Artificial Intelligence as a Basic Science for Psychoanalytic Research*

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> The empirical field of psychoanalysis as a science is defined by its objects of study. These objects of study are symbolic forms and symbolic processes: the works of man and their modes of construction. Such forms and processes are unique, species-specific, quintessentially human (Edelson 1977).

Can the field of Artificial Intelligence provide the foundations for a basic science of psychoanalysis? My answer to this question is a resounding 'yes'. Developments in Artificial Intelligence and the related field of Cognitive Science in recent years have direct bearing on a number of problems being studied by psychoanalytic researchers. The discussion that follows, which is aimed at providing a basis for these claims, focuses on four aspects of the issue. Section 1 defines the goals of the fields of Artificial Intelligence and Cognitive Science; Section 2 describes some potential contributions that these fields can make to psychoanalytic research; and Section 3 presents a case study of the usefulness of this approach drawn from my own research. Section 4 and 5 bring the computer into play first with the introduction of a pattern-directed inference system and then with a survey of computational models of the psychotherapy process.

1. The Goals of Artificial Intelligence and Cognitive Science

An interesting perspective on the goals of artificial intelligence (AI) can be obtained by examining definitions of the field given in introductory

* I wish to thank Hartvig Dahl, Merton Gill, Michael Hölzer, and Horst Kächele for valuable comments on earlier versions of this paper, the preparation of which was supported in part by PSC-CUNY Research Award 665235.

textbooks. Winston (1984) describes AI as "the study of ideas that enable computers to be intelligent." In his view the central goals of the field are (1) to make computers more useful and (2) to understand the principles that make intelligence possible. According to Rich (1983) AI is the study of how to make computers do things that, at present, people are better at. And my personal favorite (source unknown) defines AI as an attempt to get computers to exhibit behavior that would be considered intelligent if a human behaved the same way. What these definitions of AI share is, first, a commitment to the goal of making computers smarter and easier to use and, second, the belief that the way to accomplish this is to build computer systems that exhibit aspects of human intelligence.

The class of problems that AI tackles requires *symbolic* rather than *numeric* computation. Numeric problems are typically difficult for humans to solve but relatively easy for computers. Examples are counting and sorting tasks, statistics, and a variety of "number crunching" computations performed routinely in the sciences and engineering. Many kinds of symbolic computation, however, are performed with relative ease or even automatically by humans, but have proved extremely difficult for computers. Sensory perception (e.g. vision), understanding and producing natural language, expert reasoning, commonsense judgment, theorem proving, games, learning, and clinical intuition – all of these are tasks in which symbols rather than numbers are manipulated.

Unlike numeric processing, which is primarily quantitative, symbolic processing requires qualitative, logical, and inferential reasoning. Traditionally, of course, symbolic problem solving was thought to be a uniquely human ability. Since AI aims at constructing computers that can solve symbolic problems, one product of AI research will be symbolic processing machines that work with ideas and knowledge in ways that are analogous to the ways humans reason with the ideas and knowledge they possess.

Over the years the levels of success achieved by AI workers in their efforts to build computer systems capable of equaling human performance in the area of symbolic computation have gradually improved from severely limited to quite remarkable. One of the hurdles that has had to be surmounted is the fact that, owing to their complexity, reasoning in these domains almost always proceeds under conditions of uncertainty and incomplete knowledge. It is often unfeasible, if not impossible, to seek an optimal solution to a particular problem such as the next move to make in a chess game, the understanding of an English sentence, or the diagnosis of a patient seeking medical treatment. As a result researchers in this field are forced to content themselves with less than perfect answers in many cases. Simon (1981) coined the term "satisficing" – a blend of "satisfactory" and "sufficient" (sufficing) – to describe this situation.

Even with this limitation, impressive results in AI have frequently been attained at the expense of generality. A program that performs nearly flawlessly within a particular, narrowly circumscribed domain will flounder outside of its area of expertise. A chess program knows nothing about how to play checkers or backgammon; a system that understands English does not know a word of Spanish; a program knowledgeable in eye disease lacks rudimentary knowledge of psychiatric evaluation.

Whereas Artificial Intelligence has existed for about thirty years, the newer field of Cognitive Science has emerged only in the last ten. In the United States formal recognition came first in 1977 when the journal of that name appeared and was further solidified in 1979 with the establishment of the Cognitive Science Society. Cognitive Science is an aggregation of scientists studying various aspects of the human mind. The collection of researchers who consider themselves cognitive scientists are drawn primarily from the fields of cognitive psychology, linguistics, artificial intelligence, philosophy, mathematics, and neuroscience. The area of greatest interest for psychoanalytic researchers lies at the intersection of these two fields, AI and Cognitive Science.

2. What AI and Cognitive Science have to Offer Psychoanalytic Researchers

Lacking a basic science of its own throughout the nearly one hundred years of its existence, psychoanalysis has repeatedly sought in the natural, physical and social sciences formalisms that might allow the principles, tenets and beliefs of the field to be structured into a coherent scientific theory. In the course of these endeavors, psychoanalysts have borrowed concepts, models, even whole theories, from such disciplines as psychology, linguistics, philosophy of science and physics.

Edelson (1977) warned of the dangers of delving too lightly into a foreign discipline, whether a near neighbor of one's own or a distant cousin, and advised the researcher of the commitment necessary both to achieve mastery of a new field and to keep up with subsequent developments. The consequences of failing either to attain an adequate grasp initially or to keep up with changes include the risk that the researcher, influenced by outdated doctrines, may apply misguided ideas to his work.

With these caveats in mind, I shall propose in this section a conservative rather than a wholesale borrowing from the fields in question and trace in the next section exactly how and where these ideas might profitably be applied in psychoanalytic research. The major contribution that AI and Cognitive Science can make to psychoanalytic research as I see it can be stated succinctly:

> These two disciplines offer tools for representing (literally: *re-presenting*) the data of psychoanalysis in ways that shed light both on the process of therapy itself and on the cognitive structures and processes that underlie the ability of the patient and the analyst to engage in this special form of discourse.

I take "the data of psychoanalysis" to mean verbatim transcripts of recorded psychoanalytic sessions. These contain, on the part of the patient, free association discourse and, on the part of the analyst, interventions based on his or her current understanding of the patient's discourse. By "tools" I mean ideas, notions, concepts, models, and theories, some embodied in computer programs, concerning human cognitive capacities in general and, more specifically, the structure of discourse and the intentions (i.e., wishes and beliefs) that lie behind utterances.

Perhaps this abstract pronouncement will become more concrete if I illustrate with an example from the research that I have been engaged in with Hartvig Dahl for six of the ten years we have worked together. If asked how the AI/Cognitive Science paradigm has informed our work I would pinpoint two principle sources of enlightenment. The first of these is the development in Cognitive Science of a new view of concepts that is best known as "prototype theory", the leading advocate of which is Eleanor Rosch (e.g. Rosch 1978; see Smith 1985). The heart of the theory states that:

(1) A concept is mentally represented in part by a prototype, i.e., by properties that are true of some concept instances but not all, and

(2) An object will be categorized as an instance of a concept to the extent it is similar to the concept's prototype. Since instances can be expected to vary in their similarity to the prototype, some instances will be more prototypical (or simply more 'typical') members of a concept than others.

Our second source of inspiration came from AI work in knowledge representation, which deals with the problem of how to structure information in computer programs so that an intelligent system can draw inferences from it. For many years formalisms based on first order predicate logic held sway but gradually more elaborate schemata such as semantic nets, scripts, and frames have become popular. In particular, Marvin Minsky's "frame theory", which proposes frames as a fundamental means of knowledge representation in computer programs (Minsky 1975), has much in common with Rosch's prototype theory.

According to Minsky, a frame is a data structure for representing a stereotyped situation, like a child's birthday party. There are stereotyped expectations called "defaults" associated with such parties, and these are specified in the frame. For a birthday party these might include *Sunday best* as the dress for a little girl and *ice cream and cake* as food. When a description of a specific birthday party fails to mention food or dress, the default expectations from the frame, which may be thought of as a prototype, can be assumed.

3. Prototypes and Frames

What is the precise nature of psychoanalytic clinical inference? What competence underlies a psychoanalyst's ability to construct an interpretation? In our efforts to address such questions we embarked upon an intensive study of #18, 19 and 20 of the Specimen Hour as a way of discovering exactly what this patient was telling her analyst. As we unraveled this segment of discourse, we were lead, in part by the notions of categories, prototypes and frames, to postulate first *category maps* and then *event sequence frames* as forms of re-presentation (Teller and Dahl 1981a, 1984, 1986).

The method we have developed involves constructing prototype frames and searching transcripts for repetitions of the prototypes. The process begins when we can identify in the transcript a report by the patient of an event in her life that appears to be a characteristic behavior pattern. These usually take the form of brief narrative episodes where the patient relates in reasonable detail a particular incident with a particular person, e.g. "I had a fight with my husband last night. It all started when ..." We also require some indication that the episode is self-typical and not just an isolated occurrence. The prototype frame des-cribes the sequence of events in the episode as a series of predicates, each of which summarizes manifest statements made by the patient. The patient's statements, in effect, constitute the justification for the prototype frame. The prototype gives an abstract, structural description of a self-typical behavior pattern and specifies the order of events that must occur each time the pattern is repeated. When repetitions are discovered, evidence, again in the form of manifest patient statements, must be obtained for each event in the frame. If evidence is lacking for an event, the predicate from the prototype can be assumed by default.

Most of the prototype frames we have constructed are inductive generalizations from particular incidents. However the prototype developed in the illustration below is derived from a generalization that the patient herself makes about her own behavior.

The passage from which the CRITICAL-FRIENDLY prototype is constructed occurs in #48 of the Specimen Hour, which is the fifth hour of the psychoanalysis of a young married woman:

> And this makes me think of uhm, (stomach rumble) friendships I've had with other people and, something that I don't like to admit, because I don't approve of it (chuckle), so I can't imagine anybody else would, but I seem to have to find fault with just about everybody that I'm friendly with to some degree whether it's just a small degree or a larger degree. And, even though in a way I might feel inferior to them, and I imagine I feel inferior to a lot of people, I still have to find fault with them and maybe criticize them to David (husband), I don't know. I always have to openly criticize them, but in any case I have to kind've done that and then I can go on to a re–, a, some kind of friendly relationship with them. And until I've done that I can't really accept them as somebody that I want to be at all close to in any way at all. And, and if I can't, if I find I can't be critical of them in some aspect, then I just can't seem to be around them at all. I, I, I don't know, it's more than sort of being, well, it's not being in awe of them. It's just feeling very uncomfortable, I guess, with them.

The prototype CRITICAL-FRIENDLY frame with the three-event sequence shown in Figure 1 is accompanied by manifest patient statements that justify each event. In this prototype the patient states explicitly not only that when she thinks of friendships she *has to be critical* (C) before she *can be friendly* (F), i.e., 'If C then F', but also 'If not C then not F'. The prototype representation restricts the class of predicates that can match the prototype events, states the sequence in which these events must occur (though not the order they are reported in the discourse), and illustrates the contingent nature of the behaviors, namely that *if* the patient wishes to be friendly, *then* she must be critical and *only then* can she be friendly. Most importantly the prototype serves as a hypothesis about the patient and constitutes a prediction that the same

FRAME (SUMMARY PREDICATES)	SUMMARY OF JUSTIFICATION PRIMARY PREDICATES
Thinks of friendships	1. Patient has friends (And this makes me think of friendships I had with other people) 2. People in general want to have friends (group-typical behavior)

to be critical of X	2.1 I seem to have to find faults with just about everybody that I am friendly with 2.2 I still have to find fault with everybody and maybe criticize them to David 2.3 I always have to openly criticize them 2.4 If I cat be critical than I just can´t be around them

Can be friendly with X	3. I have to kind´ve done that and then I can go on to a re a some kind of friendly relationship

WARRANTS FOR GENERALIZATION
(Additional reasons for taking the deduction from P´s own generalization seriously)
1. present tense verbs
2.plural nouns
3. self-typical behavior

Figure 1 Prototype of the CRITICAL-FRIENDLY Frame

pattern will occur again. The warrant for making this generalization is also implicitly supported by the set of linguistic properties shown in Figure 1.

Data supporting the prediction of the prototype occurs in the form of reports of partial or complete instantiations of the frame elsewhere in this or other sessions. In fact there are four repetitions of the CRITICAL-FRIENDLY frame in the Hour 5. Although the detailed evidence for each instantiation cannot be given here, Table 1 summarizes

Table 1 Instantiations of the CRITICAL-FRIENDLY Frame

	[1]	[2]	[3]	[4]
EVIDENCE	ASSISTANT IN SCHOOL	TWO BOYS REPORTS	STUDENT	ANALYST FOR:
Thinks of Friendships	YES	NONE	NONE	Requires an Inference
Criticizes X (To Y:)	YES Analyst	YES Analyst	YES Parents	YES Analyst
Can be Friendly	YES	NONE	NONE	YES

the status of the evidence for the events in the repetitions. The reader is invited to examine the relevant portions of the Specimen Hour to verify this summary. When there is no evidence for or against the occurrence of a particular event, the predicate from the prototype can be assumed.

The first three instantiations are described below:

(1) #4 to #10: P criticizes her assistant for being loud, noisy, boisterous, insensitive and unfeeling, then wonders what the function of friendly advice is, if you're a good friend of somebody.

(2) #19: P complains about two boys in school who are disruptive and together too much.

(3) #22: In her student reports, P put all her energies into pointing out the negative things.

The prototype occurs in #48, and immediately afterward the analyst remarks:

> / So your thoughts turned from thinking about whether I would approve or disapprove of things you say to what you've just been talking about. There any connection? Does it follow perhaps that uh *you have some criticisms of me* that have occurred to you? / (emphasis added)

The fourth instantiation arises when the patient replies with a criticism:

> (Pause) I think if I had, I would have (chuckle) suppressed them too much to admit them. (Clears throat, sniff, pause) Uh, perhaps one – *I'm starting with one* that's less (chuckle) personal, one that I'm sure still is occurring to me at times, although I don't think it functions as much in my thinking now as it might have – is uhm, sometimes *wondering if all this* really does get anywhere, and, you know, if it *isn't some sort of a hoax*. But that's partly because I was brought up to think of it as being something that really *didn't do any good* for anybody and *just costs a lot of money*. I don't think that occurs to me as much now. (emphasis added)

A few minutes later (#61) the patient says a friendly thing:

> Because that (chuckle) is, well even this I find hard to say, and it's, it's silly, but just in thinking about clothes and wearing what you want, uhm, just in, in *noticing what you've worn* since I've started coming and the, *the variety and the freedom that you seem to have* and, and I think *I've been sort of envious* of that. (Sniff) I feel very embarrassed (chuckle) saying that. (emphasis added)

Then talking about colleagues at work (#62), she continues:

> *... it's really sort of a gesture of friendship*, I guess, to anybody, that *if you like something somebody has on, acknowledging it.* (emphasis added)

The analyst's transference intervention asserts that what the patient says is true of her relationships with other people will apply to him as well. A leap of inference is scarcely required to arrive at this conclusion. It follows directly from the structure of the preceding discourse, which contains not only a clear prototype, but also three partial instantiations. And the transference prediction is confirmed as the patient proceeds to reenact the CRITICAL-FRIENDLY frame first by claiming that psychoanalysis is a hoax and then by paying the analyst a compliment as a "gesture of friendship." Dahl (this volume) reports how the hypothesis and prediction embodied in the CRITICAL-FRIENDLY frame were corroborated in an independent study he discovered only recently, although it was carried out several years before we began this line of research.

Our meticulous examination of a single psychoanalytic session has enabled us to take a significant step toward demystifying the psychoanalytic process. The main results can be summarized as follows:

(1) Objective patterns and structures are present in the discourse of a patient in psychoanalysis. These can be discovered (e.g. by a careful listener) and are not merely constructed according to the disposition of the analyst. Techniques for finding such structures in verbatim transcripts are described in Teller and Dahl (1986).

(2) Repetition is the key to understanding free association discourse. It is the phenomenon that makes psychoanalysis a possible rather than an impossible profession. A patient repeats herself "in other words," reporting over and over the adaptive as well as the maladaptive behavior patterns. As we have claimed elsewhere, the cast may change, the situations vary, but the plots endure with structural tenacity.

(3) To a large extent, the reasoning process involved in making inferences from free association discourse appears to be informed, astute common sense. The ability to detect repetition, for example, derives from one's capacity to judge similarity, extrapolate missing information, etc. Common sense, of course, is not the sole factor accounting for psychoanalytic clinical inference. Other factors must be added to this capacity, for example, specific knowledge about psychoanalytic theory and treatment.

4. Pattern-directed Inference

Pattern-directed inference systems are computer programs that look for interesting or important situations that occur as patterns in input or memory data and use these patterns to guide overall activity by selecting and triggering appropriate responses. Although their internal structures vary widely, all include as basic components (a) a source of input, (b) a knowledge base, and (c) an inferencing mechanism to direct the reasoning process. PDIS's have been implemented for a variety of applications, including speech understanding, expert systems for medical diagnosis, and the investigation of cognitive processes such as concept formation, problem solving, and inferential reasoning (cf. Waterman and Hayes-Roth 1978).

If one imagines carrying out extensive, practical studies along the lines suggested in the preceding section, one is likely to be daunted by the arduous nature of the task. The problem cries out for a technology that would automate the process of scanning the patient's discourse for instantiations of prototype frames. These frame structures have several properties that make them excellent candidates for pattern-directed inference:

(1) Frames are orderly, contingent event sequences
(2) that are invariant across objects (people) and situations (behavior settings),
(3) whose prototype predicates can be used to fill in missing information in partial instantiations, and
(4) that, in principle, can be detected by an analyst listening to a patient or even by a computer programmed to search for repetitions in free association discourse.

To date, however, pattern-directed inference systems have been characterized by two limitations: first, when natural language input is used, a PDIS generally accepts only well-formed, grammatical English utterances, and second, a given PDIS typically operates only within a well-defined and circumscribed subject domain. A challenging goal would be the development of a PDIS that would overcome these limitations. Two basic questions are: Can a computer program operate intelligently on extended, spontaneous English discourse? And can such a system, in addition, perform across the broad range of subject domains found in speech "from the couch"?

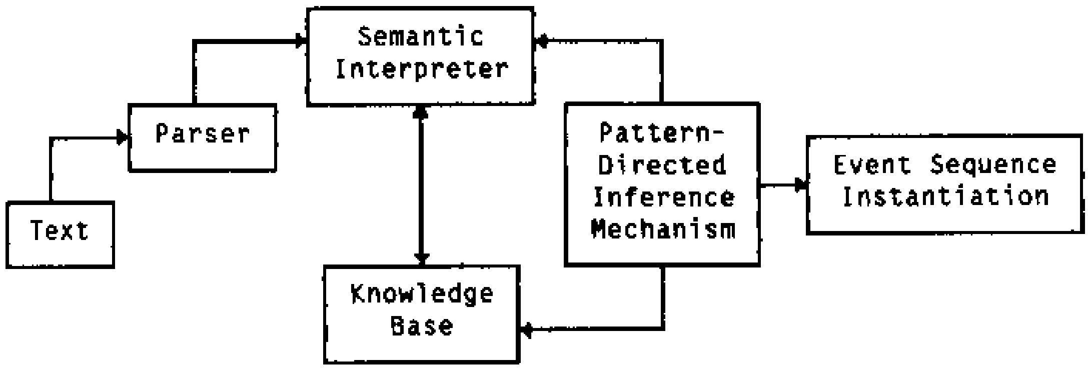

Figure 2 General Organization of a Pattern-Directed Infer- ence System for the Detection of Repetitive Event Sequences in Psychoanalytic Discourse

The task of the PDIS would be to take free association discourse as input and identify instantiations of prototype frames. The general organization of this system is shown in Figure 2. The parser and the semantic interpreter, interacting with the knowledge base, successively derive the syntactic structure discourse. The pattern-directed inference mechanism then compares semantic representations with patterns stored in the knowledge base and judges which, if any, of the input utterances qualify as instantiations of prototype frames. A successful PDIS would ultimately:

1. Accept as input the transcribed discourse of a psychoanalytic patient.
2. Operate with a knowledge base containing at least two different kinds of information: (a) a set of prototype event sequence frames known to be characteristic of the patient, and (b) a set of situation frames similar to Schank and Abelson's (1977) scripts representing typical behavior settings in the patient's life, e.g. kitchen or bedroom at home, classroom at school, analyst's waiting room, etc.
3. Search the input discourse and recognize repetitions of any of the prototype patterns that appear in different settings and are described in different words.
4. Justify each instantiation by citing evidence from the text to support the existence of the events in a sequence.
5. Produce results that are comparable to human judgments of the same material.

Constructing a system that successfully performs these tasks will require extending the state of the art in artificial intelligence. Nonetheless there is reason to be optimistic about the chances of making headway. One reason, pointed out by Hayes-Roth et al. (1978, p. 597), is that "the PDIS formalism derives much power from its factorization of complex problems into manageable, largely independent subprograms." Modularity is one of the most important features of a PDIS. Consequently work can proceed on several fronts at once, and progress in one area need not hinge on progress elsewhere. Moreover in the case of the data structures we have described it is advisable to start modestly and work incrementally, initially using only two or three frames and limiting the knowledge base to the situation frames necessary for the three paragraphs already exhaustively analyzed. The knowledge base can be expanded gradually to accommodate the entire session and eventually other sessions as well. At the current, early stage of this project, portions of the PDIS have been borrowed from existing natural language systems and are being adapted for our purposes.

The program of research suggested here tackles fundamental, unresolved problems in both artificial intelligence and psychoanalytic research. In psychoanalysis the hermeneuts are pitted against the would be scientists. There is no question that a working PDIS would be a boon to those trying to reclaim the field for science. It would be a tool for empirical investigations and provide a means of testing the claim that patterns like those I have described are discovered rather than constructed. Moreover its very existence would constitute a form of evidence in favor of the existence of patterns to be discovered and thus would lend support to the possibility that analysts can indeed find them.

In AI one particularly thorny problem, sometimes referred to as the frame selection problem, arises during natural language processing when the correct context for an utterance must be inferred from ambiguous discourse, i.e., the correct behavior setting for a narrative must be selected when the knowledge base contains several such domains. It is one thing to make correct inferences in a restricted domain consisting of only one or two settings, but the multiple behavior settings implicated in even a modest amount of patient discourse pose serious difficulties. Even a partial solution would be a significant breakthrough.

5. Computational Models of the Psychotherapy Process

A pattern-directed inference system that could find instantiations in text of the frame structures described above would follow in the tradition of computer programs that simulate some aspect of the behavior of patients or therapists. Undoubtedly the best known of these – and probably one of the most famous programs of all time – is Weizenbaum's (1966) ELIZA. When running in DOCTOR mode, ELIZA assumes the role of a nondirective Rogerian therapist, responding to input from a person at a terminal in a noncommittal manner, often simply by reformulating the input statement as a question. Intended as an illustration of how gullibly humans interact with computers, ELIZA has no knowledge of natural language and relies on keyword lookup and simple pattern matching techniques to produce replies.

Efforts to create more realistic patient verbal behavior have been the focus of Colby's work, most notably in his PARRY programs, which simulate the conversation of a paranoid male in a psychiatric interview (Colby 1981; Teller and Dahl 1981b). In terms of the mechanisms used to understand the interviewer's queries, PARRY differs little from ELIZA. Literal pattern matching gives a rough idea of the input, and an appropriate response is composed from a repertoire of over 1,800 canned utterances. Nonetheless, PARRY embodies sets of beliefs about the real world and goals to be realized. Perhaps its most interesting feature is a simple method of scaling a small set of emotions (the level of anger, for example, may range from 0 to 10) so that the intensity reflects the state of its interactions with the interviewer and influences the course of the interview. Moreover, within the limited context in which the program operates, PARRY has succeeded in convincing many psychiatrists that they were interviewing a human psychiatric patient.

Less attention as been given to ERMA, the product of Clippinger's (1977) ambition to model the discourse of a female patient in psychoanalysis. The one halting paragraph that ERMA produces includes the false starts, hesitations and disfluencies that are characteristic of actual transcripts of psychoanalytic discourse. Underlying ERMA's ability to "speak" like a human patient is a multiple agency cognitive model. Control in the system resides in the interaction of five separate modules, each designed to perform particular high level functions: LEIBNITZ (knowledge base), CALVIN (superego), FREUD (introspection), MACHIAVELLI (means-ends analysis) and CICERO (discourse). These modules interact by interrupting each other to get an idea, reflect on it, censor it, plan its expression and oversee its realization as the utterance of a patient in conflict trying to put off telling the analyst a taboo idea. Leuzinger (1984) used Clippinger's model as the framework for studying cognitive processes involved in treatment recommendations and for studying the changes of dream-handling in five patients over the course of their analyses (see Leuzinger-Bohleber and Kächele, this volume).

The contribution of the PDIS outlined above to this area of research would be unique. This can be seen if we compare this hypothetical PDIS with the projects just mentioned on three attributes: the presence of intelligent mechanisms (e.g. for understanding natural language); the role or point of view assumed by the program; and the type of output produced. The results are shown in Table 2.

> The PDIS can be thought of as simulating the behavior of a psychoanalyst listening to and drawing inferences from the discourse of a psychoanalytic patient. Does this make the PDIS a computational model of a psychoanalyst? This is a thorny question that cannot be answered briefly. The proposed PDIS embodies several principles of cognitive processing deemed to be crucial to the psychoanalytic enterprise but completely lacks other types of knowledge that may be equally important, for example, knowledge that can be gained only through

Table 2 Comparison of Computational Models of the Psycho-therapy Process

	Intelligence	Role	Output
ELIZA	no	therapist	generate reply
PARRY	some	patient	generate reply
ERMA	yes	patient	generate discourse
PDIS	yes	therapist	analyze discourse

psychoanalytic training or years of experience in treating patients. In addition, the design of the system leaves it to humans to find the prototype frames and only calls for the computer to identify repetitions. This is in fact a necessary limitation, since the process of detecting prototypes in transcripts is, at this point, scarcely understood at all. No computer can be programmed to perform a task for which there exists no principled description. Suffice it to say that, despite the usefulness of the computational approach in my research, there is absolutely no prospect that such a system could ever replicate the expertise of a human analyst.

Whether or not the PDIS is regarded as a computational model, this attempt to recast notions about psychoanalytic clinical inference into the terms of another discipline follows in the spirit of Freud's own work, most notably in the Seventh Chapter of *The Interpretation of Dreams*, where the model described in neurological terms in the Project is restated in psychological terms. If Cognitive Science were available then, Freud might well have created an AI model instead. My point here is not to indulge in idle speculation but rather to emphasize that with the conceptual and computational tools available today, we as researchers have an opportunity to achieve for psychoanalysis what Freud himself could not. This opportunity should be seized and exploited to its utmost.