DOCUMENT RESUME

ED 255 549 TM 850 181

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TITLE Developing Intuition: The Key to Creative Futures Research.
PUB DATE Apr 84
NOTE 105p. Paper presented at the Annual Meeting of the Amer: : Educational Research Association (68th, New Orlea.., LA, April 23-27, 198).
PUB TYPE Speeches/Conference Papers (150) -- Viewpoints (120)

EDRS PRICE MF01/PC05 Plus Postage.
DESCRIPTORS Cerebral Dominance; Cognitive Processes; *Creative Thinking; Creativity; *Experimenter Characteristics; *Futures (of Society); *Intuition; Models; Problem Solving; Researchers; *Research Methodology; Research Needs

ABSTRACT

Futures research involves speculation about alternative developments based upon existing data and potential choices. Effective futures research requires creativity in scientific practice rather than an overemphasis on reason. In discussing the important role of intuition in futures research, characteristics of creative scientists are reviewed and two models for creative processes are presented (Mansfield and Busse, 1981, and Wallas, 1926). The stages in Wallas' model are discussed in terms of critical cognitive processes and relationships between creativity and hemispheric dominance in information processing. A generic framework for problem-solving is also detailed (D'Zurilla and Goldfried, 1971). Integrating contributions from these approaches, techniques for developing intuition, and enhancing creativity are presented for each stage of the futures research process: (1) general orientation; (2) problem selection; (3) problem definition and formulation; (4) preparation and effort; (5) incubation and generation of hypotheses; (6) illumination; (7) decision-making; and (8) verification. Both active problem-exploration and passive self-exploration approaches to overcoming habitual reasoning methods are presented. Journal writing, attaining personal/professional synergy, applying general systems theory, relaxing or mediating, using art, analogizing, self-centering, and brainstorming, are some of the many techniques discussed to develop intuition and enhance creativity. In the final analysis the rational, systematic procedures of conventional science and the intuitive, "discontinuous," contributions of highly creative researchers complement each other. (BS)

Developing Intuition:

The Key to Creative Futures Research

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Paper presented at the Annual Meeting of

the American Educational Research Association,

April 23-27, 1984, New Orleans, Louisiana

Abstract

The paper describes the role of intuition in futures research, a field that is frequently limited by an overemphasis upon reason and an excessive dependence upon conventional methods of inquiry. There is a tendency among futures researchers to recreate the past in the present and future by avoiding critical existential questions and relying instead upon personal biases and social ideologies, consistent with the prevalent paradigm of the scientific community of which the researcher is a part. Effective futures research requires creativity in scientific practice, which is cultivated by the development of intuition.

We propose guidelines for creative futures research by integrating contributions from a number of extant models for creativity and problem solving. Techniques for developing intuition and enhancing creativity are presented for each stage of the futures research process: (1) general orientation, (2) problem selection, (3) problem definition and formulation, (4) preparation and effort, (5) incubation and generation of hypotheses, (6) illumination, (7) decision-making, and (8) verification. Special attention is paid to common characteristics of creative scientists, frustration as a core component of innovation, and useful irrational methods for practicing "personal science."

Introduction

Our thesis is simple: Effective futures research requires creativity in scientific practice, which is cultivated by the development of intuition. The sentiment of the paper is captured in two quotations from The Courage to Create by Rollo May (1975).

> What if imagination and art are not frosting at all, but the fountainhead of human experience? What if our logic and science derive from art forms and are fundamentally dependent on them rather than art being merely a decoration for our work when science and logic have produced it? (p. 124)

> Not only does reason form and re-form the world, but the "preconscious" with its impulses and needs, does so also and does so on the basis of wish and intentionality. Human beings not only think but feel and will as they make form in their world. (p. 133)

In discussing the role of intuition in futures research, we present several models of the creative process. In particular, we argue that research about the future is constrained by an overemphasis upon reason. Promises and pitfalls in futures research are considered, with special attention devoted to the perspectives and ideologies of investigators. Research is reconceptualized as existential choice, leading to the recognition that creative investigators can balance reason and intuition, certainty and doubt, and insight and convention, in a quest for truth that can be called "personal science."

Characteristics of creative scientists are reviewed at length, although we focus upon the common experience of frustration as a core component in innovation. Identification of common characteristics and experiences leads a systematic presentation of processes enlisted by creative researchers. Ways of cultivating creativity are considered as well.

A model for creative processes (Mansfield & Busse, 1981) includes several steps: problem selection, effort, constraints setting, transformation, and verification. The steps are similar to the stages of creative thought, identified and discussed in a classic text (Wallas, 1926). The treatment of the two models includes review of research and theory, as well as examination of some anecdotes related to stages in creative thinking. The stages in Wallas' model (preparation, incubation, illumination, and verification) are discussed in terms of critical cognitive processes and relationships between creativity and hemispheric dominance in information processing.

Coordination of left-brain and right-brain contributions to creativity is facilitated by effective organization of problem-solving. We describe in detail the operations of a generic framework for problem-solving (D'Zurilla & Goldfried, 1971). The framework includes the following components: general orientation, problem definition and formulation, generation of alternatives, decision-making, and verification. Although there is some overlap between the framework for problem-solving and the models for creativity, D'Zurilla and Goldfried (1971) contribute substantially to an understanding of science as a flexible, yet systematic process of inquiry.

Finally, we propose guidelines for creative futures research by integrating contributions from the three aforementioned approaches and creating an omnibus framework. Techniques for developing intuition and enhancing creativity are presented for each stage of the futures research process: (1) general orientation, (2) problem selection, (3) problem definition and formulation, (4) preparation and effort, (5) incubation and generation of hypotheses, (6) illimination, (7) decision-making, and (8) verification. The framework and presentation of techniques is organized according to anticipated preferences of creative futures researchers. We believe that one group of investigators prefers active, intentional techniques for problem-exploration, while another group favors passive, receptive approaches to innovation via self-exploration. The aim of devices used for either problem-exploration or self-exploration is to overcome the human propensity to reason in habitual ways so that intuitive resources can be brought to bear on complex futures research problems. The techniques that are discussed include journal writing, attaining personal/professional synergy, applying general systems theory, speaking with "witnesses from the future," discovering traces from the past, devising leading questions, studying Zen koans, relaxing or meditating, using art to stimulate creativity, practicing imagery and daydream methods, participating in exercise, brainstorming, thinking aloud, analogizing, recording the results of illumination, self-centering, and testing hypotheses by building scenarios.

In the final analysis, we find that the rational, systematic procedures of conventional science and the intuitive, "discontinuous" contributions of highly creative researchers complement each other. Knowledge about the future would not advance if research were left to the methods of the past. On the other hand, discoveries must be interpreted within the contexts provided by both science and community needs. Futures research is a field that hold tremendous promise for the betterment of humanity. "We are living at a time when one age is dying and the new age is not yet born" (May, 1975, p. 11). We believe that development of intuition and creativity will enable futures research to fulfill its promise in our age of vulnerability.

Promises and Pitfalls in Futures Research

Futures research is a field of inquiry involving speculation about alternative developments based upon existing data and potential choices. The future does not simply depend upon extrapolations of historical data. We do not need to know "how far we have come" in order to know "where we are going." Information about the past provides guidance in the sense that trends reveal the shape, or pattern, of change over time. The past, and then the present, provide contexts for change in the future. The form of the future will be filled by present decisions and ongoing directions, which have multiple determinants, including the values and preferences of researchers who turn their attention to the future. The pattern of change affects the perspective of the futures researcher, who affects the form of the future.

Forms of Change in Futures Research

At least three forms of change have been embraced as models by historical prophets and contemporary "futurists," depending upon their perceptions of determinism and human agency (McHale, 1978; O'Toole, 1983). One model holds that change is recurrent or cyclical since predestined sequences afford little opportunity for human decision and control. The cyclical change perspective has influenced most societies, particularly the mystical traditions of the East. While this model is not dominant in the Western world, the perspective has received much recent attention in Taoist explanations of modern physics (see Capra, 1975), systems theories and cybernetics in psychology (Bateson, 1979; Dell, 1982; Schwartz, 1982), and contemporary approaches to mysticism (Deikman, 1983; Woods, 1980). The cyclical or recurrent change model essentially rejects the view that human agents are able to produce linear, causal effects in a predictable manner. The model favors descriptions and explanations that fit existing configurations of multiple (often natural) influences. The cyclical-recurrent approach to change has some merit for futures research--especially, for inquiry guided more by intuition than by rational, scientific approaches--but it does not assume a major position in an America preoccupied with growth and improvement of life through technological advancement.

A second form of change, which has dominated the perspectives of most Western decision-makers, is the continuity change model (McHale, 1978; Miles, 1978; O'Toole, 1983). The roots of this viewpoint extend to the prophetic traditions in the early Greek states and the Middle Eastern religions. The future was assumed to unfold in a linear, deterministic, often cumulative, and sometimes knowable fashion. The continuity model emphasized the influence of history and tradition, but placed some weight on the capacity of inspired human action to contribute to social improvement. Miles (1978) argued that much contemporary futures research relies upon forecasting that is based upon extrapolation of trends and historical regularities. In this manner, the future is viewed as less an outcome of human initiative and more a result of re-creating, or perpetuating, the past. "Historicism" and related ideologies seem to be related to the continuity change approach. Within this model, breaks in historical evolution and unexpected or abrupt changes are treated as "catastrophes," revealing the implicit values in a perspective that favors smooth, continuous transitions.

The third form of change can be called the discontinuity change model. Within the model, change is viewed as primarily affected by critical events, which can be known or even created. One variant of this approach explains breaks in the smooth continuity of evolution as results of individual or collective purposive action (McHale, 1978). Another variant asserts that change is favored when trends (social, economic, political, or ecological) converge, heralding the emergence of a new perspective. The notion of paradigm shift in science (Kuhn, 1970) is consistent with the discontinuity change viewpoint. This model has been particularly relevant in explaining change in America, from the Great Depression to the rise of the counterculture in the 1960s (Meadows & Meadows, 1972; O'Toole, 1983). Discontinuity can be subsumed under the cyclical-recurrent model in order to account for a broader range of historical events and possible futures. The discontinuity model is robust in terms of explaining abrupt changes; tolerating conflicting trends and recurrent ambivalence; and understanding the dialectic forces of certainty and ambiguity in the process of speculation.

Each model presents promises and pitfalls to the researcher who would attempt to predict or create the future. While the models seem to develop and florish in specific places and times (see McHale, 1978), each approach not only represents the influence of world events, but also the biases of the reviewer of those events. Change results from the interaction of environmental events and the perceptions of decision-makers.

Perspectives of Futures Researchers

The futures researcher is faced with the tasks of describing, exploring, and prescribing what reality will become for both the researcher and his or her society (McHale, 1978). The descriptive approach to futures research is clearly speculative, offering the opportunity to imagine and create. Utopian and idealistic futurists such as H.G. Wells and Buckminster Fuller have described the future in terms of individual visions. Usually, it is apparent that descriptive and conjectural research is the product of a visionary's perspective and value system. However, it is often unclear whose interests and values are invested in exploratory research, since the forecasting and deterministic approaches that characterize exploration are treated as objective and scientific. The simulations, forecasts, and scenarios constructed to explore the future nearly always employ computer technology, quantitative research designs, and statistical methods, which are generally held to be precise and value-free. Yet, the entire process of exploratory futures research is fundamentally subjective from the selection of a problem for study to the application of technologies and the analysis of data.

The task of the prescriptive futures researcher is also subjective, although the basic nature of prescription is to foster normatively oriented projections of the future for some special interest group. Prescriptive research addresses the "willed future," an explicit valuing process consistent with the most instigative application of the discontinuity change model. Frequently, the prescriptive and descriptive futures researchers desire recognition of their special interests or unique perspectives. However, the perspective and intent of the exploratory researcher can be lost in the methods of science, while the consumers of the research assume that interpretations of empirical data are objective and neutral with respect to values.

Most researchers are aware of the inherent subjectivity in their research and theory-building efforts, and therefore, they systematically apply the technologies of science to control for experimenter biases and errors. However, the commitment invested in the selection of a research design and the attachment of the researcher to one or more cherished theories may lead to unintentional distortions. The well-meaning futures researcher, using the best technologies available, may still encounter a "confirmatory bias" in which data are likely to be interpreted as evidence that one's theory or hypothesis is true (Mahoney, 1976; Meehl, 1967). Futures research, being inherently more subjective than other fields, must acknowledge that science serves the researcher and that clinging to the myth of objectivity is an act of "methodolatry," in which the tools of science becomes idols.

> Starting with the premise that data are not, as the Latin origin suggests given but, instead, gotten, we face the urgent necessity of breaking with the tradition that has annointed facts and figures with a kind of sacrosanctity and, rather of taking the part of the Pirandello character who said, "A fact is like a sack' it won't stand up till you've put something in it" (Hoos, 1978, p. 61).

"Facts" are used in futures research under the guise of exploration to guide public policy and professional action. "Facts" have been used by some researchers to demonstrate that fossil fuels are being depleted at dangerous rates and to prove that the United States alone has ample reserves of fuels for centuries to come (Hoos, 1978). In either case, the speculative nature of the data should have been made clear. The researcher should be willing to assume responsibility for any prescriptive implications of the results. Given the likelihood that futures research will be closely scrutinized--and could serve a variety of special interests --the researchers should be sensitive to pitfalls and acknowledge his or her perspective.

Just as values can be lost or distorted within a prematurely objective, exploratory approach to a futures question, so can the creative potentials of the futures researcher be undermined by employing narrow, quantitative methods exclusively. The overemphasis on forecasting and linear, deterministic applications of the continuity change model has lead not only to repetition of perspectives and values from the past, but also to exclusion of desirable, alternative futures. The prevailing social values in contemporary America promote certain ideologies among futures researchers and stifle creativity. The dominant ideologies include "historicism," assumptions of inevitable progression over time according to past trends; "scientism," assumptions of superiority of positivist models and meta-advocacy of preferences by invoking the persuasive power of research; and "technological determinism," assumptions of technological imperatives to fix problems because "what can be developed must be developed" (Hoos, 1978).

The dominant ideologies of futurists favor the emergence of an elite group of researchers who could ultimately control information and planning. The ideologies do not favor insights, which could be conceived by researchers who are not bound by "technological rationalism" (Hoos, 1978). A major question arises when one acknowledges the existence of dominant ideologies in future research: Why do researchers seem to recreate the past, ignore novel alternatives and, instead, support the status quo? The answer may be found in a tacit dimension of futures research: the results of futures studies also provide support for the researcher who is seeking continuity and certainty. Decision-making in the futures research enterprise may represent a series of existential choices that maintain reality for socie and meaning for the researcher.

Futures Research as Existential Choice

Fut from the Delphic Oracle to the Delphi method, has always enjoyed erable public support. Looking to the future is an age-old preoccupation of humankind, which distinguishes us as a species and confronts us with our uniqueness.

> The idea of the future is one of the central symbols through which human beings have ordered their present and have given meaning to their past. While futures research in the academic sense is a recent pursuit, conjecture, speculation, and exploration of future events have always been prime features of the human condition. Human survival itself is very largely predicated on the conscious capacity to organizae present activities in terms of past experience and future goals (McHale, 1978, p. 5).

The prevalent contemporary view of the future is that alternative developments are possible through human choice and advancement in technology. We tend to recreate the past because we look to history and to current trends in order to identify alternatives and validate our choices. However, novel breakthroughs require inventors to remove themselves from the conventions of existing perspectives and to experience loss of certainty and support from peers and society (Axelrod, 1979).

According to Rollo May (1979), breakthroughs require tremendous courage to create and commitment to find truth. Creating the future involves the destruction of conviction and abandonment of facts in favor of doubt and imagination. The creative individual confronts anxiety associated with the possibility that one's cherished views, including the person's known relationships in the world, are false. The creator also experiences guilt through realization that insight or discovery may destroy what countless others believe is essential to survival in the material, intellectual, or spiritual worlds. On the other hand, we are driven to the creative encounter because the human being creates self and experiences dignity through choices.

"Truth comes into being out of non-being, into the present out of the practical future" (Sartre, 1979, p. 231). Yet, in the process of creativity "...the questioner is called into question in his very being by the questioned" (Sartre, 1979, p. 152). The courage to speculate openly about the future must overcome the doubts and anxieties which are bound to be associated with this conceptual flexibility. Such courage arises out of commitment to truth-seeking and the discovery process, which has been associated historically with the best efforts in scientific inquiry. Unfortunately, the readiness to envision and imagine the future is often subverted to "learning" the conventions that are already known, to finding the facts that are most consistent with the favored consensus on reality. The worst of science is manifested in the common practice of rejecting unfavorable results of pointing to sampling and methodological problems while citing as evidence data from other "poor" studies that support the position that is advocated (see DiLoreto, 1971).

Another pitfall to creative futures research is the possibility that a genuine breakthrough will become the convention of tomorrow. In this instance, an intellectual innovation becomes dogma for followers who are drawn to the truth and the creator becomes constrained by the idea that was discovered. Sigmund Freud is often cited as a prototypical creator in the science of human behavior. Yet, in spite of the genius of his contributions to our understanding of psychology, his zealous advocacy of psychosexual theory has been interpreted as an example of how strong is the human need for certainty. Becker (1973), an existential psychoanalyst, indicated that Freud created and continued to confirm his theory in order to perceive control of his life and, in so doing, to overcome his fear of death. Freud's advocacy represented a break from scientific inquiry and provided a context of convention against which his students rebelled in order to make their own creative contributions.

> I can still recall vividly how Freud said to me, "My dear Jung, promise me never to abandon the sexual theory. That is the most essential thing of all. You see we must make a dogma of it, an unshakable bulwark."....There was no mistaking the fact that Freud was emotionally involved in his sexual theory to an extraordinary degree. When he spoke of it his tone became urgent, almost anxious....A strange deeply moved expression came over his face....To me the sexual theory was just as occult, that is to say, just as unproven an hypothesis, as many other speculative views. As I saw it, a scientific truth was a hypothesis which might be adequate for the moment but not to be preserved as an article of faith for all time. (Jung, 1965, pp. 149-151)

In the ideal world, theory provides a framework for organizing present observations and a context for changing one's beliefs in the future. Without the check and balance of flexibility and doubt, however, the human quest for meaning is subverted in increasing certainty. Creativity is replaced with dogma. The dialectical process of moving between certainty and doubt is stifled. As a result, there is no creative synthesis of the two, which emerges only in the passion for discovery and the commitment to truth (Arieti, 1976; May, 1975).

The willingness to expose one's central beliefs to possible refutation in scientific inquiry is a heroic act (Becker, 1973), requiring choice and intentionality (Ivey, 1969; May, 1969).

> The main difference between him (the scientist) and the layman is that he has enlisted in this search for truth deliberately, willingly, and consciously and that he then proceeds to learn as much as he can

> about the techniques and ethics of truth-seeking. Indeed, science in general can be considered a technique with which fallible men try to outwit their own human propensities to fear the truth, to avoid it, and to distort it. (Maslow, 1966, p. 29)

Science serves the creative individual by providing rational methods for seeking truth and overcoming personal biases and dogmas associated with the times. The creative individual serves the scientific community by extending the boundaries of known truth and improving methods of inquiry. The scientific tools are essentially rational; they have the potential to be relatively objective and precise in their ideal applications, description and exploration. The inventor, or creator, is essentially subjective and invested in certain perspectives and values. The creative scientist must actually behave somewhat irrationally in order to break through the "facts" and conventions that the rational methods and techniques favor.

The existential approach to futures research suggests that truth in the future may be best known by 1) applying the methods of scientific inquiry in order to circumvent some personal biases and distortions that would arise through exclusive reliance upon subjectivity and introspection; (2) recognizing that preoccupation with methods and techniques amounts to "scientism" (not science) and "methodolatry," both of which present serious obstacles to truth-seeking and discovery; (3) recognizing that preoccupation with the results of scientific innovation can lead to conventional thinking and dogma; and (4) applying the methods of self-exploration and self-discovery in order to create intellectual breakthroughs and hypotheses, which can then be subjected to the process of scientific review. According to this view, the process of futures research is both objective and subjective, historical and idealistic.

Futures research begins with the individual creative scientist. The abilities to describe, explore, and prescribe the future are based in a commitment to unbiased truth-seeking and a faith in both oneself and the methods of inquiry. The process of creative futures research is rational and objective, on the one hand, and irrational and subjective, on the other. Intellectual breakthroughs depend upon awareness of context for change, conceptual flexibility, skills in using the methods of inquiry, creative courage in risking anxiety and guilt, and emergence of insight. Much of futures research recreates or confirms the past because it lacks insight. The existential position reveals that the creative futures researcher will begin the process of inquiry by self-exploration. Insights emerge from the most subjective, irrational processes of self-discovery.

In the Apologia (see Rouse, 1956), Socrates reported that he was the wisest man in the world since his friend, Chaerephon, had received his revelation at Delphi from Apollo. The sage interpreted the revelation to mean that he was wisest because he was aware of the limitations imposed by his ignorance. Socrates knew that he was indeed wiser than the people who "knew all" and missed the most important thing, humility. The god counseled Socrates to "Know thyself." This was the fount from which the innovator of Western philosophy drew his creative ideas, but, he also traveled in the marketplace, gathering data from others, as he pursued and modeled, episteme, true knowledge.

Some of the characteristics of creative scientists are clear. They enjoy relative certainty, but they admit of doubt. They seem to possess self-knowledge and autonomy, yet, they are aware of their limitations. They seem to have the ability to actualize their potentials, then transcend the self in the quest for meaning and truth (Maslow, 1971; May, 1975). Futures research is an excellent field of inquiry for exploring the self and the world. By examining the future, the researcher addresses individual existential needs, while contributing to the maintenance, and ideally, the improvement of society.

Since the promises of futures research are realized through self-knowledge, and the pitfalls are encountered in preoccupation with methods and results, the process of creative exploration may be understood by considering the personal qualities of innovators. It is assumed that there is sufficient similarity in the existential paths of creative scientists to warrant examination of shared characteristics.

Characteristics of Creative Scientists

In order to review the qualities and characteristics of creative scientists, which should be possessed by insightful futures researchers, the term, "creativity," should be defined. "Creativity" implies work, or a product of work, that is found to be high in originality and value by an appropriate peer group. In futures research, other scientists in the field would determine the standards for originality and value because work widely accepted as creative in everyday life could be viewed as conventional or outmoded by experts in a field. In addition, the highest levels of creativity are suggested by work that involves transformation, combining elements in a manner that defies tradition and yields a new perspective, and condensation, combining elements so that creations have intensity and concentration of meaning, requiring repeated examination for full appreciation (Jackson & Messick, 1967). Mansfield and Busse (1981) described scientists whose work demonstrated creativity at the professional level as "auctors," a Latin word for builder or inventor. In addition to possessing above average intelligence and intensive training in a field related to the discovery, auctors were found to have certain qualities and characteristics (Mansfield & Busse, 1981).

Most auctors (e.g., Chambers, 1969; Roe, 1953) who have discussed highly creative adult professionals, including auctorive scientists, have identified autonomy as a key personality variable in creativity. Auctors tend to reject authority, place highest value upon independent questioning, and strive for independence in career. Yet, they are not negatively independent or dogmatic. Auctors possess the complementary characteristics of personal flexibility and openness to experience. They are free to experiment and try new methods because they have tolerance for ambiguity and complexity, and they are unconcerned with maintaining order and close adherence to routines.

Auctors also experience the need to be original and novel (Arieti, 1976; Mansfield & Busse, 1981). Highly creative individuals cultivate originality by viewing themselves as creative and setting high personal standards for originality and excellence. They are willing to forego job security and other employment benefits in order to pursue research of personal interest. Under these conditions, the auctors are willing to work hard and to persist even though the path is difficult. Therefore, they tend to be more productive than less creative peers in such arenas as patents, inventions, publications, and professional presentations. However, this high commitment to task and self-directed motivation has the negative side effect of the auctor's subordination of nearly everything else in life, including finances, family life, interpersonal relations, and leisure activities. Since many creative breakthroughs actually occur during leisure (see Poincaré, 1952; Wallas, 1926), neglect of recreation, relaxation, and hobbies may eventually result in stagnation, professional "burnout," and blocks to creativity.

Another characteristic of the most highly creative scientists, which probably mitigates against stagnation and habitual "sameness" in perception, is aesthetic sensitivity (Mansfield & Busse, 1981). Auctors seek solutions to problems that are elegant, embodying truth and beauty. Their work often attains the highest standards for creativity, transformation and condensation (Jackson & Messick, 1967); thus, requiring considerable scrutiny from professional peers in order to be understood fully. Aesthetic sensitivty is expressed as a preference for complexity and bringing order, or meaning, to chaotic, frequently disparate, elements (May, 1975). Therefore, this characteristic is probably related to discovering subtle patterns and relationships in data that would appear unrelated or irrelevant to the less creative eye. Auctors are able to hasten the process of discovery because of their ability to discern linkages among existing environmental determinants that would take years for less creative scientists to identify (Merton, 1973). In addition, the "art" of creative science seems to be related to the auctor's ability to bring personal talents to bear upon chance events.

According to Austin (1978), four types of chance influence creative accomplishment. The first type of chance, "blind luck," does not depend upon personal characteristics of the recipient of insight. This type of discovery is represented by such constructs as revelation, fate, and accident. The second type of chance is related to the curiosity of the scientist and his or her general exploratory behavior. "Good luck" occurs when the energetic activities of the creative scientist increase the likelihood that the random ideas in fresh combinations will yield novel products. Characteristics related to the second type include need to be original, commitment to work, personal flexibility, and openness to experience (Mansfield & Busse, 1981). The third type of chance favors the scientist whose preparation and keen observation enables discovery of faint clues. This type depends both upon the scientist's training, or experience, and sensitivity to discerning patterns of relatedness. The fourth type of chance stems from highly individualized activities that lead to fortuitous discoveries. Such activities as distinctive hobbies and lifestyles favor creative independent expression. The final type seems to interact best with the autonomous individual's idiosyncracies. Creative work arising from the fourth type of chance is related to childhood upbringing.

Autonomous scientists are likely to develop in homes characterized more by intellectual stimulation than by emotional closeness among family members (Mansfield & Busse, 1981). Such scientists tend to develop independence because they are not constrained by the well-developed belief systems of parents, friends, or institutions. The third type of chance discovery is probably cultivated later in the creative scientist's life. Auctors whose preparation and perception facilitate identification of faint clues, which intimate new discoveries, may benefit from close, long-term, one-to-one relationships with mentors from the same field of inquiry. Frequently, this group of creative scientists complete "apprenticeships" with masters in the field during graduate training (Chambers, 1973; Wallach, 1976). The sensitivity to clues, developed over the course of intensive training and apprenticeship, may represent a more innate talent for a subset of "artistic" scientists, who enjoy an ability to transform and condense ideas due to high flexibility and openness to experience. According to the career development theories of Roe (1957) and Holland (1973), scientists (particularly in the social and behavioral sciences) are similar to artists in terms of temperament or personality. The second type of chance discovery, "good luck," is probably the most frequent form of creativity. It is cultivated by persistence and commitment to work, characteristics which probably enable the less creative and artistic scientist to discover patterns by active learning or by frustration.

Most creative scientists encounter discoveries because they are frustrated by their research problems (see May, 1975; Poincare, 1952; Wallas, 1926). This mechanism for creativity is one of the most interesting. It provides an opportunity for understanding the creative process in such a way that intentional cultivation of insight becomes possible. Cultivation of autonomy and aesthetic sensitivity would require much time and extraordinary effort. Therefore, the promise of increasing creative characteristics in all scientists is presented by the study of frustration in hard-working, active investigators.

Frustration and the Creative Process

Frustration represents a crossroad in the creative process in that relative certainty gives way to relative doubt, enabling the investigator to try new methods, discard old "facts," and break through conventions to encounter new perspectives. After a period of intense self-absorption and analysis of the known, the creative scientist will overcome the need to control and will abandon the self to the creative process.

> We cannot will to have insights. We cannot will creativity. But we can will to give ourselves to the encounter with intensity of dedication and commitment. The deeper aspects of awareness are activated to the extent that the person is committed to the encounter. (May, 1975; pp. 46-47)

The encounter is a meeting between two poles of experience: the subjective pole is the conscious person who is ready for the creative act, while the objective pole is the world in which the creator exists through the design of patterns of meaningful relationships. Frustration and anxiety occur when the creator is not able to know the world, not able to orient the self in existence.

Fundamentally, a creative breakthrough is not simply the end result of a cumulative growth process, or a chance discovery. The creative breakthrough results from a dynamic struggle within the person between what is consciously thought on the one hand, and on the other, an insight that is trying to be born on the other. When the patterns that are consciously known from training and experience no longer serve the individual in explanation, prediction, and problem-solving, the unconscious can provide a rich source for new ideas and patterns (May, 1975).

> The idea, the new form which suddenly becomes present, came in order to complete an incomplete Gestalt with which one was struggling in conscious awareness. One can quite accurately speak of this incomplete Gestalt, this unfinished pattern, this unfinished form, as constituting the "call" that was answered by the unconscious. (May, 1975, p. 62)

In the final analysis, creativity is a function of the degree to which the investigator can tolerate uncertainty and anxiety, which, in turn, is related to the extent to which new perspectives are tried. Frustration leads to abandonment of existing views and methods, and therefore, abandonment of the self to uncertainty. If the person is able to tolerate the ambiguity and tension, then unconscious processes contribute to a new sense of relative certainty by creating novel patterns of relatedness in the world.

Many researchers possess some talent for creativity, but they are unwilling to experience the frustration and anxiety required for most discoveries. They may possess independence and need for originality, but lack personal flexibility and openness to experience. Others may lack the commitment to investigate and thus abandon the quest when novel answers are not forthcoming. Some researchers have the aesthetic sensitivity that would lead to insights, but do not possess sufficient levels of autonomy or do not understand the value of persistence. In all of these hypothetical cases, the creative process is thwarted by the comfort of convention and certainty. The existing methods and ideas serve the cautious researcher so there is no incentive to take the path that may lead to breakthrough. There is an incentive, however, to maintain the status quo because it connects the scientist with the experiential world. However, the maintenance of the status quo contributes to the "re-packaging" of old ideas and the re-creating of the past in the present. Therefore, the speculations of the conventional futures researcher represent the perpetuation of the past in the future.

Similarly, some researchers have placed the "tried-and-true" techniques and tools for exploration (e.g., linear, deterministic methods and computer-based, quantitative approaches) between themselves and the creative process. In a real sense, the success of technology has blocked off the "creativity of the spirit" (May, 1975, p. 71). In addition, creative thinking on the part of futures researchers may threaten the structures and presuppositions of a rational, orderly, technologically-oriented society (Feyerabend, 1982; May, 1975). Therefore, a chasm between "rebellious" artists and more rational decision-makers tends to exist. They infrequently share methods and ideas, although the artist possesses the perspective which could promote insight and the scientist possesses the perspective which could harness the insight, insuring its public value.

The answer to the problem of creative science is neither the false objectivity of scientism and methodolatry, nor the rejection of all technology. Artists, poets, and existential thinkers are quick to reject the scientific methods and technologies, because they focus upon the pitfalls of rational thought.

Every technique serves, or can be made to serve, some desire or some

> fear; conversely, every desire as every fear tends to invent its appropriate technique. From this standpoint, despair consists in the recognition of the ultimate inefficacy of all technices, joined to the inability or the refusal to change over to new ground--a ground where all technics are seen to be incompatible with the fundamental nature of being, which itself escapes our grasp (in so far as our grasp is limited to the world of objects and to this alone). It is for this reason that we seem nowadays to have entered upon the very era of despair; we have not ceased to believe in technics, that is to envision reality as a complex of problems, yet at the same time the failure of technics as a whole is as discernible to us as its partial triumphs. (Marcel, 1971, pp. 30-31)

According to this view, humankind is at the mercy of technology, which seems to take on a distorted life of its own. This means "...he is increasingly incapable of controlling his technics, or rather of controlling his own control" (Marcel, 1971, p. 31). Therefore, the "technological man" cuts off the self from doubt and uncertainty, succumbing to personal pride and knowledge of objects, rather than awareness of the resources of the self. Similar positions have been advanced by contemporary critics of science and technology, the "new Dionysians" (see Laing, 1960; Reich, 1970; Roszak, 1972).

The Greening of America (Reich, 1970), a highly popular work from the "Me Decade," promised a kind of Utopian United States in which concern for consciousness would outstrip the restrictive view of scientific rationality. Reich (1970) argued for the primacy of direct experience of self and nature, which ultimately resulted in a trend toward mystical naturalism on the one hand and homocentric self-absorption on the other (Holton, 1978). Left unchecked by reason, this "new Dionysian" position could deteriorate into parochialism and elitism. The private path is not an adequate means to problem-solving in the public world. Self-absorption does not produce meaningful social change (Schur, 1976) or creative breakthrough (May, 1975). Indeed, self-abandonment, or self-transcendence, seems to be responsible for truly creative scientific discovery, which tends to result in "consciousness-raising," or paradigm shifting, for large numbers of people (Maslow, 1971; May, 1975).

While the new Dionysians have called for an expansion of science to include personal exploration, the "new Apollonians," a rival contemporary force, have urged a return to the logical and mathematical sides of science in the quest for objectivity and advanced technology (Holton, 1978). The new Apollonians, best represented by the example of Imre Lakatos of the London School of Economics, argue vigorously that scientific progress has been harmed by "psychologism," "sceptical irrationalism," and the "new wave of student anarchism" (Lakatos, 1976). The new Apollonians have attempted to preserve the rules of rationality and the conventions of the scientific method that contribute to greater control over the subjective "distortions" of the investigator. The new Dionysians have attempted to convince us that personal distortions constitute reality, and are the proper subject for scientific inquiry. In truth, both schools of thought are right, each having made a contribution to the advancement of science. An example may illustrate their joint contribution.

Feyerabend (1982) recalled a series of lectures, delivered at the London School of Economics, in which he tried to place the rules and methods of science in proper perspective. The office window of Lakatos was directly opposite the window of Feyerabend's lecture hall. Lakatos would listen to

Feyerabend's arguments against conventionalism in science and then storm into the lecture hall to raise objections. Feyerabend's point was that rules had to be broken in the progress of science, particularly such revolutions as the rise of quantum theory. Lakatos' behavior demonstrated the importance of the existence of rules in scientific progress, and even provided the context for Feyerabend's criticisms.

In science, history provides the conventions, rules, and methods, that become the grist for the creative mill. Some rules must be violated and new methods must be innovated in order to escape the increasingly dogmatic continuity of the past, which has taken several forms in futures research: historicism, scientism, and technological determinism (Hoos, 1978). Some conventions and methods must be retained in order to assess the effects of discontinuity (e.g., creative breakthrough) over time, control zealous subjectivism and ethnocentrism, and discourage mysticism and elitism. Reason and intuition complement one another in the creative process, as well as in the maintenance of standards for scientific inquiry.

The futures researcher must respond to the challenge of maintaining the conventions of science that foster inquiry, while overcoming the tendency to recreate the past. In addition, the auctors must cultivate the talents needed for insight and discovery, while avoiding the trap of self-absorption. Researchers must be prepared to confront the frustration encountered in the creative process. Information about the creative process itself, especially the role of intuition in discovery, provides some guidance for the preparation of futures researchers.

<u>Cultivating Creativity in Futures Rese..rchers</u>

"We are living at a time when one age is dying and the new age is not yet born" (May, 1975, p. 11). Certainly, we are living in the "time of the parenthesis" between operations of an industrial America and an emerging information society (Naisbitt, 1982). Since World War II, we have seen tremendous changes and conflicts in marriage and family choices, employment and career perspectives, religious and spiritual institutions, scientific and technological contributions, social and cultural values, and economic and political perspectives. Futures researchers face tremendous challenge in bringing meaning to the myriad of trends and the ambiguity of the times.

> Every profession can and does require some creative courage. In our day, technology and engineering, diplomacy, and certainly teaching, all of these professions and scores of others are in the midst of radical change and require courageous persons to appreciate and direct this change. The need for creative courage is in direct proportion to the degree of change the profession is undergoing. (May, 1975, pp. 21-22)

Futures researchers must not only be technically proficient and well-informed about problems in their fields, but also they must possess the integrity and creative potential that comes from careful self-exploration. The following sections describe means for cultivating self-knowledge, so that researchers may contribute to the discovery and creation of viable alternative futures.

<u>Processes Used by Creative Researchers</u>

Research is an art, in the sense that the discovery of solutions to problems is creative, and a science, in the sense that the methods applied in order to evaluate the problem solutions are rational. The processes used by creative researchers include careful selection of a problem for study, extended effort to solve the problem, setting and changing constraints on problem solution, and verifying, then elaborating outcomes

(Mansfield & Busse, 1981).

Selection of a problem is probably the most demanding process in creative research because it requires an extraordinary sensitivity to patterns in previously gathered data and in concurrent observations of the world. This sensitivity differentiates auctors from less creative researchers, who seem to stumble upon moderate discoveries after intensive trial-and-error (Mansfield & Busse, 1981). Creative problem selection requires the availability of adequate resources and support for the exercise of aesthetic sensitivity. In a recent review of successful Research & Development enterprises, Peters and Waterman (1982) discussed the operation of "skunk works" (special work setting) in fostering creative autonomy. They noted that many companies provided support for the impulsive and irrational innovators (called "champions") by removing them from the daily demands of the work setting and allowing them to exercise their sensitivity with as little interference as possible. Similar cloistering is encountered in universities committed to excellence in research. Peters and Waterman (1982) also emphasized the importance of hierarchal support for innovation and direct mentoring in "skunk works." As noted in a previous section, highly creative scientists enjoyed long-term apprenticeships with masters in their fields. Half of the American Nobel prize winners worked, as young scientists, with the direction and support of prize winners from previous generations (Zuckerman, 1977).

In summary, <u>creative problem selection</u> requires (1) aesthetic sensitivity probably facilitated through having completed an apprenticeship with a supportive mentor; and (2) freedom to innovate, resulting from both support from peers and superiors and opportunity to speculate (without routine distractions) in a secure work environment. A setting that is conducive to good problem selection is also important in enabling the second process of creative researchers, extending effort to solve the problem.

Major discoveries arise after an prolonged period has been invested in problem-solving. Einstein spent seven years working on the problem of the velocity of light in relation to different frames of reference before discovering the solution to the problem of special relativity (Mansfield & Busse, 1981). Investing time and effort in the search for solution increases the likelihood that chance associations will provide clues for problem solving. Extended time invested in exploratory behavior also heightens frustration and readiness to try nonconventional solutions. Each individual probably requires an optimal level of creative effort in order to realize (1) insights from chance association and pattern recognition and (2) arousal sufficient to stimulate novel, irrational attempts at problem solution.

The next process in creative research is setting and removing constraints. Empirical, theoretical, and methodological constraints limit the scope within which an inquiry is conducted (Mansfield & Busse, 1981). Such constraints form the foundation of the particular science from which a creative discovery will eventually emerge. Empirical constraints represent the data that are known according to the conventions of the field and the realities perceived by the scientist. Often, errors in measurement and unexplained data indicate that the empirical limits of the investigator are too narrow, creating the need for changing certain constraints and, therefore, admitting more data to the problem solution process. Theoretical constraints consist of the model problems and solutions, which are available to a community of investigators by virtue of the fact that they fit the extant, consensually-validated paradigm of the time. Theoretical limitations, which are self-imposed by the researcher who wishes to remain a member in good standing of the scientific community (see Axelrod, 1979), are perhaps the most restrictive because they are self-perpetuating. The array of constructs that constitute a theoretical system determine the investigators perception of reality and the appropriate methods for exploring phenomena.

Methodological constraints are concerned with instrumentation, research strategy, and statistical analysis. They impose practical limitations upon the scope of investigations. Changes in methodological restrictions sometimes affect empirical and theoretical conventions. For example, there were tremendous advances in biology upon development of the electron microscope, in physics after the construction of the cyclotron, and in astronomy following the innovation of the radio telescope (Mansfield & Busse, 1981). In these cases, technological advances were stimulated by empirical constraints and theoretical dictates, and, in turn, the realities and approaches of investigators were transformed by improvements in methodology. In the social and behavioral sciences, advances in computer and statistical technologies actually impose restraints upon the research done in those fields. Many researchers in the social/behavioral sciences fit their problems and solutions to the powerful technologies believed to be intrinsically related to "hard science." By pursuing an idealized "scientific" methodology, which actually does not characterize the much sought after "pure" sciences (see Capra, 1975), the social, or behavioral, researcher often produces results that are trivial in terms of the complexities of human interactions and that are barren in the theoretical sense. The methodological, theoretical, and empirical constraints of futures research demand serious consideration if breakthroughs are to occur.

In futures research, investigators seem to make effective use of the existing technologies and theoretical constraints in describing, exploring, and prescribing present reality. However, much of the forecasting, modeling, simulating, extrapolating, and surveying is oriented to justifying or explaining present actions (Hoos, 1978; McHale, 1978; Miles, 1978). With the exception of a few visionaries (e.g., Buckminster Fuller), futures research does not address how we might fit present choices and actions to discernable and desirable alternative futures. The research implicitly favors the past, as manifested in the immediate present, rather than explicitly valuing facets of the present according to future biases. Moreover, the impact of the continuity model for futures studies has been counterbalanced by the more pessimistic forecasts of some catastrophe models, including the anticipated limits to growth (Meadows & Meadows, 1972) and the potential for annihilation, or self-destruction (Schell, 1982). New methods and theories are needed to expand the views of future realities. Scenario-building and cross-impact estimation (O'Toole, 1983) represent two promising approaches. The increaingly sophisticated fields of parapsychology (Leshan & Margenau, 1982; Targ & Puthoff, 1977), consciousness studies (Lee, Ornstein, Galin, Deikman, & Tart, 1976; Lilly, 1977; Ornstein, 1974), and transpersonal psychology (Deikman, 1982; Walsh & Vaughan, 1980) hold promise for revolutionizing futures research.

The creative researcher sets constraints that are consistent with the boundaries of the field of inquiry and that do not preclude discovery of revolutionary new approaches. <u>Creative constraint setting</u> consists of increasing awareness of empirical, theoretical, and methodological limitations, which comes from adequate training and experience in the field, and commitment to expand the boundaries of the science. Therefore, setting constraints is closely related to changing constraints.

In attempting to solve a problem within conventional boundaries, the creative researcher will likely encounter a need for reorientation. Constraints based upon central assumptions of a major theory or a prevailing paradigm are very resistant to change; therefore, the thinking of the researcher is exposed to extraordinary tension. According to Kuhn (1970), paradigm change is most frequently encountered among investigators who are young or new to the field and therefore not strongly committed to existing theories. The scientific community is slow to reject the existing paradigm. It will not change unless a compelling, plausible alternative is developed. The researcher, however, finds it hard to develop an alternative theory because such work involves not only the realization of an intellectual breakthrough, but also, the prolonged working outside of convention and consensus.

Koestler (1964), noted how reluctance to change suppresses the breaking of constraints.

> Kepler, too, nearly threw away the elliptic orbits (his discovery in astronomy); for almost three years he held the solution in his hands without seeing it. His conscious mind refused to accept the "cartload of dung" which the underground had cast up. When the battle was over, he confessed: "Why should I mince my words? The truth of Nature, which I had rejected and chased away, returned by stealth through the backdoor, disguising itself to be accepted. Ah: what a foolish bird I have been!" (p. 217)

The role of unconscious processes, such as intuition, is as important as rational processes in changing constraints.

The transformation, or restructuring, of constraints involves viewing the research problem from a radically different perspective (Mansfield &

Busse, 1981). Creative transformation of constraints seems to require both investigator sensitivity in the selection of a problem (and perhaps intuiting an answer that suggests a certain question), and extended effort to solve the problem through conventional means. Extended effort may impress the research question upon the unconscious (Gruber, 1974; Wallas, 1926) or ready the researcher for change through the experience of frustration (see pp. 19-24). Many creative scientists report the emergence of solutions following the breaking away from the problem.

Breaking away from the problem for a time may facilitate random associations, which provide keys to problem-solving. The associations may arise from hobbies, dreams, or encounters with nature (Mansfield & Busse, 1981). The connections may also represent the interaction of chance stimuli and investigator exploratory behavior. The success of breaking away from a problem in order to change constraints is a function of the investigator's flexibility, discarding of habitual thought processes, and openness to experience, resulting in awareness of new information. In the literature, there are two famous cases of creative transformation.

According to Henri Poincaré (1952), mathematical creation is the result of sudden insight, breaking through after a period of intense work.

> The changes of travel made me forget my mathematical work. Having reached Coutances, we entered an omnibus to go some place or other. At the moment when I put my foot on the step the idea came to me, without anything in my former thoughts seeming to have paved the way for it, that the transformations I had used to define the Fuchsian functions were identical with those of non-Euclidean geometry. I did not verify the idea; I should not have had time, as, upon taking my seat on the omnibus, I went on with a conversation already commenced,

but I felt a perfect certainty (p. 26)

Continuing, Poincaré (1952) recalled another incident and later discussed the role of the "subliminal self."

> Then I turned my attention to the study of some arithmetical questions apparently without much success and without a suspicion of any connections with my preceding researches. Disgusted with failure, I went to spend a few days at the seaside, and thought of something else. One morning, walking on the bluff, the idea came to me, with just the same characteristics of brevity, suddenness and immediate certainty (p. 26).

> The useful combinations (of ideas) are precisely the most beautiful, I mean those best able to charm this special sensibility that all mathematicians know....only certain ones are harmonious, and, consequently, at once useful and beautiful. They will be capable of touching this special sensibility of the geometer of which I have just spoken, and which, once aroused, will cast our attention to them, and thus give them occasion to become conscious. (p. 29)

The second famous case of creative transformation involved the dreams and waking "hallucinations" (vivid images) of Fredrich August von Kekule, a major contributor to the development of organic chemistry. In his major review of creativity, Koestler (1964) included Kekule's descriptions of insight, one of which, like the experience of Poincaré, involved a bus trip.

> One fine evening, I was returning by the last omnibus, "outside" as usual, through the deserted streets of the metropolis, which are at other times so full of life. I fell into a reverie, and lo! the atoms were gambolling before my eyes. Whenever, hitherto, these diminuitive beings had appeared to me, they had always been in motion;

> but up to that time, I had never been able to discern the nature of their motion....I spent part of the night putting on paper at least sketches of these dream forms. (p. 170)

Another report from this creative scientist involved the dream discovery of the structure of benzene, which Koestler (1964) described as one of the most important in history.

> I turned my chair and dozed....Again the atoms were gambolling before my eyes. This time the smaller groups kept modestly in the background. My mental eye, rendered more acute by repeated visions of this kind, could now distinguish larger structures, of manifold conformation; long rows, sometimes more closely fitted together; all twining and twisting in snakelike motion. But look! What was that? One of the snakes had seized hold of its own tail, and the form whirled mockingly before my eyes. As if by a flash of lightning I awoke...Let us learn to dream, gentlemen (p. 118).

This case suggests that value of recurrent transformations and their contributions to changing constraints. Both Kekule and Poincaré cultivated their creative, intuitive abilities and, then, subjected their recent insights to scientific verification, the final process used by creative scientists.

"The process of formulating new constraints and testing them is repeated until, by successive approximations, the scientist constructs a set of constraints leading to an acceptable solution [illegible] & Busse, 1981, p. 98). The process of <u>creative verification</u> involves constructing hypotheses, which have been generated by intuition and transformation; investing commitment in the testing of the hypotheses, but refraining from bias and self-fulfilling expectations; and reforming hypotheses according to empirical data, modifying theory and methods as needed. If the solution involves a major restructuring of the field, it is incumbent upon the researcher to indicate how studies unrelated to his or her discovery should be framed. In this manner, the boundaries of a field are expanded and the realities of the innovator, the scientific community, and the society at large are affected. Therefore, the process of creative verification includes the testing of hypotheses within a breakthrough study and the elaboration of the problem solution in the context provided by the field.

The processes used by auctorive scientists involve creative problem selection, creative effort, creative constraint setting, creative transformation, and creative verification. While these five processes apply specifically to the activities of highly creative scientists, they resemble rather closely the steps in creativity described in a classic model (Wallas, 1926). The model provides additional detail about the role of intuition in creativity and suggests means for cultivating insight in futures researchers.

A Model for Creative Thought

In 1926, Graham Wallas, a political scientist at the University of London, provided a four-stage model of creative thought, which has become a standard for discussing and exploring the process of creativity. The model stresses the deleterious effects that "unrelieved labor" exert on the emergence of creative insight. Wallas, instead, argued for the necessity of maintaining a balance between active, intellectual activity and relaxation, of both a mental and a physical nature.

The model, or framework, consists of four consecutive stages: preparation, incubation, illumination, and verification. Preparation is concerned with the collection and organization of data relevant to solution of a problem. The second stage, incubation, involves some form of relaxation, resulting in the subordination of the linear, analytic thought, which characterizes preparation, to more intuitive mental activity. Incubation is followed by the frequently reported "Aha!" experience of sudden discovery, bringing about illumination of the solution to the problem. The final stage of the model, verification, entails a testing and evaluation of the goodness of the solution. Completion of the preparation stage and implementation of the verification stage require attainment of a sufficient level of academic discipline, employing habits, skills, and systems of knowledge acquired in formal learning settings (e.g., graduate or professional school).

Wallas (1926) observed that university-educated persons have at their disposal extensive bodies of knowledge, encompassing many diverse fields, from which they can extract a wide range of potentially useful associations. The highly diversified, liberally educated individual is favored in the model. The recent emphasis in education upon training specialists and career-oriented technicians may actually mitigate against creativity in some instances. The increasing trend toward employment of problem-solving teams, consisting of persons from different academic disciplines and career background, is a reflection of the insularity of knowledge in our highly specialized, technologically advanced society. The trend represents an attempt at facilitating access to insights to be gained by viewing a problem from a variety of perspectives.

Within the preparation stage, there is systematic analysis and diligent attacking of the problem, usually without satisfactory issue. The effort expended during the period does serve, however, to formulate an explicit statement of the problem, as well as a specific question to be answered by the subsequent problem-solving process. The formulation of the problem following extended effort represents two of the processes used by creative scientists, namely, identification of a research question and good scientific inquiry.

Gowen (1979) described the preparation stage as an analysis of the problem under the control of logical processes, originating in the left hemisphere of the human brain. The purpose of preparation is to provide a body of verbal terminology, which will later be used in the verification stage in order to determine problem solution. The terminology also affords the means by which the discovery product, arising from right hemispheric imaginal processes, can be translated to verbal representation. The translation is needed to communicate the discovery to the scientific community and society. Otherwise the insight is destined to remain an intuitive, pleasant affect.

The verificiation stage is analogous to the preparation stage in that it is a period of intense conscious activity, bound by mathematical, scientific, and rational rules. The purpose of this last stage is to refine the solution in its essential form by means of analyzing or measuring the product of the illumination stage, which, in turn, is an outcome of the incubation stage. In verification, intellectual discipline, committed effort, and conciseness of thought are critical. Both verification and preparation are types of convergent thinking, in which careful consideration of given facts leads to a single, most appropriate solution (Guilford, 1976).

Between preparation and verification are the two stages essential to creative thought, incubation and illumination. The illumination stage is often recalled as a sudden inspiration, like the aforementioned insights of Poincaré and Kekule. However, Wallas (1926) described illumination as the culmination of a series of successful syntheses of associations, which unfold at the unconscious level during the incubation stage. In this respect, illumination is very similar to the changing of constraints and the intellectual breakthroughs, which were considered in earlier sections (pp. 31-33).

The incubation stage is the most enigmatic of the four components of the model. It has provided much material for psychological speculation and investigation. The long-term concentration, or "massed practice," employed during this stage seems to temporarily depress creative production. Yet, the extended effort usually produces frustration and readiness to break away from the problem-solving. Incubation is frequently manifested as a period of relaxation when active, conscious study is suspended. Both mental and physical relaxation are facilitated by involvement in recreation, hobby, exercise, or travel. The accompanying release of conscious mental attention allows the unconscious a period of free reign, during which aesthetic sensitivity and free association interact with subtle environmental patterns and chance stimuli. The result of this interaction is an insight or breakthrough that is then recognized as an illumination. The discovery creates incentive to change constraints upon problem solution, confronting conventions and "old" ideas with novelty.

Incubation is closely related to divergent thinking, which in Guldford's (1976) Structure of Intellect model is an intuitive, analogic thought process. Divergent thinking is characterized by fluency in word, concept, and association; flexibility of thought; ability to transform (similar to changing constraints); and facility in figural and semantic elaboration (Guilford, 1976). The divergent thinking that characterizes at least a major part of incubation provides a diversity of possible solutions, the range somewhat dependent upon the background and preparation of the individual. In terms of futures research, divergent thinking during incubation may provide the much needed alternative futures and new perspectives which are essential to creative forecasting. At some point in the incubation stage, the divergent products are somehow combined or integrated to form both random, useless associations and "beautiful," potential solutions. According to Poincaré (1952), only certain combinations are "harmonious" and useful when exposed to the "geometer," the special sensibility of the creative scientist. The fitting of possible solutions to the aesthetic sensitivity of the researcher seems to involve pattern recognition and translation of the intuitive and imaginal products of right-brain thinking to the rational and verbal ideas of the left-brain (Gowen, 1979).

The process of pattern recognition and information translation occurring in the latter part of the incubation stage gives rise to a phenomenon described by Wallas (1926) as "intimation", the feeling that a solution is near. Intimation probably reflects the experience of restructuring or closing of a Gestalt, preceeding the flash of insight and changing of constraints (Mansfield & Busse, 1981). The experience of intimation involves pleasant sensation and positive affect (Wallas, 1926). May (1975) discussed this facet of creativity as a type of ecstacy (from "ex-stasis," to stand out from), in which the individual is freed from the usual split between subject and object. Ecstacy brings intense consciousness, accompanying the union of form and passion with order an vitality. The process is neither irrational or rational; it is "suprarational," bring together intellectual, volitional, and emotional functions in the synthesis of the known world with the creative insight (May, 1975).

Arieti (1976) also emphasized "the magic synthesis," in his psychoanalytic account of the creative process. He viewed creative thought as the confluence of the rational and logical operations of the conscious and the irrational and intuitive forces of the unconscious. He labeled this conjunction of primitive and higher-order cognitive operations "tertiary process" in order to distinguish it from primary and secondary processes in the psychoanalytic model (Arieti, 1976). From the perspective of transpersonal psychology, which is devoted to the study of consciousness and its evolution (see Walsh & Vaughan, 1980), the suprarational and tertiary process of intimation sounds like an altered state of consciousness (Ornstein, 1974). The emotional ecstacy of intimation is similar to the "peak experiences" of highly actualized individuals who accomplish self-transcendence (Maslow, 1971). Self-transcendence is one goal of meditation, a deep state of relaxation in which heightened awareness is reported. Meditation, in its historical (Poincaré, 1952) and contemporary (Shear, 1980) forms, is a method of incubation, while intimation signals an altered state of awareness, preceeding illumination and return to the rational, conscious state of verification.

The process of intimation also bears resemblance to transformation, a convergent thinking operation in which a creative product affords a new reality by virtue of its novel constraints (Jackson & Messick, 1967). Rather than emphasizing divergent thinking as the key to creativity, associative theory (Mednick, 1962) stresses the importance of constructing useful combinations of ideas. The more remote the elements of a novel combination are, the more creative the solution. Rothenberg (1976) described "Janusian thinking" as an essential cognitive component in the creative process. Janusian thinking involves the purposeful, concurrent combination of two contradictory or antithetical concepts. The resulting construct, a "unity of opposites," underlies effective procedures in problem-solving (e.g., Prince, 1970) and creative writing (Egri, 1960). While dialectical reasoning, a favorite of Socrates, seems to hold an important position in creativity, it is afforded a very narrow role in scientific materialism (Bunge, 1981), the predominant philosophy of science in America. Yet, resolution of the contradiction of apparent opposites is critical in the self-examination of mind, an existenti·˙ self-creation process accompanying creative productivity in the material world (May, 19⁊Ↄ). Janusian thinking is also central to Eastern conceptions of reality, which are presently enjoying prominence in some sectors of Western science (Capra, 1975; Salk, 1983). Finally, this pattern of thinking is held to be crucial to the balancing of reason and intuition, the benchmark of attaining a mature personality according to Carl Jung (1965).

The understanding of Wallas' (1926) model for creative thought has been advanced by research on cerebral hemispheric dominance, initiated in the 1960s by Roger Sperry's experiments on split-brain patients. The cerebral cortex of the brain is divided into two hemispheres, which are joined by interconnecting nerve fibers called the "corpus coliosum" (Ornstein, 1974). Each human being, and the self that represents individual consciousness, is actually controlled by two "half-brains" that are specialized for different functions in information processing (see Myers, 1982). The left hemisphere is specialized for analytic thinking, logic, language processing, and abstract reasoning. The right-hemisphere is specialized for intuitive thinking, aesthetics, imagery processing, and concrete, sensory experience. While the left-brain is predominantly verbal, rational, and linear in organization of thought, the right-brain is primarily nonverbal, synthetic, and analogic in organization. The left-brain is concerned with analyzing parts of experience over time) hence, it is favored in the traditional scientific method), and the right-brain is invested in recognizing wholes (patterns) of experience in space, not time. Left-brain functioning is characterized by a consecutive series of event-operations. Right-brain functioning is characterized by parallel series of event-associations, some random and some contiguous. The left-hemisphere is dominant during waking hours and normal states of consciousness. Therefore, awareness of right hemispheric processes is limited, and, in fact, imaginal contents of right-brain thought are difficult to access through left-brain verbal codes (Paivio, 1971). With the "quieting" of left-brain operations, through diversion or meditation, the more elusive right-brain contributions to problem-solving can be realized.

Creative insights are the result of right-hemispheric mental images and associations being translated into left-hemispheric ideas and generalizations. When left-brain activities are allayed, the resulting images often seem to possess the heuristic effect of vaguely hinting to the conscious that a discovery is about to be realized. Major scientific discoveries require well-developed reason and intuition. Many logical and empirical problems encountered when applying the rigid rules and standards of the left hemisphere could be overcome by the looser "thought experiments" that the right hemisphere can conceive (West, 1975). The illumination that emerges from the incubation stage can then be returned to the evaluative operations of the verification stage. The success of the verification stage, with its resulting translation of private insight into data for public review, depends upon the left-brain analytic skills, as well as the knowledge and effort invested in the preparation stage. According to the Wallas (1926) model for creative thought, and its contemporary support, creativity is cultivated by infusing scientific reason with intuition.

The cultivation of creativity provides the key to effective futures research: the conduct of inquiry in which the self and the world are explored with the goal of creating alternative futures consistent with the values of the researcher and the ideals of society. Creative futures research involves overcoming historical constraints and applying new visions, born of intuition and tested by reason, to the charting of the future. The process of creative futures research enables the investigator to forge meaning from encounter with the world, rather than retreating to the comfort of scientism and methodolartry. As a result, the creative futures researcher, transcending self in the search for truth and harmony, acts a catalyst in the process of continuous change. The repetition of the past in continuity is disrupted by the creative vision of the futures researcher. The discontinuity of the intellectual breakthrough becomes the recurrent, cyclical theme that has enabled the advancement of humankind. Although advancement is presently arrested in the ethnocentric, "technological determinism" of the times, "one age is dying and the new age is not yet born" (May, 1975, p. 11). The field of futures research, an inherently personal science, has the potential for serving as midwife to a new, more humane, age.

> The future is contingent, not completely prescribed, except for the immediate necessity to evaluate in order to live a life of integrity. The specific gravity of the burden of change has moved from genetic to cultural evolution.... Cultural evolution is a child of no more than twenty or thirty thousand years. What will be the future of our evolutionary course? Will it be cyclical in the classical sense? Will it be linear in the modern sense? Yet we know the laws of nature are not linear. Certainly, life is more than mere endless repetition. We must restore the importance of each moment, each deed. This is

impossible if the future is nothing but a mechanical extrapolation of the past. Dignity becomes possible only with choice. The choice is ours. (Anshen in Salk, 1983, pp. xiv-xv)

Two models for the cultivation of creativity in futures research were presented in this section. The first model described the processes used by auctorive researchers: creative problem selection, creative effort, creative constraint setting, creative transformation, and creative verification. The second model described the generic process of creative thought, involving four stages: preparation, incubation (including intimation), illumination, and verification. Similarities in the models suggested that creativity depends upon the balancing of left-brain and right-brain operations: reason and intuition, analysis and synthesis, evaluation and association, verbalization and imagination, linear problem-solving and parallel solution-recognition. Creative thought, especially in the scientific realm, is a function of the adequacy of communication between the two information processing systems, which can be facilitated through effective organization of problem-solving.

Organization of Creative Problem-Solving

Effective organization of analytic procedures and intuitive processes is essential to creative problem-solving. Good organization of analytic procedures provides access to extant knowledge. We call this organization "education," a societal investment that promotes maintenance of "facts" (bits of knowledge), theories, methods, and technolgies. Education insures continuity in the application of constraints. "...The whole stock of human knowledge is lost by death every seventy years and this has to be replaced by transferring the knowledge structure from decaying old minds into decaying young ones" (Boulding, 1975, p. 69). The cultivation of intuitive processes has received considerably less attention than education for knowledge-transfer. Education is a prerequisite for fruitful preparation of creative thought. Without intuition, the preparation stage persists until trial-and-error or change discovery produce a modest insight. In order to promote breakthroughs in futures research,a model for creative problem-solving has been organized according to procedures that facilitate development of intuition and transition from left-brain to right-brain processing. The model for creative problem-solving integrates observations of the creative process (Mansfield & Busse, 1981; Wallas, 1926) within a research-based framework for effective decision-making.

A Framework for Problem-Solving

D'Zurilla and Goldfried (1971) reviewed the theoretical and research literature on problem-solving and produced a now classic framework for organizing procedures. Their definition of problem-solving is consistent with the practice of creative futures research: "Problem-solving was defined as a behavioral process which (a) makes available a variety of response alternatives for dealing with a problem situation and (b) increases the probability of selecting the most effective response from among these alternatives" (D'Zurilla & Goldfried, 1971, p. 107). According to their rationale for a structured approach to problem-solving, the complexity of human interactions and the ever-changing nature of society create needs for effective decision-making and implementation strategies. Lacking decision-making and problem-solving skills predisposes the individual to behave ineffectively, often leading to abnormal behavior and emotional disturbance. The same ills can be attributed to a society that cannot plan effectively for the present and for preventing problems in the future. The model consists of five stages, which are somewhat similar to the creative processes already considered: general orientation, problem definition and formulation, generation of alternatives, decision-making, and verification.

The general orientation stage is perhaps most important to the existential position on creativity. The stage includes engagement of a problem-solving "set" of expectations for success and beliefs related to personal power. The effective problem-solver has faith in the self and the process, and he or she is able to fit personal needs and interests to the demands of the environment. The effective problem-solver learns to control tendencies to respond on first impulse and to respond by "doing nothing" for a prolonged period. Effective solutions require the ability to recognize problem situations when they arise, a skill related to creative sensitivity, as well as the ability to persist in the problem-solving encounter. The following statements reflect expectations associated with a strong general orientation: (1) This problem can be solved, (2) I can be effective in solving the problem, (3) I expect beneficial outcomes from problem-solving, and (4) The beneficial outcomes result from my personal efforts. These expectations are related to a construct, self-efficacy, which Bandura (1982) has described as the central mechanism and common denominator in change.

The second stage in the framework includes several operations required for effective problem definition and formulation. A major requirement of creative problem-solving is defining aspects of the problem situation in concrete, operational terms, identifying specifically what needs to be done and how one could accomplish goals which affect the desired change. The next step involves formulating the problem in terms of a hierarchy of elements and goals. Elements are intially classified as relevant or irrelevant to problem solution. Goals are classified as major or minor, superordinate or subordinate, ends or means. Here the problem-solver is confronted with personal values, issues, and potential conflicts in the problem-solving process. Some major classification strategies were discussed by D'Zurilla and Goldfried (1971).

One strategy for classifying information about the problem situation is to relate elements to members of a category with which the individual has had experience in the past. This strategy illustrates the importance of preparation, prior training, and existing constraints. In effective futures research, the strategy clarifies the value of explicating current trends in relation to past events. Another valuable strategy involves arranging and rearranging stimuli perceived in the environment to generate new classifications. In this manner, sensitivity to subtle patterns of relatedness in existing data may be discerned. Classifying and reclassifying reduces the likelihood of inappropriate generalization of past learning to new problem-solving situations. In a sense, reclassification strategies may function to "confuse" the problem-solver, confounding existing constraints, and creating conditions that favor recognition of gaps in available information. A final strategy of great importance in creative classification is specifying information (elements) needed to fill a set, or class, by means of the inquiry method, which consists of asking questions that will elicit pieces of relevant information. Successful transition to the next stage in problem-solving, generation of alternatives, is based upon knowing the right questions to ask, not prematurely identifying "right" answers.

Generation of alternatives has two related goals: generating alternative strategies for problem-solving and identifying alternative specific methods for solving the parts of the problem, which were recognized in the definition/formulation stage. Effective problem-solving in this stage seems to be related to an ability to move easily from general, molar classifications to specific, molecular sets. The problem-solver must be able to use deduction and induction, as well as, divergent and convergent thinking processes. The generation of alternatives stage bears a close resemblance to the incubation stage in Wallas' (1926) model; however, D'Zurilla and Goldfried (1971) treat their stage as an active, exploratory process, more like the setting and changing of constraints described by Mansfield and Busse (1981) than the passive, receptive process highlighted by Wallas (1926).

In the framework of D'Zurilla and Goldfried (1971), brainstorming is presented as the major means for generating alternatives. Much of the research on generating alternatives addressed the procedures of brainstorming, a group approach to creative problem-solving developed in 1938 and made famous by Alex Osborn. Osborn (1963) was actually much influenced by the classic model of Wallas (1926), but in marketing his Applied Imagination techniques in the Western world (particularly, business and industry), he found that a highly structured, "technology for creativity" was the most acceptable approach. Therefore, his book (Osborn, 1963) represents a rich resource for identifying specific brainstorming techniques.

The basic principles of brainstorming clearly indicate worth of the procedure for evoking alternatives and stimulating new perspectives. The latter part of the procedure actually involves the combination and association that were discussed earlier in the context of incubation and intimation (pp. 36-41). The basic principles include (1) criticism of any idea is ruled out, (2) "freewheeling," or unrestrained thinking and verbalization, is encouraged to generate unusual ideas, (3) numerous ideas are sought because quantity breeds quality, and (4) combination and reorganization of ideas are used to improve promising, novel contributions (D'Zurilla & Goldfried, 1971; Osborn, 1963). According to the philosophy underlying the procedure, deferment of judgment results in creative ideation. This tenet is consistent with the observation that critical, evaluative left-brain operations must be temporarily suspended in order for intuition to produce creative alternatives.

In brainstorming, freewheeling is welcomed because ideas are easier to "tame down" than to "think up." During freewheeling, individuals in the problem-solving group are instructed to let their imaginations "run loose" and to produce an abundance of responses to the task at hand. However, strictly speaking, this procedure is not "free association," which represents a more passive, less task-oriented, and more person-oriented approach to incubation. Parnes (1967) described freewheeling methods as "limited criteria thinking," in which responses are minimally constrained to relevance to the problem, as previously defined and formulated. Therefore, the utility of brainstorming is bound to the adequacy of problem selection and specification.

In their review of the literature, D'Zurilla and Goldfried (1971) describe a number of research-based techniques for implementing the freewheeling component of brainstorming. In one approach, participants are instructed to "Be original" and provide different responses to stimulus words each time they are called upon in the group. Another variant of freewheeling involves the individual responding for a set period (e.g., 30 seconds) to a stimulus word before moving on to the next word, or next participant in the group setting. As the quantity of ideas increases, more novel responses are realized and naturally occuring associations and combinations tend to improve the utility of ideas that are "on the table." The last half of the brainstorming session, when divergent production gives way somewhat to synthesis, typically results in generation of some elegant, "beautiful," and useful alternatives. While the combination process seems to emerge after a period of time, Osborn (1963) offered additional techniques for stimulating association and improvement including: "forced relationships," combining each specific idea with every other idea; "hitchhiking," adding one's original contribution to an existing idea; and a host of modification/substitution techniques, addition, magnification, rearrangement, omission, reversal, etc. Within brainstorming, like other creative attempts to generate alternatives, record-keeping, or note-writing, is essential because insights are fleeting and creative products are easily forgotten. Adequate records also facilitate transition to the next stage of problem-solving, decision-making.

The decision-making stage is characterized by the application of systematic methods for determining the "goodness" of a solution, typically according to certain rules or standards. For example, a hypothesis emerging from the previous stages could be subjected to the following scientific rules: A good hypothesis must be (1) relevant to the question it attempts to answer, to the data it attempts to explain; (2) falsifiable to the extent it can be put to the empirical test, leading to either confirmation or refutation; (3) compatible with known facts and principles, and previously established hypotheses; (4) powerful in terms of its ability to predict or explain a greater range of observations than a competing hypothesis and (5) simple in comparison to other hypotheses. Decision-making incorporates not only the "impartial" rules of science, but also the personal preferences and expectations of the researcher.

Individual decision-making, under conditions of uncertainty in a problem-solving effort, is usually influenced by estimations of how likely will be a given alternative and what will be its costs and payoffs to me (and sometimes society) if the alternative occurs. This human decision-making style serves as the heart of the personal science of creative futures research. This model of human choice is consistent with the existential approach to futures research. In addition, the "subjectively expected utility model" (Edwards, 1961) provides a means for making explicit individual expectations and values. Cross-impact and cost-benefit approaches to planning in futures research capture the essence of this approach to decision-making (O'Toole, 1983). Subjectively expected utility decisions take into account the probabilities of solving different facets of complex problems, the values attached to alternative particular solutions, the possibilities of creating new problems by solving particular problems (a neglected aspect of decision-making in the creation of the atomic bomb), and the present and future interests of the decision-maker and his or her society. Basing decisions upon subjective interests and relatively objetive scientific criteria insures that problem-solving is relevant for the individual, the scientific community, and the public in general.

The final stage in problem-solving is verification of the actua' consequences of decision-making. If adequate time and resources have been invested in problem definition/formulation and decision-making, then it is likely that verification will involve establishing, then documenting, that a hypothesis or choice is, in reality, "best." When systematic and rigorous methods for verification are implemented, there is little doubt about the "goodness" of a choice, most competent observers would agree with the evaluation. If verification is biased (e.g., a self-fulfilling prophesy), then controversy often arises and the problem-solving process itself is confounded. Making explicit that values inherent in decisions can result in verification of results that others can understand and discuss, even through they may disagree with the interpretation of the outcomes. Typically, outcomes that are congruent with standards made explicit in decision-making will be accepted as evidence by persons who share the standards. Verification also provides feedback, which enables recycling in the problem-solving model to decision-making or an earlier stage.

The verification stage is the crucial component in problem-solving as a system. D'Zurilla and Goldfried (1971) emphasized the value of the TOTE (Test-Operate-Test-Exit) model (Miller, Galanter, & Pribram, 1960) for verification activities. In the TOTE model, the problem-solver first tests the goodness of an alternative selected in the decision-making process against the standards used to arrive at the choice and the goals identified in problem formulation. If the "test" reveals congruence between outcome and standards, outcome and goals, then the problem-solver exits the verification stage with some certainty about the value of a decision or hypothesis. If a lack of congruence is encountered, then the problem-solver must return to the appropriate stage in the framework and complete the stages that follow that one. Frequently, the TOTE procedure will reveal that the best alternative was not selected, given the rules of decision-making. In this case, all that is needed is testing the new decision against the standards and goals. Sometimes, a lack of congruence reveals inadequate problem formulation, so the problem-solver must reutrn to the second stage and complete new operations in the stages that follow. Upon eventual exiting of the verification stage, the researcher gains information that not only establishes the value of a hypothesis and resolves a problem, but also that contributes to increased expectations for efficacy in problem-solving.

Therefore, creative problem-solving produces benefits for the community and the individual researcher, whose personal and career satisfaction is bound to the "goodness" of the problem-solving process.

The framework of D'Zurilla and Goldfried (1971) concretizes some procedures and adds some elements that were not addressed in the creative processes identified by Mansfield and Busse (1981) or the creative thought model of Wallas (1926). The addition of a general orientation stage and the clarification of subjective aspects of decision-making provide direction for organizing creative problem-solving. With this expanded view of the principles and procedures of creative problem-solving, we can now offer a comprehensive treatment of the subject, including guidelines and techniques.

Guidelines for Creative Futures Research

The process of creative futures research requires commitment to intentional self-exploration and systematic problem-solving. The aim of creative futures research is personal/professional synergy (see Nicholson & Golson, 1983) in which choices in the practice of futures research reflect individual values, and choices in individual existence advance human knowledge and promote beneficial change for society. The futures researcher has the unique challenge of making meaning for self and others in the period between certainty and doubt, convention and chaos. Intellectual breakthroughs, which produce joy and purpose for the individual and utility and direction for society, require the balancing of historical contributions and future goals, scientific standards and individual vision, reason and intuition. The following framework will hopefully provide some direction for personal/professional synergy. The guidelines are organized according to steps, or stages, borrowed from the preceding models. We believe that creative futures research includes at least the following stages: (1) general orientation,

(2) problem selection, (3) problem definition and formulation, (4) preparation and effort, (5) incubation and generation of hypotheses, (6) illumination, (7) decision-making, and (8) verification. Recommendations and exemplary techniques will be included in the description of each stage.

General Orientation. The stage of general orientation to futures research establishes the major connection between self-creation and scientific innovation. During this stage, which is the most stable and continuous form of change in the life of the futures researcher, the individual embraces or rejects ideologies, conforms to conventions or expresses independence in perspective, and assumes the role of the apprentice or accepts the challenge of mentoring. While none of the above are "either-or" propositions, we believe that the general outlook of the individual futures researcher favors one end of the continuum or the other. The most auctorive futures researchers probably possess the following characteristics by virtue of their upbringing, education, career awareness, present work setting, and unique life experience.

Auctors in futures research are likely to be autonomous, having obtained a high level of individuation through openness to experience. They are likely to be flexible in processing information, negotiating, and communicating with others. Therefore, they tend to have high levels of empathy and respect for the human condition. Through moves in childhood or travels as adults, auctorive futures researchers are sensitive to national, cultural, and socioeconomic differences in needs and values. They frequently view problems and research questions from a broad perspective, taking into account global ecological consequences of decisions and worldwise implications of economic and political actions. They are not afraid to take unpopular stands or pursue "irrelevant" problems because they are motivated by ideals and values that are higher-order than those controlling day-to-day activities in the material world.

Creative futures researchers often possess characteristics of "transcending self-actualizers" (Maslow, 1971). They are "metamotivated" to pursue truth, beauty, justice, and wisdom. They are spontaneous and authentic, concerned rather than competitive, in interactions with others. Auctors are paradoxically powerful and self-assured, and humble and self-sacrificing. They often describe their personal and professional commitments in terms of a "mission," and occasionally they describe their lives as though they were instruments for truth-seeking. Auctorive futures researchers tend to have profoundly religious or spiritual beliefs, although the beliefs are more personal than conventional. However, they are not elitists or mystics. They integrate spiritual and transpersonal beliefs with daily life--.e.g., reading philosophy while waiting on the laundry.

One of the more obvious features of the general orientation of creative futures researchers is the desire to bring knowledge from many disciplines to bear upon questions and problems. Therefore, auctorive futures researchers probably enjoyed challenging liberal arts and sciences education at the undergraduate level, and may have pursued more generalist studies at the graduate/professional level. They eschew specialization and the boundaries it creates. Thus, creative futures researchers would be frequently involved in continuing education, professional associations, and self-directed studies. They tend to read a lot and to maintain friendships with talented, creative individuals from a variety of backgrounds. Usually, their creative contributions will arise in fields in which they possess extensive training and experience. However, the training and experience may have been secured via nontraditional routes, leading to some interesting combinations and "twists" in career paths. Some auctors view their regular employment as a means for securing funds or other resources in order to support personal research.

The fundamental characteristic of the creative futures researcher is the possession of high levels of perceived self-efficacy, generally speaking and specifically in the research pursuit. The auctorive researcher is likely to have experienced considerable success at a relatively young age. In addition, the auctor often begins to make major contributions to his or her field during young adulthood, in graduate school or in apprenticeship with a mentor. The creative researcher is willing to expend effort and persist in spite of difficulty because of personal resiliency and the expectation of eventual success in the chosen endeavor. They "stack the deck" in favor of success by pursuing integrated lines of research, building upon previous discoveries, and selecting problems that are challenging, yet viable. Auctors refrain from self-defeating patterns of research by selectively investing time and effort and recognizing limits to knowledge and expertise. They are sceptical about "quick-fix" and historical approaches (e.g., "With time, the desirable past will repeat itself") to problem-solving, but they are willing to consider the arguments of strong individuals--even those with whom they disagree or persons who would be labeled "kooks" by others.

Self-efficacy is also expressed through the choice of problems for futures research. Creative futures researchers tend to avoid forecasts that favor complacency or fatalism. Instead, they are likely to engage in predictions that recognize the potential contributions of human beings. The more optimistic auctors will offer forecasts that are visionary, suggesting alternatives that require pioneer or vanguard efforts. The more pessimistic auctors will offer forecasts that suggest opportunities for heroism and value-based sacrifice. Forecasts and predictions in futures research can be improved (in the sense that people are empowered by having alternative futures that they can create) by increasing self-efficacy and creative problem-solving orientation in researchers.

A technique for increasing self-efficacy and problem-solving "set" in creative futures researchers is journal writing. Keeping a personal journal, in which the self and developing research questions are explored, represents both means and end. The journal, as a type of diary, is a means for developing self-awareness and for recognizing just how creative one can be. It also provides a means for recording insights, drawing "gambolling atoms" (like Kekule) or other dream figures, and confronting the anxiety associated with creativity. The journal *qua* diary also serves the purpose of allowing a context for changing constraints. The futures researcher, who is encountering a particularly difficult problem, can retrospectively pinpoint antecedents for changing ideas or methods by referring to journal entries made during the period. The journal is an end itself, in the sense that we would know relatively little about creativity in general and innovation in science in particular except for the fact that most auctors have maintained journals, diaries, or memoirs. As an end product, the journal could be used to interpret the innovation in the context of the life of the creative scientist. In this manner, we could learn about the creative process in certain fields of interest and could learn first-hand about creativity by imitating the techniques and "thought experiments" of the auctor.

Journal writing presents an excellent vehicle for practicing the "personal science" that is represented by the general orientation to creative futures research. In virtually any domain of life, the "personal scientist" could ask researchable questions or venture hypotheses, subject these to an effective problem-solving process, and record the results of these experiments in the journal. This technique is similar to the cognitive-behavioral approach to psychological report writing advocated by Meichenbaum (1976). The cognitive-behavioral approach recognizes the influence of the examiner upon the testing enterprise. Therefore, it calls for the investigator to record publically the hypotheses, the methods by which they are tested, and the outcomes, including the rejection of hypotheses for other positions. Using this procedure in journal writing would make the thinking of the researcher accessible to the public of interested reviewers.

Some less scientific approaches to journal writing could also provide for the developing researcher a sense of progress, thereby enhancing self-efficacy. Use of the journal for self-exploration allows the researcher to "play" with ideas and possibly develop intuition, as well. The creative researcher may wish to frame journal entries in terms of one or more questions about the future. For example, "What will be the impacts of holograms and laser technologies upon classroom teaching in the year 2000?" Then, the researcher would begin writing spontaneously (the key to creative journal writing), honestly, deeply, and fluidly. Organization, grammatical style, and technical accuracy are not important in this type of journal writing. Expressing oneself candidly, in order to expose values; vividly, to access right-brain data through metaphor; and immediately, to capture fleeting insights, is most important. Other techniques include writing for an imaginary audience, searching for contradictions and "opposites" in previous entries and then writing to resolve them, writing a "letter from the future" in which one looks back to what happened in the present, and creating an autobiography which focuses upon daily feelings rather than specific happenings. Some good resources for journal writing include The New Diary (Rainer, 1978) and Keeping Your Personal Journal (Simons, 1978).

In the present section, we have attempted to discuss some general principles and procedures associated with general orientation to creative futures research. Several aspects of this stage were emphasized: auctors learn to be independent, open to experience, and flexible in perspective; they tend to possess characteristics similar to those of "transcending self-actualizers" (Maslow, 1971); they eschew specialization and seek broad, interdisciplinary knowledge; they notice their successes and expect to find beneficial solutions with effort and persistance; and they select problems for futures research that acknowledge the potential power of individuals to shape their destinies. Journal writing was suggested as a technique for increasing self-efficacy and creativity. In order to facilitate the development of creativity in this stage of problem-solving, we offer the following recommendations to futures researchers.

1. Establish a good relationship with a mentor, who is interested in your personal and professional growth.
2. Read daily some subject that you know little about, especially if you have avoided the subject in the past.
3. Maintain a personal journal on a regular basis, focusing upon successes and indicators of progress in your research.

Problem Selection. The stage of problem selection in creative futures research flows naturally from the general orientation stage. In fact, changes in research problems and professional interests are usually intimately related to shifts in general orientation. As one's views of the self, the world, and the future change, there are likely to be corresponding changes in personal and professional life. By noting how changes in one's personal life affect occupational interests and how changes in research and professional activities affect interpersonal relations and home life, the creative futures researcher develops sensitivity to the direction of the career path.

The intentional, autonomous futures researcher is interested in the following questions. Why did I choose this research question? What will the study mean to me personally? How may the results of this study affect the way I view myself, my world, and my future? What outcome is likely to shock or disappoint me? How will this study fit with my personal life and my career goals? When will I know that I have chosen the "right" line of research or that it is time for a change? Will the process of this study bring meaning to my life? Will the outcome of this study produce any benefits for loved ones or others in society? These questions confront the investigator with the intrinsically existential nature of futures research. The questions make good stimuli for journal writing and the answers have the potential to act as heuristics for personal/professional synergy.

Personal/professional synergy refers to the balancing of personal and professional commitments in order to forge a career that makes sense (Nicholson & Golson, 1983). The goal of futures research problem selection in the context of personal/professional synergy is to reduce the likelihood of occupational stagnation and burnout, and increase the probability of innovation and personal renewal. Ideally, problem selection will contribute to "psychological hardiness," viewing change as challenge rather than as a stressor (Nicholson & Golson, 1983, p. 159). According to the personal/professional synergy perspective, problems should be selected in such a manner that there is adequate time for private, productive, and intimate renewal in personal and professional life.

The synergistic perspective enables the futures researcher to treat career as lifelong learning. It encourages auctors to value "recurrent education," the alternating of life emphases upon occupation, home or family, leisure, and continuing education, depending upon the developmental stage of the researcher. For example, the young researcher who devotes too much time to a particular study or a prematurely formed line of research may fail to encounter insights available in leisure activities and stimuli for creativity that arise in supportive, intimate relationships. Without proper balance, lack of investment in private and intimate time may affect advesely the professional research effort. Biases and distortions are likely to be expressed in the process of research and the interpretation of outcomes when personal and interpersonal needs go unrecognized. On the other hand, when there is recognition of individual needs, the researcher is able to pursue truth, as objectively as possible, and to bring the insights garnered from diverse life experiences to bear upon creative problem solutions.

Personal/professional synergy is basically knowing what sort of research problem to select in a given life situation. Early in a research career, the best problem to select would be one that is delimited, "nested" within an ongoing line of productive research (perhaps directed by a mentor), moderately demanding, and likely to be fruitful. In this case, the developing researcher not only has the opportunity to learn through direction in a "hands-on" effort, but also to succeed clearly in the short-run. To tackle a "great life's work" early in one's career is to crystallize interests prematurely and to unbalance the career, by placing too much emphasis upon occupation and investing too little time in personal renewal and self-exploration. The proper research problem for the autonomous acutor may be the project that answers a recurring question in life and that provides the opportunity for a significant contribution to society. In this situation, the auctor selects a problem, which (when it is answered) contributes to a sense of immortality or connection to eternity. There are different needs and purposes for the creative futures researcher who will innovate a useful product and the auctorive futures researcher who will place a personal stamp upon the thinking of generations to come.

In the analysis of the problem selection stage of creative futures research, it is clear that the operations involve much more than just finding a topic that is acceptable according to conventional scientific criteria. Problem selection is closely linked to general orientation, and both reflect an existential approach to the research effort. According to our perspective, selection of a research problem, in a specific study or a line of inquiry, is affected by the prevailing needs of the investigator. The relative balance between personal and professional activities is critical to the emergence of creativity over the lifespan.

In this section, we discussed the career of the creative futures researcher as balance in lifelong learning. The value of recurrent education was suggested: alternating emphases upon occupation, home, leisure, and continuing education. In addition, personal/professional synergy was provided as a context for selecting problems in a viable, self-renewing, and productive manner. In order to continue our contribution to the development of creativity in futures researchers, we wish to offer the following recommendations, which are specific to the problem selection stage, yet complementary to those offered in the general orientation section.

4. Develop a personal time management system, which reflects investment of quality time each day in private, occupational, and interpersonal activities.

5. Plan times each day for creative thought by setting aside at least one hour for journal writing, private speculation, relaxation/leisure, or "browsing" through books and resources for new ideas.

6. Complete periodically a career timeline in which you note significant events in lifelong learning and speculate about dates for accomplishing future goals.

Problem Definition and Formulation. As suggested by the framework of D'Zurilla and Goldfried (1971), the stage of problem definition and formulation has received considerable attention in the research literature. Most futures researchers are familiar with the steps involved in operationalizing a research question and framing the problem in such a manner that a specific hypothesis can be generated. However, techniques for creative classification are not as well known.

In futures research, classification of stimuli in the problem situation--as causes, antecedents, precursors, signs, correlates, etc.--is very difficult because "...the future is an ill-structured problem" (Mendell, 1978, p. 149). We frequently do not know what data is needed and we possess few useful models and prescriptions. Ultimately, there is no such thing as "truth" about a complex, evolving environment; there is no such thing as a "solution" to an ill-structured futures problem (Mendell, 1978). Rather, the process of futures research must be open with respect to gathering data from the environment, according to an existing perspective, and to fitting a new model to the situation, when incoming data challenge perspective. Ideally, the futures researcher will be able to assume the role of a "Lockean inquirer," who examines available empirical data with as little model construction as possible. However, this approach is likely to overwhelm the investigator with too much information from the complex environment. Then, the researcher discovers the utility of the role of a "Leibnizian inquirer," who structures the process of information-gathering by confronting data with well-developed theories. Adoption of this role in problem formulation manages the chaos in complicated data by imposing form, but the application of a fixed model tends to filter out new information. Habitual use of a model that has "finished," impermeable boundaries results in the pitfalls of ideology and confirmatory bias, which were discussed in a previous section (pp. 7-9). Avoidance of explicit theories and models creates excessive uncertainty and confusion, avoidance of responsibility, and injury to self-efficacy. Therefore, the creative futures researcher must strike a balance between data-oriented and model-oriented approaches to information gathering (Mendell, 1978).

According to contemporary approaches to cognition (see Neisser, 1976), we evaluate the data of experience by framing situations, which have similar characteristics, according to the conceptual "maps" or schemata that we possess. We are able to classify situations as similar, and treat them as cues for certain kinds of actions, since there are some significant, recurring properties across situations that "afford" a given meaning. When we encounter situations that can be recognized, the data that are processed tend to confirm existing schemata. We naturally seek additional confirmation by admitting more and more data. As increasing amounts of data are processed, there is a greater likelihood of encountering some "new" invariant property of the situation. New data refute aspects of existing models, sometimes leading to change in classification or perspective. This process underlies the changing of constraints in a research problem. Abrupt and profound changes in conceptual structure may explain part of the experience of insight. The futures researcher can create encounters that favor flexibility in perspective by first looking for the familiar properties in new or ambiguous situations, and then, searching for new data in familiar situations.

The best way to serve the inter-related processes of model-building and data-gathering is to define, initially, the problem situation in as clear and precise a manner as possible. This will help the researcher find what he or she is looking for in a potentially chaotic situation. Explicit problem definition not only fosters a readiness to process more (and potentially dissonant) information about a problem situation, but also, facilitates the "courage to create" by increasing certainty and self-efficacy. Being explicit renders the research more accessible to professional peers and to society which has the right to examine the goals and values of someone who would tamper with the future. When the existing model of the futures researcher is confirmed, then the application of some techniques may assist in processing new data in flexible, creative ways.

An omnibus technique that encourages creative problem formulation is application of general system theory (von Bertalanffy, 1968) in futures research. Systems theory and cybernetics shift the attention of the investigator from single-category, single-cause, single-effect models to multicategory, multicause, multieffect formulations (Schwartz, 1982). As a technique, systems thinking reduces the likelihood that problems will be framed in terms of "either-or" propositions. Instead, it promotes "both-and" thinking in which contexts and patterns emerge from whole scenarios. Joining facets of experience with "and" rather than causal or logical connectors suppresses the "vertical thinking" (de Bono, 1968) that orders classification in habitual and conventional ways. "Lateral thinking" increases the range of connections, revealing whole patterns in complex interactions and suggesting "gaps" in the overall problem situation that beckon research.

Although it is beyond the scope of this paper to describe the many interesting concepts in systems theory, several constructs have special value for futures research. The notion of "punctuation" (Dell, 1982), breaking complex sequences of interaction into recognizable parts, is critical in fixing the futures researcher's perspective. If an observer of a complex system of interactions decides to punctuate a sequence in brief, specific, linear, cause-and-effect "chunks," then the person may imagine the future as a nearly unidimensional chain of deterministic choices. In addition, this investigator is likely to envision the cause of the future arising earlier in the chain, perhaps the immediate past. Should another observer punctuate the same system of interactions into larger chunks, allowing connections among actors and elements to reveal higher-order patterns (e.g., reciprocity, complementarity, and circular causation), the view of the future is likely to be more cyclical-recurrent than continuous. A key to using systemic thinking in futures research is to try to identify the circularities of interaction that constitute higher-order coherence in a problem situation. The researcher might ask, "How can I describe what may happen when these influences fit together?" or "What would be the context for the behavioral coherence of this group discontinuously transforming the system as a whole?"

Some of the questions that can be asked within the systems perspective will provide additional data for problem formulation, as well as for self-exploration. According to Bateson (1979), information about differences among events observed in the empirical world leads to concern for facts and particulars. Information about differences between classes of events in a sample of possible events leads to relational thinking and tentative generalizations. Finally, information about differences among "classes of classes of events" leads to discovery of shifts in states of consciousness, awareness of connectedness of all living things, and sense of self-referential mental processes. As we have frequently suggested in the present paper, close examination of phenomena in the environment, the "objects" of scientific inquiry, leads to self-examination of individual existence.

The technique of systems thinking has tremendous power for freeing the problem formulation process. Examination of the goodness of fit among elements in a system, or agents in a pattern of interactions, can suggest gaps in present information, as well as influences that are emerging as trends. Since it is difficult for the individual futures researcher to overcome [illegible] ways of framing problems, it is frequently useful to speak with [illegible] whose differences in perspective can stimulate pattern recognition.

A useful approach to stimulating pattern recognition is <u>speaking with "witnesses from the future"</u> (Amara, 1978). Given our present understanding of perception, it is impossible to actually witness the future. However, the acumen of a particular auctor can provide a radically different context for reviewing research questions. Auctors can serve as surrogate explorers in time, when they have substantial knowledge in the field under study, personal interest in the outcome of the study, appreciation for historical and future contexts, and aesthetic sensitivity. Insights for problem formulation can be secured through informal visits with witnesses, formal supervisory sessions, or correspondence by mail. Unlike mentors, witnesses typically provide short-term assistance, helping a researcher who is stuck in the formulation stage.

Another approach to stimulating pattern recognition is discovering traces from the past, which are becoming patterns or trends of the future (Amara, 1978). Typically, this technique involves extending perceptions of the past and present into the future through extrapolation and forecasting. Extrapolation is ostensibly data-oriented and removed from theories and values. However, we have argued elsewhere in this paper (pp. 4-9) that linear extrapolation is subject to a continuity bias and to such ideologies as historicism. A surrogate for extrapolation, which explicitly conveys values and goals, is scenario-writing. A scenario is a "slice of future history," in which a participant-observer translates past and present trends into one or more alternative futures. This approach reflects the "willed future" in its form: "What is conceivable and viable, given the opportunities and limitations we project for the future?"

A final approach to creative problem formulation is devising leading questions (Mendell, 1978). Leading questions not only expose gaps in necessary information, but also provide a transition to the next stage of futures research, preparation and effort. The questions should be devised so that they capture essential facets of historical and futuristic perspectives. The answers to a series of leading questions should generate a research problem that could produce several hypotheses or solutions. Yet, the answers should provide sufficient direction for organized preparation and effort. An example is "What if the late 1990s were a replay of the turbulent 1960s, but the rebels were older adults instead of young people?" This question would encourage the futures researcher to consider characteristics of the people and the times as reflected in the past and the present. This line of inquiry would also force the investigator to speculate about the characteristics of older adults in the 1990s. Considerable preparation and background work would be required to flesh-out the implications of the question. Given the scope of the inquiry, this leading question would probably result in a number of hypotheses, which could incorporate quantitative indices and scenario-type descriptions.

This section included a number of techniques for enhancing problem definition and formulation. We emphasized the importance of explicit definition, in order to overcome cognitive biases and promote readiness for exploration of new data. The challenge of problem definition and formulation was identified in the necessity of striking a balance between data-oriented and model-oriented approaches to information gathering. The application of systems theory in futures research was indicated. Systems thinking provides a promising approach for resolving tendencies to emphasize either raw data or existing theory. In addition, systems thinking seems to have potential for improving pattern recognition in problem formulation and self-exploration. Several approaches were considered in the context of stimulating pattern recognition: speaking with "witnesses from the future," discovering traces from the past, and devising leading questions. We offer the following recommendations for developing creativity in problem definition and formulation.

7. Read one of the works of Gregory Bateson, an innovator who contributed significantly to the apparent paradigm shift in science towards systemic, wholistic thinking.

8. Identify and speak with a witness from the future who could help you recognize some patterns that you may not have considered in your work to date.

9. Practice the technique of devising leading questions, in journal

writing or during private creative time.

Preparation and Effort. This stage follows problem definition and formulation, preparing the way for the emergence of intuitive problem-solving, which occurs in the next stage, incubation and the generation of hypotheses. While it is obvious that the creative futures researcher must prepare for problem-solution by studying, assessing existing constraints, and framing the boundaries of the project, it is not clear why intense work and persistence in using logical methods actually facilitates intuition. We have speculated that frustration, encountered during extended work without success, contributes to readiness to change constraints or perspectives (see pp.19-24). Similarly, processing a large amount of information may create some cognitive dissonance (a motivator for change) since new data are likely to confront existing schemata. The most straight-forward interpretation of the value of preparation in creative problem-solving is that extended effort often leads to relaxing or breaking away from the research question. Then the disciplined, left-brain operations give way to indirect, right-brain processes. Intuition heeds the call of exhausted reason.

Most diligent, hard-working researchers have encountered the "blocks" to problem-solving that arise from preparation and effort. Some researchers have probably experienced a feeling of "stuckness" in systematically approaching well-defined, overly structured problems. The intellectual disciplines of scholarship and scientific method do not seem to work. In fact, the structure of the research question and the rigidity of inquiry may render the problem unsolvable in the conventional approach. However, the researcher can learn much about the self and the world through discovery of what does not work. Failure with old methods and ideas can pave the way for new learnings. Such is the case in the study of Zen koans or questions. They cannot be solved through conventional thinking, but the discipline and structured inquiry, which characterize the initial problem-solving efforts, prepare the student to experience enlightment.

A Zen koan is a paradoxical teaching method aimed at forcing a student to transcend the abstract conceptualizing and logical reasoning of customary problem-solving. The study of Zen koans, or other word puzzles such as Sufi teaching stories (see Shah, 1970), represents a technique for developing creative preparation and effort (Kubose & Umemoto, 1980). The typical learning situation involves a student apprentice seeking knowledge from a Zen master. The student is earnestly committed to the quest for truth, hoping to learn the "right methods" of inquiry through long years of study with the master. Initially, the master provides direction regarding the "right" way to think and act, to meditate and practice physical discipline. At some point in the training, the master will respond to the student's request for knowledge by assigning a koan for study. The student may be instructed to return for more knowledge when the right answer is found. The koan is so deceptively simple that the student expects to solve the question immediately, and therefore, diligently applies the sharpened tools of discipline and reason. The paradox of the koan is that it is framed in simple language, encouraging effort and basic logic in the student's initial approach. However, it cannot be solved by a rational approach.

A famous example of a koan is "What is the sound of one hand clapping?" There is no "right" or logical answer to this question. Instead, an appropriate response from a student might be extending one's hand to the master. Another famous anecdote in Zen is the case of that student who wished to learn quickly the art of swordsmanship from a renowned master. The student indicated his willingness to study and practice in a concerted, tireless manner. He asked the master how long it would take to acquire the skill. The master replied, "Ten years." Then, the student continued to describe his strong motivation to learn and his willingness to work long hours to hasten the learning process. He asked the master about the duration of training under such extraordinary conditions. The master replied, "Twenty years; a student in such a hurry learns slowly."

The koan represents a type of preparation that could assist futures researchers in generating creative solutions to problems. Long periods of concentration on a research problem, which has been clearly delimited, will frequently lead to frustration. The creative futures researcher will not abandon the question at this point. Instead, the investigator will attempt new ways of approaching his or her study. In Zen, the student eventually experiences deflection of attention away from the problem as logically framed and toward other disciplined approaches such as "zazen," an intensive meditation experience in which subject and object boundaries are dissolved (Kapleau, 1966). In this manner, preparation and effort provide an intentional transition to the incubation stage of creative problem-solving. By setting aside sufficient time to concentrate intensely on problems and persisting in study in spite of frustration, the creative futures researcher actually invests in the success of the next stage of problem-solving.

In this section, we wished to emphasize some unusual characteristics of preparation and effort. Most competent researchers understand the importance of background study and commitment of time to the investigation. We believe that the most innovative problem-solutions will emerge from intense, intially well-structured approaches. Creative preparation is probably characterized by extraordinary investment of time and energy in sometimes marathom problem-solving efforts. The literature on auctors (see Mansfield & Busse, 1981) indicates that they evidence extreme commitment to work as manifested in their scholarly productivity. According to our view, the content of the work is less important than the investment of effort. In keeping with our goal of suggesting techniques for developing creativity, we offer the following recommendations for preparation and effort.

10. Incorporate some periods of intense concentration and effort in your time management plan for personal/professional synergy.
11. Develop an understanding of the Zen approach to preparation by reading a popular account of the discipline, such as Zen in the Art of Archery (Herrigel, 1953).
12. Find the answer to the following koan.

Once there was an old man who asked a Buddhist scholar, "Of the so (notes that explain a classic text, e.g., a Buddhist sutra) and the sho (notes that further explain the so), which is broader in meaning?" The scholar said, Sho explains the so, and so explains the text." The old man said, "What does the text explain?" (Hoffman, 1977, p. 67)

Incubation and Generation of Hypotheses. This stage provides opportunities for creative thought and intellectual breakthrough. The activities associated with the stage lead to quieting of dominant, left-brain processes and evoking of intuitive, right-brain operations. Incubation and generation of hypotheses act upon the readiness to change constraints produced by preparation and effort. Both components suppress logical, habitual cognition, encouraging the production of diverse ideas, the formation of novel associations, and the recognition of new patterns of relatedness. The chance events and intentional activities of the incubation component represent deflection of attention away from overt, conscious problem-solving. Incubation is characterized by self-exploration techniques that are (1) process-oriented, (2) relatively unstructured, (3) relational (fitting self to others or self to world), and (4) concrete and sensory. The planned events and intentional activities of the generation of hypotheses component represent concentration of attention upon many, diverse attempts at problem-solving. Generation of hypotheses is characterized by problem-exploration techniques that are (1) task- or outcome-oriented, (3) relatively structured, (3) instrumental (expressing self though actions upon the world), and (4) abstract and verbal.

The active techniques involved in generation of hypotheses foster creativity by systematically varying perspectives so that new ideas may be synthesized. The more passive techniques involved in incubation foster creativity by increasing receptivity to new patterns of relatedness in stimuli. Creative generation of hypotheses "unfreezes cognition" in the sense that boundaries of existing theories and models, held by the researcher, become more flexible. Creative incubation "freezes cognition" in the sense that openness to experience requires formation of novel, tentative boundaries for personal and environmental data. Creative associations are formed and constraints are changed from involvement in either component.

Generation of hypotheses through active, problem-exploration techniques seems to best assist the futures researcher who typically functions as a "Leibnizian inquirer" (Mendell, 1978). This type of researcher possesses well-developed theories of the future and benefits most from the new data afforded by instrumental changes in perspective. By engaging in numerous activities to generate alternatives, the investigator is exposed to many new ideas, which, in combination, may result in the shifting of perspective to an innovative hypothesis. On the other hand, incubation through passive, self-exploration techniques seems to best help the "Lockean" futures researcher, who is typically open to lots of data from experience (Mendell, 1978). Incubation, in effect, limits the amount of information that is processed so that form can be imposed upon existing data by means of pattern recognition and model construction. Intense involvement in either component may result in an altered state of consciousness in which subject-object distinctions in perspective are rendered meaningless. The result of prolonged activity in this stage may be self-transcendence: in incubation, transcendence of self-absorption, and in generation of hypotheses, transcendence of task absorption. As discussed earlier (pp.38-40), the experience of intimation heralds transcendence to the illumination stage.

Techniques for effective incubation include participation in leisure acitivity, relaxation, meditation, art, and exercise. Recreational activities, such as hobbies and vacations, contribute to renewal in personal/professional synergy and increase the likelihood of new experiences and chance associations. Relaxation, important in stress management, provides a balancing effect to the significant mental and physical demands of intensive preparation. In addition, the "relaxation response" (Benson, 1975) evokes a qualitatively different state of consciousness, which facilitates creativity. The relaxation response, which is a secular version of transcendental meditation, involves muscular relaxation, deep breathing, and mental calmness, all of which are facilitated by subvocal repetition of a number. While Benson (1975) discusses the value of relaxation for managing hypertension and reducing risk for other stress-related diseases, proponents of transcendental meditation (e.g., Shear, 1980) emphasize the value of deep relaxation for the creative process.

According to Shear (1980), many creative individuals have experienced the restfulness, automatic unfoldment, deep consciousness, and joy that characterize transcendental meditation. The following lines from William Wordsworth describe the experience.

...that serene and blessed mood,
In which the affections gently lead us on
Until, the breath of this corporeal frame
And even the motion of our human blood
Almost suspended, we are laid asleep
In body, and become a living soul;
While with an eye made quiet by the power
Of Harmony, and the deep power of joy,
We see into the life of things. (de Selincourt, 1944, p. 260)

Among those said to find inspiration in meditation were Paul Valery, the French poet, Brahms and Mozart, and Einstein (Shear, 1980). Others find artistic expression to be a useful incubation device.

The use of art to express and stimulate creativity has a long history. For example, nonverbal thought, facilitated by drawing and actually recorded in pictures, has played a major role in the development of technology, from crude saw mills to elaborate machines (Ferguson, 1977). Contemporary approaches to the role of art in creativity (Adams, 1974; Edwards, 1979; Franck, 1980) recommend the artisitic enterprise for developing imagination and relativity in thought. Although most programs for developing artistic creativity are targeted at children (see Gardner, 1982), adults can benefit from some of the techniques. An excellent resource for enhancing creativity through art is Drawing on the Right Side of the Brain (Edwards, 1979). One of the techniques from the book, "upside-down drawing," involves forcing a shift from left-hemisphere mode to right-hemisphere mode by copying an upside-down image. This exercise can produce some extraordinary results, not only in the quality of the drawing, but also the production of an altered state.

Incubation can be stimulated by self-expression in art (e.g., drawing), and in other modalities, such as drama and dance. Many creative media can facilitate the growth of imagination, and therefore, increase the range of potential s utions to research problems. Behavior therapists (Cautela, 1977; Singer, 1971) have recognized the value of imagery and daydream methods for solving psychological problems. The application of imagery-based techniques in behavior therapy has revealed that (1) imagery exists in several modalities, (2) some persons have greater ease in imagining than others, and (3) ability to imagine can be improved through training. Most people report ability in visual imagery, in the sense that they can recall previous experiences in some detail or respond to a stimulus word (e.g., "green") with a degree of visualization. A few people have problems with visual imagery, typically because they are very verbal individuals or they have preferences for imagery in other modalities. The channels for imagery include sound (auditory imagery), taste (gustatory), touch (tactual), smell (olfactory), bodily motion (kinesthetic), and general physical sense (somatic imagery). The creative futures researcher should be able to develop skills for the incubation period by engaging in as many forms of imagery as possible. For example, "What will the typical urban setting of the year 2000 smell like?" Creative and expressive arts provide excellent vehicles for self-exploration, and indirectly problem-exploration, in the incubation stage.

Another technique for cultivating creativity in incubation is participation in exercise or physical conditioning. Glasser (1976), in describing "positive addiction," found that persons who engage in noncompetitive, regular exercise of about an hour per day report altered states of consciousness similar to those associated with meditation. Some runners report such peak experiences as heightened ability to concentrate, limitless energy, and "flow," a breaking down of the sense of being separate from other objects in the world (Porter, 1978). In addition, exercise presents the more conventional values of better health, increased stamina and aerobic capacity, and stronger self-efficacy (Glasser, 1976). Jogging would be an excellent incubation strategy for the auctorive futures researcher.

Creative incubation involves deflecting attention from conscious to unconscious problem-solving. Several techniques were suggested in terms of their value for altering consciousness, contributing to personal/professional synergy, and facilitating pattern recognition. The major techniques were practicing relaxation or meditation, using artisitic expression, manipulating imagery, and participating in exercise. The approaches to generation of hypotheses, the second component in this stage, are more problem-oriented and less concerned with self-exploration than the strategies for cultivating incubation.

Techniques for effective generation of hypotheses include brainstorming, the prototype for generation of alternatives; thinking aloud, a verbal method; and analogizing, an imagery-based approach. Brainstorming has been considered in detail in an earlier section (pp.47-49); therefore, only the basic procedures will be summarized. The major principles include (1) eliminating criticism and evaluation, (2) engaging in unrestrained idea generation, (3) seeking as many solutions as possible, and (4) improving ideas by combination and modification. While the technique is usually employed in group settings, in order to generate creative associations from many individual contributions, brainstorming can take the form of a personal effort.

Thinking aloud represents an individual brainstorming strategy in which "freewheeling" verbal production increases the likelihood of novel association and perspective shifting. This technique involves (1) compiling a list of stimulus words from the preparation efforts, (2) responding to each of the words by speaking into an audiotape recorder for a designated period, and (3) reviewing the verbal products for new ideas and connections. The utility of the procedure is probably based in the rapid, unrestrained production. Therefore, the researcher who engages in thinking aloud for creative problem-solving will need to practice the expression of ideas without editing or requiring complete, grammatically-correct utterances.

The technique of analogizing provides the means for shifting from verbal thinking to imagery. Since there are two well-developed programs for building analogy skills, Synectics (Gordon & Poze, 1981) and Mindspring (Prince, 1975), specific techniques will be presented within general descriptions of the programs. Analogizing, in its various forms, essentially requires the creative individual to discover functional similarities between things that are otherwise unlike.

Synectics is a training model for developing innovative solutions to institutional, group, or individual problems. It is applied most frequently to creative problem-solving in industry and education. The basic premise of the model is that analogy formation enables an introduction of conscious materials (previously-learned information, skills, and perspectives) to the "subconscious," which then refines the materials into innovative products and returns them to the conscious, verbal mode of thinking. According to the model (Gordon & Poze, 1981), the first step in this transfer process is the formation of a functional analog.

The functional analog involves "thinking aloud" (not related to the version mentioned earlier): approaching the problem analytically at first, attempting to arrive at the essence of an object by employing a variety of verbal symbols, and finally narrowing them down to a conventional metaphor, stated verbally. This metaphor produces an image (usually visual, but theoretically including other modalities), believed to be produced by the subconscious, but kept alive by conscious attention. The visual images are usually fuzzy and indistinct, allowing a variety of analog formations to occur. Gordon (1961) has defined a number of variations of analogy and metaphor for "making the familiar strange" and instigating the psychological states of detachment, speculation, involvement with object, and deferment of solution. These variations are treated as "operational mechanisms."

One of the mechanisms, direct analogy, involves the actual comparison of parallel facts, constructs, and technologies in one field with those of another, often very different, discipline. Gordon (1961) observed that some of the most rewarding analogies in the development of industrial products have been discovered by direct analogy to knowledge in biology--particularly, the functions of biological organisms.

Another mechanism is personal analogy, a technique requiring personal identification with the object being studied. A chemist, for example, would become "one" with the molecules under investigation, discarding analytic detachment in order to empathize with them as they are pushed and pulled about by various forces. Einstein revised electromagnetic theory by completing a Gedanken experiment in which he envisioned himself travelling parallel to a beam of light (Holton, 1978).

A final mechanism operates upon fantasy visualization. The fantasy analogy technique encourages the investigator to imagine the last stage of a creative endeavor in its ideal form without the interference of any barriers. By restraining premature judgment of the viability of a solution or hypothesis, the researcher is able to expand the range of alternatives and to examine ideas that might have been otherwise overlooked by the rational faculties. The second program for developing creativity, Mindspring (Prince, 1975), also emphasizes fantasy and imagination in its techniques.

Prince (1975) incorporated these associative methods into a system of thinking operations termed the Mindspring theory. The theory delineates some recurrent cognitive strategies in creative problem-solving: (1) wishing, (2) retrieving, (3) comparing, (4) transforming (or recycling to the first operation if the retrieved solution is unacceptable), and (5) imaging. Conditions necessary for the success of the operations include ability to suspend arrival at an early solution and willingness to balance the desire for precision with tolerance for approximation. Therefore, this training model possesses characteristics of both brainstorming and Synectics.

Wishing, closely related to Gordon's (1961) fantasy analogy technique, is usually the first operation employed, since it serves as a catalyst for subsequent steps in the model. It often requires the innovator to imagine an optimal, albeit seemingly unrealistic result. The invention of the Polaroid camera by Dr. Edwin Land was inspired by his daughter's then-fanciful desire for photographs she could view instantly.

The second operation is retrieval of existing, relevant information. Although this would seem to be a rather straight-forward process, most problem-solvers create obstacles to retrieval. Since there is a tendency to avoid activity in areas about which one lacks knowledge, the majority of people are in the habit of retrieving only a small part of what they know. Specialization in education and career favors easy access to "expert" knowledge and fosters intolerance of imprecision and approximation. Yet, information from a diverse array of fields actually facilitates intellectual breakthrough through the generation of many alternative hypotheses. In addition, since retrieval is accessed through the current, habitual mode of information processing, while storage may have been accomplished via a different processing network, access is frequently problematic.

Comparing is an operation that is learned at an early age, being engaged within the framework of values and standards associated with socialization. A frequent emphasis on the precise and the definitive, however, leads the individual to compare only in relation to exactness of fit, discarding approximate or imperfectly-parallel matches. This preoccupation with perfection leads the researcher to discard many otherwise promising leads as inappropriate to the problem at hand, because of their flaws.

As the third strategy in the Mindspring model, creative comparing, like retrieving, involves relating the similarities of disparate elements and focusing on the positive implications of the elements for creative innovation. Beginning with the premise that a particular idea will work helps in removing the presumed negative consequences of being wrong, freeing the individual to explore the possibilities and benefits of a concept more fully.

Effective transforming, the fourth operation, involves a realization of one's potential for retrieving, appending, deleting, altering, augmenting and combining elements. It, along with the other mechanisms of creative thinking, necessitates a tolerance for a certain amount of risk, unpredictability, ambiguity, anxiety, and incorrectness. One must also be comfortable with the possibility of obtaining a completely unanticipated result.

Imaging, or the ability to visualize, play with, bend, intertwine and generally distort words and concepts, is a technique that is useful in breaking through barriers to effective transforming, comparing and information retrieval. It affords direct access to "forgotten" memories and potentially creative associations. The following techniques are representative of imaging.

"Essential paradox" (Prince, 1975) is a two-word phrase, one containing the essence of a single feature of a problem, and the other representing a paradox of the first. The most frequently used combinations are nouns and adjectives, used for making book title-type phrases. In this mechanism, individuals are directed to define an object in a compressed way. They are instructed to envision having written a book about a particular concept or object, then inventing a poetic, paradoxical two-word title that captures its essence.

The Essential Paradox technique is closely related to Rothenberg's (1976) concept of "Janusian thinking," which is also used in conjunction with sociodrama classes in creative problem-solving workshops. The sociodrama participants are instructed to write scenarios containing characters who possess such opposing traits as selfish-generous or clever-stupid. The scenarios describe "collision conflicts" for which the authors could conceptualize no viable solution. They are then distributed to other team members to role-play, resulting in a variety of creative syntheses and solutions (Torrance, 1979). Both "picture making" and "cloud watching" are also employed in making creative associations, the vehicle in these being visual imagery (Prince, 1975).

In picture making, the individual selects a key feature of the problem, suspends direct attention on it, then makes an abstract drawing or doodle using colored pens. The problem-solver analyzes the drawing, attempting to conceive a concrete image from the abstraction. Following this comes the cycle of comparison and transformation operations, relating the image to the problem, as outlined above. In cloud watching, the innovator once again conceptualizes a key problem element then releases it, concentrating instead on a cloud image. Within the cloud, one watches for more specific images to unfold. When a particularly striking image forms, it is clarified and embellished. Next, it is processed through the comparing and transforming steps in the model. If the innovative product provides a valuable problem solution or hypothesis, it is subsequently stored.

The rich array of techniques arising from the Mindspring model can provide an excellent resource for generation of hypotheses. Both Mindspring and Synectics emphasize application of imagery in creative problem-solving. Along with thinking aloud and brainstorming, the models offer a variety of active, intentional strategies for problem-exploration. While many futures researchers, having existing theories to develop, will likely be drawn to the active techniques for gathering data and generating alternative hypotheses, the more passive techniques of incubation should not be neglected. Actually, the active problem-exploration techniques could be incorporated within passive self-exploration experiences as games or recreational activities. However, the incubation techniques have their own merits, particularly when they follow extended effort and preparation. Incubation occupies a recurrent position in the advocated personal/professional synergy, as well.

We have attempted to overview a large volume of material related to the stage of incubation and generation of hypotheses, a period in creative problem-solving in which effort is transferred from logical, analytical approaches to intuitive, consciousness-expanding operations. The products that are synthesized during this stage are then experienced as innovations or intellectual breakthroughs in the next stage, illumination. The following recommendations are offered to encourage expansion of the range of incubation and hypothesis generation alternatives among creative futures researchers.

13. Complete some of the exercises in Drawing on the Right Side of the Brain (Edwards, 1979).
14. Cultivate imagery by approaching futures research problems from all modalities.
15. Join some colleagues in brainstorming hypotheses for a particularly complex research problem.

Illumination. The stage of illumination is often experienced by the individual as a sudden flash of insight. In the Wallas (1926) model, this stage follows incubation and precedes verification. Our approach treats illumination as a less distinct phenomenon in discovery. It can be the result of incubation or generation of hypotheses. In addition, more than one insight or intellectual breakthrough may occur during this fruitful period. The products of illumination are subjected to decision-making in creative futures research.

Intimation, a pleasant experience associated with the anticipation of a near-future solution, is sometimes realized at the close of the incubation period. This experience can be treated as a signal that a potentially creative idea or hypothesis will come without additional effort. In fact, return to an active period of preparation may actually interfere with the closure process in pattern recognition or restructuring. Intimation occasionally follows the more active procedures used to generate alternative hypotheses. In this instance, the investigator may sense that it is a good time to stop the activities of the incubation/generation stage.

The momentary halt provides a valuable transition period for the realization of insight.

An outcome of intimation, which is expressed in the illumination stage, is a sense of certainty that an insight is important. While this is one of the frequently reported "rewards" of creative thought, it produces two possibly adverse side effects. One characteristic associated with a strong feeling of certainty is an unwillingness or inability to consider competing ideas. Biases can be introduced by inadequate generation of alternatives (the earlier stage) and confirmed by the powerful experience of illumination. In this manner, the decision-making and verification stages are compromised. Therefore, the enthusiasm of certainty should not lead to a "final" solution. Instead, the energy and conviction produced by the experience should be channeled into the essential commitment to truth-seeking. The creative researcher will always emerge from illumination with several good hypotheses.

The second side effect of illumination is a sense that the insight, about which one is so certain, will persist for some time. This is a serious pitfall for creative research because brilliant, vivid ideas are frequently lost in memory and new experience. It is essential that the products of illimination be recorded as soon as possible. Some of the efficient, portable techniques from the field of cognitive assessment (Merluzzi, Glass, & Genest, 1981) have considerable value for <u>recording the results of illumination</u>. One technique involves carrying index cards which have convenient, explicit instructions for "thought-listing" or recording insights. Another approach requires that an associate contact that researcher on a randomized schedule during the later part of incubation, particularly if the investigator has recently reported the intimation experience. In this technique, the associate would make telephone calls according to the random schedule, ask the researcher some pertinent, prearranged questions, and record the comments on some form. Keeping such records insures that the creative researcher will enjoy the opportunity to review ideas prior to the decision-making.

This section provided a brief consideration of techniques for preserving both the "magic" of insights and the integrity of the problem-solving process. Intimation and illumination are powerful emotional experiences in which the dedicated investigator is rewarded for effective problem formulation and preparation. It is demoralizing to lose the products of illumination through carelessness. Similarly, self-efficacy and personal/professional synergy are adversely affected by retrospective realization of implicit biases in the decision-making and verificaiton procedures. Therefore, hypotheses arising from the stage of illumination should be treated as tentative alternatives and preserved for examination through careful, systematic recording. Our recommendations for this stage of creative futures research address these issues.

16. Plan to generate at least two research hypotheses, in addition to the null hypothesis, for every futures question.
17. Recognize the experience of intimation as a cue for suspension of problem-exploration effort and enactment of previously organized plans for recording insights.
18. Develop a system of plans, inquiry protocols, and forms, which will be available for implementation of easy-access recording.

Decision-Making. One of the best understood stages in problem-solving is decision-making. However, it represents a period in the research process that is particularly prone to abuse. Decisions, like problems and insights, are tentative, reversible choices in creative futures research because the "ill-structured" nature of the future demands that decisions be capable of re-evaluation as antecedent conditions and consequences unfold. There should be less concern with making "correct" and scientifically respectable decisions and more dedication to framing tentative choices in such a way numerous alternatives can be recognized. As an analogy, the process of futures research should sometimes be like a fishing expedition, rather than always like the adept handling of a razor.

Hypotheses should be minimally relevant to the questions they attempt to answer. Yet, the researcher must be aware that no hypothesis can ultimately account for the vast range of relevant data in an uncertain futures problem. Hypotheses should also be powerful, when they attempt to predict or explain the important data that constitute future existence. However, too-powerful hypotheses tend to be self-fulfilling and prematurely compelling in comparison to competing ideas. In this situation, the range of alternative futures is artificially restricted and the quest for truth is discouraged. The guesses presented for decision-making should additionally be simple without being reductionistic. The complex nature of individual, interpersonal, and systemic change suggest that simple hypotheses will miss the mark. Creative futures researchers are willing to accept hypotheses that are broader and "rougher" approximations than those enjoyed in tightly controlled, narrowly delimited experimental settings.

Creative futures research hypotheses are often incompatible with some known facts and principles. However, this divergence from what is known forms a foundation that is critical to innovation. Alternative futures require truly novel guesses or the procedures of research blindly recreate the past. In order to tolerate broad, occasionally incompatible hypotheses within a scientific model, some conventions must be applied in evaluating the "goodness" of competing alternatives. The major convention is the requirement that the futures research hypothesis must be falsifiable to the extent that it can be subjected to some empirical test. Nevertheless, the criteria for testing need not be those applied in the rigorously controlled experimental situation. Standards for evaluating data should be clearly stated, but they need not be restricted to quantitative methods or requirements for digital, linear punctuation of experience. In reality, the complex problems of the future probably require "broad-brush" generalizations and anecdotal descriptions. Therefore, the standards used in evaluating the research value of alternative futures research hypotheses should be expansive rather than restrictive, qualitative rather than exclusively quantitative, and anecdotal rather than digital. Paradigms for futures research will be discussed briefly in the section on the verification stage.

Decision-making in effective futures research also requires careful attention to the values of the individual investigator. To do otherwise is to deny the essentially existential nature of the research effort. Errors and biases in decision-making can be somewhat controlled by making values and preferences explicit, instead of leaving them covert. Just as the constructs contained in hypotheses are put to the test during verification operations, the values of the investigator are exposed to potential refutation. An appropriate approach to the "willed future" is to develop standards for hypotheses that take into account their scientific and personal merit.

One technique for creative decision-making is to develop a list of personally valued standards for identifying research hypotheses. The list should at least address the prominent criteria for scientific evaluation:

(1) relevancy, (2) falsifiability, (3) compatibility, (4) power, and (5) parsimony. However, the list should not stop here. The creative futures researcher should bring all sorts of personal, professional, interpersonal, social, and higher-order values to bear upon decision-making. The subjectively expected utilities of each hypothesis would be determined in the ideal decision-making scenario. A viable technique for incorporating many preferences and ideals in the process is "self-centering."

The self-centering technique (created by the senior author) encourages comparison of ideas or hypotheses according to the explicit values of the researcher. The technique essentially involves repeated rank-ordering of alternatives based upon how well each hypothesis satisfies or addresses a given need, interest, or value. The needs, interests, and values are listed prior to the rank-ordering, and evaluations are made as independently as possible. For the purpose of futures research alternatives with the top three average ranks are retained for testing or verification purposes. The exercise can be completed by means of card sorting or completing a written evaluation matrix.

In this section, we have tried to discuss central issues in creative decision-making. Assuming that the previous steps in problem-solving have generated an array of potentially sound hypotheses, the creative futures researcher must face the challenge of selecting the best ones for additional investigation. The standards for decision-making in conventional science favor alternatives that reflect historical choices and narrow accounts of the future. The investigator confronts directly the tension between justifying the past and the present, and unearthing the "willed future." In order to create a rich set of alternative futures, decisions must be tentatively framed and subjected to periodic review, generally scientific in origin, and specifically related to personal values. In order to promote reconceptualization of decision-making among futures researchers, we wish to recommend the following practices.

19. Redefine criteria for scientific merit of hypotheses according to personal preferences for scope and precision in data-gathering.
20. Review a completed research project in terms of various kinds of empirical data that were not considered in evaluating your hypotheses.
21. Complete a self-centering exercise in deciding among several alternative choices that could be made in a selected personal or professional matter.

Verification. The final stage of creative futures research is verification. It is beyond the scope of the present paper to discuss the merits of the many extant research design, methodological, and measurement options available to the contemporary researcher. The TOTE model, discussed in a previous section (pp.50-51), can be considered a generic approach to evaluating the outcomes of decisions that are selected and implemented. The testing of futures research hypotheses presents some special problems, which should be addressed.

Hypotheses that attempt to describe, predict, or explain the future, encounter the inevitable problem of lack of structure and control. The "laboratory"is some situation that does not presently exist, although historical trends and existing precursors may strongly suggest that a given future in en potencia, or in the process of becoming. The fundamental testing of futures-oriented hypotheses involves determination of how well a selected estimate or piece of speculation fits one or more sets of data or events. Usually, there is not an opportunity to wait for the future to unfold in order to verify the "goodness" of a hypothesis; therefore, various surrogates, samples, and simulations are used. Although most investigators would readily admit that the future is "ill-structured," uncertain, and influenced by numerous complex interactions, many of the "defining studies," which attempt to establish evidence for the goodness of a futures-oriented hypothesis, approach their research questions in a very linear, objective manner. Frequently, the underlying assumptions of a study are unidimensional, reductionistic, digital, deterministic, and static. Although these assumptions sometimes lead to creative methods for "proving" hypotheses, they can foster restrictive, ideologically-based, and humanly uninvolved types of research, which do not address the complexity and challenge of the future.

An apparent paradigm shift in science away from linear, single cause-and-effect models toward wholistic, systemic approaches (see Schwartz, 1982) may portend dramatic changes in verification strategies. Linear thinking is based upon punctuation of experience into digital events: "either something happens or it does not happen," and sometimes "if this happens, then this thing follows." Digital communication is adequate for describing the interaction of a human being with an object, but it can lead to errors in interpretation when applied to interactions among human beings (Haley, 1976). Analogic communication, expressed in verbal metaphors and in actions, seems better suited to capturing the "meaning" in the enormous amount of data generated by human interactions. It has its own justificatory logic in the sense that analogic accounts attempt to describe rather than prove. Analogic communication, when transformed into stories and anecdotes, can illustrate the similarities among different situations and sets of data. By providing many examples and identifying similarities in context, the anecdotalist is able to provide a rich, compelling view of the world, without eliminating large chunks of data. Since the data of "muddleheaded anecdotalism" (Simons, 1978) is close to the data of futures research, the creative investigator should consider collecting stories and scenarios in the verification stage. Testing hypotheses by means of building scenarios around careful, naturalistic observations is a promising approach.

Futures research is frequently targeted to some identifiable segment of society, a particular geographical location, an environmental setting, or a specific population. Although targets for futures studies do not always exist in the present, there are usually a few environmental antecedents that are accessible. Researchers who are willing to examine closely the antecedents, as they develop, may not only uncover additional concrete data, but also, recognize nonlinear patterns of relatedness. Direct, naturalistic observation of systems in process provides an outstanding opportunity to verify the outcomes of futures research. In addition, actual field involvement in the study encourages the investigator to examine personal and professional meanings attached to complex interactions in a system of interest. In a sense, naturalistic inquiry favors immersion in a project. The researcher retains a professional role and applies the most accurate methods of investigation. However, he or she is also involved authentically in the project, attentive to personal values, sensitized to the implications of the study for the population of interest, and responsive to a wealth of empirical data, which might otherwise go unnoticed.

Verification in creative futures research represents a microcosm of the issues affecting other stages in the model. Basically, the theme of verification is "How can one test the value of a futures research solution while remaining true to the innovation and the data it attempts to addresss and retaining the conventions that define an inquiry as scientific?" The auctorive researcher must reject some conventional scientific practices and purposes in order to create. However, the scientific community (and the larger system of society) actually determines the context for changing perspectives: enabling then possibly recognizing breakthroughs and products of creative research. The problem is essentially one of "changing yet remaining the same." The recurrent pattern of discontinuous insights contributed by individual researchers facilitates the continuous evolution of science.

Verification is related to the first stage in our model in the sense that the outcomes of specific research efforts affect the general orientation of the investigator. The means for testing research hypotheses also confront the insights of self-creation. The creative futures researcher exposes cherished beliefs and perspectives to refutation. The methods of verification must not only control biases and subjective error in evaluation, but also, reflect the values of the scientist engaged in personal/professional synergy. Therefore, verification must be relatively objective, while remaining intrinsically personal. As the autonomous futures researcher struggles with the conventions of science and the choices to make private ideas public, sense of self-efficacy and career meaning are forged.

The operations of the verification stage are also related to the processes of problem selection, definition, and formulation, the next three steps in the model. Success in investigating a problem is dependent upon the extent to which the data revealed in the course of verification actually answer a research question. The techniques of framing a question for study provide direction for subsequent creativity, decision-making, and verification. Problem formulation determines whether a given study is more data-oriented or theory-oriented. Initial approaches to defining a futures research problem probably establishes whether the investigation will examine linear, discrete phenomena or complex, systemic experience.

"Preparation and effort, "the stage following problem definition and formulatic is indirectly related to verification. The investigator embarks upon a study with the expectation that effort will produce meaningful results. When there are errors in problem formulation or verification, preparation and effort seems "wasted," and therefore, personal/professional synergy is affected. On the other hand, extended effort, in concert w .h incubation/illumination, creates the risk that decision-making and verification will be compromised. The experience of intimation, following effort and incubation, or generation of hypotheses, produces such a sense of well-being and certainty that some hypotheses may be favored in the evaluation process.

In this section, we have tried to examine some alternative approaches to those traditionally included in verification. We believe that the practice of futures research would be more creative if hypotheses were evaluated within the context of relevant systems of interaction. Also, the construction of anecdotes and scenarios may better account for complex futures, than the linear, digital approaches to verification, which seem to maintain or justify the past, rather than address evolving opportunities. Finally, creative futures research should involve some fieldwork, in which naturalistic observations uncover maximum data and refine the conventional scientific methods. We recommend the following activities for cultivating creativity in the verification stage.

22. Interview several actual or potential subjects from a research population of interest and record their anecdotal accour . of the future.

23. Write a practice- or policy-oriented paper that translates the results of a recent research project into specific recommendations for attaining a desired future.

24. Conduct a small research project as a field study or naturalistic investigation.

Having completed our recommendations and our framework for cultivating creativity in futures research, we wish to return to the central theme of the paper.

Summary

Why do futures researchers seem to recreate the past, ignore novel alternatives, and support the status quo? The answer was found in the tacit dimension of research: the results of investigation provide continuity for not only the scientific community and society at large, but also the investigator, who must confront uncertainty and find the courage to create. Futures research sustains reality for society and meaning for the individual researcher.

Faced with the challenge of research, some investigators avoid or distort truth. Science provides a method for fallible humans to describe, predict, and explain a complex and potentially chaotic future. Yet, the conventional nature of science creates pitfalls for the researcher who would become preoccupied with methods and results. Therefore, the process of research is essentially one of acquiring self-knowledge, during the course of which innovations can arise.

The creative breakthrough is a struggle within the person between what is known and an insight trying to be born. When the patterns that are consciously known from scientific training and experience no longer serve the exploration process, the unconscious can provide a rich resource for new ideas. Intuition in creative futures research contributes to a new balance between uncertainty and doubt by suggesting novel patterns of relatedness in the world. While the success of technology can block off the "creativity of the spirit," intuition can heed the call of exhausted reason. The two can work in concert for the purposes of creative futures research: the conduct of inquiry in which the self and the world are explored with the goal of creating alternative futures consistent with the values of the researcher and the ideals of society.

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