ENHANCING HUMAN PERFORMANCE: An Evaluation of "New Age" Techniques Considered by the U.S. Army

by John A. Swets and Robert A. Bjork

Unconventional techniques considered by the United States Army for enhancing human performance were reviewed during a two-year study by a committee of the National Research Council. Little or no scientific evidence was found to support the effectiveness of several, including neurolinguistic programming in interpersonal influence and such paranormal techniques as remote viewing and psychokinesis. Mixed results were seen to characterize other techniques, for example, group-cohesion procedures. Further study was suggested for a few, including mental practice of motor skills. Guidelines requested of the committee for future army evaluation of enhancement techniques stressed the need for, and the conduct of, both laboratory and field research. The committee recommended further consideration of mainstream research in the behavioral sciences as a basis for effective performance enhancements.

Five years ago the Army Research Institute (ARI) asked the National Research Council to assess a field of techniques designed to enhance human performance. As a class, these techniques are extraordinary in that they were developed outside of mainstream research in the behavioral sciences and are accompanied by strong claims for high effectiveness. The ARI wanted a committee to examine the potential of certain specified techniques, to recommend appropriate criteria for evaluating such techniques, and, where possible, to specify the research necessary to advance understanding of performance enhancements in areas of behavior related to the proposed techniques. In pursuing this line of investigation, the ARI was reacting to broad and substantial advocacy in the army of trying to gain large enhancements of human performance by any conceivable means.

The army's interests, as summarized by ARI, included more efficient learning, improved motor skills, altered mental states, stress reduction, interpersonal influence, group cohesion, and certain parapsychological processes. More specifically, the army was considering the possibilities that learning could take place during sleep, that learning might be accelerated via packaged programs designed for that purpose, and that motor skills might be enhanced by guided imagery, mental practice, visual concentration, and biofeedback. Further, it wished to pursue the possibility that mental states could be altered by self-induced hypnotism, meditation, focused concentration, or the integration of activity in the brain's hemispheres, in order to promote periods of peak performance. The army was also interested in whether biofeedback and methods that purport to alter mental states might be useful in managing stress. Certain aspects of interpersonal and group processes were under examination as well, including whether group cohesion, which might be fostered by keeping army units intact, enhances group and individual performance. Finally, the army had an interest in such parapsychological processes as remote viewing and psychokinesis, or mind over matter, especially mental influence on the functioning of remote machines.

It may at first seem strange that anyone in the army was interested in the panoply of behavioral processes and techniques that characterized the countercultural human-potential movement of the 1960s. However, in the 1980s advocates of such techniques have had success with an approach that is more entrepreneurial than ideological. Moreover, the techniques are presented less as related to general well-being and more as related to specific tasks, such as marksmanship, second-language learning, and sleep inducement. The army is not alone in this interest: Private industry and the general public have also given much attention to these New Age techniques in commercially available programs of general training and self help. The army's interest in extending human abilities through parapsychological processes originated primarily in intelligence circles rather than in training circles, but para-

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psychology soon became a bedfellow of the unconventional training techniques in the army.

FORMATION OF THE NRC COMMITTEE

In conversations between Edgar M. Johnson, technical director of ARI, and David A. Goslin, then executive director of the Commission on Behavioral and Social Sciences and Education (CBASSE) of the NRC, and in a formal letter request, it was indicated that the ARI leadership wanted help, not only to reduce broad pressures on it that had recently intensified, but also with an important national problem of interest to private industry and the public as well as the military. CBASSE members who evaluated this request included psychologists William K. Estes, Ira J. Hirsh, Lauren Resnick, and Stanley Schachter. In response to the request, CBASSE moved to set up a committee especially for the purpose, with suggestions for particular kinds of expertise also from other advisers including psychologists Robert Boruch, Wendell R. Garner, Bert F. Green, and Gardner Lindzey. The first author of this article was enlisted as committee chair and, together with Goslin, he developed the final recommendations for membership that were endorsed by the commission.[1] Daniel Druckman was appointed as the committee's study director.

The Committee on Techniques for the Enhancement of Human Performance (henceforth, the committee) met first in late July 1985. ARI's Johnson along with George Lawrence, its liaison to the committee, arranged for several speakers at the first meeting, who informed and sometimes perplexed the members. A few speakers described single techniques, others waxed enthusiastic about the full range of them, and one, a retired general, spoke eloquently of his own extensive psychokinetic powers.

General Maxwell R. Thurman was the motivational speaker at dinner the first evening. His graphs demonstrated that in terms of recruits' test scores, the army was doing increasingly better, and also better compared to the other services. His review of the traditional and growing demands placed on soldiers, however, made clear that these demands continued to outstrip abilities by a large margin.

THE COMMITTEE'S APPROACH

The committee could easily imagine the great difficulties faced in converting recruits, most of them with minimal education as well as short terms of duty, into soldiers who possess the personal and social skills needed in battle as well as the technical skills needed to operate and maintain complex equipment. It could understand urges to look beyond slow, narrow, and insufficiently targeted mainstream research on human performance to enhancements that could come from elsewhere. And it was aware that those in the army responsible for training and technique evaluation would face difficulties in responding to strong enhancement claims (both by army officers and outside vendors) for diverse and far-ranging techniques. The committee agreed that the general problem deserved objective and thorough examination and was willing to initiate such a study.

Subcommittees were formed on various facets of the problem, including evaluation issues, sleep learning, accelerated learning, guided imagery, biofeedback, split-brain effects, stress management, cohesion, influence, and parapsychology. The committee met as a whole six times in 2 years, in whole or part made ten site visits, invited twenty or so briefings, and commissioned ten background review papers.[2] It met twice with a Resource Advisory Group of army officers formed for the purpose.[3]

ARMY BACKGROUND

The army's interest in parapsychology is reported to be longstanding, including, for example, sponsorship of ESP research by J.B. Rhine in the early 1950s. Remote-viewing experiments were conducted for the army by the Stanford Research Institute in the 1970s. A military concern has been that the Soviets have been active in the development of psychic abilities, including the ability to affect the behavior of others through mental telepathy. A proposal developed in the army for the First Earth Battalion envisioned warrior monks with a range of parapsy-

1. The committee consisted of John A. Swets, chair, Robert A. Bjork, Thomas D. Cook, Gerald C. Davison, Lloyd G. Humphreys, Ray Hyman, Daniel M. Landers, Sandra A. Mobley, Lyman W. Porter, Michael I. Posner, Walter Schneider, Jerome E. Singer, Sally P. Springer, and Richard F. Thompson.

2. Ten commissioned papers, available from the National Academy Press, are these: Eric Eich, Learning during sleep; Robert E. Slavin, Principles of effective instruction; Deborah L. Feltz, Daniel M. Landers, and Betsy J. Becker, A revised meta-analysis of the mental practice literature on motor skill learning; Seymour Levine, Stress and performance; Raymond W. Novaco, Stress reduction and the military; Dean G. Pruitt, Jennifer Crocker, and Deborah Hanes, Matching and other influence strategies; Boaz Tamir and Gideon Kunda, Culture and military performance; James E. Alcock, A comprehensive review of major empirical studies in parapsychology involving random event generators and remote viewing; Monica J. Harris and Robert Rosenthal, Interpersonal expectancy effects and human performance research; Dale Griffin, Intuitive judgment and the evaluation of evidence.

3. The Resource Advisory Group consisted of general officers who held the positions of Deputy Chief of Staff for Personnel, Deputy Chief of Staff for Intelligence, Director of Army Research and Technology, Commander of the Soldier Support Center, and Commander, Medical Research and Development Command and as well the Assistant Secretary of the Army for Manpower and Reserve Affairs.

chological abilities allowing them, for example, to leave their bodies and to walk through walls. (See, e.g., Squires, 1988.) These ideas and enhancement techniques of the sort mentioned above were advanced by an informal group of some 300 army officers known as the Delta Force (not to be confused with the antiterrorist unit having the same name). Several other task forces in the army were organized in the 1970s to examine and promote the techniques.

An influential memo pulling much of this together for the army was written in 1982 by General Thurman, then a lieutenant general and deputy chief of staff for personnel (Thurman went on to become a four-star general and vice chief of staff, and was an architect of the army's very successful recruiting campaign with the slogan of "Be all that you can be.") He subsequently led the army's training effort as commander of the Training and Doctrine Command. His memo identified "accelerated learning, inferential focus, previsualization, psychokinetics and biokinetics, remote viewing, biophysical stress prevention, etc." as techniques that "should be considered." It was based in part on a half-dozen commercially available techniques that may be characterized as follows.

Suggestive accelerative learning and teaching techniques (SALTT) combine physical relaxation, mental concentration, guided imagery, suggestion, and baroque music to improve classroom performance. The *Journal of the Society for Accelerative Learning and Teaching* publishes evaluations of applications of SALTT to language training, typing instruction, high-school science courses, and so forth.

Concentrix designates a specific procedure for training visual concentration on a target, broadly defined, and maximizing hand-eye coordination, balance, body control, and sensory and visualization skills. It is intended for application not only to marksmanship but to the operation of complex equipment, movement over long distances with the objectives of reducing fatigue, and intelligence gathering.

Hemi-Sync,℠ short for hemispheric synchronization, consists of presenting tones of slightly different frequency to each ear to produce a beating sound. An EEG-measured brain response follows changes in the beat frequency and changing sound patterns are thought to change states of awareness. Recommended applications are for language learning, stress reduction, reading skills, problem solving, creativity, and sleep control.

Stress-management techniques are designed to alleviate anxiety and tension and are implemented by self-help books and groups and by clinics. They often emphasize fitness, nutrition, and life styles, as well as strategies such as progressive relaxation and image rehearsal. Promoters claim an interactive effect and put forth a particular package of techniques.

Neuroinguistic programming (NLP) is intended primarily to be a means of exerting influence over others. The skilled practitioner is supposed to be able to determine what representational system (e.g., visual, auditory, or kinesthetic) another person is using at the moment—by observing his or her speech, eye movements, and posture—and then to frame communications to that person in terms of the particular representational system in use. A national association is reported to have a membership of about 500 persons.

In 1983, an *ad hoc* subgroup of the Army Science Board, formed in response to General Thurman's memo, issued a report supportive of further consideration of these techniques. The group had been exposed to them in an "experiential workshop format" during a four-day meeting at the Monroe Institute of Applied Sciences, developer of Hemi-Sync. It recommended that formal mechanisms be established to undertake a major effort on "human technologies," that "technologies should be sorted into those which require a scientific base and need verifiable, repeatable data for evaluation versus those which are more analytic representing principles of good practice and are evaluated by consensus, acceptance and overall effectiveness," and, further, that research efforts be managed jointly by the Army Research Institute and the Medical R&D Command.

In 1984, ARI, which reported then to General Thurman, hired a program manager, commissioned review papers on five techniques, and requested of the National Research Council that a committee examine the area. In 1985, ARI initiated research on several of the techniques and reviewed army research in progress elsewhere.

THE COMMITTEE'S SPECIFIC FINDINGS

Learning During Sleep

The committee recommended that the army give sleep learning a "second look." Considering only the sleep-learning literature, there seemed little basis for any kind of positive recommendation. This conclusion was reinforced in a detailed briefing by LaVerne Johnson of the Naval Health Research Center. When all possible criteria are applied to verify that the learner is truly asleep, there appears to be no evidence of conscious recognition or recall of materials presented during sleep (for a thorough review, see Aarons, 1976). In fact, since the mid-1970s research activity on sleep learning has nearly stopped, at least in this country.

The committee, however, was influenced by recent developments in basic research on "implicit memory," "stimulus-driven processing," "learning without awareness," and related topics (for reviews, see Richardson-Klavehn & Bjork, 1988; Schacter, 1987; Shimamura, 1986; and the commissioned paper by Eich, footnote 2).

pared for the Army Research Institute by John Palmer and from a review of the same studies that it commissioned Alcock to make. The committee also reviewed the other main body of experimental research, namely, on Ganzfeld experiments, in which a homogeneous visual field is used to alter states of mind in the interest of receiving psi signals. A paper on intuitive judgment and the evaluation of evidence was prepared for the committee by Griffin (see footnote 2).

With particular attention to the three sets of experimental studies, but including its other reviews and experiences, the committee found no scientific warrant for the existence of parapsychological phenomena. ("No scientific justification" was the phrase agreed on with NRC editors for the committee's report, but "warrant" captures better the intended sense.) Though the committee therefore saw no reason for direct army involvement, it felt that monitoring by the army of the main, current, experimental work would be prudent and suitable. If that monitoring led to the proposal of specific studies, the recommendations were that army and outside scientists arrive at an agreed-upon research protocol, that the research be conducted by proponents and skeptics, and that attention be given to the manipulability and practical application of any effects found to exist.

GENERAL CONCLUSIONS AND RECOMMENDATIONS

The committee observed a pervasive army tendency to accept and implement enhancement techniques on the basis of personal or clinical experience and marketplace popularity instead of on the basis of research evidence that could establish the existence and usefulness of an enhancement effect. In expressing its concern about this practice, the committee issued a list of questions about presumed enhancement techniques that had been prepared by scientists at the Walter Reed Army Institute for Research: What changes will the technique produce? What evidence supports the claims for the technique? What theories stand behind it? Who will be able to use it? What are its implications for army operations? How does it fit with army philosophy? What are the cost-benefit factors? (Hegge, Tyner, & Genser, 1983).

Because strong claims of support from basic research have been made for some of the techniques the committee examined, the committee reviewed in its report what it takes to justify a scientific claim. Specifically, it highlighted the need to conduct basic research so that inferences could be drawn in accordance with scientific standards—inferences about novel concepts, causation, alternative explanations of causal relations, and the generalizability of causal relations. Standards for evaluating field tests of enhancement programs were also reviewed, including such factors as immediate effects, side effects, assigning merit and meeting needs, likelihood of transfer, and contrast with alternatives.

The committee acknowledged the differences between rational decision making in science and in practical contexts, for example, differences in the benefits of correct decisions and the costs of incorrect decisions and in what is viewed as a timely decision. It recommended that the army acknowledge such differences explicitly in connection with decisions about particular techniques. It set forth an analysis of the unreliability of testimonies as evidence for enhancement effects. And it stipulated what it thought would be useful mechanisms for advice to different parts of the army as well as bidding procedures it felt would facilitate informed choices of programs and vendors.

The committee recommended that the army continue to examine vigorously enhancement techniques that appear promising. It added the advice that the examination should be systematic and should include techniques drawn from mainstream research as well as packages promoted by vendors. A main concern of the committee was to link more closely the army's great interest in enhancing human performance and its substantial resources for conducting tests to evaluate techniques. The committee remarked on the potential for transfer to the civilian sector.

COMMITTEE PUBLICATIONS

The committee's final report was published as a book by the National Academy Press in early 1988, entitled *Enhancing human performance: Issues, theories, and techniques*, edited by Druckman and Swets. (A second printing was made a year later.) With preliminary copies available, a briefing was given army officials and a press conference was held in December 1987, with Swets, Bjork, Hyman, Singer, and Druckman representing the committee. The press conference was attended by some fifty reporters who heard a 15-minute prepared statement and then raised questions for an hour or so. Primary articles appeared in the *New York Times* (Leary, 1987), *Washington Post* (Squires, 1987a, 1987b), *Washington Times* (Price, 1987), and *Los Angeles Times* (Gillette, 1987), and articles based on them appeared in many other local and regional newspapers. Other news articles were published in *Science* (Holden, 1987), *Science News* (Greenberg, 1988), *Science and Government Report* (Greenberg, 1987), *APA Monitor* (Hostetler, 1988), *Psychology Today* (Roberts, 1988), *The Chronicle of Higher Education* (Wheeler, 1987), Beijing's *Science and Technology Daily* for June 29, 1988, and the NRC's *News Report* (Jarmal, 1988). Swets and Druckman co-authored an op-ed article that was printed in 25 daily newspapers.

The press conference was videotaped by NBC, CNN, and the United States Information Agency. CNN re-

played small segments for a few days. NBC's camera did not operate properly so Tom Brokaw's evening news used file footage representing some of the Army's more lurid past interests, for example, in walking through walls, and he commented in kind. National Public Radio presented for a few days an interview with Robert Bjork on learning techniques.

PUBLIC REACTION

The committee's book was reviewed descriptively under the heading "Briefly Noted" by Sheldon Zedeck (1988) in *Contemporary Psychology*. It was reviewed extensively by Philip Morrison (1988) in *Scientific American*. We appreciated his summary: "Among the most difficult lessons in science is how not to deceive yourself. This patient and judicious overview offers genuine help" (p. 109). Irwin Child (1988), in a review for *Choice*, complimented the exposition of general principles of evaluation but noted what he called the report's "bias against exploration of apparent anomalies not yet well attested" (p. 536). Kendrick Frazier (1988) reviewed the book extensively for the *Skeptical Inquirer*, with emphasis on paranormal phenomena.

Druckman and Swets received several phone calls and letters, many of them complimentary (wanting more information and making suggestions), for example, from the Los Angeles Police Department, and many of them expressing concern over negative treatment of particular techniques. In an interchange of several letters, Wilse Webb argued that we had been too generous to one technique, that sleep learning was not worth a "second look."

The strongest reactions came as expected from proponents of the paranormal and these tended to be in letters addressed to Frank Press, Chairman of the National Research Council. Robert Jahn, former Dean of Princeton's School of Engineering and Applied Science, wrote that a biased committee made factual errors in reviewing his experiments on mental biasing of random number generators. A copy from Jahn to Senator Claiborne Pell was followed by a letter from Pell to Press. The senator was concerned, among other things, about the possible impact of the committee's report on the National Science Foundation, which was said to be reconsidering support of parapsychological research, and he no doubt had in mind his plans to sponsor a bill to create a commission to study parapsychology and other performance-enhancement techniques, a bill co-sponsored by Senators Gore and Kassebaum and now in committee (e.g., *Newsweek*, June 26, 1989, p. 8). Not satisfied by the committee's detailed replies to Jahn's letters, Jahn and Pell carried their case to the undersecretary of the army, who responded that it would be improper for the army to insert itself in this argument and that failing direct resolution with the NRC, resolution could be pursued through scientific forums and journals.

The President of the Parapsychological Association, Inc., Richard S. Broughton, also wrote to chairman Press, emphasizing what he and his associates saw as bias in the selection of the committee and an attempt by the committee's chair to suppress a positive evaluation of a set of parapsychology studies. Upon what it considered an inadequate response from the NRC, the association published a lengthy report as a "Reply to the National Research Council Study on Parapsychology." That reply was reviewed in the *The Chronicle of Higher Education* (Wheeler, 1988) and in *Omni* magazine (Huyghe, 1989). Similarly, R.A. McConnell of the University of Pittsburgh wrote Druckman and Swets and then mailed extensively a set of his materials, including his correspondence with the NRC and an earlier article by him. Colonel John Alexander (Ret.), one of the briefers at the committee's first meeting, challenged the validity of its report in the periodical *New Realities* (Alexander, 1989). We should add that the NRC's executive office consistently supported the committee's conclusions (and, we understand, put off a potential donor as a result).[5]

THE ARMY'S REACTION

Army leadership was initially concerned about the early publicity, primarily the negative treatment by NBC News. Concern was expressed to and within the army by advocates of specific techniques that had received negative evaluations. Field leaders at first showed limited interest, largely through calls by users or opponents of specific techniques. As time went on, the army received favorable comments from several sources about the committee's report and the interest of field leaders increased. One apparently influential event was Druckman's briefing of the army's Human Factors Technical Group in May 1988; another was the favorable mention of the report in the chief of staff's monthly newsletter.

In September 1988, Bjork, Druckman, Johnson, and Swets went to General Thurman's headquarters at Fort Monroe, Virginia, to brief him on the study and to pro-

5. Colonel Alexander, who co-hosted the committee at Cleve Backster's laboratory test of the emotional response of Posner's leukocytes, wrote that the committee denigrated such scientific research by mentioning also the scientifically unsupported ideas of psychic warfare and psychotronic weapons. Meanwhile, R.A. McConnell wrote that the committee's mention of Backster's research was an attempt to taint legitimate research on parapsychology. We noticed that the Parapsychological Association, Inc., did not collaborate with McConnell in its complaint about the committee's report and that Robert Jahn chose to keep his adverse reaction separate from that of the Parapsychological Association, Inc.

discussion of learning during sleep) that seem sensitive to types of learning without awareness ("data-driven processing"), there is renewed interest in subliminal learning (e.g., Jacoby & Whitehouse, in press; Marcel, 1983). While such results suggest a new look at the subliminal-learning issue, a large variety of subliminal tapes designed to alter attitudes, enhance confidence, reduce anxieties, and so forth, have had striking success in the marketplace.

Manipulating mental, emotional, and arousal states

A draft review of the literature on techniques to change mental states, commissioned by ARI and prepared by J. Brener and S.R Connally, was reviewed by Druckman and Posner for implications for task performance. Research developments in various fields, including health psychology, suggest that altered states of consciousness may affect a variety of physiological processes. The converse may be true as well; recent work suggests that mood states may be altered by influences on bloodflow that are a consequence of the differing facial muscular patterns corresponding to various emotional expressions (Zajonc, Murphy, & Inglehart, 1989). ARI, motivated by the problem of detecting deception (Hyman, 1989), has urged the committee to consider also the physical manifestations of mental and emotional states.

Career development

A class of techniques designed to improve performance through increased self-insight is widely used in public and private organizations; included are assessment batteries designed to facilitate leadership, interpersonal influence skills, team building, and decision making. Specific examples are the Myers-Briggs Type Indicator (Myers & McCaulley, 1985), the Managerial Grid (Blake & Mouton, 1964), and the Social Styles Profile (Merrill & Reid, 1981). These techniques have considerable appeal to trainers as well as to the trainees because of high "face validity," but they have been subject to little rigorous research. To help define the questions, the committee commissioned Paul Thayer to write a critical review of the relevant literature.

Part-whole methods to enhance group processes

At its first meeting the continuing committee became convinced that certain issues of group performance deserved study. Should the members of a working group be trained as a team or individually? If team training facilitates initial performance, is that advantage offset by greater disruption when original members of the team need to be replaced by new members? Should the individuals in a group be trained in only their task, or should there be backup training to increase the flexibility of the group? Current research may not supply definitive answers to these and a number of related questions, but the issues are important enough to army functioning to be addressed, if only to clarify the questions and to outline needed research.

CONCLUSION

Although other arrangements might be workable, we found that the National Research Council provides an ideal setting for a study of this sort. The Council was designed expressly for the purpose, first under the sponsorship of the National Academy of Science and now administered as well by the National Academy of Engineering and the Institute of Medicine. The NAS was chartered by Congress in 1863; the NRC was established in 1916. Among the NRC's strengths are that it spans the scientific and professional disciplines; it benefits from the prestige of its governing academies; it provides in competent fashion the services required by committee function; and it follows guidelines to promote thorough and objective reports, including procedures for proposal and report review. Committee members are suggested by broadly based advisers, proposed by a commission's staff and executive director working with the committee's chairperson, nominated by the commission, and appointed by the NRC's chairperson in the interests of competence, relevance, and diversity of viewpoints. They are asked to verify that they have no conflict of interest and they serve without financial compensation.

Members of the committee generally regarded their task as challenging and they demonstrated consistently that it was engaging. They came to the meetings almost without exception, made site visits willingly, submitted draft sections of the report nearly on time, and achieved consensus in an advised, efficient, and congenial way. They feel that their training and experience were adequate to the task and they are pleased to recommend the process to psychologists and scientists in related fields. The continuing committee can reasonably anticipate that it will contribute more by steering the army toward promising new ways to enhance training and performance and less by saving the Army from investing in ineffective techniques. It will likely also serve an advisory role for some specific enhancement projects undertaken in the army.

A long-term, successful impact of the committee's work, in both of its phases, is hardly assured. The power of the human-potential movement in the minds of the citizenry, as evidenced by its marketplace popularity, dwarfs the force of mainstream psychology. New Age techniques are also apparently making substantial inroads on the more than $30 billion a year that the American Society for Training and Development estimates to be spent on formal courses in industry (*Wall Street Jour-*

nal, August 5, 1986). The army, of course, will continue to have serious needs for performance enhancement and will continue to be bombarded by strong, new claims for existing and new techniques. The lack of theoretical and empirical support for many such techniques does not stifle their ability to capture the imagination of consumers.

Still, the Condon Report of 1968 on unidentified flying objects was cited recently (Alexander, 1989) as continuing to depress the government's interest in that subject positive to substitute. The continuing challenge to mainstream psychology will be to translate its findings and concepts into practical enhancement techniques and to package those techniques so it can "give psychology away"—or sell it, for that matter. The committee's efforts, we submit, should be only an installment.

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That research, employing amnesic as well as normal subjects, has illustrated that certain indirect measures of memory (for example, perceptual identification, word-fragment completion, procedural skills) can show large effects of prior episodes when conventional recall and recognition measures fail to show any such effects. Viewed in that context, only certain types of learning should take place during true EEG-verified sleep, and learning should show up on only certain types of memory tests. In general, the past negative results were obtained with inappropriate presentation procedures and with testing procedures that were insensitive to any learning that might take place.

The committee's primary recommendation was that the degree of learning of materials presented during sleep be examined again as a basic-research problem. Rather than looking at intentional recall or recognition of material presented during true sleep, the committee urged the army to look for effects such as lowering of perceptual thresholds for items presented during sleep, semantic or affective biasing in the postsleep interpretation of verbal items as a consequence of their being presented in biased contexts during sleep, repetition effects (enhancing postsleep performance on material studied before the sleep period by repeating the material during the sleep period), and priming effects (facilitating postsleep acquisition of material by presenting that material during the preceding sleep period).

Recent research on state dependencies in human learning (Eich, 1989) also influenced the committee. If learning during sleep is to some extent state-specific, then it might transfer more effectively to the states of drowsiness and semisleep that accompany exhaustion and sleep deprivation than it does to the normal waking state. Since cognitive performance deteriorates under sleep deprivation, such potential transfer of sleep-training might help the subject when he or she needs it most. Finally, the committee thought that learning that depends on sleep disruption might be examined from a cost-benefit standpoint; procedures that disrupt the quantity or quality of sleep might shorten training or have other benefits that could outweigh their costs.

Accelerated Learning

The committee focused primarily on one particular learning package, SALTT (Suggestive accelerative learning and teaching techniques.) Literature in the *Journal of the Society of Accelerative Learning* was reviewed and committee member Schneider attended the society's national meeting in 1986. The commissioned paper by Slavin provided background information on the teacher's contributions to effective instruction and the paper by Harris and Rosenthal considered the potential contribution of the learner's expectations in the SALTT environment (see footnote 2).

The committee concluded that the extravagant claims for accelerated learning programs are unjustified. The effectiveness of such programs did not exceed what might be expected on the basis of the mainstream instructional elements (for example, imagery, cooperative learning, tests as motivational devices and learning events) that are embedded in a non-traditional framework including relaxation exercises and special music. The committee did feel, however, that there was value in the kind of holistic approach to instruction exemplified by such programs. The army was encouraged to use its resources to evaluate competing training procedures in order to isolate the components of instruction that are effective in army settings.

Improving Motor Skills

The committee focused on three strategies to enhance motor skills: mental practice, visual concentration, and biofeedback. A background paper by Feltz, Landers, and Becker on the mental-practice literature was solicited by the committee (see footnote 2), and there were four briefings: one on peak performance issues, and three by experts on or promoters of visual-training techniques. In addition, Landers and Bjork made site visits to the headquarters of SyberVision® and to the Vic Braden Tennis Academy. SyberVision is a highly successful marketer of audio and visual tapes designed to enhance skills such as golf, tennis, skiing, bowling, racquetball, and others. Tapes such as "The Neuropsychology of Achievement" address more global skills. What is shown on the tapes and the instructions to the learner are supposedly guided by a principle of "neuromuscular programming," which is in turn derived from Karl Pribram's holographic theory of brain function. The subcommittee interviewed Pribram, director of research for SyberVision, and Stephen DeVore, founder and president.

With respect to mental practice, defined as "the symbolic rehearsal of a physical activity in the absence of any gross muscular movements" (Richardson, 1967, p. 95), the committee's recommendations were quite positive. A meta-analysis of the relevant research literature revealed that mental practice yields a gain in performance on the order of half a standard deviation when compared to appropriate controls. The gain is somewhat greater for motor tasks that incorporate a substantial cognitive component, and the advantages of mental practice can be enhanced if physical practice and mental practice are interspersed. The committee recommended that the army evaluate mental practice as a training component in operational military tasks, and that the army pursue basic research to determine what mixture of mental and phys-

ical practice might be optimal (given considerations of expense, equipment availability, and so forth).[4]

Concerning visual-training programs, the committee concluded that there was no research base to suggest that such training leads to improved performance. There is evidence that certain visual abilities can be improved by training the eye muscles, but evidence that attentional skills can be enhanced by visual training is lacking.

The committee concluded that there remain too many loose ends for the relationship between biofeedback and skilled performance to be determined. Part of the problem is that biofeedback is often used as part of broader therapeutic programs that incorporate other, possibly effective, techniques. Another problem is that biofeedback is used to train physiological parameters (heart rate, for example) although clear knowledge of the most desirable levels of these parameters with respect to a given skill typically does not exist. In cases where that relationship is known (e.g., hand warmth and finger dexterity), there is evidence of performance benefit.

Altering Mental States

The idea that people can achieve an internal state that will be optimal for a broad range of performance has been appealing. Some level of arousal is optimal for performance of a given complexity (Duffy, 1962; Yerkes & Dodson, 1908) and, specifically, the optimal level decreases as task complexity increases (Easterbrook, 1959). This concept fits the behavior theories of the 1950s, which specified that a source of energy or drive is required to keep the organism active and was reinforced by the physiological discovery of a diffuse activating system in the brain (Moruzzi & Magoun, 1949). However, with new knowledge of the variety and specificity of neurotransmitter systems (Robbins & Everitt, 1982) and with psychological theory focused on cognition, we have begun to think of a large number of cortical computations in widely distributed neural systems (Rumelhart & McClelland, 1986). The view that cortical computations are modulated by different transmitter systems in varying ways makes it more difficult to suppose that any training technique will provide optimal states for all forms of physical and mental activity. An example comes from the finding that the optimal conditions of alertness for rapid responding differ from those for the best memory performance (Posner, 1975).

Unfortunately, the committee did not find time to explore the evidence for the wide variety of specific training or induction methods that might provide a basis for techniques for manipulating internal states. It recommended a literature review of links between such techniques and changes in performance and, in its next phase, will examine further the techniques of intensive meditation and self-hypnosis.

The committee considered issues of brain asymmetry in detail. It reviewed Hemi-Sync, in part through a visit by Springer, Thompson, Druckman, and Lawrence to the Monroe Institute in Virginia where it was developed. Although this technique is said to be valuable in therapeutic settings (pain control in cancer patients, alcohol abuse, retardation, autism, and seizure disorders) and though formal research designs have been approximated for its application in a few educational settings (courses in basic broadcasting, ear training, and introductory psychology), the committee concluded that current attempts to alter performance through coordinating the two hemispheres by an external or instructional device do not appear to be effective. It observed, more generally, that the scientific evaluation of claims for enhancing performance by involving the hemispheres differentially awaits the development of reliable measures of hemispheric activity in individuals.

Stress Management

The clear thrust of the evidence from various types of research on stress, from animal studies as well as human studies, is that an individual's uncertainty about impending events and sense of control over them are the main factors in perceived stress. This conclusion is supported by the extensive review paper on stress and performance prepared for the committee by Seymour Levine (see footnote 2). A case in point is the study of hormonal and behavioral responses of Norwegian paratroop trainees as they made repeated jumps from a tower on a guide wire (Ursin, Baade, & Levine, 1978). Initially high elevations of cortisone in the blood were reduced to basal levels after the second jump and fear ratings changed similarly.

The implications of this research evidence for the army are complex. There surely are practical limitations on how much knowledge and understanding of the future can be disseminated during combat and on how much individual or group control can be permitted or demonstrated. Moreover, though the committee focused primarily on stress reduction, the army must also induce stress during training to prepare soldiers for real combat. A study by Novaco, Cook, and Sarason (1983) showed that providing marine recruits with more realistic information about what lies in store for them, and about the skills necessary for coping with the rigors of boot camp, led them to exhibit higher expectations of personal control and efficacy.

4. Following on that recommendation, an experiment is underway at the Redstone Arsenal in Alabama to evaluate mental practice as a component in the training of complex soldering of electronic circuits. Landers guided the design of conditions that will permit a comparison of mental-practice, placebo, and standard training groups.

The committee reviewed individual and intrapsychic approaches to stress reduction, including arousal reduction (relaxation training and biofeedback), cognitive restructuring and problem solving, and behavioral skills training. Regarding biofeedback, on which a conclusion was specifically requested of the committee, it was found that although biofeedback can achieve a reduction of muscle tension, it does not reduce stress effectively.

Committee members' appreciation of military stress was enhanced by a visit to Fort Benning, Georgia, where they viewed paratroop training (and arranged, and then mercifully aborted, an opportunity for David Goslin to make a jump). They saw Bradley vehicles maneuvering under fire and then rode in one. They also heard a presentation and viewed a videotape on the extraordinarily demanding and stressful procedures of Ranger training, which centers on several weeks of long daily marches over difficult and hazardous terrains under severe environmental conditions.

Influence Strategies

The committee's treatment of strategies of social influence centered on neurolinguistic programming (NLP). NLP's wide use in the army was described by army representative Robert Klaus in two briefings; a background paper by Pruitt, Crocker, and Hanes was recruited by the committee (footnote 2); and Singer, Davison, Mobley, and Druckmann attended a workshop on NLP techniques and interviewed Richard Bandler, one of the developers of NLP. The conclusion was that little if any evidence exists either to support NLP's assumptions or to indicate that it is effective as a strategy for social influence.

NLP has also been used as a means to model expert performance and the committee's visit to Fort Benning included a review of a test of this aspect of NLP as applied to marksmanship. Though the committee could find only one evaluation of NLP as a model of expert performance, and found that one wanting, it did conclude that the investigation of expert models constitutes a worthwhile activity for the army, and the continuing committee plans to pursue that topic.

Group Cohesion

The army is quite committed to developing group cohesion. Its current COHORT system of keeping units intact is motivated by the desire to enhance group performance by increasing group cohesion. The chair of the committee's resource advisory group, Lieutenant General Robert M. Elton, and the commander of the Army Research Institute, Colonel William Darryl Henderson, have written in support of it (Elton, 1984; Henderson, 1985). A technical report from the Walter Reed Army Institute for Research points out that civilian scholars as well as senior military officers accept that cohesion inhibits breakdown, without regard to the research community's ability to demonstrate relationships ("The New Manning System Field Evaluation," 1986, No. 3, p. 9). Peters and Waterman's *In Search of Excellence* (1982) may represent civilian scholars in this regard, and indeed, the research community has been supportive to a degree (e.g., Campbell, 1975; Katz & Kahn, 1966).

The committee, however, believed that the arguments in favor ought to be treated as hypotheses rather than conclusions, citing difficulties in separating consequences and indicators of cohesion, the gap between improved cohesion and better unit performance, the tendency to rely on single-factor explanations of group performance, and the possibility of reciprocal effects between cohesion and performance. The current evidence makes it necessary for organizations seeking to benefit from cohesion to proceed largely on faith; the committee referred to some possible negative consequences of cohesion as reviewed by Porter, Lawler, and Hackman (1975): ineffective handling of deviance, "group think," increased impact of any existing negative norms, and increased intergroup conflict. The committee also discussed issues of implementation that it saw as having received little attention. A background paper by Tamir and Kunda (footnote 2) developed implications from the cultural perspective advanced by Schein (1985).

Parapsychology

The subcommittee on parapsychology made its principal site visits to the laboratories of Robert Jahn at Princeton University and Helmut Schmidt in San Antonio to discuss experiments on the psychokinetic control of random event generators. Experiments on remote viewing were also discussed at Princeton. Hyman and Humphreys were joined on both visits by Dr. Paul Horwitz, a consultant to the committee and a physicist at Bolt Beranek and Newman Inc., who had organized a 1979 symposium on "Physics and Parapsychology" for the American Physical Society that included as speakers Helmut Schmidt and Ray Hyman. Also visiting Professor Jahn were Druckman, Lawrence, and Paul Holland, then a member of the committee. Hyman visited Edward May at the Stanford Research Institute to discuss experiments on random event generators and remote viewing. Hyman and Horwitz were briefed by representatives of the U.S. Army Laboratory Command on parapsychology and military intelligence; Druckman and Swets were briefed on Soviet parapsychology by representatives of the Army Foreign Science and Technology Center and the Defense Intelligence Agency. In connection with a meeting held in San Diego, the entire committee, kindly accompanied by local psychology professors George Mandler and William McGill, visited the laboratory of Cleve Backster who sug-

gests that the electrical activity of a preparation of leukocytes taken from the mouth of a human subject responds to the emotional states of the subject, at a later time and in a different place. For this visit, the promise to the committee, not fulfilled, was an observable demonstration of anomalous events.

Visitors to Professor Jahn's laboratory were shown how subjects sit in front of one of three kinds of random event generators and attempt to affect the behavior of the device in one of three ways: In the PK + mode, the subject tries to get a higher than chance level of hits; in PK − mode, a lower than chance level; and in baseline mode, a number of hits equal to the chance level. Under volitional conditions, the subject is free to select among the three modes; under instructed conditions, he or she is not. Horwitz observed that the investigators reported no differences in results occasioned by a transition from a true random event generator (an analogue electronic device or a mechanical device) to a pseudorandom event generator (a digital, programmed device) that is actually deterministic and nonrandom. They believed that their subjects could will changes in a voltage or voltage threshold of a noise source or changes in the trajectories of small balls falling down a chute with multiple obstacles and, equally well, changes in certain bits (from zeros to ones or vice versa) of predetermined and otherwise completely reproducible sequences as generated by an array of shift registers.

At his Mind Science Foundation in San Antonio, Dr. Schmidt described an experiment designed to permit a skeptical group of scientists to apply adequate controls to a psychokinesis experiment without destroying the psychological environment for a subject that is said by psi researchers to be critical for obtaining positive results. Both groups use a piece of data not yet available (e.g., specified weather data from the *New York Times* at some agreed upon future date) as a pointer into a given table of random numbers, which will generate "seed numbers" to a pseudorandom number generator and hence produce a predetermined sequence of ones and zeros. Both groups follow a set procedure to assign PK + and PK − modes to the seed numbers and thereby instructions for the subject. An agreement made during the site visit to conduct a joint experiment with Dr. Horwitz as participant, which would be monitored by the committee, was not followed up by Dr. Schmidt.

The committee benefited from a review of the literature on remote viewing and random event generators pre-

to right: Davison, Bjork, Posner, Hyman, Schneider, Swets, Landers, Mobley, Porter, Druckman, Humphreys, Thompson, Springer, and Singer.