

Scripts Plans Goals and Understanding

An Inquiry into Human Knowledge Structures

Roger Schank
Robert Abelson



**Scripts, Plans, Goals
and Understanding**

The Artificial Intelligence Series

Roger C Schank

Consulting Editor

Scripts, Plans, Goals and Understanding

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Roger C Schank
Robert P Abelson
Yale University



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Preface

In the summer of 1971, there was a workshop in an ill-defined field at the intersection of psychology, artificial intelligence, and linguistics. The fifteen participants were in various ways interested in the representation of large systems of knowledge (or beliefs) based upon an understanding process operating upon information expressed in natural language. The two of us first came to appreciate each other's work at that workshop.

There was a self-conscious sense at that workshop that maybe we were defining a new field, crossing previously rigid interdisciplinary boundaries. There were self-mocking toasts to the 'proclamation from Mount Quissett' (actually a small hill overlooking Quissett Harbor, Massachusetts) that henceforth this new discipline would exist and be called some name that we had not the foresight to anticipate.

The Quissett proclamation was not far from the mark – in part because it was self-fulfilling. Other conferences, some new books, and even a new journal have come about in this new field that has come to be called Cognitive Science. In addition, the two of us began to collaborate after that summer. That collaboration was facilitated when Schank moved to Yale in 1974.

A major reason it is possible for the two of us to work together on problems in human and computer understanding is that we both believe that we need computers as the metaphor in terms of which we create our theories and as the arbiter of the plausibility of our theories. There is such a range of problems and procedures involved in the understanding process that to not use a computer is simply not to know whether what you are theorizing about could ever possibly work, let alone be right.

From time to time our different backgrounds (Schank in artificial intelligence and Abelson in social psychology) caused us, in developing this book and the ideas behind it, to differ in approaches to certain problems. Abelson needed constantly to be restrained from wandering into abstract psychologizing beyond the scope of this book. (This restraint was not always effective; several Abelsonian meanders have survived.) Schank needed to be dissuaded from too much reliance on argument by cutesy example and from giving too many ad hoc lists of conceptual entities. (Such dissuasion had its limits, too. The reader will find many Schankian examples and an occasional ad hoc entity.) The two of us disagreed somewhat on the potential importance of validating experimental psychological data, but this disagreement never reached serious proportions because both of us view the present status of the experimental literature as not as helpful as we would like.

The book we have written is unusual in many ways. It is not a sum-up of things we have proven or know to be true. There are loose ends, even unnoticed ends, abounding. We had to choose between continuing on indefinitely until we were sure that what we had was right and complete, or stopping somewhat arbitrarily. We chose the latter because we realize that most research is never really finished.

The book advances four main theoretical entities: scripts, plans, goals, and themes. Each of the four is somewhat less well defined than its immediate predecessor. We feel we really understand scripts, are pretty sure about plans, somewhat less certain about goals, fuzzy about themes and completely uncertain what lies beyond that. Nonetheless, we feel strongly that our ideas are significant enough to warrant publication. We hope that the reader will allow for the imperfections of work that is still in its infancy.

This book is unusual in another way, namely that it is not a book that lies clearly in any academic discipline. It does not conform to standard conceptions of a psychology book because it does not report experiments. It does meet normal expectations for a report on artificial intelligence research because its description of computer programs is only cursory. It is not a book about linguistics because it deals with issues that exist apart from whatever language is being spoken. Nonetheless we feel that it is in fact a book about all three fields. But as we were not certain exactly what audience we were writing to, the book at times has the flavor of a mass-oriented work, aiming squarely at the middle and leaving the technical aside.

Although this book was written by the two of us, the research we report here is also the product of many seminars and discussions that took place over a two year period. The following Yale students and research staff participated in those discussions and often contributed key insights that helped us to carry on: Joshua Auerbach, Jaime Carbonell, Richard Cullingford, Gerald DeJong, Anatole Gershman, Richard Granger, Gregory Harris, Wendy Lehnert, James Meehan, Richard Proudfoot, Christopher Riesbeck, Mallory Selfridge, Walter Stutzman and Robert Wilensky.

In particular, James Meehan, Robert Wilensky, Wendy Lehnert, and Richard Cullingford contributed written material which was included either directly or indirectly in the context of this book. Richard Cullingford wrote small portions of Chapter 3 and prepared all of section 8.3. The SAM program was put together by him. He wrote the script applier part of that program and oversaw the rest of the project. Robert Wilensky wrote a great part of sections 5.6 and 7.2 and also prepared section 8.6. Since he has been working on plans and goals in PAM, many other ideas presented here may also be indirectly attributable to him. Wendy Lehnert and Robert Wilensky contributed to the ideas which germinated section 7.4. James Meehan contributed to the ideas in Chapter 4 and prepared section 8.5. Gerald DeJong prepared section 8.4 and was primarily responsible for the FRUMP program. The pieces of section 8.2 that describe different parts of SAM were written by the people who programmed those parts.

Many people have been responsible in various ways for the production of this book. Ann Clementino designed the graphics in the book and prepared the book to be typeset by the Yale Mergenthaler Printing Device. Walter Stutzman ran the typesetting programs as well as doing every other chore imaginable in getting the book to physically exist. Without their effort the book would have cost more, been available much later, and probably been a lot less attractive. Diane Schank edited the final draft and cleaned up some of the unwieldy prose. Hana Schank provided food for thought in Chapter 9.

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**To our fathers
Maxwell Schank
and
Miles Abelson**

**Scripts, Plans, Goals
and Understanding**

1 Introduction

1.1 What this book is about

This book reflects a convergence of interests at the intersection of psychology and artificial intelligence. What is the nature of knowledge and how is this knowledge used? These questions lie at the core of both psychology and artificial intelligence. The psychologist who studies 'knowledge systems' wants to know how concepts are structured in the human mind, how such concepts develop, and how they are used in understanding and behavior. The artificial intelligence researcher wants to know how to program a computer so that it can understand and interact with the outside world. The two orientations intersect when the psychologist and the computer scientist agree that the best way to approach the problem of building an intelligent machine is to emulate the human conceptual mechanisms that deal with language. There is no way to develop adequate

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computer 'understanding' without providing the computer with extensive knowledge of the particular world with which it must deal. Mechanistic approaches based on tight logical systems are inadequate when extended to real-world tasks. The real world is messy and often illogical. Therefore artificial intelligence (henceforth AI) has had to leave such approaches behind and become much more psychological (cf. Schank and Colby, 1973; Bobrow and Collins, 1975; Boden, 1976). At the same time, researchers in psychology have found it helpful to view people as 'information processors' actively trying to extract sense from the continual flow of information in the complicated world around them. Thus psychologists have become more interested in machine models of real-world knowledge systems. The name 'cognitive science' has been used to refer to this convergence of interests in psychology and artificial intelligence (Collins, 1976).

This working partnership in 'cognitive science' does not mean that psychologists and computer scientists are developing a single comprehensive theory in which people are no different from machines. Psychology and artificial intelligence have many points of difference in methods and goals. Intellectual history, like political history, is full of shifting alliances between different interest groups. We mention this because for many commentators, the blood quickens when computers and human beings are associated in any way. Strong claims for similarity (e.g., Newell and Simon, 1972) are countered by extravagant alarms (e.g., Weizenbaum, 1976). Enthusiasts and horrified skeptics rush to debate such questions as whether a computer could ever be in love. We are not interested in trying to get computers to have feelings (whatever that might turn out to mean philosophically), nor are we interested in pretending that feelings don't exist. We simply want to work on an important area of overlapping interest, namely a theory of knowledge systems. As it turns out, this overlap is substantial. For both people and machines, each in their own way, there is a serious problem in common of making sense out of what they hear, see, or are told about the world. The conceptual apparatus necessary to perform even a partial feat of understanding is formidable and fascinating. Our analysis of this apparatus is what this book is about.

1.2 Knowledge: Form and Content

A staggering amount of knowledge about the world is available to human beings individually and collectively. Before we set out on a theory of knowledge systems, we ought to ask ourselves: knowledge about what? We must be wary of the possibility that knowledge in one domain may be organized according to principles different from knowledge in another. Perhaps there is no single set of rules and relations for constructing all potential knowledge bases at will. A desire for generality and elegance might inspire a theorist to seek a 'universal' knowledge system. But if you try to imagine the simultaneous storage of knowledge about how to solve partial differential equations, how to smuggle marijuana from Mexico, how to outmaneuver your opponent in a squash game, how to prepare a legal brief, how to write song lyrics, and how to get fed when you are hungry, you will begin to glimpse the nature of the problems.

Procedures for intelligently applying past knowledge to new experience often seem to require common sense and practical rules of thumb in addition to, or instead of, formal analysis (Abelson, 1975). The prospects for the general theorist to cope with all the varied applications of common sense are especially dismal. Nevertheless, many artificial intelligence researchers take a generalist point of view. It is in the best tradition of mathematics (in which computer scientists are generally well trained) that great power is gained by separating form and content: the same system of equations may account for a great many apparently disparate phenomena. It is also a central tenet in computer science that generality is highly desirable. Turing's (1936) original principle of the general purpose machine has often been embraced as though the computer were (or soon would be) in practice a general purpose machine. The field of artificial intelligence is full of intellectual optimists who love powerful abstractions and who strive to develop all-embracing formalisms.

It is possible to be somewhat more pragmatic about knowledge, however. The five-year-old child learning to tie shoelaces need not in the process be learning anything whatsoever about mathematical topology. There is a range of psychological views on the nature of knowledge, and we shall say a little more about this in the next section. For now, we simply note that we will take a pragmatic view. We believe that the form of knowledge representation should not be separated too far from its content. When the content changes drastically, the form should change, too. The reader will encounter plenty of abstractions in this book, but each set of them will be

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pegged specifically to a particular type of real-world content. Where generalizing is possible, we will attempt to take advantage of it, but we will not try to force generality where it seems unnatural.

In order to adopt this attitude, we have set some boundaries on the type of knowledge we will consider. Our focus will be upon the world of psychological and physical events occupying the mental life of ordinary individuals, which can be understood and expressed in ordinary language. Our knowledge systems will embody what has been called 'naive psychology' (Heider, 1958) – the common sense (though perhaps wrong) assumptions which people make about the motives and behavior of themselves and others – and also a kind of 'naive physics', or primitive intuition about physical reality, as is captured in Conceptual Dependency (CD) theory (Schank, 1972, 1975). This book goes well beyond CD theory, however. That theory provides a meaning representation for events. Here we are concerned with the intentional and contextual connections between events, especially as they occur in human purposive action sequences. This new stratum of conceptual entities we call the Knowledge Structure (KS) level. It deals with human intentions, dispositions, and relationships. While it is possible computers cannot actually experience such intentions and relationships, they can perfectly well be programmed to have some understanding of their occurrence and significance, thus functioning as smart observers. If our theory is apt, it will provide a model of the human observer of the human scene; it will also explain how to construct a computer observer of the human scene, and lead to the eventual building of a computer participant in the human world.

Often our emphasis will be on the nature of potential understanding of two or three sentences, story fragments, or longer stories. These provide a straightforward and helpful way to pose the major issues. Lurking beneath the surface, however, is an interest in the ingredients of personal belief systems about the world, which dispose people toward alternative social, religious, or political actions. One of us has a major interest in belief systems and ideologies (Abelson, 1973). This book is not directly addressed to that interest, but the concepts developed are a major part of that total effort.

What we will not present in this book is a general apparatus for attempting to represent any and all knowledge. We give no information retrieval methods of interest to library scientists. The reader with a passion for mathematics and/or logic will be disappointed. Likewise, anyone wondering, for example, whether we could get a computer to play squash or roll pasta dough should not wait with

bated breath. The geometry of bouncing balls, the 'feel' of dough texture, and many other aspects of human activities involve knowledge falling outside of our present boundaries. This is because (among other reasons) visual and kinesthetic processes cannot readily be represented in verbal form. However, a great deal of the human scene can be represented verbally, and we have no lack of things to work on.

1.3 Traditional Points of View

We have mentioned that our task lies at the intersection of psychology (more specifically, cognitive psychology and cognitive social psychology) and artificial intelligence. Since we are concerned with verbally expressible knowledge, there is also an overlap with linguistics. When one tries to work in a disciplinary intersection, one inevitably comes into conflict with the traditional standards, habits, and orientations of the parent disciplines. This is especially true when the disciplines correspond to university departments, breeding suspicion of out-groups (cf. Campbell, 1969). Here we briefly sketch some of these conflicts, which we have resolved somewhat differently from others working at the same intersection.

Psychology is a heterogeneous discipline. The major subdivisions are developmental, clinical, cognitive and social psychology, and psychobiology. It is surprising to the non-psychologist but familiar to all but the youngest generation of psychologists that cognitive psychology is a relatively new branch of study. American experimental psychology was dominated for so long by behaviorism – roughly, from 1935 to 1960 – that the study of mental processes lay almost entirely dormant while other branches of psychology were developing rapidly. Since mental events could not be observed directly, there was scientific resistance toward relying on them to explain anything, whatever the scientist's common sense might tell him. Introspective evidence was not regarded as objectively trustworthy.

Since 1960, there has been an enormous surge of careful experimental work on mental phenomena. Skinner notwithstanding, hu-

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man psychology could not seem to do without cognitive processes. Nevertheless, the methodological caution of the behaviorists was carried over into this resurgence. Acceptable scientific procedure called for quantitative response measurements such as accuracy of recall or choice reaction time when subjects were confronted with well-controlled stimulus tasks. In the verbal domain, stimulus control usually entailed repetitive trials on isolated verbal materials, deliberately avoiding meaningful connotations in the experimental situation. While recent experimental materials have not been as trivial as the old-fashioned nonsense syllables, neither have they been genuinely meaningful or even necessarily plausible. Experimental tasks are often unusual and/or unnatural in relation to tasks encountered daily by people in using language. For example, in a well-known experiment by Foss and Jenkins (1973), subjects listened to 48 sentences such as 'The farmer placed the straw beside the wagon', with instructions to press a key the instant they first heard the phoneme 'b'. In another well-known series of experiments by Anderson and Bower (1973), subjects heard 32 unrelated sentences such as 'In the park, the hippie kissed the debutante', 'In the bank, the tailor tackled the lawyer', etc., and an hour later were asked to recall as many of them as they could. The artificiality of tasks such as the latter led Spiro (1975) to remark tartly,

Why should a research subject integrate the to-be-remembered information with his or her other knowledge? The role the information will play in his or her life can be summarized as follows: take in the information, hold it for some period of time, give it back to the experimenter in as close to the original form as possible, and then forget it forever. The information cannot be perceived as anything but useless to the subject in his or her life (given the common employment of esoteric or clearly fictional topics as stimulus materials). The information, even when not clearly fictional, is probably not true. In any case, the subject knows that the relative truth of the information has nothing to do with the purpose of the experiment.
(p.11)

In complaining about the lack of meaningful context in experiments such as these, it is no doubt unfair to present them out of their context. The experimenters had serious purposes, and the data were of some interest. But since our needs are for a set of interrelated constructs to explain the process of natural understanding of connected discourse, this style of experimentation is both too unnatural and too slow. There has been a gradual increase in research with connected discourse as stimulus material (e.g., Bransford and Johnson, 1972; Kintsch, 1974; Frederiksen, 1975; Thorndyke, 1977)

but the field is still marked with a very cautious theoretical attitude. We are willing to theorize far in advance of the usual kind of experimental validation because we need a large theory whereas experimental validation comes by tiny bits and pieces. Our approach, in the artificial intelligence tradition, is discussed in Section 1.6.

If the research properties of experimental cognitive psychology are often unduly restrictive, the traditions in the field of linguistics are even more restrictive. Linguistics has concerned itself with the problem of how to map deep representations into surface representations (see Chomsky, 1965). After a long obsession with syntactically dominated deep representations, recent work in linguistics has oriented deep representations much more towards considerations of meaning (Lakoff, 1971; Clark, 1974). Despite this reorientation linguists have managed to miss the central problems.

Two fundamental problems stand out: How do people map natural language strings into a representation of their meaning? How do people encode thoughts into natural language strings? Because of a purported interest in the purely formal properties of language, linguists have consciously avoided both of these naturalistic problems. The second question seems, on the surface, to be closer to a linguist's heart. But linguists treat generation as a problem of determining whether a string is grammatical, i.e., whether it can be generated by the grammar they have set up. A grammar that generates natural language strings would be interesting and useful of course, if, and this is a big 'if', it started at the right place. Linguists tend to start their grammars at the node S (for sentence). People, on the other hand, start with an already well-formed idea (or the beginnings of an idea) that they want to express. Linguists thus wind up concerning themselves with considerations of semantics at the level of 'Can I say this string? Will it mean something'? People already know what they want to say and that it is meaningful.

Two remedies for this linguistic notion of semantics come to mind. For the generation problem the obvious solution is to start the process earlier. How do people get thoughts to express? Linguists explicitly consign this question to other disciplines; yet it is an important part of the generation process, and one which when treated as a linguistic question completely changes the process under investigation. The other remedy is to apply such semantic considerations as 'Does this string mean something?' to the problem of understanding what someone else has said. Questions of how strings can be meaningfully interpreted belong to the domain of understanding, not generation, where Chomsky (1965, 1971) has repeatedly

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put them. (Actually Chomsky would deny that he works on generation. Transformationalists prefer to think of themselves as working on an abstract formalism with no process notions present at all.)

Linguists have almost totally ignored the question of how human understanding works. Since human understanding is dependent on the ability to decode language this seems odd at best. Some 'computational linguists', (e.g., Friedman, 1969 and Kay, 1973) have attacked the problem. However, they have followed linguistic tradition and consequently have maintained one of the fundamental flaws of linguistics in their work. They have divided the problem into linguistic and non-linguistic parts, a division that holds up no better for understanding than it does for generation.

Artificial intelligence has a somewhat more congenial recent history. The field is relatively new, and its early efforts were predominantly oriented toward getting computers to solve logical and mathematical problems (e.g., Newell, Shaw and Simon, 1957; Minsky, 1961; Feigenbaum and Feldman, 1963; Nilsson, 1971), and to play games such as checkers (Samuel, 1963) and chess (Bernstein et al, 1958; Newell, Shaw and Simon, 1958) intelligently. Early efforts to have computers deal with natural language were marked either by drastic failure (as in the case of mechanical translation from one language to another) or drastic oversimplification in the admissible vocabulary (Green et al, 1961) and grammar (Abelson, 1963; Colby and Gilbert, 1964), or by programming tricks producing smooth locutions which made the computer seem smarter than it actually was (Weizenbaum, 1966).

It has nevertheless been consistently regarded as important that computers deal well with natural language. In practical terms, such a development would mean that anyone could interact with a computer without learning a programming language or some special code to communicate about a special problem, whether it be library or consumer information, travel and ticket reservations, suggestions about home repairs, crop protection, first aid, etc. Computerized teaching programs would not have to be restricted to giving multiple-choice tests of the student's knowledge, but could interpret and respond intelligently to free-form answers and questions from the student. None of these high-sounding things are possible, of course, unless the computer really 'understands' the input. And that is the theoretical significance of these practical questions – to solve them requires no less than articulating the detailed nature of 'understanding'. If we understood how a human understands, then we might know how to make a computer understand, and vice versa.

In the last several years there have been two clusters of developments in artificial intelligence which are miles ahead of previous efforts. First, there is a new generation of programs for 'parsing' sentences (in English and other languages) – that is, for deciding the proper features (such as what part of speech) to assign to each word in a sentence. The approaches of Woods (1970), Winograd (1972), Riesbeck (1975) and Marcus (1975) differ in the relative priority they give to syntactic or semantic features in parsing, but all agree that semantic features are considerably more important than linguists had generally been willing to acknowledge. Second, there has been increasing recognition that context is of overwhelming importance in the interpretation of text. Implicit real-world knowledge is very often applied by the understander, and this knowledge can be very highly structured. The appropriate ingredients for extracting the meaning of a sentence, therefore, are often nowhere to be found within the sentence.

There are several famous illustrations of this latter point. Collins and Quillian's (1972) is:

- 1 The policeman held up his hand and stopped the car.

Somehow in understanding this sentence we effortlessly create a driver who steps on a brake in response to seeing the policeman's hand. None of these intermediate links are mentioned in sentence (1). Another example, (from Abelson, 1969) is:

- 2 I went to three drugstores this morning.

Very innocently, the concept that the person must not have found what he wanted in the first two drugstores is implied, otherwise why would he have gone to three? This kind of implicit inference is very common – and of course can be wrong, but it is intrinsic to natural understanding that useful, fallible presumptions creep in.

Perhaps the simplest example of implicit inferences can be seen in a simple sentence such as (from Schank, 1972):

- 3 I like apples.

The speaker is talking about 'eating' but this is not explicitly mentioned. And why should it be? The speaker, unless he is deliberately trying to fool his listener, knows that the listener knows what action is being implicitly referenced. These examples were constructed with a point in mind, but are not really unusual. In all of them, and in many, many other examples to be found in this book, more is at issue than 'semantics'. It is 'pragmatics', the way things usually work – not how they might conceivably work – which most often im-

pels the reader toward an interpretation. The reader brings a large repertoire of knowledge structures to the understanding task. Elsewhere these structures have been called 'frames' (Minsky, 1975) and 'schemata' (Rumelhart, 1976). Rumelhart puts the matter very well when he says, 'The process of understanding a passage consists in finding a schema which will account for it.'

Interestingly, the idea of the schema in the interpretation of human events has a long tradition in social psychology. American social psychology had its roots in Gestalt psychology, and therefore did not succumb to the excesses of behaviorism the way human experimental psychology did. The phenomenology of mental life maintained a central role, largely through the towering influence of Kurt Lewin in the 1940's. Lewin (1936) wrote about human goal strivings in terms of internal images people had of their 'life spaces'. Since then a long succession of social psychologists have appealed to structured ideational kernels of the way people supposed the world to be organized: Heider's (1946, 1958) 'balance principle' and 'naive psychology'; Festinger's (1957) 'cognitive dissonance theory'; Abelson and Rosenberg's (1958) 'psycho-logic'; Kelley's (1967) and Jones and Davis' (1966) 'attribution theory', and many more. The terminology of the 'schema' is very much active in the 1970's (cf. Kelley, 1971; Tesser, 1977), even in areas well beyond social psychology (Rumelhart, 1975; Bobrow and Norman, 1975; Rumelhart and Ortony, 1976). The second author's orientations in the present book can be traced back to earlier excursions into 'hot cognition' (Abelson, 1963), 'individual belief systems' (Abelson and Carroll, 1965), and 'implicational molecules' (Abelson and Reich, 1969).

There is a very long theoretical stride, however, from the idea that highly structured knowledge dominates the understanding process, to the specification of the details of the most appropriate structures. It does not take one very far to say that schemas are important: one must know the content of the schemas. To be eclectic here is to say nothing. If one falls back on the abstract position that only form is important, that the human mind is capable of developing knowledge structures of infinitely varied content, then one sacrifices the essence of the structure concept, namely the strong expectations which make reality understandable. In other words, a knowledge structure theory must make a commitment to particular content schemas.

The commitment to particular content is a policy we follow consistently throughout the book. Whether we are talking of scripts, plans,

goals, themes, etc., we try whenever feasible to lay out the particulars of members of these conceptual categories. This is the same policy as was followed by the first author in developing Conceptual Dependency theory (Schank, 1972) to describe individual actions.

There has been much debate over whether the conceptual primitives of CD theory are the 'right' primitives, and some criticism that the theory is ad hoc. For many purposes, however, the important criterion is whether the theory is useful. Further, we would argue that any theory proposed as a replacement will have to come to grips with the same content issues as CD theory, and will more than likely end up with much the same primitives (as did Norman and Rumelhart (1975) for example). Indeed, the systematic linguistic exploration by Jackendoff (1976) of candidates for primitives seems to point in this direction.

We anticipate that there will be similar debate about the primitives we will propose in this book for higher-level knowledge structures. We will not be dogmatic about particular primitives, however, knowing that revisions in our scheme will no doubt be necessary as psychological validations and unanticipated theoretical considerations come along.

1.4 Conceptual Dependency Theory

In order to understand what follows in this book it is helpful to have a rudimentary exposure to Conceptual Dependency Theory. The theory has been described at length elsewhere (see especially Schank, 1975); we need not go into it in much detail here.

Conceptual Dependency (henceforth CD) is a theory of the representation of the meaning of sentences. The basic axiom of the theory is:

- A For any two sentences that are identical in meaning, regardless of language, there should be only one representation.

The above axiom has an important corollary that derives from it.

- B Any information in a sentence that is implicit must be made explicit in the representation of the meaning of that sentence.

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These two rules have forced us to look for one economical form for representing meaning. In doing so, we have invented the initial framework:

- C The meaning propositions underlying language are called conceptualizations. A conceptualization can be active or stative.
- D An active conceptualization has the form:
Actor Action Object Direction (Instrument)
- E A stative conceptualization has the form:
Object (is in) State (with Value)

The form that we postulate for conceptualizations has led us to the principle of primitive actions. That is, because a conceptualization is defined as an actor doing something to an object in a direction, we have had to determine just what an actor can do. Clearly, Principle A forces us to look closely at actions that seem similar to see if we can extract the essence of their similarity. Principle B forces us to make explicit whatever differences there might be between two actions and to express them accordingly. For example, two verbs in a language may share a similar primitive element (as 'give' and 'take' share the primitive element **TRANSFER of POSSESSION**) but also have differences. The best representation for our purposes for a given verb then, will be the primitive element it shares with other verbs, plus the explicitly stated concepts that make it unique. As it happens, these explicitly stated concepts also turn out to share similar elements with other verbs, so that often a verb is represented as a particular combination of primitive actions and states none of which are unique to that verb, but whose combination is entirely unique. (Many verbs are represented entirely by states with no primitive act used at all.)

The primitive acts of Conceptual Dependency are:

ATRANS The transfer of an abstract relationship such as possession, ownership or control. Thus, one sense of 'give' is: **ATRANS** something to someone else; a sense of 'take' is: **ATRANS** something to oneself. 'Buy' is made up of two conceptualizations that cause each other, one an **ATRANS** of money, the other an **ATRANS** of the object being bought.
