Classifiers As A Reflection Of Mind:

The Experiential, Imaginative, And Ecological Aspects

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Preface

We are now in a period in which the nature of the mind is being studied intensively and radically reassessed. Ideas as fundamental as *concept* and *category* are undergoing extensive revaluation and change, as are our ideas of what constitute human reason and human knowledge. At the center of this reassessment is our idea of what a category is. The classical view is that entities form categories on the basis of shared properties; they are in the category if they have the given properties and out if they don't. Classical logic and mathematics depend on this view, as does our traditional conception of human rationality.

Empirical studies of how human beings actually categorize suggest that this view is fundamentally incorrect – and not in ways that can easily be patched up or extended. In place of the classical view, a new view of human categorization called *prototype theory* is emerging. It shows the human mind to be much richer and more complex than classical theorists had imagined.

The present volume has several goals: First, to provide of general overview of prototype theory as it contrasts with the classical theory. Second, to review many of the results that have led to the current reevaluation. Third, to review some of the principal defenses of the classical theory. And fourth, to survey some of the contributions to prototype theory coming out of contemporary cognitive linguistics.

Human language provides perhaps the richest source of data for studies of human categorization. If this volume has any merit, it lies in its survey of three of the most detailed linguistic studies of natural categorization to date – those of the concept *anger*, the concept *over*, and English *there*-constructions. Relatively simple examples can always be handled by some extension, or patched-up version of the classical view. It is in the really complex cases that the explanatory power of prototype theory emerges. Any serious defense of the classical view will have to handle such complex cases adequately.

The current revolution in computer technology has led to a widespread mind-as-computer metaphor, and with it, a computational theory of mind based on that metaphor. Prototype theory brings up serious problems for present computational theories of mind. It brings into question the adequacy of present views of *memory, knowledge*, and *understanding*. Perhaps even more strikingly, it suggests that present ideas of what a *computation* is will be insufficient for any adequate theory of mind.

Introduction

People use concepts to categorize things, and they act on those categorizations. Without the ability to conceptualize and categorize, we could not function at all, either in the physical world or in our social or intellectual lives. The theory of categorization is therefore central to any understanding of our conceptual system, and therefore necessary to any understanding of how we human beings function and what makes us human.

Most categorization is automatic and unconscious, and if we become aware of it at all, it is only in problematic cases. In moving about the world, we automatically categorize people, animals and physical objects, both natural and man-made. This sometimes leads to the impression that we just categorize things as they are, that things come in natural kinds, and that our categories of mind fit the kinds of things in the world. But a large part of our categorization, and maybe most of it, is not of this kind at all. It is abstract. We categorize events, actions, perceptions, emotions, spatial relationships, social relationships, and abstract entities of an enormous range: governments, illnesses, social practices and entities in both scientific and folk theories -- entities like electrons and colds. Any adequate account of the human conceptual system must provide an accurate theory for all our categorization, both concrete and abstract.

Among the things people categorize most are other people. As a person you are constantly being categorized -- mostly by other human beings, but also by institutions: credit companies, advertisers, perhaps even the FBI. Are you a man or woman; Christian, Jew; gay, straight; doctor, lawyer, businessman, academic; rich, poor; married, single; tall, short; American, German, French, Japanese; and on and on. Categorization is necessary. It is one of the principal means we have of coping with the world, and people just can't function without it. Since categorization is pervasive and here to stay, we may as well understand how it works.

This is especially important because it can be pernicious. People use stereotypes in categorizing other people. These can be racial, national, or sexual stereotypes. And the most horrible of abuses have resulted: slavery, genocide, repression and discrimination of all sorts. The use of stereotypes is not about to disappear. If you think the use of stereotypes can be wiped out, read on. Stereotypes are part of the cognitive mechanism we use in categorization. They are part of the way human beings think. The question is not *whether* people will use stereotypes to categorize, but *which ones* they will use.

Stereotypes are special cases of what I call "Cognitive Models". These are structures which provide an idealization of our experience, and which we use in categorizing. Most importantly, they provide a metaphysics in terms of which we function. In the area of abstract categories -- friendships, governments, types of actions and events -- our idealized cognitive models have a special force. Since we *act* in terms of them, they have the power to mold reality -- social, interpersonal, and emotional reality. We need an awareness of how this takes place.

Categories and cognitive models are not to be taken lightly. It is of the greatest importance that we understand what they are like and how they are used. For more than two millenia, from Aristotle to the later work of Wittgenstein, categories were assumed to be well understood. But in a remarkably short time all that has changed. The classical theory of categories is being reappraised in all of the cognitive sciences. There is now a competing view of the way people naturally categorize things. It is referred to perhaps most accurately as the theory of natural categorization, but more often as "prototype theory".

Prototype theory suggests that we have to understand the human mind in a very different way. Take for example two views that are both taken for granted as everyday folk knowledge, and have achieved the status of self-evident truths in most of the academic world:

-Categories are container-like: things are either inside them or outside them.

-When things are categorized the same way, it is because of what they have in common.

Empirical studies have indicated that both of these assumptions are inadequate. Such cases may occur but they are not the norm.

One important consequence of this is that it requires that our notion of *sameness* be changed. One of the main reasons we categorize things is so that we can treat things in the same category in the same way. It is commonly believed that we treat things the same way because they *are* the same in some important respect -- or at least because we perceive them as such. Prototype theory forces us to face up to the fact that we often treat things the same even though there is little or nothing that we can find that they have in common. It suggests instead that we place things in the same category on the basis of sometimes very indirect relationships among them. Part of what we will be discussing below is just what kind of indirect relationships these are. If we treat different things in the same way, we ought to at least know why and how.

To some, it is disturbing to discover that categorization is not just putting things together in a kind of abstract container on the basis of their common properties. To deny it seems to be denying common sense. The classical theory is, more or less, our everyday folk theory of what a category is. Moreover, a great many attempts to construct man-made systems of categories -- from mathematics to law to the rules of games -- use our everyday common-sense understanding of categories, which corresponds in many ways to the classical theory.

On the whole, we will be studying categories that have evolved naturally, rather than categories that have been consciously constructed using the classical theory or our folk version of it. Such natural categories seem not to fit the classical theory. But, as we will also see, even man-made categories which are explicitly constructed to fit the classical theory may turn out not do so. The concept of *number* is a good example. The category *number* was taken early on in the history of mathematics to include only the natural numbers: 1, 2, 3, ... The category was taken to have a clear boundary around it; everything either was a number or wasn't. But the concept has been extended by successive generations of mathematicians to include first zero, then the negative numbers, the rational numbers, the irrational numbers, imaginary numbers, infinitesimals, transfinite cardinals, infinite ordinals, etc. Each time the extension was taken to involve a clear boundary -- and the dispute was where the boundary should be drawn correctly. But it makes no sense to ask whether imaginary numbers or infinitesimals or transfinite cardinals are *really* numbers or not. If anything is in the category *number*, the natural numbers are. But the question of what is or is not in the category *number* depends on such factors as what your mathematical concerns are and what kinds of imaginative projections beyond the natural numbers you find reasonable. It is a question that equally well-informed mathematicians can disagree about -- and one they have disagreed about over the centuries.

The category *number* was constructed to have the clear boundaries that the classical theory requires. But times changed. Our knowledge and our imaginative capacities extended, and the category turned out not to have those clear boundaries after all.

Imaginative Rationality

To me the most interesting part of the current reappraisal of categorization is that it requires a change in our understanding of what man is. We have inherited the view of man as a rational animal. It is reason, a purely intellectual faculty, that has been seen as setting man apart from the other animals. But rationality is itself defined in classical terms, and is bound up with the classical theory of categories. Classical rationality is usually associated with classical logic, which in turn is based on the classical view of categorization. Changes in our view of categorization require changes in our view of reason and rationality, and hence in our understanding of what it means to be a "rational animal".

The glory of classical rationality is abstract reason -- the ability to use abstract concepts and to reason with them. If the classical view of categorization, and hence of rationality, is to be challenged, it is in the domain of abstract concepts that the challenge will be most important. It is for that reason that the present study will be primarily concerned with abstract categories, in addition to the traditional concern with categories of physical objects.

Among the things excluded from classical rationality are the so-called "figures of speech", among them metaphor and metonymy. These are taken to be mere aspects of language rather than aspects of thought. Johnson and I (1980) have provided considerable evidence that metaphor and metonymy are not mere matters of language, but are rather fundamental mechanisms of thought. Metaphor is a way of understanding one domain of experience in terms of another, via a structural mapping, which is itself grounded in experience. Metonymy is a way of using one aspect of a conceptual structure to represent, or stand for, another. Most abstract concepts, Johnson and I have argued, are understood metaphorically or metonymically, often in terms of concepts that are grounded in physical experience. If we are correct, rationality is not just a matter of logic and pure intellect, but much more a matter of both imaginative projection on the one hand, and bodily experience, especially perception and motor activity, on the other.

Both bodily experience and imaginative projection are outside the traditional view of abstract rationality. But it is the combination of the two that Johnson and I have taken to be the foundation of our view of *imaginative rationality.* Such a view of rationality meshes well with a number of the empirical results on which the theory of natural categorization is based, particularly what we will refer to as *basic-level* results. These suggest that there is a level of experience at which human beings function optimally in their environment, given their perceptual and motor capacities, and their abilities to notice, to form mental images, to move their bodies, and to remember. It is at this basic level that we most readily and accurately distinguish certain real discontinuities in nature -- like the differences between monkeys and elephants and giraffes. To drop down to a subordinate level and distinguish among kinds of monkeys or kinds of elephants takes more attention to detail, and we are likely to make more mistakes. At the basic level, gestalt perception -- or attention to overall shape -- suffices. At subordinate, or lower levels, we have to mark distinctions that we don't perceive as part of overall gestalts.

Another way to think about discontinuities in nature is that there is a clustering, or convergence, of certain aspects of reality. Thus, animals with trunks also happen to have thick legs and large floppy ears. The fact that trunks and large floppy ears and thick legs are not evenly distributed among all the animals gives rise to a discontinuity between elephants and other kinds of animals. If such characteristics were evenly distributed, there would be a continuum between elephants and other animals sharing those characteristics. Such clusterings or discontinuities occur all levels from the atom to the cell to the galaxy. But only when they occur at the basic level of human experience are they readily and accurately distinguished via gestalt perception.

Our widespread and largely successful basic-level experience leads us to believe that we simply perceive and conceptualize things pretty much as they are, that conceptual structure is uniform at all levels, and correspondingly, that concepts are organized and processed uniformly regardless of level. One of the surprising results of research in natural categorization is that such level-differences matter in the way we organize and process our concepts. As we shall see, basic-level concepts have a special place in our conceptual system.

In this respect, the view of imaginative rationality that we are putting forth has a foundation in reality -- both reality external to us and our real interactions with, and experiences of, the world. It assumes that there are real discontinutities in nature and real basic-level human experiences. Basic-level perception and motor activity fit those real discontinuities in nature very well. We conceptualize concrete entities, like elephants or chairs, via cognitive models -- conceptual schemas that fit our basic-level experiences relatively accurately. Abstract concepts arise via projections of basic-level structures onto abstract domains. Such projections constitute metaphors. But natural metaphors that arise spontaneously to characterize abstract concepts are not matters of fancy or whims of the individual imagination. They too have a basis in real shared experience. (See Lakoff and Johnson, 1980.)

Johnson and I call this view of conceptual structure *experientialist*. It has the advantage of fitting those intuitions that have made naive realism popular. It says that if you see a cat on a mat, chances are there really is a cat and there really is a mat and the cat is really on the mat. After all, cats and mats are basic-level physical concepts, and human beings are extremely accurate in dealing with basic-level physical experiences. But experientialism goes well beyond cats and mats. It is able to transcend naive realism in permitting an adequate account of our understanding of abstract concepts like love and the mind. And it does so by demonstrating the nonobvious ways in which we metaphorically project physical experiences onto abstract conceptual domains. Experientialsm also permits an empirically adequate theory of the way human beings categorize their experience, both their physical experience and their metaphorically understood experience. As we shall see, this is beyond the bounds of naive realism.

The present book is an extension of the theory of conceptual structure presented by Johnson and myself in *Metaphors We Live By* (1980). I have turned my attention to categorization for a number of reasons. First, facts about categorization provide crucial tests for theories of conceptual structure. Secondly, the results from studies of basic-level categorization provide a non-idealist foundation for our theory of metaphorical concepts. Thirdly, prototype theory, together with our theory of metaphor, can make sense of a wide variety of phenomena.

However, it should be noted that most of the results presented here are independent of experientialist philosophy. The researchers cited, for the most part, have no such philosophical commitments. Prototype theory stands on its own as a scientific account of human categorization. It is, however, by no means uninteresting that it accords with experientialist views on human thought and human language, and not with classical views.

A Cognitive Model Approach

It is the purpose of the present work to review a number of the contributions to prototype theory made by linguists. For the most part, this work makes use of the concept of an *idealized cognitive model*. However, it should be made clear at the outset that the cognitive model approach is not generally assumed among researchers in prototype theory. Such pioneers such as Brent Berlin and Eleanor Rosch had no commitment to cognitive models of the sort we will be discussing here. The early anthroplogical and psychological studies did not seem to force one to a cognitive model approach, and Berlin and Rosch were, very reasonably, unwilling to draw conclusions unwarranted by their data. Though a cognitive model approach seems consistent with their findings, it is only the more recent linguistic studies that seem to require the use of cognitive models.

The kinds of cognitive models we will be discussing are of four types:

-Propositional
-Image-schematic
-Metaphoric
-Metonymic

The question of whether all four types are needed is currently a question of much debate. Some researchers (for example, Pylyshyn (19xx)) have argued that image-schematic models can be eliminated in favor of propositional representations. Some, like Kosslyn (19xx), have argued that both are needed. Still others, including Langacker (19xx) and myself (Lakoff, 19xx), have argued that propositional representations can be eliminated in favor of image-schematic, metaphoric, and metonymic models plus prototype theory. The present volume will not be concerned with these issues. Until questions such as these are resolved, there will be no adequate general theory of cognitive models. However, detailed examples of all the types of models above are given in Chapters XX and XX below, so that the reader can get a fairly detailed idea of what such models will have to be like.

Propositional models are widely used in linguistics, cognitive psychology, artificial intelligence, and cognitive anthropology. Their recent history began with Fillmore's (1967) concept of a *case frame*, and continued with his subsequent development of frame-and-scene semantics (Fillmore, 19xx). Rumelhart and Norman and Anderson and Bower (19xx) adapted Fillmore's concept of case frames in reviving Bartlett's (19xx) notion of a *schema*. Minsky's (19xx) concept of a *frame*, Schank and Abelson's concept of a *script*, Lakoff's (1977) *linguistic gestalts* and Langacker's (19xx) *functional assemblies* are all developments in the same spirit.

Metaphoric and metonymic models have been examined in detail by Lakoff and Johnson (1980). Gentner (19xx) and Carbonell (19xx) have also done detailed studies of metaphoric models. Image-schematic models have been explored by Langacker (19xx), Lindner (19xx), Brugman (1981), and Casad (19xx). Fauconnier's (19xx) pioneering work on mental spaces is also in the image-schematic tradition.

Cognitive models have at least the following properties:

-They are holistic. That is, they provide an overall structuring of some domain of experience.

-They have parts, but they are not compositional functions of of those parts. That is, they do not result simply by putting the parts together according to certain general principles.

The view we are proposing is that human beings have a general schematizing capacity -- a way of comprehending experience via cognitive models. People use such models in complex and nonobvious ways in categorizing their experience.

Taxonomies and Cross-Categorizations

There are two very simple types of cognitive models that are well-known and occur widely -- both in natural and consciously constructed systems of thought. They are of particular interest because they are models of how categories are organized relative to one another. The first is the *taxonomy*. Taxonomies characterize a hierarchical organization of the kinds of things that there are in a domain. Typical natural domains are plants, animals, artifacts of various sorts, etc. Taxonomic models are tree structures of the following familiar sort:

Add diagram

The top node of the tree specifies the domain. At each lower level, there is a set of nodes that specifies divisions into kinds at that level. Here is an oversimplified example of a taxonomy of living things:

Add diagram

Cross-classifications, on the other hand, characterize organizations of categories at the same level. They involve what are called *distinctive features*, that is, those characteristics that minimally distinguish one subcategory from another. A very common example occurs in linguistics. For example, pronouns in English are distinguished from one another in terms of the distinctive features of PERSON and NUMBER:

Add diagram

Third person singular pronouns are further distinguished by the feature GENDER.

Add diagram

We will refer to such models as *feature models*. Mixed classication models, including both hierarchical and cross-classification, are also common. We will refer to them as *tree+ feature* models.

Simple taxonomic and cross-classification models fall within the classical theory of categorization. In fact, they are the principal modes of categorical organization employed by the classical theory. The development of prototype theory is due, largely, to the discovery of cases where tree+ feature models are inadequate.

Base Models and Clustering

A *base model* provides a holistically structured background in terms of which one category (or concept) is distinguished from contrasting categories (or concepts). The general notion of a base model is taken from the works of Fillmore (19xx) and Langacker (1982). The most simple-minded example I know is the characterization of the concept *hypotenuse*. The base model is a right triangle. The hypotenuse is the side opposite the right angle. The right triangle is a holistic structure, and it makes sense to speak of a hypotenuse only in terms of such a structure. Taxonomies are also examples of base models, since they too are holistic structures in terms of which categories are distinguished from contrasting categories.

It is part of our folk conception of taxonomic models that each domain of experience that is taxonomically structured is correctly structured by only one taxonomic model. Taxonomies, after all, divide things into kinds, and it is commonly taken for granted that there is only one correct division into kinds. Since scientific theories develop out of folk theories, it is not at all surprising to find that folk criteria for the application of taxonomic models find their way into science. A particularly interesting example of this is discussed by Gould (19xx) in his classic "What, If Anything, Is A Zebra?".

Gould describes the heated disputes betweeen two groups of biologists -- the cladists and the pheneticists. Each of these applies different criteria for determining the 'one correct taxonomy' of living beings. The pheneticists look at overall similarity in form, function, and biological role, while the cladists are primarily concerned with branching order in the course of evolution and look at *shared derived characters*, that is, features present only in members of an immediate lineage, and not in distant primitive ancestors. Ideally, overall similarity ought to converge with evolutionary branching order and yield the same taxonomy. Traditional taxonomists use both kinds of information. But in a considerable number of cases there is a divergence between the cladistic and phenetic taxonomic models.

Gould's discussion is particularly interesting (p. 363):

> Some of our most common and comforting groups no longer exist if classifcations most be based on cladograms [evolutionary branching diagrams]...I regret to report that there is surely no such thing as a fish. About 20,000 species of vertebrates have scales and fins and live in water, but they do not form a coherent cladistic group. Some -- the lungfish and the coelacanth in particular -- are geneologically close to the creatures that crawled out on land to become amphibians, reptiles, birds, and mammals. In a cladistic ordering of trout, lungfish, and any bird or mammal, the lungfish must form a sister group with the sparrow or elephant, leaving the trout in its stream. The characters that form our vernacular concept of "fish" are all shared primitive and do not therefore specify cladistic groups.
>
> At this point, many biologists rebel, and rightly I think. The cladogram of trout, lungfish, and elephant is undoubtedly true as an expression of branching order in time. But must classifications be based only on cladistic information? A coelacanth looks like a fish, tastes like a fish, acts like a fish, and therefore -- in some legitimate sense beyond hidebound tradition -- *is* a fish.

Gould continues (p. 365):

> Phenetic similarity often correlates very poorly with recency of common ancestry. Our ideal world requires a constancy of evolutionary rate in all lineages. But rates are enormously variable. Some lineages change not at all for tens of millions of years; others undergo marked alterations in a mere thousand. When the forebears of terrestrial vertebrates first split off from a common ancestry with coelacanths, they were still unambiguously fish in appearance. But they have evolved, along numerous lines during some 250 million years, into frogs, dinosaurs, flamingos, and rhinoceroses. Coelacanths, on the other hand, are still coelacanths. By branching order, the modern coelacanth may be closer to a rhino than a tuna. But while rhinos, on a rapidly evolving line, are now markedly different from that common ancestor, coelacanths still look and act like fish -- and we might as well say so.

There are several things here worth noticing. First, both the cladists and pheneticists assume the classical theory. They are seeking well-defined classes based on shared characteristics. Where they differ is on which shared characteristics are to be considered. Second, the cladists, the pheneticists, and traditionalists like Gould, who try to balance both kinds of criteria, all follow the folk theory that there is only one correct taxonomy.

Even though Gould recognizes the scientific validity of the cladists' views, he cannot simply say that there are two different taxonomies, equally correct for different reasons. As a traditional taxonomist, he feels forced to make a choice. Third, and perhaps most fascinating, his choice is based on what he calls "subjective" criteria -- what a coelacanth looks like and tastes like to a human being. As we will see below, there is long tradition of using such humanly-based criteria in taxonomic biology.

But the general point should be clear. There are two kinds of taxonomic models available to traditional biologists: the cladistic and the phenetic. Ideally, they are supposed to converge, and they do in a great many cases, but by no means in all. One may admit, as Gould does, that both have scientific validity. Still the force of the folk theory of taxonomic models is so strong that [biologists feel that] a choice must be made.

It should come as no surprise that such situations not only arise in science, but in everyday life as well. Ordinary everyday concepts are defined relative to base models. Quite often, there is not just a single monolithic base model, but instead a complex model made up of more than one individual model. The concept may be based on the ideal assumption that these models converge.

An example is the concept *mother*. According to the classical theory, it should be possible to give clear necessary and sufficient conditions for *mother* that will fit all the cases and apply equally to all of them. Such a definition might be something like: *a woman who has given birth to a child.* But as we will see, no such definition will cover the full range of cases. *Mother* is a concept that is based on a complex ideal model in which a number of individual base models converge, forming what has been called a "cluster concept". The models in the cluster are:

-A birth model: the person giving birth is the *mother.*

-A nurturance model: the female adult who nurtures and raises a child is the *mother* of that child.

-A marital model: the wife of the father is the *mother.*

-A geneological model: the female of the first ascending generation is the *mother.*

-A genetic model: the female who contributed the genetic material is the *mother.*

The concept *mother* normally involves a complex model in which all of these individual base models convergeto form a cluster. But because of the complexities of modern life, they have come to diverge more and more. Still, many people feel the pressure to pick one base model as being the right one, the one that "really" defines what a mother is. But although one might try to argue that only one of these characterizes the "real" concept of *mother*, the linguistic evidence does not bear this out. As the following sentences indicate, there is more than one criterion for "real" motherhood:

-I was adopted and I don't know who my real mother is.
-I am not a nurturant person, so I don't think I could ever be a real mother to any child.
-My real mother died when I was an embryo, and I was frozen and later emplanted in the womb of the woman who gave birth to me.
-I had a genetic mother who contributed the egg that was planted in the womb of my real mother, who gave birth to me and raised me.
-By genetic engineering, the genes in the egg my father's sperm fertilized were spliced

together from genes in the eggs of twenty different women. I wouldn't call any of them my real mother. My real mother is the woman who bore and raised me, even though I don't have any single genetic mother.

In short, more than one of these models contributes to the characterization of a *real mother*, and any one of them may be absent from such a characterization. Still, the very idea that there is such a thing as a *real mother* seems to require a choice among models where they diverge. It would be bizarre for someone to say:

-I have four real mothers: the woman who contributed my genes, the woman who gave birth to me, the woman who raised me, and my father's current wife.

When the cluster of models that jointly characterize a concept diverge, there is still a strong pull to view one as the most important. This is reflected in the institution of dictionaries. Each dictionary, by historical convention, must list a primary meaning when a word has more than one. Not surprisingly, the human beings who write dictionaries have varied on their choices. Dr. Johnson chose the birth model as primary, and many of the applied linguists who work for the publishers of dictionaries, as is so often the case, have simply played it safe and copied him. But not all. Funk and Wagnall's Standard chose the nurturance model as primary, while the American College Dictionary chose the geneological model. Though choices made by dictionary-makers are of no scientific importance, they do reflect the fact that, even among people who construct definitions for a living, there is no single, generally accepted base model for such a common concept as "mother".

When the base models for *mother* diverge, we get compound expressions like *step-mother, surrogate mother, adoptive mother, foster mother, biological mother, donor mother*, etc. Such compounds, of course, do not represent simple subcategories, that is, kinds of ordinary mothers. Rather, they describe cases where there is a lack of convergence of the various models.

And, not surprisingly, different models are used as the basis of different extensions of *mother*. For example, the birth model is the basis of the metaphorical sense in

-Necessity is the mother of invention

while the nurturance model is basis for the derived verb in

-He wants his girlfriend to mother him.

The geneological model is the basis for the metaphorical extension of *mother* and *daughter* used in the description of the tree diagrams that linguists use to describe sentence structure. If node A is immediately above node B in a tree, A is called the *mother* and B, the *daughter*. Even in the case of metaphorical extensions, there is no single privileged base model for *mother* on which the extensions are based. This accords with the evidence cited above which indicates that the concept *mother* is defined by a cluster of converging base models.

This phenomenon is beyond the scope of the classical theory. The concept *mother* is not clearly defined, once and for all, in terms of common necessary and sufficient conditions. There need be no necessary and sufficient conditions for motherhood shared by normal biological mothers, donor mothers (who donate an egg), surrogate mothers (who bear the child, but may not have donated the egg), adoptive mothers, unwed mothers who give their children up for adoption, and stepmothers. They are all mothers by virtue of their relation to the ideal case, where the base models converge. That ideal case is one of the many kinds of cases that are referred to by the term "prototype".

As we will see shortly, the term "prototype" covers a range of cases. In this case, the prototype is conceptually central to our understanding, in that the nonprototypical cases are understood relative to it.

Representative Models

We have used the term *base model* to refer to a holistic structuring that characterizes contrasting or related categories. The base model defines the nature of the contrast or relationship. In taxonomic base models, we find contrasting categories such as: *bird, animal, reptile, amphibian, fish,....* In the birth model cited above, there are related concepts: *mother* and *child.* As we saw above, *mother* is not characterized in terms of a simple, individual base model, but rather in terms of a complex ideal model, where several base models converge. This ideal characterizes the prototypical case of a mother. But it is by no means the only case of a mother. Nonprototypical cases are defined by cases where the models diverge, as when the person who gives birth to a child is not the same as the person who raises it. Here the prototypical case is conceptually central, and the nonprototypical cases can diverge further and further from it, depending on just how much divergence there is from the ideal case.

We will use the term *prototype* to refer to a model which is conceptually central, or primary relative to some reasoning process or other cognitive task. Ideal models defined by a cluster of convergent base models, as in the case of *mother,* constitute just one kind of prototype. There is, however, an equally important class of prototypes that do not involve base models at all. These are what we will call *representative models.*

A representative model is one where one or more subcategories, or one or more individual category members (called *exemplars*), are taken to stand for the entire category. Representative models can be thought of as kinds of metonymic models, in which a part stands for the whole. Perhaps the most important thing to bear in mind about representative models is that they are not all-purpose models. They are usually used for certain kinds of reasoning and other tasks, but they are usually not the only models used in reasoning about a category. It is common for a category to have both base models and representative models, and for them to be used differently.

It should also be made clear at the outset that there is a good reason why there are many types of representative models -- and why there many be no fixed limit on the number of types. In general, metonymic models are used in the following situations:

-There is a "target" concept A to be understood for some purpose in some context.

-There is a conceptual structure containing both A, and another concept B.

-B is either part of A, or is closely associated with it in that conceptual structure. Typically, a choice of B will uniquely determine A, given that conceptual structure.

-Compared to A, B is either easier to understand, easier to process, easier to recognize, or more immediately useful for the given purpose in the given context.

-A metonymic model is model of how A and B are related in a conceptual structure, together with a function from B to A.

When such a conventional metomymic model exists as part of a conceptual system, B may be used to stand, metonymically, for A. Here are some common examples:

PART STANDING FOR WHOLE

-We need some new faces around here.
-They've got a good arm in right field.

PLACE STANDING FOR INSTITUTION

-The White House hasn't given its approval yet.
-Paris is raising skirts this year.

PRODUCER STANDING FOR PRODUCT

-I hate to read Heidigger.
-I have a Picasso on my wall.

THING USED STANDING FOR USER

-We need to hire an extra gun.
-The buses are on strike.

Representative models for categories are cases of metonymy, where either a subcategory, or a category member, or a submodel of the category is used to stand for the entire category -- for the purpose of performing some cognitive task in some context. The cognitive task may be any of the following: drawing inferences, making judgements (about probability, morality, etc.), or it may simply be comprehending the category as a whole. When it is easier to use a metonmym to understand a category, we tend to do so -- especially when there is a conventionalized metonymic model available to us.

Most of the representative models we will be discussing are conventional for one reason or another -- whether social tradition, biological capacity, or man-made convention. These tend to be relatively stable parts of our conceptual structure. However, there are also cases of individual representative models. These tend to vary a lot and to be unstable. Though such cases exist and are important, we will mainly be concerned here with conventional models that are shared by members of a cultural community.

Given the metonymic nature of representative models, it should come as no surprise that there are a profusion of types, and that they depend on such things as cognitive tasks to be performed, contexts of use, and cognitive resources at ones disposal. Metonymy in general works that way. If you need to understand a concept for some reason, you use whatever resources are at hand. Conventional metonymic models, where one concept stands for another, constitute an extremely important part of our conceptual system. Since we have many cognitive tasks to be performed regularly, and many kinds of conceptual resources, it should come as no surprise that there should be many types (probably not a fixed number) of representative models.

Social Stereotypes

Social stereotypes are perhaps the best known kind of representative model. Again, take the example of *mother*. According to our social stereotype, mothers are housewives. Thus, we have no complex category like *housewife mother*, since that is taken to be the norm. However, we do have the complex category *working mother*, which is defined to be in contrast with the stereotypical mother who is a housewife. The housewife-mother stereotype arises from a stereotypical view of nurturance, which is associated with the nurturance model. According to the stereotypical view, mothers who do not stay at home all day with their children cannot properly nurture them. There is also a stereotypical view of work, according to which it is done away from the home, and housework and childrearing don't count. This is the stereotype that the bumpersticker "All Mothers Are Working Mothers" is meant to counter.

The housewife-mother stereotype is therefore defined relative to the nurturance model. Thus, an unwed mother who gives up her child for adoption and then goes to work is still a mother, by virtue of the birth model, but she is not a *working mother*. The reason is that it is the nurturance model, not the birth model, that is relevant here.

This example shows the following:

-A social stereotype (e.g., the housewife-mother) may be a consequence of a social stereotype of only one of the base models (e.g., the nurturance model).

-A subcategory (e.g., working mother) may be defined in contrast with a stereotype (e.g., the housewife-mother).

-When both of the above occur, it is only the relevant base model (e.g., the nurturance model) that is used as a background for defining the subcategory (e.g., working mother).

Thus, only those mothers for whom nurturance is an issue can be so categorized. Stepmothers and adoptive mothers may also be working mothers, but biological mothers who have given up their children for adoption and surrogate mothers (who have only had a child for someone else) are not working mothers -- even though they may happen to be holding down a job.

Stereotypical models are important for a theory of conceptual structure in a number of ways. First, as we have seen, they may be used to motivate and define a contrasting subcategory like *working mother*. This is important because, according to the classical theory, such cases should not exist. In the classical theory, social stereotypes have no *cognitive* function -- that is, no role at all in defining *concepts* and *conceptual categories*. But the fact that the conceptual category *working mother* is defined by constrast with the housewife-mother stereotype indicates that stereotypes do have a role in characterizing concepts.

Secondly, stereotypes may be used to define a normal expectation which is linguistically marked. For example, the word *but* in English is used to mark a situation which is in constrast to some model that serves as a norm. Stereotypic models may serve this function:

NORMAL: She is a mother, but she isn't a housewife.
STRANGE: She is a mother, but she's a housewife.

The latter sentence could only be used is there were a different social stereotype. These phenomena show that stereotypes serve important cognitive functions. Other such functions include making probability judgments, drawing inferences, and making moral judgements -- all of which are well-documented in feminist literature in the case of the housewife-mother stereotype.

So far, we have seen two kinds of models for *mother*:

-An ideal model, consisting of a cluster of converging base models.
-A stereotypic model, which is a representative model, not a base model.

Both models are prototypical, but in different ways. Together, they form a cluster with a composite prototype: the best example of a mother is a biological mother who is a housewife, principally concerned with nurturance, not working, a generation older than the child, and married to the child's father. This composite prototype imposes what is called a *representativeness structure* on the category: the closer an individual is to the prototype, the more representative a mother she is.

Representativeness structures are linear. They concern nothing but closeness to the prototypical case, and thus they hide most of the richness of structure that exists in the cognitive models that characterize the category. Representativeness structures, though real, are mere shadows of cognitive models. It is important to bear this in mind, since prototype theory is sometimes thought of as involving only such linear representativeness structures and not cognitive models. This is an extremely impoverished view of prototype theory, and not the one that is current in contemporary cognitive linguistics.

The study of representativeness structures has played an important role in the history of prototype theory -- largely in demonstrating that prototypes do exist and in making a bare first approximation to finding out what they are and what properties they have. But a full study of category structure must go well beyond just isolating a prototype and giving a linear ranking of how close nonprototypical cases are. At the very least, it must provide an account of the details of the cognitive models that give rise to the representativeness structure.

Other Types of Representative Models

BOOKMARK

We use certain members or subcategories of a category as models to represent the entire category in reasoning and in other tasks. There are many kinds of representative models:

-social stereotypes (e.g., the swinging bachelor)
-paragon models (e.g., Babe Ruth)
-typical examples (e.g., the average family)
-salient reference points (e.g., central blue)
-ideal types (e.g., the ideal president, mother)
-familiar well-understood examples (e.g., single-digit numbers)
-generators (e.g., single-digit numbers)
-memorable individual cases (e.g., the DC-10 crash in Chicago)

All these kinds of representative models may function as "prototypes", that is, they may be used as a basis

-for placing something in the category
-for deciding how good an example of the category something is
-for drawing inferences about other category members
-for drawing inferences about the category as a whole
-and for making probability judgements.

Representative models often impose a structure on the category, according to which the representative model is taken as "central" and other members of subcategories as more or less peripheral, depending on their relationship to the representative model. Actually a given category may have more than one representative model or more than one kind of representative model. Prototype theory claims that such representative models are central to conceptual structure because of the wide range of important cognitive functions that they serve. In the classical theory, representative models play no part in conceptual structure. As a consequence, the classical view of rationality excludes all of the uses of representative models listed above. Prototype theory, on the other hand, claims that they are an essential part of what makes us rational animals.

Let us take a simple example of a representative model. Consider the category of natural numbers. The subcategory of numbers between zero and ten, together with procedures for addition and multiplication, constitutes a representative model of the whole category. Thus, large numbers can be understood as sums of products of the numbers between one and ten, or as sequences of single-digit numbers. Moreover, we compute with large numbers via our ability to compute with numbers between zero and ten. In other words, we determine the computational properties of large numbers using the computational properties of the numbers in our representative model. It is only by using this representative model that we are able to conceptualize and comprehend the natural numbers in general. And if we did not have such a representative model, we could not add, subtract, multiply, etc.

This happens to be a very special example of a representative model. It is a model that *generates* the entire category. That is, *all* of the natural numbers can be understood as sums of products of numbers between zero and ten. A category of this sort is called a *recursive* category -- that is, a category generated via a representative model. Such categories are common in mathematics, but fairly rare in everyday life. Representative models usually do not generate the entire category that they represent. Let us take some examples:

-Social stereotypes: Our knowledge of the stereotypical housewife does not characterize all housewives.

-Best examples: Babe Ruth is an excellent example of a baseball player. We use our knowledge about him to characterize limts on our expectations of other baseball players. But our knowledge about him does not characterize baseball players in general.

-Typical examples: We may use our knowledge about the average family to draw conclusions about families in general, but that knowledge does not characterize families in general.

Prototype theory claims that representative models are are used in reasoning and are central to our understanding of concepts.

The Cornerstones

The theory of natural categorization, as I understand it, is based on three fundamental ideas: ***basic-level concepts, family resemblances***, and ***cognitive models***, with cognitive models coming in two types, ***base models*** and ***representative models***. We have already given a brief account of basic-level concepts, and a more detailed account will be given below in Chapter XX. The idea of family resemblances comes from Wittgenstein (Philosophical Investigations, I, 66-69). Wittgenstein was reacting against certain aspects of the classical view of categories. Briefly, these were:

-Categories have precise boundaries.
-The members of a category all have something in common.
-A category is defined by precise necessary and sufficient conditions, which state what the members have in common and thereby determine the precise boundaries of the category.

Wittgenstein's discussion is worth quoting at some length:

66. Consider for example the proceedings that we call "games". I mean board-games, card-games, ball-games, Olympic games, and so on. What is common to all of them? -- Don't say: "There *must* be something common, or they would not be called 'games'" -- but *look and see* whether there is anything common to *all*. --For if you look at them you will not see something that is common to *all*, but similarities, relationships, and a whole series of them at that. To repeat: don't think, but look! --Look for example at board-games, with their multifarious relationships. Now pass to card-games; here you find many correspondences with the first group, but many common features drop out and others appear. When we pass next to ball-games, much that is common is retained, but much is lost. -- Are they all 'amusing'? Compare chess with noughts and crosses. Or is there always winning and losing, or competitition between players? Think of patience. In ball games there is winning and losing; but when a child throws a ball against the wall and catches it again, this feature has disappeared. Look at the parts played by skill and luck; and at the difference between skill in chess and skill in tennis. Think now of games like ring-a-ring-a-roses; here is the element of amusement, but how many other characteristic features have disappeared! And we can go through the many, many other groups of games in the same way; can see how similarities crop up and disappear.

And the result of the examination is: we see a complicated network of similarities overlapping and criss-crossing: sometimes overall similarities, sometimes similarities of detail.

67. I can think of no better expression to characterize these similarities than "family resemblances"; for the various resemblances between members of a family: build, features, colour of eyes, gait, temperament, etc. etc. overlap and crisscross in the same way. -- And I shall say: 'games' form a family.

And for instance the kinds of number form a family in the same way. Why do we call something a "number"? Well, perhaps because it has a -- direct -- relationship with several things which have hitherto been called number; and this can be said to give it an indirect relationship to other things we call the same name. And we extend our concept of number, as in spinning a thread we twist fibre on fibre. And the strength of the thread does not reside in the fact that some one fibre runs through its whole length, but in the overlapping of many fibres.

But if someone wished to say: "There is something common to all these constructions -- namely the disjunction of their common properties" -- I should reply: Now you are only playing with words. One might as well say: "Something runs through the whole thread -- namely the continuous overlapping of those fibres".

68. All right: the concept of number is defined for you as the logical sum of these individual interrelated concepts: cardinal numbers, rational numbers, irrational numbers, etc.; and in the same way, the concept of a game as the logical sum of a corresponding set of sub-concepts." --It need not be so. For I *can* give the concept 'number' rigid limits in this way, that is, use the word "number" for a rigidly limited concept, but I can also use it so that the extension of the concept is not closed by a frontier. And this is how we do use the word "game". For how is the concept of a game bounded? What still counts as a game and what no longer does? Can you

> give the boundary? No. You can *draw* one; for none has so far been drawn. (But that never troubled you before when you used the word "game".)

The idea of representative and nonrepresentative models also orignated with Wittgenstein (Philosophical Investigations, 70):

> Someone says to me: "Show the children a game." I teach them gaming with dice, and the other says "I didn't mean that sort of game." Must the exclusion of the game with dice have come before his mind when he gave me the order?

The point is that dice isn't a representative example of a game and that such knowledge is part of what you know if you understand what a game is.

To summarize briefly:

-A category need not have rigid boundaries.

-The members of a category need not have any one thing in common.

-The members of a category have similarities and/or bear relationships to one another.

-Categories may be extended.

-Part of knowing a concept is knowing which examples are representative.

-It is possible for a concept to be defined by representative examples and family resemblances.

It is also important to point out what is *not* being claimed:

-It is not being claimed that *all* categories must have inexact boundaries. Precise lines may be drawn for some purposes, and the possibility is left open as to whether some concepts naturally have precise boundaries.

-It is not being claimed that all concepts are completely defined by representative examples and family resemblances. It is only suggested that it is possible for concepts to be so defined.

-It is not being claimed that members of a category never share any common properties. It is only claimed that they need not do so, and that common properties are not sufficient to characterize a category.

I mention this because it is a common misconception about prototype theory that such claims are being made. It is common to come accross claims that prototype theory is false because such and such a category has precise boundaries or because its members share a common property. It is important to bear in mind that prototype theory permits classical cases; rather then being counterexamples, they are merely uninteresting cases where the classical theory and prototype theory happen to coincide.

Beyond Wittgenstein

Contemporary prototype theory has extended Wittgenstein's observations in many ways. Here are some of the extensions:

-Basic-level concepts.
-Cognitive models, including metaphorical models and image models.
-Chaining-structures to characterize family resemblances.
-Representative models of many types.

The first three will be discussed at some length in the chapters to come. However, the idea that there are many types of representative models has not been investigated as thoroughly as the other ideas. Although it is one of the most intriguing ideas in prototype theory, we can do little more than mention it briefly and give some examples.

Representative Models and Base Models

We use certain members or subcategories of a category as models to represent the entire category in reasoning and in other tasks. There are many kinds of representative models:

-social stereotypes (e.g., the swinging bachelor)
-best examples (e.g., Babe Ruth)
-typical examples (e.g., the average family)
-salient reference points (e.g., central blue)
-ideal types (e.g., the ideal president)
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Prototype theory claims that representative models are are used in reasoning and are central to our understanding of concepts. But representative models are, of course, not the whole story. Other kinds of models are used in categorization. Following Langacker (1982), I will refer to these as *base* models. Base models are taken as backgrounds used in characterizing a concept (see Fillmore (19xx) and Chapter xx below). The most simple-minded example I know is the characterization of the concept *hypotenuse*. The base model is a right triangle. The hypotenuse is the side opposite the right angle. This is, of course, a technical concept in geometry, rather than a natural, everyday concept. It has only a base model and no represententative models. As such, it is an excellent example of a classical concept, since it can be completely conceptualized in a single, simple base by precise necessary and sufficient conditions, without any representative models. Prototype theory does not exclude such cases. It does, however, suggest that they are not the norm for concepts that arise naturally. Those concepts which, like *hypotenuse,* are precisely characterized relative to a single, monolithic base model are the best examples of classical concepts.

Given the distinction between base models and representative models, one might be led to a false conclusion, namely:

-Concepts defined with respect to base models are classical concepts.

-The classical theory is correct, but incomplete; to make it complete one can merely add representative models.

There are some obvious problems. First, this does not account for Wittgenstein's example of the concept "game", since it doesn't seem to be characterized by a single base model. Second, it does not account for recursive categories, which are completely and precisely characterized via representative models. The example we gave above was the concept "natural number". Third, and perhaps most importantly, concepts are commonly defined with respect to more than one base model. When this happens, we get effects that do not accord with the classical theory. An example is the concept *mother*, which has at least the following base models:

-A birth model: the person giving birth is the *mother*.
-A nurturance model: the female adult who nurtures and raises a child is the *mother* of that child.
-A marital model: the wife of the father is the *mother*.
-A family tree model: the female one node up from you on your family tree is your *mother*.
-A genetic model: the person who contributed the egg is the *mother*.

The concept *mother* normally involves all of these base models. Ideally, they converge. But because of the complexities of modern life, they have come to diverge more and more. One might try to argue that only one of these characterizes the "real" concept of *mother*, but the linguistic evidence does not bear this out, as the following sentences show:

-I was adopted and I don't know who my real mother is.
-I am not a nurturant person, so I don't think I could ever be a real mother to any child.
-My real mother died when I was an embryo, and I was frozen and later emplanted in the womb of the woman who gave birth to me.
-I had a genetic mother who contributed the egg that was planted in the womb of my real mother, who gave birth to me and raised me.
-By genetic engineering, the genes in the egg my father's sperm fertilized were spliced together from genes in the eggs of twenty different women. I wouldn't call any of them my real mother. My real mother is the woman who bore and raised me, even though I don't have any single genetic mother.

In short, each of these models contributes to the characterization of a *real mother*.

When these base models diverge, we get special cases like *stepmother, surrogate mother, adoptive mother, biological mother*, etc. And different models are used as the basis of different extensions of *mother*. For example, the birth model is the basis of the metaphorical sense in

-Necessity is the mother of invention

while the nurturance model is basis for the derived verb in

-He wants his girlfriend to mother him.

All of this indicates that there is no single privileged base model in terms of which the concept *mother* is defined. And the intersection of all these models constitutes a kind of representative model. This is a principle of prototype theory:

-When a concept has more than one base model, the intersection of its base models functions as a representative model.

Representative models are used in certain types of reasoning, and intersections of base models are also used in those types of reasoning.

Of course, there are other representative models for the concept *mother* -- social stereotypes, ideals, etc. In short, *mother* is characterized by a number of models that have different cognitive statuses. This should not be surprising. Mothers are important in many areas of our lives. Our understanding of the concept mother is very complex, and differs from one conceptual domain to another. We therefore have different models for different domains. This is the norm, rather than the exception for concepts that have arisen naturally and are in widespread regular use.

Base models do seem to have some sort of special cognitive status. They characterize whole collections of related, and contrasting, concepts that fit together in an organized way. This gives base models more stability than say, models that characterize social stereotypes or ideals or best examples. For example, our social stereotype of a mother has changed considerably in the past century, but our base models have remained constant. Still, social stereotypes do matter so far as conceptual structure is concerned. It seems fair to say that our concept of a mother has changed in important ways in the past century.

Mother is a good example of what Putnam (19xx) has referred to as "cluster concept". It is a case where a cluster of criteria together characterize a concept. As Putnam observes, this is not only the case for ordinary everyday concepts like *mother* or *man* (his example). Scientific concepts also work this way. Putnam cites the concept *energy,* which is defined in physics by its role in various equations. There are a considerable number of such equations that converge to characterize energy -- and a number of them have changed in the course of physics.