DOCUMENT RESUME

ED 376 423 CG 025 844

AUTHOR Brack, Greg; And Others
TITLE Artificial Intelligence, Counseling, and Cognitive Psychology.
PUB DATE Apr 94
NOTE 38p.; Paper presented at the Annual Meeting of the American Educational Research Association (New Orleans, LA, April 4-8, 1994).
PUB TYPE Speeches/Conference Papers (150) -- Information Analyses (070)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Artificial Intelligence; Cognitive Processes; *Cognitive Psychology; Computers; *Computer Simulation; *Counseling; *Counselors; Epistemology; Heuristics; Learning Processes; Logical Thinking; Simulated Environment; *Simulation

ABSTRACT

With the exception of a few key writers, counselors largely ignore the benefits that Artificial Intelligence (AI) and Cognitive Psychology (CP) can bring to counseling. It is demonstrated that AI and CP can be integrated into the counseling literature. How AI and CP can offer new perspectives on information processing, cognition, and helping is focused upon. Some of the various computer simulations developed by the authors along with those programs available from software publishers, are reviewed. Such programs can provide a potent means of simulating various counseling related systems. Besides providing insights into clinical practice, such simulations can offer training and supervision experiences into CP studies of systems theory, emergent properties, and emotions. The rapid evolvement of AI and CP in the last few years means that the only major barrier to opening these fields to counseling applications is ignorance of their applicability and their availability. These technologies allow counselors to experience more empirical thought experimenting environments so that therapists can test these simulations against the real world of counseling. While these technologies will never replace more traditional research paradigms, they can become an invaluable adjunctive teaching and research tool for counseling professionals. (Contains 38 references.) (RJM)

Artificial Intelligence, Counseling, and Cognitive Psychology

Greg Brack, Ph.D.

Department of Counseling and Psychological Services

Georgia State University

Catherine Brack, Ph.D.

Counseling Center

Georgia State University

Christopher McCarthy, M.A.

Rebecca Beaton

Candis Akins, M.B.A.

Joseph Coberly

Kevin Eames, M.S.

Department of Counseling and Psychological Services

Georgia State University

Running Head: AI, Counseling, & CP

Paper presented at the American Educational Research Association Annual Meeting, April 4-8, 1994, New Orleans, LA.

Correspondence regarding this article should be addressed to:

Catherine J. Brack, Ph.D.
Georgia State University
Counseling Center
University Plaza
Atlanta, GA 30303-3083

Abstract

The purpose of the present paper is to demonstrate that Artificial Intelligence (AI) and Cognitive Psychology (CP) can be integrated into the counseling literature. The primary premise of this paper is illustrate that AI and CP can offer new perspectives on information processing, cognition, and helping. This paper reviews various computer simulations developed by the authors, as well as those programs available from software publishers, that can provide a potent means of simulating various counseling related systems. Besides providing insights into clinical practice, such simulations can offer training and supervision experiences into CP studies of systems theory, emergent properties, and emotions.

Artificial Intelligence, Counseling, and Cognitive Psychology

"Most AI projects are exploration of ways things might be done...There is very little chance that a philosopher will be surprized...by the results of his own thought experiment, but this happens all the time in AI." (Dennett, 1990, p.289)

"I propose that if psychoanalysis is in trouble, artificial intelligence may be able to help." (Turkle, 1990, p. 242).

The two quotes that begin this paper illustrate the main theme of the present study: Artificial Intelligence (AI) offers important ways of exploring concepts in Cognitive Psychology (CP) and counseling. The synthesis of AI and CP has a long and rich history from before the cybernetic TOTE model which issued in the widespread acceptance of CP (Miller, Galanter, & Pribram, 1960). In fact, the TOTE model is now being used as a dominant theory in one of counseling's hottest new fields - traumatology and dissociation (for detailed reviews see Braun 1988a & 1988b). Currently, Holland's classic texts on induction (Holland, Holyoak, Nisbett, & Thagard, 1986) and adaptation (Holland, 1975) are becoming critical to simulators of the human mind and to information processing.

Yet, with the exception of a few key writers such as Braun (1988a & b) and Mahoney (1991), counselors have been less likely to be consumers of such important work. In particular, as Mahoney illustrated, cognitive-behavioral counselors have much to gain from explorations of these interactive fields. The purpose of the present paper is to demonstrate that Artificial Intelligence (AI) and Cognitive Psychology (CP) can be integrated into the counseling literature, especially in the areas of information processing, cognition/emotion, systems theory, and helping processes.

It is of course no surprise to helping professionals that cognitive-behavioral models based on cognitive psychology have received widespread attention and application within the clinical domain and clinical research literature. In particular, cognitive-behavioral theorists have suggested that negative affect is linked to how emotional events are cognitively processed (Ellis, 1967, Beck, 1976). However, although theories of emotion have been postulated in the science of psychology at least since William James (1884), the precise process whereby negative emotions develop has not been fully defined (Roseman, 1982). Unfortunately, among all this clinical and research attention, relatively less scholarly effort has been extended to formal quantitative investigations of the cognition/affect relationships. This is somewhat surprising, since such research questions would seemingly be highly appropriate for counseling studies.

The present authors have performed a variety of research projects (McCarthy & Brack, 1992; McCarthy, Brack, & Matheny, 1993; McCarthy, Brack, Matheny, & Beaton, 1994) investigating one particular model of cognitive psychology - Roseman, Spindel, & Jose's (1990) detailed quantitative model that illustrates how specific appraisals of events are linked to specific emotional responses. Our previous work has focused on more traditional quantitative self-report survey's (except for McCarthy, Brack, Matheny & Beaton, 1994) in the same vain as Roseman and his associates, but this approach is limited on many fronts. Due to the demands of human research, it is very difficult to examine the development of the cognitions/emotions over any specific time period, and these research techniques rarely allow precise experimental manipulation. Many aspects of Roseman's model are difficult to test directly, especially in a detailed examination with the large pool of subjects needed for multivariate quantitative studies, which is distressing since as Roseman's model allows specific tests of distinct appraisal patterns. The present paper illustrates that computer technology and software provide an important domain for testing the assumptions of Roseman's model in an exacting, prolonged investigation that is impossible in the "real world" of counseling settings. While the present authors do not claim that such simulations are replacements for research with human subjects, AI technologies provide an effective and efficient means of simulating a chosen model, so that subsequent human research can be more focused on the phenomena of value to counselors. As Dennett (1990) illustrates, AI projects allow empirical testing of various thought experiments and theories popular to social scientists, especially applied social scientists such as counselors.

This paper reviews various computer simulations developed by the authors and available from software publishers that can provide a potent means of simulating various counseling related systems. Besides providing insights into clinical practice, these simulations can offer training and supervision experiences into CP studies of systems theory, emergent properties, and emotions. Roseman's model is used as a unifying these across the various types of computer simulations. Therefore, Roseman's model will be explained to orient readers to the ideas being tested. Next, several types of computer simulations and their application to Roseman's model will be reviewed. Finally, the implications of this model and its simulations to counseling will be discussed.

Roseman's Model of Appraisal/Emotion Linkages

Roseman, Spindel, & Jose (1990) have developed model that illustrates that specific appraisals of events are linked to specific emotional responses. They suggested that their model might be universal across all human interactions, but it has not been fully tested in applied settings. What is unique about their model is that it identifies the specific appraisal patterns that lead to discrete emotional states. Roseman et al. believe that we make appraisals based on the following dimensions:

Situational state - whether a specific event is consistent or inconsistent with what is desired.

Motivational state - whether the individual is seeking something pleasurable or striving to avoid something painful.

Probability - whether the occurrence of an event is appraised as certain or uncertain.

Power - how much the individual feels capable of coping with the situation.

Agency - appraisal of the situation as caused by self, others, or circumstances.

Legitimacy - whether or not the individual believes they deserved the occurrence of the event.

Based on the above appraisals, Roseman et al. (1990) believed they could determine how the individual would feel in a given set of circumstances. Roseman's theory includes 10 specific negative emotions - disgust, distress, sadness, fear, unfriendliness, anger, frustration, shame, regret, and guilt. The six positive emotions included were joy, relief, affection, pride, hope, and surprise. Based on appraisals of the above dimensions, Roseman et al. (1990) believed that specific emotional states could be identified. Table 1, derived from Roseman et al. (1990), demonstrates the specific relationships of appraisals to emotional states.

Insert Table 1 about here

For example, an event inconsistent with one's motives (appraised as low in situational state), one in which the individual felt weak (appraised as low in power) and was caused by oneself (appraised as high on agency-self) would result in the emotional state of shame. However, changing just one appraisal dimension will, according to the model, result in an entirely different emotion. Continuing with the above example, if an individual appraises the event as caused by another person (appraised as high on agency-other) and all of the other appraisal dimensions remaining constant, the individual will feel the emotion of dislike.

Types of Computer Simulations

The discerning reader may have noticed that the term "artificial intelligence" has yet to be defined, and it is far beyond the scope of this paper to enter that controversial subject. Instead, Turkle's (1990) divides AI into two major camps:

a. rule driven advanced computer programs; and

b. emergent AI pattern models.

Rule-driven programs are one major branch of AI research based on Boole's formalized rules of logical interfence in algebraic form (Turkle, 1990). Turkle's list of AI programs includes emergent programs in which rules that set up a system of independent elements from whose interactions intelligence is expected to emerge. Sometimes these programs are termed "bottom-up programming" and involve establishing a finite set of deterministic rules which are repeatedly iterated until an emergent pattern of interest becomes established. A newer variant of emergent AI has been aptly titled "Artificial Life" (AL) programs which utilize the emergent model to simulate the development of complex patterns reminiscent to "life" and the concepts of evolution, adaptation, and change. It is beyond the scope of the present paper to compare and contrast AI with AL. Interested readers are referred to (Keeley, 1994) for a detailed discussion of this topic. The present paper will focus on the software allied with emergent AI and AL as it seems to be particularly suited to simulating the thought experiments of counseling professionals. As will be discussed below, these programs have provided insights into how learning may explain the acquisition of dominant appraisal patterns and how a variety of environments may selectively reinforce appraisal styles.

A specific set of emergent programs involves the use of cellular automata (CA) and particularly the software program called LIFE developed initially by Conway (see Prata, 1993). CA programs can be used to model the interactions of large groups of individuals over expended periods of time. The CA format is particularly useful to model the situation state appraisals which Roseman's model states are the primary factor in differentiating negative affect. CA simulations provide realistic interactive software environments to test the influence of a wide variety of parameters upon appraisal patterns.

Another type of program reviewed is "Genetic Algorithms" (GA) which involve establishing a variety of appraisal profiles and then letting a designed simulated environment select the most adaptive and fit profile to grow and develop. The GA discussed in this presentation is based upon the work of Holland (1975) and Koza

(1992). These computer scientists have essentially found a cybernetic means of integrating the theory of evolution and natural selection into programming environments. The strength of GAs is that they can determine the most adaptive appraisal pattern for highly complex simulated environments. These environments can be simulations taken from actual case histories or theoretically driven systems taken from the literature. Such models are perhaps the only available means of testing many of the basic tenets of cognitive-behavioral theory, such as acquisition of appraisal bias, contagion of appraisal bias and emotional distress, and the adaptive function of negative affect and appraisal.

Finally, the software program "SIMLIFE" which combines the CA and GA programs which may provide the most highly developed means of testing the synthesis of AI, CP and counseling will be discussed. Each program and the results of its application to this model will be discussed in more detail.

Cellular Automata

Cellular automata are excellent models for simulating complex and dynamic systems which evolve through time (Prata, 1993; Rietman, 1993; Rucker, 1989; Toffoli & Margolus, 1987). The Cellular Automata consist of a lattice of "cells" each representing a unique system member which interacts with other cells in the "local neighborhood." For instance, consider the 3X3 lattice shown below which consists of 9 cells:

ABC
DEF
GHI

Notice that cell "E" is surrounded by eight other cells with which it can interact. Cellular automata have three characteristics of interest to counselors:

a. Each cell works in parallel with the cells on the lattice, but yet each cell keeps its autonomy when interacting with its neighbors;

b. The cell is affected by only its local neighborhood and so brings some simplicity to what could be a frighteningly complex set of interactions (very important for simulators); and

c. Each cell is homogeneous in reference to other cells and thus all members of the lattice follow the same rule set (Rucker, 1989). It was not until the late 1960's and early 1970's that Cellular Automata became widely popular and studied by both amateur and professional AI researchers (Rietman, 1993; Toffoli & Margolus, 1987). The birth of this popularity is due in part to Martin Gardner's article on the now famous "LIFE" Cellular Automata program written by John Conway (Gardner, 1970). Conway was a mathematician at Cambridge when he wrote the program to simulate the birth and death of cells on a "petri dish." Conway provided the program with a relatively simple set of rules inherent to the development of each cell on the dish:

a. A cell's birth is determined by having three living neighbors in its local neighborhood;

b. A cell stays alive only if it has two or three living neighbors in the local neighborhood; and

c. All other possibilities result in the death of the cell.

Yet, the potential emergent complexity of such a simple system is staggering as nine cells with two possible states (live or dead) that interact in this rule pattern have 512 possible patterns on the lattice! Also, the ultimate complexity of the rules can be set as high as 2^{512} if each pattern has its own unique rule set - far beyond modern computing technology (Prata, 1993). Still, Conway's basic LIFE program is sufficiently complex to simulate a vast domain of psychosocial phenomena.

Although it is widely recognized by clinicans that emotions often appear to be contagious and spread throughout human social groups, surprisingly little empirical work has investigated these ideas (Hatfield, Cacioppo, & Rapson, 1992). Roseman's model is appropriate to investigate emotional contagion, since he views negative affect as primarily determined by situation state (whether a specific event is consistent or inconsistent with what is desired by the individual). Negative affectors appraise events as inconsistent with their desired state. If only this one appraisal pattern is contagious (i.e., Person B begins to appraise his or her life as an inconsistent situational state based on contact with Person A who is a negative affector), then negative affect could act as an emotional virus. All that is needed is to consider a "live" cell as a negative affector (i.e., an individual whose appraisal bias is to see events an inconsistent) and "dead" cells representing positive affectors (i.e., individuals who appraise events as consistent).

The problem with Conway's original LIFE program is that its rules are not psychologically realistic. Therefore, a version of the program which allows the parameters to be altered such as LIFE 3000, written by David Bunnell for the WINDOWS DOS environment (Prata, 1993) was used. For the present paper, the rules were as follows:

a. A cell's birth is determined by having at least three living neighbors in its local neighborhood. (Note: in some simulations, the parameter was at least four living neighbors.);

b. A cell stays alive only if it has at least three living neighbors in the local neighborhood. (Note: In some simulations, the parameter was at least four living neighbors); and

c. All other possibilities result in the death of the cell.

These parameters were used so that at some boundary point when enough negative affect was present, the cell would become negative or stay negative. In Conway's original version, a cell could be "crowded out" at some boundary point and die, but it is unlikely that humans would revert to positive affect when "surrounded" by negative affectors. Thus, the cell is prevented from reverting to positive affect unless there is less than three (or in some simulations four) negative affectors. Also, the ability of the LIFE 3000 program to set the lattice from a 10x10 lattice to 75x75 lattice offers a vast number of realistic human social groups to simulate. Third, the LIFE 3000 program allows the lattice to overlap (called "world wrap") into torus patterns, or to not overlap and lead to "borders" at the edge of the simulated system. Fourth, LIFE 3000 provides a "mutation" option which randomly will add up to 100 "live cells" (negative affectors) at each iteration. Finally, the program will look for stable patterns becoming established and alert the researcher to stable patterns existing in the lattice.

Though a vast research literature as been collected on Conway's rules, there seems to be nothing known about the more psychological relevant parameters set in the present study, so each simulation was an exploration of unexplored territory. The LIFE 3000 program has been applied to two simulations:

a. General research into what patterns emerge through time with these parameters; and

b. Comparison of these simulations with "real world data."

Detailed descriptions of either set of results are far beyond the scope of the present paper. A second research report is being prepared detailing how the simulations can be tested and compared in real world environments (specifically school systems) and can be provided to interested readers (Brack, Smith, & Mayhall, 1994). In the present paper, only trends discerned in the thousands of simulations conducted are discussed.

Clearly, the graphic nature of the LIFE 3000 program has allowed the testing of the emotional contagion theory of negative affect and has shown that as negative affect innoculation increases an individual's tolerance of "bad mood" (i.e., moving the parameter from birth of negative affect from three neighbors to four neighbors), the difficulty of establishing stable patterns of negative affect increases exponentially. Further, the simulations suggest that a critical boundary exists at the three/four neighbor rule. Thus, even a relative weak mood innoculation program that helped individuals to tolerate only one more negative affector before reverting to negative affect themselves can have tremendous psychosocial consequences for human systems. Therefore, the LIFE 3000 program can serve as an important test of community mental health interventions. Further, these simulations can suggest ways of intervening with cognitive-behavioral interventions that target specific negative affect laden appraisals.

Currently, the LIFE 3000 program is being used with school administrators to test school-wide staff interventions for increasing morale and reducing staff turnover. The use of the LIFE 3000 program has illustrated the emergence of "negative cliques" interacting within the school environment. Feedback from staff indicates that the LIFE 3000 program accurately can model the development and maintenance of such cliques and the toxic contagious effects such cliques have on surrounding staff. In fact, the mere introduction of the simulation and its graphic presentation to the staff seemed to serve as a form of cognitive-behavioral intervention when the staff became aware of the potential of contagious negative affect.

Readers interested in pursuing Celluar Automata research in detail have other available options. The authors highly recommend the software "CA LAB" marketed by Autodesk and written by Rudy Rucker and the Autodesk staff. CA LAB offers many diverse forms of Cellular Automata with up to 64K states per cell. For intensive and advanced work, researchers are drawing upon the text of Toffoli and Margolus (1987) on the use of a CAM-6 board which can run the Cellular Automata as fast a contemporary supercomputer, but the hardware runs approximately $1500 and requires experience with hardware installation. While the present authors have used the CA LAB program extensively, we have yet to purchase and install the CAM-6 board and cannot advise other researchers on its use.

In summary, the use of Cellular Automata technology has served as a useful "thought experiment" and has provided an important cognitive-behavioral intervention for organization consultations dealing with negative affect among staff.

Emergent Bottom-up Programs

The bottom-up emergent programs described were run under SPSSX (MVS mainframe) which allowed the developed data patterns to be tested with traditional statistical analysis and allowed iterations of 10,000 to one million series per simulation. The specifics of the program are beyond the scope of the present paper as the program alone is nearly 20 pages long. Interested readers may contact the authors for a detailed Appendix listing this program. A client profile for each appraisal was established and then tested against designed simulated worlds. When an appraisal was correctly matched to the existing world value, the client's appraisal bias was reinforced 1% in the simulated client's use of that appraisal value in the next iteration. This reflects Skinner's (1938) definition of a reinforcer as the increase in the probability of a response - in our case 1 percentage point. Also, the addition of 1% increase in appraisal probability demonstrates that learning and appraisal may serve as a positive feedback loop which also makes these concepts potentially open to consideration as dynamic non-linear complex system sensitive to initial conditions. Such systems are considered prime candidates for Chaos and Complexity theoretical modeling (Brack, Brack, & Zucker, In press). To review the implications of Chaos and Complexity for counseling or how these simulations display such trends, refer to previous writings by the present authors for further information (Brack, 1993; Brack, Brack, Zucker, & Penick, 1993; Brack et al., In press).

While each simulated appraisal was autonomous, the emergent interactive patterns were monitored by the program. Once one emerged as dominant, the program stopped. The model utilized was stocastic so that "NOISE", inaccurate perception, and inattention all were captured by the simulation. A primary premise of the program is that, although no one always appraises in a specific way, there are a variety of biases that do exist, so that people tend to appraise in more probable ways. Our program may be the only one which examines trends and not rigidly set patterns. Thus, as Turkle (1990) stated, emergent programs do not rely on rigid and comprehensive rule structures to govern the development of the simulation.

When an environment was randomly established, over millions of iterations through hundreds of developed scenarios, a dominant appraisal pattern consistently emerged. Yet, beyond a stocastic prediction, the specific emergent profile was generally unpredictable. Thus, in random environments, appraisal biases appear but in a seemingly chaotic manner. This is a major support for the use of Complexity theory for cognitive-behavioral studies. Hoyert (1992) has already determined that some forms of learning match Chaos theory models. These simulations suggest that cognitive appraisal <u>may</u> also be chaotically established via sensitivity to the initial reinforcers in the environment.

Yet, the simulations made it possible to structure environments with higher probabilities of certain appraisals being present, but the chaotic development of the appraisal bias was still apparent, if dampened. This finding would represent what Bak and Chen (1991) called a "weakly chaotic system". For instance, in simulations which modeled a client with an affective disorder entering therapy, therapy proved to alter the client's appraisal pattern, but often merely moved the client from negative affect to another equally negative emotion. In particular, many of the simulations resembled Eysenck's (1966) initial reports of counseling effectiveness which suggested that in the early phases of therapy, client affect may change unpredictably to alternative but equally troubling emotions.

Clearly, the complexity of the relationship of emergent affective states and environment states was repeatedly demonstrated. When highly complex environments were tested (i.e., a depressing work environment, an empowering therapist, and a neutral romantic partner), often counter-intuitive appraisal profiles emerged. These results seemed to support Bateson's (Bateson & Bateson, 1987) adage that "dysfunction" was highly adaptive within certain environments.

The importance of specific appraisal change interventions was demonstrated by these models, and these results have tremendous clinical significance.

Genetic Algorithms

Genetic Algorithms programs were written by the present authors on QBASIC for IBM compatibles to run on personal computers for extensive periods of time that is often unavailable on BATCH style mainframes. These programs test how appraisal patterns can be entrenched within certain environments. The extensive computer time is critical for the development of the appraisal pattern's fitness within the simulated environment. In these programs, fitness was defined as the number of correct matches of the profile type to the environment. The environment was designed by the researchers for each simulation. The most fit profiles were allowed to replicate each generation with other successful profiles, thus creating heterozygous profile "offspring" which were also bred and tested. Depending on the length and parameters of the simulations, the authors recommend that researchers use a 486 model computer as the increased processing speed is extremely useful, since even on a 486 the simulations can run for 24 or more hours. (Details of the program will be provided by the authors in a detailed Appendix of the programs upon request.)

The program begins with 16 "homozygous" two chromosome (four genes/chromosome) appraisal profiles. There is no ability for mutation or cross-over in this program, since the 16 profiles represent the entire search space to be explored. The goal of the program is to find and breed the most fit profile, not to identify it as would occur in more advance and complex programs and simulations.

In general, the genetic algorithms replicated the results of the emergent bottom-up programs described earlier. Although more adaptive appraisal patterns emerge through the simulations history, the genetic algorithms illustrate that the program "cheats" by storing less fit profiles that can emerge as dominant if the environment changes. Evolutionary epistemologists contend humans have evolved a fit, but not perfectly accurate world view in order to maximize the ability to closely monitor the world and to ensure an ability to change that world view where necessary (Campbell, 19). The genetic algorithms support that clients likely retain "unfit" or at least neutral appraisal patterns for use if castastrophic changes are encountered. "Hedging one's bet" is an excellent example of how "dysfuntional attitudes" may go in remission but never be totally lost. Experience with the genetic algorithms shows the ultimate usefulness of this strategy.

The genetic algorithms are also extremely sensitive to environmental variation and quickly adapt to the chance patterns of the pseudo-random numbers at the core of these programs. The genetic algorithms seem to demonstrate a subtle adaptation to even the slightest pattern in the algorithm's environment. These findings illustrate that even extremely simple emergent models can describe the complexity and subtlety of the human mind. Many of a client's cognitive biases only appear dysfunctional when viewed in the simplistic restricted context of the counselor's office. The genetic algorithms illustrate clearly that often counter-intuitive perspectives and biases are highly fit and adaptive in the more realistic and complex world outside the therapy hour.

SIMLIFE

Perhaps the most exciting development to be reviewed in this paper is the widespread availablity of the software "SIMLIFE" which combines cellular automata, genetic algorithms, and computer graphics in a low cost package (less the $70.00). The version of SIMLIFE tested by the present authors was the WINDOWS DOS on a 486 IBM compatible. SIMLIFE is the latest in a line of artificial life programs beginning with the simulation of urban development (SIMCITY), animal interactions (SIMANT), farm ecosystems (SIMFARM), and global ecological change (SIMEARTH) all developed by the MAXIS corporation. SIMLIFE was designed by Ken Karakotsios, Justin McCormick, and other software specialists at MAXIS. Karakotsios traces its development to both Conway's LIFE and other Cellular Automata programs and to Rudy Rucker's CA LAB computer class at San Jose State University. The goal of SIMLIFE is to model as realistically as possible an ecosystem's development and the functioning of climate, soil, plant, and animal components of the simulated world. SIMLIFE can simulate up to 32 plants and 32 animals in a highly complex meterological and biome varied world of up to 256x512 cells. The complexity of combining both Cellular Automata technology with the design of genetic algorithms allows researchers to ask question which combine both technologies. The "plant" species contain 15 genes (both discrete and continuous) and "animal" species contain 46 genes (also discrete and continuous) which can meet the algorithmic needs of most beginning simulators. SIMOFFICE is a saved games which extends ecosystem the work world. Plants represent office work. Employees are herbivores that consume work to stay employeed. If work runs out, they will be laid off (die). If not, the number of employees grows (Karakotsios & Bremer, 1993). The goal of the simulation is to create a growing and viable organization.

SIMLIFE provides a complex assortment of mutation parameters, genetic versus random recombination options, and biome characteristics to manipulate. The most exciting component of SIMOFFICE is its conception that different environments grow different information forms (plants) that may then be processed (eaten) by a variety of "informavores." Simulators can control not only the environment growing the information, but the information's interrelationships with information consumers and the background environment. To date, there does not seem another program designed to model such a complex variety of parameters so relevant to applied social scientists. Further, the theoretical basis of environments growing various kind of organic information is virtually an unexplored domain of either theoretical or empirical development within cognitive psychology and counseling. With a minimum of training researchers can learn to design their own information biomes, information species and informavores.

SIMLIFE has the best ability to graph and summarize the volumes of data occuring throughout the simulation.

MAXIS is currently developing even more advanced data logging software to further provide simulation assesssment. There is an almost total ignorance of how to process, summarize, and chart the data produced by the simulation. The emergent nature of these models can baffle researchers with an overwhelming amount of data. The most significant contribution of SIMLIFe is its most well know reference guide (Karakotsios & Bremer, 1993) that provides invaluable guidelines on simulating and analyzing the results of such simulations which can save hundreds of hours. Interested simulators are encouraged to begin with this text.

A second trend emerging from the SIMLIFE models is the difficulty of establishing complex and diverse ecosystems. The automatic genetic algorithms available in the program tend to perform adequately, but the human interface seems to add immeasurably to the development of the ecosystem. Due to the limitations of contemporary personal computers, even extensive computer time is miniscule in comparison to the lengthy time periods required for actual real world ecosystem development. SIMLIFE teaches an appreciation of the sensitivity of systems and the possibility that the single action of one member of that system effect through the system (Brack, 1993). Interacting with the SIMOFFICE module leads to appreciate this point.

A third result of working with SIMLIFE is that future development of emergent complex phenomena are easily within the reach of even the least trained computer user. Before SIMLIFE, extensive training and experience in programming and consumption the often technical AI literature was required. Then the resultant graphics (if even designed into the program) often disappointed other users. SIMLIFE allows investigation of both single gene and gene groupings over time. All that is required is the operationalization of the phenotype into psychologically meaningful concepts as in SIMOFFICE.

Summary

The goal of the present paper has been to discuss how the fields of artificial intelligence, counseling and cognitive psychology have important contributions to make to each other. It is regretful that counseling has tended to avoid this rich potential for exploration. Of course, Weizenbaum's programs of ELIZA and DOCTOR resulted in widespread discussion of the role of the counselor for effective counseling change (Peat, 1988). Although ELIZA was basically stupid and barely above random responses, some users found the program invaluable as a source of reflection and acceptance. Artificial intelligence has come a long way since that time, but counseling has been quite avoidant in utiling such advances. Artifical intelligence literature can be daunting to most counseling researchers, and the present paper reflects the computer experise of over 15 years work reviewing and experimenting with artificial intelligence. During these 15 years, the the availability of advanced personal computers and simulation software at highly affordable prices has increased. The present paper has de-focused the mechanics of the reviewed programs and instead focused on their use and general trends discerned from their use. Currently, counselors with only a minimum of computer expertise can purchase such advanced programs as SIMLIFE and begin advanced simulation modeling. Such a possibility was largely unavailable even a few years ago. Perhaps for the first time, the only major barrier to opening these fields to counseling applications is the ignorance of their applicability and easy availability. While the literature may still prove difficult, the proceedings of the first three artificial life conferences are published and fairly easy to consume (Langton, 1989; Langton, Taylor, Farmer, & Rasmussen, 1992; Langton, 1994). For this reason, the present paper minimized the technological aspects of our work and maximized its implications. With the publication of Roseman's model, an exciting theoretical perspective is waiting to be explored and cognitive-behavioral counseling may actually become much more of an empirical science with extensive simulations and modeling of its basic assumptions. Any counselor considering any of the newer perspective of cognitive psychology and systems theory can profit by extensive experimentation with these models. They provide insights into theory unavailable elsewhere. As a teaching tool, these programs provide an intuitive understanding of the complexity of the development of the human mind as it grows and develops throughout the lifespan. Counselors who really want to "understand what makes a client tick" could use these models to reflect upon. Certainly, counseling never seems either as easy or as simple once one encounters these models and tinkers with their various parameters. The goal of these technologies is not to explain human behavior. This is not a likely technological possibility in the near future. Instead these technologies allow counselors to have a more empirical thought experimenting environment to explore and to test against the real world of counseling. These technologies will never replace more traditional research paradigms but can become an invaluable adjunctive teaching and research tool to counseling professionals. We believe that this alone is worth the effort it takes to enter and accumulate to the newer domains of "cyberspace" in the twenty-first century.

References

Bak, P., & Chen, K. (1991). Self-organized criticality. cientific American, January, 46-53.

Bateson, G., & Bateson, C. (1987). Angels fear. New York: MacMillan.

Beck, A.T. (1976). Cognitive therapy and emotional disorders. New York: International Universities Press.

Brack, G. (1993, August). Chaos theory: A critical new dimension to consultation. Paper presented at the Annual Meeting of the American Psychological Association, Toronto, Canada.

Brack, G., Smith, R.M., & Mayhall, M.B. (1994, August). Computer simulations as a basis of school-based consultations. Paper to be presented at the Annual Meeting of the American Psychological Association, Los Angeles, CA.

Braun, B.G. (1988a). The BASK model of dissociation, Part 1. Dissociation, 1, 4-23.

Braun, B.G. (1988b). The BASK model of dissociation, Part 2: Treatment. Dissociation, 1, 16-23.

Campbell, D.T. (1988). Methodology and epistemology for social science. Chicago, IL: The University of Chicago Press.

Dennett, D.C. (1990). When philosophers encounter artificial intelligence. In S.R. Graubard (Ed.), pp. 241-268, The artifical intelligence debate: False starts, real foundations. Cambridge, MA: The MIT Press.

Ellis, A. (1967). Rational-emotive psychotherapy. In D. Arbuckle (Ed.), Counseling and psychotherapy. New York: McGraw-Hill.

Eysenck, H.J. (1966). The effects of psychotherapy. New York: International Science Press.

Gardner, M. (1970). Mathematical games: The fantasy combinations of John Conway's new solitaire game "life." Scientific American, October, 120-123.

Hatfield, E., Cacioppo, J.T., & Rapson, R.L. (1992). Primitive emotional contagion. In M.S. Clark (Ed.), pp. 151-177, Emotion and social behavior. Newbury Park, CA.

Holland, J.H., Holyoak, K.J., Nisbett, R.E., & Thagard, P.R. (1986). Induction: Processes of inference, learning, and discovery. Cambridge, MA: The MIT Press.

Holland, J.H. (1975). Adaptation in natural and artificial systems. Ann Arbor, MI: The University of Michigan Press.

Hoyert, M. (1992). Order and chaos in fixed-interval schedules of reinforcement. Journal of the Experimental Analysis of Behavior, 57, 339-363.

James, W. (1884). What is an emotion? Mind, 9, 188-205.

Karakotsios, K., & Bremer, M. (1993). SIMLIFE: The official strategy guide. Rocklin, CA: Prima Publishing.

Keeley, B.L. (1994). Against the global replacement: On the application of the philosophy of artificial intelligence to artificial life. In Langton, C.G. (1994). (Ed.), pp. 569-588, Artificial life III. Reading, MA: Addison-Wesley.

Koza, J.R. (1992). Genetic programming. Cambridge, MA: The MIT Press.

Langton, C.G. (1989). (Ed.) Artificial life. Reading, MA: Addison-Wesley.

Langton, C.G., Taylor, C., Farmer, J.D., & Rasmussen, S. (1992). (Eds.) Artificial life II. Reading, MA: Addison-Wesley.

Langton, C.G. (1994). (Ed.) Artificial life III. Reading, MA: Addison-Wesley.

Mahoney, M.J. (1991). Human change processes. New York: Basic Books.

McCarthy, C. & Brack, G. (1992, August). Cognitive appraisals of emotional events within the family of origin. Paper presented at the Annual Meeting of the American Psychological Association, Washington, D.C.

McCarthy, C. & Brack, G. (1993, April). The impact of cognitive appraisals on emotions produced by stressful events. Paper presented at the Annual Meeting of the American Educational Research Association, Atlanta, GA.

McCarthy, Brack, & Matheny, (1993, November). The relationship of cognitive appraisals to stress coping resources in stressful events. Paper presented at the Division 17 Southest Regional Conference, Gainesville, FL.

McCarthy, C., Brack, G., Matheny, K., & Beaton, R. (1994, April). A multifaceted analysis of a new therapeutic model of linking appraisals to affective experience. Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, LA.

Miller, G.A., Galanter, E., & Pribram, K.H. (1960). Plans and the structure of behavior. New York: Holt, Rinehart, & Winston.

Peat, F.D. (1988). Artificial intelligence: How machines think. New York: Bean.

Prata, S. (1993). Artificial life playhouse. Corte Madera, CA: Waite Group Press.

Rietman, E. (1993). Creating artifical life: Self-organization. New York: Wincrest/McGraw-Hill.

Rucker, R. (1989). CA lab. Sausalito, CA: Autodesk.

Roseman, I. (1982). Cognitive determinants of emotions. Unpublished doctoral dissertation. Yale University.

Roseman, I., Spindel, M., & Jose, P. (1990). Appraisals of emotion-eliciting events: testing a theory of discrete emotions. Journal of Personality and Social Psychology, 59, 899-915.

Skinner, B.F. (1938). The behavior of organisms: An experimental analysis. New York: Appleton-Century-Crofts.

Toffoli, T., & Margolus, N. (1987). Cellular automata machines. Cambridge, MA: The MIT Press.

Turkle, S. (1990). Artificial intelligence and psychoanalysis: A new alliance. In S.R. Graubard (Ed.), pp. 241-268, The artifical intelligence debate: False starts, real foundations. Cambridge, MA: The MIT Press.

Table 1: A simplified version of the Roseman model

	Positive emotions: Achieved Rewards	Positive emotions: Achieved Avoided Punishment	Negative emotions: Did not achieve Rewards	Negative emotions: Did not achieve Avoided Punishment	
Circumstances Caused					
Unknown			SURPRIZE		
Uncertain	HOPE		FEAR		Weak
Certain	JOY	RELIEF	SADNESS	DISTRESS	Weak
Uncertain	HOPE		FRUSTRATION		Strong
Certain	JOY	RELIEF	FRUSTRATION		Strong
Other Caused					
Uncertain	LIKING		DISLIKE		Weak
Certain	LIKING		DISLIKE		Weak
Uncertain	LIKING		ANGER		Strong
Certain	LIKING		ANGER		Strong
Self Caused					
Uncertain	PRIDE		SHAME/GUILT		Weak
Certain	PRIDE		SHAME/GUILT		Weak
Uncertain	PRIDE		REGRET		Strong
Certain	PRIDE		REGRET		Strong