A Phenomenological Study of Thinking[1]

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It is now widely recognized that psychology is deficient when assessed in terms of systematic, foundational progress.[2] I contend that this deficiency is at least partly the result of psychology's failure to really understand its own subject matter and that, if its research were phenomenologically based, psychology would be better able to resolve its critical issues. My own research interest, the psychology of thinking, provides a particularly ripe opportunity for phenomenologically based research. This opportunity arises because thinking is almost universally acknowledged to be a crucially important topic, and yet it has been highly resistent to explication by traditional research methods.[3] In this paper, I will first review the current impasse in the psychology of

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[2]Certainly the theme of psychology's foundational disarray should be well known by now. Giorgi (1970a) documented it well a decade ago, and Kendler (1981) has emphasized it again. This widely acknowledged fractionation has even prompted whimsical characterizations of psychology's "identity crisis" (Perloff, 1979) in the official publications of the APA.

[3]A quick survey of introductory texts finds that thinking is considered "the most significant activity that humans engage in" (Haber & Runyon, 1978, p. 135), "the most complex form of human behavior" (Hilgard, Atkinson & Atkinson, 1975, p. 270) or "the most uniquely psychological subject" (Marx, 1976, p. 179). Despite this recognized importance, psychology's inability to adequately research thinking has left psychologists to conclude that it is "the most frustrating" (Guilford, 1960, p. 6) or "the most intractable" (Weimer, 1974, p. 440) of all psychological phenomena, or else simply to note that "no one can give an adequate account of much of human thinking" (Skinner, 1974, p. 223).

thinking and, second, show how phenomenological research on thinking can resolve this impasse.

The dominant approach in the contemporary psychology of thinking is that of information processing.[4] Based on the pioneering efforts of Newell and Simon, this new approach asserts that the person, like the computer, is an information processing system, whose thinking can therefore be demonstrated with computer simulation models (Newell, Shaw & Simon, 1958b; Newell & Simon, 1961, 1972; Simon, 1978, 1979, Simon & Newell, 1964, 1971). According to their view, the computer simulation program is taken as a precise model of how thinking proceeds. Their model yields the conclusion that thinking is essentially symbol manipulation in the same sense that computer processing is. In other words, thinking is viewed as a series of elementary or primitive processes, combined serially according to explicit, predetermined rules, each process of which is a formally definite operation for the manipulation of information in the form of elemental and discrete symbols.

How are we to determine the validity of such a model? Newell and Simon first sought to validate it by recourse to the argument of sufficiency: that is, if a program contained all of the statements required for the computer to peform a task that requires a person to think, the program can be taken as a simulation of thinking (Newell, Shaw & Simon, 1958b; Newell & Simon, 1961; Simon & Newell, 1964). And from the beginning chess playing was chosen as the "type case" of such a task (Newell, 1955; Newell, Shaw & Simon, 1958a). Indeed, chess playing has become so important a task for computer simulation efforts that it is now referred to as the "fruit fly" of that field (Hearst, 1978). Although chess programs have never attained the playing strengh that overly optimistic, early estimates claimed they would (Simon & Newell, 1958), the best recent ones have exhibited considerably improved capabilities. However, the criterion that similarlity of results alone could establish the validity of the computer model was eventually acknowledged to be inadequate, after it was pointed out that similar results were no guarantee that they had been attained in a similar manner (de Groot, 1978; Gunderson, 1964; Hearst, 1967). For example, airplanes can fly, but the result is not a simulation of birds flying because they do not fly in the same way (Simon, 1980). Most informa-

[4]In fact, a recent text on systems in psychology even goes so far as to conclude that " 'information processing' has become something of a synonym for cognitive psychology itself" (Robinson, 1979, p. 303). Furthermore, Neisser (1980), an influential cognitive psychologist who has criticized the information processing view and attempted to distinguish his own work from theirs, concludes that, with regards specifically to thinking, the information processing approach is the only currently organized one.

tion processing theorists now admit that it is the processes themselves that must be simulated and not merely the results (Simon & Newell, 1971; Simon, 1980). But this requirement led to an additional problem: the lack of data on how human thinking actually proceeds. For example, how do we decide whether or not a chess playing program simulates human thinking in chess? This question is so problematic because the information processing approach sought to simulate thinking before it understood thinking, presuming to know the very phenomenon that needed to be disclosed. Indeed, advocates as well as critics are increasingly recognizing that efforts to improve simulation programs are reaching an impasse, limited by a lack of understanding of how people actually think, and that this impasse can be remedied only by a direct investigation of human thinking (Charness, 1978; Hearst, 1978; Neisser, 1976; Newell, 1973; Raphael, 1976; Wilding, 1978). Some information processing researchers have attempted to fill this gap by searching for similarities between the steps taken by computer simulation programs and protocols spoken by human subjects engaged in solving the same problem (Newell & Simon, 1961, 1972). Such comparisons can be quite ambiguous because of the differences between the computer language of the simulation program and the ordinary language used by the human subject (Boden, 1972; Kendler, 1981; Simon & Newell, 1971). To insure fidelity under these circumstances, a rigorous analysis of the human protocols in their own right should be the necessary first step. But this has not been done. Instead, information processing preconceptions have biased these comparisons in ways that can be severely criticized (Aanstoos, 1983; Frijda, 1967; Wilding, 1978).[5] Briefly, similarities claimed by information processing researchers arise to the extent that thinking has been preconceived as unduly mechanistic (e.g., by insisting that elementary processes occur in the absence of any manifestation), and the computer as unduly anthropomorphic (e.g., by attributing such characteristics as choice, purpose, and even self-reflection). Less partial scholars, on the other hand, have noted a wide array of differences.[6] A crucial debate con-

[5]Even Newell's (1977) more thoughtful effort to specify a means of protocol analysis that would be helpful "for developing theory rather than for validating theory" remains faithful to inferred information processing preconceptions, as its aim is to identify the presumed elemental "operators" applied to a "problem space" to incrementally change a "state of knowledge."

[6]Regarding chess playing programs in particular, various writers have pointed out many significant empirical anomalies as well as essential differences which they feel distinguish human thinking from computer simulation models. I have discussed these arguments elsewhere (Aanstoos, 1983) and can give only the briefest characterizations here. Among the empirical anomalies noted are the following: the computer program's search function generates thousands of possible positions in the process of selecting a move, while a

cerning the validity of their criticisms lies ready to emerge within the psychology of thinking, and the larger implications of artificial intelligence is already generating a heated controversy among philosophers. In fact, philosophers have advanced both a priori arguments in favor of the computer model as well as a priori arguments against it (Anderson, 1964; Boden, 1977; Crosson & Sayre, 1967; Dreyfus, 1979; Haugeland, 1981; Hofstader & Dennett, 1981). But no one has yet accomplished the direct, descriptive study necessary to provide the empirical evidence with which to address the question.[7]

Because of this gap in the research, I conducted such an investigation of thinking, as it is exemplified during chess playing, for my doctoral dissertation (Aanstoos, 1983). In the remainder of this paper, I would like to share that research with you. I will first briefly review my method, then present some of my results, and then I will discuss the significance that these results have for the controversy concerning the computer simulation model.

Method

The method I employed consisted of gathering descriptive data in the form of think aloud protocols from five subjects, all of whom were proficient chess players. Each subject was asked to think aloud while playing an entire game of chess, and their verbalizations were tape recorded and then transcribed.[8] These transcriptions form an enor-

person considers no more than a hundred at most; the computer's search and evaluation functions are limited by predetermined guidelines, whereas the person can consider even such unusual exceptions as queen sacrifices; the computer's evaluation function overlooks deferrable consequences as a result of the "horizon effect," whereas the person does not; the computer's evaluation function evaluates statically, thereby overemphasizing material value at the expense of dynamic possibilities, whereas the person does not. Essential differences between the computer model and human thinking that have been proposed to account for the anomalies include the following: short-term look ahead vs. long range planning; predetermined vs. situated generalizations; serial vs. simultaneous goal seeking; elemental vs. structural memory; context-free vs. contextual parameters; incremental vs. wholistic sense of the task; inflexible vs. flexible adherence to guidelines; explicit knowledge vs. being able to formulate as well as solve problems.

[7]Probably de Groot's (1978) descriptive findings on thinking while solving a chess problem come closest, but his study is flawed, for reasons I have discussed elsewhere (Aanstoos, 1981). As a note of historical interest, over 70 years ago Dewey (1910) did a minor demonstration study of thinking in a direct, descriptive manner.

[8]The subjects' opponents wore headphones, which prevented them from hearing what the subjects were saying. Also, it is important to realize that the method utilized here is not an introspective one. The subjects were not asked to become spectators of their own consciousness. Rather than standing back from their lived experience, they were asked to think aloud while engaged in that lived experience. What makes this vital difference

mously rich source of data, since each subject spoke almost without pause over the entire course of a game that lasted from one to four hours. Before I go on to describe how these protocols were analyzed, I would first simply like to read a segment of the raw data, to give you a sense of the texture of this sort of descriptive data. Those of you who are not chess players yourselves may be assuming that thinking in chess is the epitome of cold, logical calculating. Indeed it is just that sort of presupposition that lends the computer model its credibility. While some parts of each protocol include rather detailed and careful scrutinizing, it may surprise you how often moves are chosen after thinking based on impressionistic considerations.[9] With that in mind, I have selected this segment from the protocol of my Master-rated subject. Since there is less than one chess Master per million people in this country, he is obviously a person who knows his chess. This segment begins right after his opponent made his ninth move and ends with his making his own tenth move:

> Well he played bishop to king two. Oh frustration. Well I was naughty. Um. So. I can play pawn to king four, or queen to rook five. I guess as far as keeping options open pawn to king rook four looks like the juiciest move. Um. If he plays pawn to king bishop three, I can take it. Get modest compensation. Uhm. Queen to knight five, queen to rook four, both look, plausible. Um. I guess I'll play pawn to king rook four (Aanstoos, 1983, p. 241).

Each of these protocols was then analyzed by means of the phenomenological method recently adapted to empirical psychological research by Giorigi (1970b, 1975a, 1975b). The analysis remained faithful to the descriptive nature of the data, to disclose its essential meaning directly rather than on the basis of a hypothetical framework. In contrast with the analyses of protocols done by information processing researchers, my aim was noninferential. I sought not to test hypotheses but to discern the essential meanings of the subjects' descriptions. Therefore I began with the phenomenological procedure of bracketing, or setting aside, preconceptions about the phenomenon, to attend to the way that it was lived by the subject. This procedure was carried out by reading the transcripts with an attunement not merely to the

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possible is the phenomenological method. Phenomenological analysis does not require already abstracted data (whether quantified, formalized, or introspected). It provides a way of attending to the prereflective, to experience as it is lived.

[9]Nor should such thinking necessarily be considered inferior to computer chess programs, since this subject's level of tournament performance is at least equal to that achieved by any chess playing program.

factual content of the words but to the intentional, lived experience of the subject. That facilitated the next step of articulating the essential meaning of that lived experience. Such essences, not obvious in advance, must be brought to a selfshowing. I followed Giorgi's (1975a) procedure of identifying meaning units, specifying their central themes, and then articulating the structural coherence of those themes.

RESULTS

The results of the analysis are structurally interrelated essential themes that disclose how thinking is manifested in chess playing. This general structure, in its entirety, is about twenty-five pages long and thus too lengthy to present here. Instead, I will cite a highly abridged summary of that structure:

> "Thinking as it is exemplified during chess playing is a process of discovering and making explicit certain implicit possibilities that are virtually present in the position. These possibilities are expressed symbolically, and are specifically those of transforming the position. This effort of making such possible transformations explicit is therefore essentially pragmatic in the sense that the aim is to achieve a favorable transformation of the position within the overall aim of winning the game. Thinking concerns itself with these possibilities in three ways; by taking them as a question, by characterizing them as possibilities in their own specificity, and by determining their pragmatic appropriateness to the context of the game. In doing so, thinking thematizes the relation of these possibilities to the position as a whole. In other words, thinking grasps this relational unity by the way that it is implied by the possibilities. This relational unity is itself a network of implications, with both temporal and spatial references to further possibilities. Temporally, it implies relations between past, present and future moves. Spatially, it implies relations between pieces on the board. Thinking grasps this relational unity from the particular perspective of the player, illuminating only those aspects of it that appear as relevant. The specific means by which thinking determines the implicatory significance of its possibles is by grasping their 'if-then' relations within the larger referential unity of the position" (Aanstoos, 1983, p. 123).

While such a summary may be evocative of the larger general structure from which it was taken, it cannot, by itself, disclose the fecundity of this research with regard to the specific problems encountered by the information processing model. Instead, I will next take several of these specific points and demonstrate how these results contribute to their resolution.

Look Ahead

The information processing model posits a look ahead function that proceeds in a linear, move-by-move counting out fashion, to a predetermined depth. The results of this study also include data in which such move-by-move sequences are taken as objects of thought. However, in contradiction to the information processing model, such move-by-move sequences were always embedded within thinking's overarching contact with an implicit sense of the flow of the game as a whole. This relation of the particular move to the flow of the game was achieved as a unity by thinking through a sense of "initiative" as a telic characteristic. And it was that unity that guided thinking's looking ahead, even in the absence of any counting out sequence. For example, S.1 refrained from moving his queen at one point based on thinking that he would need it where it was to counteract his opponent's future attack on that side of the board. That looking ahead involved no specific sequence of counting out at all, but was based on the sense that the initiative was changing toward his opponent. As another example, thinking about the consequences that a move in the middle game had for the endgame was typical for the subjects, yet that is something no model based on a sequential look ahead can simulate. In other words, the results show that the information processing model's problem cannot be resolved simply by lengthening its look ahead to a further depth. Rather they indicate that thinking looks ahead in an essentially different way.

Purposiveness

The information processing model posits predetermined heuristic rules as guiding thinking to certain moves and not others. The results of this study do show that general principles are involved in thinking in chess. However, rather than simply adhering to predetermined guidelines as sheer facticities, thinking took them up as guidelines, as objects of thought. As such, they were questioned as possibilities. For example, S.4 followed the principle of posting a knight on the sixth rank when he had the opportunity to do so, as an explicit following of a maxim that it is advantageous to do so. But the maxim itself was thematic as a question, and following it meant extending that questioning to the position on the board. In other words, the maxim did not serve to conclude thinking but to evoke it. So, even when followed, maxims serve as signifiers rather than as rigid rules. Perhaps an even more clear example of this difference between thinking's flexibility and the model's rigidity occurred in those instances when thinking took up again as questionable the very possible moves it had already rejected. For example, S.1 repeatedly reconsidered playing "pawn takes pawn" after having decided against it "on general principles." Such data provide ample support for the distinction that thinking determines the applicability of guidelines within the context of the game or situation, in contrast to the predetermination that is made for the program's heuristics.

Goal seeking.

The information processing model asserts that thinking is essentially serial processing, able to pursue only one goal at a time. The descriptive results are also revelatory on this point because they show thinking pursuing a multiplicity of goals simultaneously. More specifically, they show that this simultaneity is possible because the goals are related to each other as theme and horizon. For example, S.2's pursuit of the goal of controlling the center was thematic and his goal of maintaining the initiative was horizonal. Both could be pursued simultaneously because of their intrinsic relatedness at a structural level. This finding undercuts Newell and Simon's argument against such multiplicity, for they had based their argument on the demonstration that a person cannot do two unrelated rasks simultaneously (Newell & Simon, 1972; Simon & Newell, 1971). This understanding of the structural relatedness of thinking's goals needs also to be distinguished from the information processing model's use of goals and subgoals, for example Newell & Simon (1972). Such a model achieves a goal by breaking it down into steps, called subgoals, and then establishes subroutines to solve these subgoals one at a time to narrow the difference between the present state and the goal state. It would appear that thinking also includes this use of goals and subgoals. For example, S.1 wondered whether or not to open the long diagonal to attain greater offensive threats. To read that as compatible with the information processing model, however, is to miss a crucial distinction made evident in the structural analysis. The difference is that, for thinking, the former (in this case, the open diagonal) is not one small step on the way to the latter (in this case, greater offensive threats). Rather, the latter, as initiative, is the horizonal meaning of the former. The open diagonal, as theme, is not isolated from its horizon as if it were one step on the way toward something other than itself. Rather it is embedded in that horizon specifically by means of a referential unity of implications.

Memory

In information processing models, memory serves thinking by storing an enormous amount of information in the form of isolated bits. This research showed that memorial objects do indeed serve thinking, but in a much more concise and organized form. It is concise because memorial objects are taken up as objects of thought only as they are appropriate to the present game. Thinking's capacity to grasp this essential similarity is what enables it to make more limited yet more effective use of memory. The effectiveness of thinking's use of memorial objects is also dependent on another structural difference with the computer model: the memorial objects are recalled as dynamic wholes, for example, S.1's remembering of his previous similar game. Indeed, it is only because it is recalled as a whole that he can discriminate its essential similarity.

Overall sense of the task

Two important differences may be noted here between the results of the descriptive study and the information processing model. For the model, the game is incrementally put together, that is, constructed from discrete elements. In contrast, thinking is guided by an overall sense of the game, which it evaluates dynamically. This overall sense that unites any individual move within the flow of the game is possible because each move refers to a larger whole (the referential unity) and because the shifting balance of offensive opportunities and defensive necessities is itself an object of thought (as "initiative"). This overall sense is not an artefact of incremental objects but is itself their telic structure. Similarly, it is "the initiative" as an object of thought that founds the dynamic evaluations typical for the subjects. S.1 and S.4, for example, continued to regard their position as superior to their opponents' even while they were down a pawn in material.

Level of knowing.

Information processing models function completely on the basis of formal and explicit criteria. The descriptive data, however, reveal that thinking is guided by a tacit awareness of objects of thought that remain implicit. For example, all of the subjects recognized certain moves as being significant even without being able to specify wherein their significance lay. This difference may be most crucial to the information processing model since its whole approach is based on the belief that thinking can be represented as a formal, explicit system. In contrast, the subjects' thinking was guided by the implicit referential significances of the position. An example from the descriptive results is the role that a sense of closure, as an implicit and nonformal characteristic, had for thinking.

Role of experience.

Information processing models seek to explain intuition on the basis of stored patterns from previous experience. But, as in the use of memorial objects in general, the elemental and predetermined nature of the program's stored patterns differ from the wholistic and contextually relevant patterns that the subjects used from their previous experience. And, with regard to the issue of intuition in particular, analysis of those instances wherein a subject thematized a particular move "out of the blue" as it were, reveals that it is the explicit thematization of a possibility that had already been referred to implicitly before that. This explicitation of a previously implicit object of thought therefore depends on previous experience in that the object of thought had been previously experienced implicitly. However, it does not require, nor does it arise from, an array of thousands of elemental and predetermined patterns, as posited by the simulation programs.

Expectations.

Though absent from information processing models, expectations were frequent objects of thought for all subjects. They concerned not only the position (e.g., "there's got to be something here though. I just know there's got to be something here" by S.4) but also the opponent's intentions (e.g., "after pawn to queen three as I expect him to play" by S.3). These expectations are not inferences or calculations but the temporal adumbrations (given through the referential arcs) of "initiative" as an object of thought.

Opponent's style.

A sense of the opponent's "chess personality," likewise absent from computer processing models, was a common object of thought for the subjects. The descriptive results reveal that this sense of the opponent emerges in the course of the game. At first, the opponent is grasped almost anonymously, simply as "the opponent." Early thematizations of the opponent are based on the subjects' empathically putting themselves in their opponents' perspective. There is a phase of questioning the opponent's ability by some subjects. Then eventually the opponent's style coalesces of a specific object of thought. For example, S.1 concluded "Now I have some kind of idea of what kind of player I'm dealing with . . . take everything in sight, especially when you're down in material."

In conclusion, I would like to point out that I have not presented these nine issues as if they are comprehensive, but only as representative. What they represent is the intersection of the limits of the computer simulation approach with the efficacy of a direct, phenomenological approach.

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