# Meetings

## Intelligent Verbal Behavior

Progress in the study of intelligent verbal behavior was the topic of a 2-week conference on artificial intelligence, linguistics, and psychology, held at the summer conference center of the National Academy of Sciences in Woods Hole, Massachusetts (11 to 23 July 1971). Although the participants from the three fields differ in goals, the recognition of their common interests in the study of natural language, memory, and cognitive processes offers an encouraging sign of progress.

The conference participants examined the basic processes needed to model human knowledge, linguistic interactions, and thought capability. The ability to understand an input from the context of its appearance (rather than from internal sentence components alone) requires the consideration of knowledge that may not have been mentioned in the discourse, but that is assumed by the speaker of the language. An organized memory system seems to be necessary; the format discussed most frequently during the conference was that of a directed, labeled network of information. Memory processes should permit the network to acquire new information, both by adding new concepts and experiences and by recombining, discriminating, and generalizing the knowledge already present in the network. In addition, it should be possible for an intelligent system to perform logical deductions on the information contained within the memory.

The ability to process natural language by computers was viewed as entering its second generation of development. Parsers now use procedures that combine both syntactic and semantic information in order to determine the most likely interpretation of a sentence, rather than the characteristic earlier approach of enumerating all possible interpretations. These new parsers offer prospects for placing heavy reliance on general semantic and conceptual structures and are capable of using the context of the discourse, as well as a general knowledge of the problem under discussion, to perform their analyses. Although current systems are adequate only for models of specialized content areas, considerable discussion was given to the analyses of conceptual paradigms that might be involved in more extensive human cognitive systems.

The further development of semantic networks and natural language parsers will provide potential bases for new directions in the use of the computer as an educational tool. Thus, in the teaching of a particular content area, it appears to be possible to provide the system with a rich universe of knowledge. Students could then freely probe and question such knowledge structures. Moreover, it may ultimately be possible for the system to model the strengths and weaknesses in the growing knowledge structure of the student, thus permitting it to adapt teaching strategy accordingly.

The group felt that the social consequences of present endeavors should continually be under examination as the power of these systems increases. It was generally agreed that the understanding of intelligent behavior, whether it be of man or of machine, has important potential benefits to society, such as the educational uses discussed above. But negative consequences are also likely to accompany such developments, the most obvious being the use of these systems to collect and evaluate large files of political and personal data on individuals. Although the participants did not foresee simple resolution of the dilemmas in weighing potential benefits and dangers of scientific knowledge, it was felt that the social implications of the creation of intelligent systems must be faced willingly by both the researchers themselves and by those who support the research.

The conference was sponsored by the Mathematical Social Science Board within a grant from the National Science Foundation. The participants, listed by institution, were R. P. Abelson, chairman (Yale University); J. D. Becker, D. G. Bobrow, J. R. Carbonell, W. A. Woods (Bolt Beranek and Newman, Inc.); R. Quillian (Bolt Beranek and Newman, Inc., and University of California, Irvine); S. Baranofsky, R. Simmons (University of Texas); K. Colby, H. Enea, R. Schank (Stanford University); A. Fink, E. Kelley, P. Stone (Harvard University); M. Kibens, R. Lindsay (University of Michigan); D. A. Norman (University of California, San Diego); B. Raphael, A. E. Robinson (Stanford Research Institute); J. Weizenbaum (Massachusetts Institute of Technology); R. M. Kaplan (Rand Corporation); and G. A. Miller (Institute for Advanced Study).

D. A. NORMAN
*University of California, San Diego*
R. P. ABELSON
*Yale University, New Haven, Connecticut*

## Prospects of Gene Therapy

The prospects of developing gene therapy to treat inherited diseases were discussed by specialists of different disciplines at a meeting jointly sponsored by the National Institute of Neurological Diseases and Stroke and by the Fogarty International Center at the Stone House at the National Institutes of Health (NIH). Medical researchers have the following concern. More than 2 percent of humans suffer from diseases or defects in vitality that are inherited according to Mendelian laws (that is, have alterations within single chromosomes, resulting in, for example, homocysteinuria, sickle cell anemia, and the like). In addition, more than 5 percent have familial disorders whose tendency to develop depends both on the environment and on the cumulative effect of two or more genetic defects (diabetes, schizophrenia, and certain cancers). In fibroblasts, shed by the growing embryo and obtained through amniocentesis, some hereditary diseases can be detected either by the cytological analysis of chromosome anomalies (mongolism) or by biochemical tests (Lesch-Nyhan syndrome). If such an analysis clearly indicates the presence of a hereditary disease, the fetus can be aborted. Whether this kind of eugenics will be extensively employed depends on each society's ethical decisions, influenced by religious attitudes and economic affluence. But only a small fraction of all hereditary defects can be discovered by amniocentesis because most do not show up in fibroblasts. Most hereditary diseases will therefore persist in the human population and, with certain glamorous ex-