental versus non-mental categorization correspond to a real and important distinction in the world? Must any adequate theory of the number and nature of the universe's basic kinds recognize the existence of mental and non-mental objects, properties, etc.? Within the framework of specific answers to such questions philosophers and scientists strive to systematically formulate, observe, and theorize about mental phenomena and entities as well as to characterize the place of mental phenomena and entities in relationship to physical phenomena and entities. In other words, if these categories mark a fundamental distinction between kinds, what relationship do these kinds have to one another? In this chapter I outline the idea of an ontological framework. I go on in this and latter chapters to discuss how such ontological frameworks emerge, how they guide theorizing, and their relative role to more advanced theorizing.

1.2 Ontological Frameworks

Cooperative investigation and theorizing requires formulating and agreeing upon basic ideological and methodological constraints within which researchers conduct inquiry. Such constraints serve to focus investigation and provide much of the framework with which to construct theories. For instance, most people do not think that logically impossible situations can serve as counterexamples to a theory. So, when told that circles consist of sets of points equidistant from a center point on a Euclidean plane, it strikes people as irrelevant to object, "But what if the circle is a square?" Thus, philosophers generally agree upon the constraint that counterexamples to theories must pass the minimum standard of logical possibility. Similarly, scientists accept that statistically significant findings must meet the minimum standard of .95 probability, meaning the probability of the experimental result occurring by chance alone must be less than .05.

As a general rule, in the earliest stages of inquiry researchers tend to debate ideological and methodological constraints extensively and explicitly. While debates over ideological and methodological constraints appear extensively in discussions and writings at the beginning of inquiries, these constraints tend to have a looser connection to observation and methodology. As inquiry develops, researchers spend less time explicitly discussing the more general fundamental constraints and focus much more on refining and rigorously implementing domain-specific categories, techniques, and methods. All of the thinkers in this text and in course attempt conduct their inquiry within the context of one of the most basic early constraints on inquiry, what I'll call an ontological framework. An ontological framework articulates a hypothesis regarding number and often the nature of the fundamental categories for some domain. Fundamental categories consist of the set of categories considered essential and ineliminable in any adequate account of the phenomena in some domain. These categories further constrain the sorts of attributions and dynamical interactions theorists can utilize. Indeed, a great deal of the theoretical discussion within the philosophy of mind concerns the proper ontological framework within which to understand the mind. Specifically, the debate centers on the nature and number of fundamental kinds of stuff. Do the mental and non-mental categories both exist within a single overarching category—say, material substance? Or, do the mental and non-mental categories constitute two fundamental kinds of stuff—say, material substance and physical substance? Moreover, theorizing regarding the nature, properties, and operations of the mind occurs within an ontological framework. For instance, if the categories of mental and non-mental pick out fundamentally different kinds of stuff, what relationships can these kinds have with one another? On the other hand, if the categories of mental and non-mental do not pick out fundamentally different kinds of stuff, how and when do non-mental kinds become physical kinds? As we will see throughout the term, philosophers and scientists have developed a baffling array of answers to such questions.

Inquiries into the nature of the mind and its relationship to the non-mental world do not represent a unique case. All inquiries begin by formulating ontological frameworks. Without basic categories, one cannot even describe the phenomena of a domain or articulate the relationships between elements of the domain. For example, the ontological framework of modern physics includes the fundamental category of force. All change and many cases of stasis must ultimately result from the actions of one or more forces. Without the supposition of forces, physicists would have no means of explaining change. Thus, modern physicists claim that adequate theories of physical phenomena must include the category of forces. For the most part, this supposition of an ontological framework fades into the background once theorists reach a general consensus as to its elements. However, it continues to exist and to guide the efforts of researchers even once they no longer actively propose and debate candidate frameworks. Moreover, small and large changes can a do occur in ontological frameworks as theories, methods, and evidence accumulate. Sometimes in the face of accumulating difficulties researchers will even abandon one ontological framework in favor of another. For instance, prior to general relativity physicists consider space and time to be distinct elements of the universe. After general relativity, space and time become a single element space/time.

1.3 Ontological Frameworks Specify Basic Relational Structure

The category of forces illustrates some important potential aspects of an ontological framework. First, some of the elements of an ontological framework prove less central than, even dependent upon, other elements.

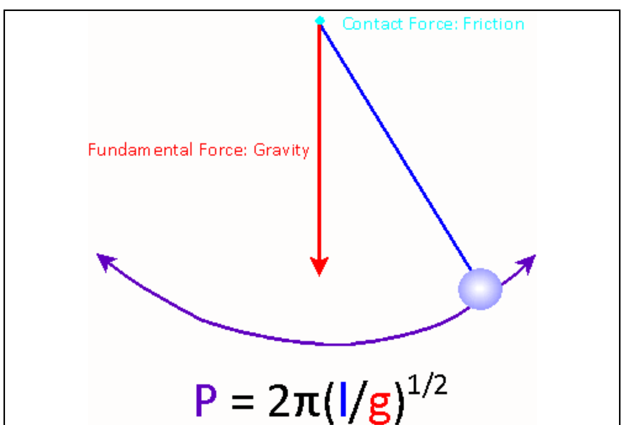


Diagram illustrating how both contact and fundamental forces operate in pendulums. Since all contact forces result from fundamental forces acting on objects, the pendulum's swing as well as the contact pressure that results in the drag at the arm pivot result from the fundamental force of gravitation (in red). The contact force, friction (in light blue), operates at the pendulum arm pivot resulting from the surface drag during the swing of the pendulum.

The relationships between various categorizations within an ontological relationship can serve to constrain the manner in which theorists describe and predict the phenomena within a given domain. Indeed, modern physics recognizes two general categories of forces. On the one hand, physicists appeal to "contact forces." Contact forces transfer energy by direct mechanical contact. For example, friction is such a force. On the other hand, physicists also posit the category of "fundamental forces." Fundamental forces (sometimes called field forces or interactive forces) constitute the current hypothesis as to the number and nature of essential and ineliminable forces in modern physics. Thus, contact forces prove dependent upon fundamental forces in that all contact forces ultimately result from fundamental forces acting on objects. For example, friction at the pivot of a pendulum results from the surfaces dragging against one another during the swing of the pendulum (see diagram on left). The swing itself as well as the contact pressure that results in the drag (the frictional contact force) comes from gravitation (a fundamental force).

1.4 Ontological Frameworks Evolve and Change

Fundamental forces illustrate a second important point regarding ontological frameworks; the elements and properties of an ontological framework can change as inquiry progresses. Theorists can alter the nature, number, or relationship between fundamental categories during the course of inquiry. During periods of relatively unproblematic progress ontological frameworks fall into the background, often not appearing at all in discussions by researchers. However, when problems arise in the development of a science, small and large adjustments to an ontological framework—even abandonment—can occur. During periods in which theorists grapple with difficulties in inquiry ontological frameworks often reemerge in their discussions. The discussions may center around specific changes or theorists may consider more global changes to an ontological framework.

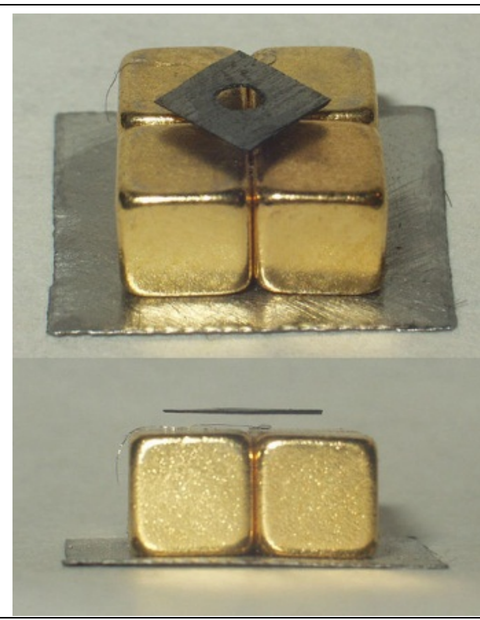
For example, physicists currently recognize four fundamental forces; gravitation,[28] electromagnetism,[29] strong nuclear force,[30] and weak nuclear force.[31] In the history of physics, the number and nature of fundamental forces can and has increased and decreased over time. During these changes the role of forces does not change, nor do theorists discuss any changes to that role. Rather, theorists debate the nature and number of forces necessary to understand and explain the dynamical changes in physical phenomena. Indeed, prior to James Clarke Maxwell's[32] publication of "On Physical Lines of Force," on 1861 and *Treatise on Electricity and Magnetism* in 1873.[33, 34] physicists treat electric force and magnetic force as separate fundamental forces. Today, however, physicists posit a single force, electromagnetic force. Indeed, Maxwell's book represents a synthesis of work that begins around 1820 with the Danish chemist and physicist Hans Christian Ørsted.[35] Ørsted reports his discovery that an electric current can deflect a compass needle in his *Experimenta Circa Effectum Conflictus Electrici in Acum Magneticam* in 1820.[36]


Hans Christian Ørsted (1777–1851)
From: Wikipedia


Michael Faraday (1791–1867)
From: History of Surgery


Sir Humphry Davy (1778-1829)
From: Wikipedia


James Clerk Maxwell (1777–1851)
From: BBC


Picture of "A small (~6mm) piece of pyrolytic graphite levitating over a permanent neodymium magnet array (5mm cubes on a piece of steel). Note that the poles of the magnets are aligned vertically and alternate (two with north facing up, and two with south facing up, diagonally)." This is an example of diamagnetism. Description and picture from: Wikipedia

The next significant contribution to the unification of electric and magnetic forces comes from the work of Michael Faraday,[37] an English chemist and physicist. Faraday's family could not afford to give him much formal education and he begins his career as a book binder's apprentice. However, Faraday reads the books he binds extensively and attends scientific lectures. Faraday attends a lecture given by the English chemist Humphry Davy.[38] Davy so impresses Faraday that Faraday seeks employment in Davy's lab, submitting a letter together with a 300 page book based upon notes from Davy's lectures. Davy hires Faraday, first as a secretary and later as an assistant. Faraday designs experiments that result in the homopolar motor[39] (an electric motor with a fixed magnetic polarity), reveal electromagnetic induction[40] (the flow of an electric current through a conducive medium [like a wire] by changing the electric field), diamagnetism[41](the property of some materials to create an opposing magnetic field when one applies a magnetic field to that material; see diagram below), and that show that magnetic forces can affect light (the Faraday Effect[42]). Faraday also argues that electric phenomena result from a single kind of electricity and that electromagnetic forces extend beyond the physical conductor. His contemporaries reject much of his work, in part because he lacks the mathematical

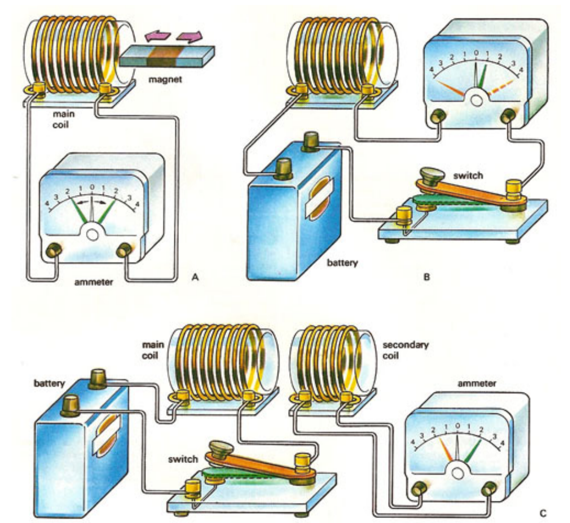
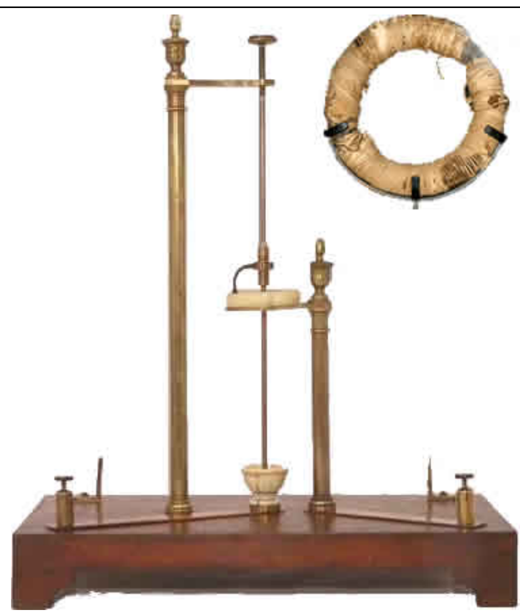
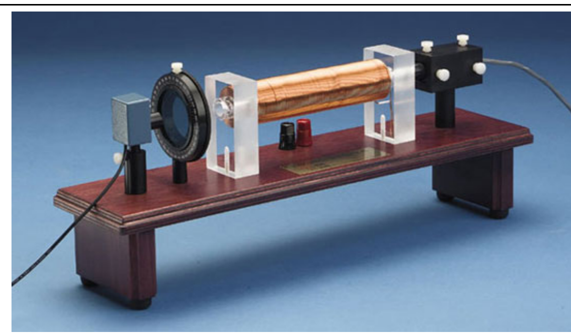


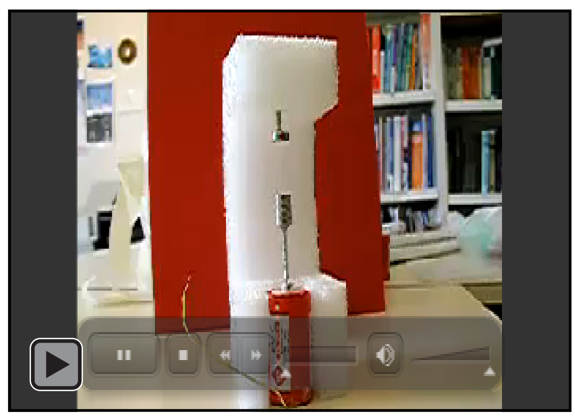
Diagram depicting electromagnetic induction. From: David Darling
Link to java applet that illustrates electromagnetic induction



Picture of Faraday's actual magnet and total apparatus for creating the Faraday Effect. From: Physics Info



Picture of a device to create a Faraday Effect: the Signal Processor/Lock-In Amplifier (SPLIA1-A). From: Teachspin



Video of homemade homopolar engine Click to view video. From: Youtube

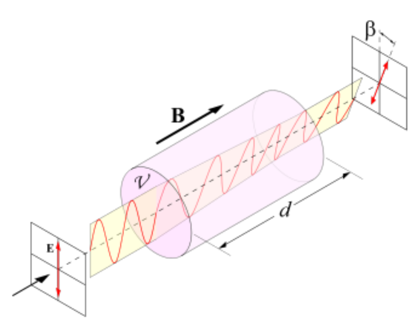


Diagram of light rotation polarization due to Faraday effect. From: Wikipedia knowledge to express his theories mathematically. [37, 43, 44] Finally, Maxwell publishes his *Treatise on Electricity and Magnetism*[33] that includes four laws. Together these laws form the basis of classical electrodynamical theory. One of the laws expresses Faraday's results on electromagnetic induction. Maxwell's work unifies electric, magnetic, and light phenomena, showing that all result from the same entity--electromagnetic fields traveling through space as waves that move at the speed of light.[33]

1.4 Chapter Summary

In summary, ontological frameworks provide structure and constraints upon inquiry—especially early inquiry--by forwarding a hypothesis regarding number and nature of the fundamental categories for some domain. Fundamental categories serve in an ontological framework as the essential and ineliminable elements in any adequate account of the phenomena in some domain. They also constrain the sorts of attributions and dynamical interactions theorists can utilize to explain phenomena. Thus, force serves as a fundamental category in physics. Forces function as the only means by which change can occur in physics. As the example of forces in physics illustrates, an ontological framework can specify not only the elements of a given domain, but the role that those elements can play within that domain. Thus, forces function in physics as the sole cause of change. Additionally, some of the elements of an ontological framework prove less central, even dependent upon, other elements. As inquiry begins to get traction, the role of ontological frameworks becomes less obvious and they tend to fall into the background. During such periods an ontological framework functions like a set of background assumptions regarding the domain. During the course of inquiry, however, difficulties may arise that lead theorists to reconsider their ontological frameworks. For example, the nature and number of elements of an ontological framework can change as inquiry progresses.

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