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ABSTRACT

This report reviews and analyzes the development and status of computer-assisted-guidance (CAG) systems. In terms of eight major topics which are introduced in a discussion of guidance and the computer, the report discusses the capabilities of computers in reference to other resources for guidance and describes and differentiates various CAG systems. The eight focuses with their minor headings are scope (information and guidance, data processing, and populations and settings), content (appraisal, information, decision-making, and planning), structure (direct access to information, structured search for occupations, cross-walks, and recapitulation for decision-making), style (interactivity, hardware, system design, and script-writing), procedures (what to include, sources of data, interpretation of data, and updating information), costs (itemization of components and typical costs per terminal hour), effects, and rationales for guidance and models of career decision-making (Parson's true reasoning, trait-matching for success or membership, and freedom, understanding, competence, and satisfaction). A list of references and glossary of acronyms are appended. (YLB)

COMPUTER-ASSISTED GUIDANCE: CONCEPTS AND PRACTICES

RR-80-1

by

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ABSTRACT

The development and status of computer-assisted guidance systems are reviewed and analyzed. They are compared with other career guidance resources and differentiated from one another in terms of such major topics as scope, content, structure, style, procedures, cost, effects, and rationales and models.

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PREFACE

The authors are closely associated with one of the computer-assisted guidance systems discussed in this report. Inevitably, the question of objectivity must be considered.

This is not a question of factual accuracy. All facts and observations reported are readily documented and stand on their own feet. Still, even if a report consisted only of statements of facts, it would not be entirely objective. There is a process of selection (and therefore of judgment) in deciding which facts to report. Differential knowledge may also be a frequent source of bias: writers, no matter how impartial, may know and understand some systems better than others.

We have tried to guard against these different sources of bias--favoritism, insufficient knowledge, and imperfect understanding. At the same time, we have tried to make explicit the point of view from which we write. Thus, we have refrained as much as possible from expressing gratuitous opinions, but we have not shrunk from making relevant judgments that might enhance the usefulness of the report. Such judgments are offered for what they are worth, given their source.

INTRODUCTION

Computer-assisted guidance resembles instruction in that it aims to foster the acquisition of knowledge, the development of understanding, and the mastery of competencies. It differs, however, in that a substantial portion of the knowledge must be provided by the learner. In guidance, the learner is part of the content. Career decisions depend largely on the values, interests, and abilities of the decision-maker; so it is essential to bring the student's "latent knowledge" (as Socrates calls it) of these characteristics into explicit awareness and expression.

A further distinction lies in a comparison of the purposes of education and guidance (Katz, 1968): Education purports to deal primarily with the "universals" in the culture, while guidance is concerned with the "alternatives." This dichotomy is not just a distinction; it also suggests an interaction:

> If the role of education is to transmit the culture, the role of guidance is to help the individual come to terms with the culture--that is, to see himself in the culture. But first he must see the culture in himself. Thus, his first question should be, "Where have my values come from?" His second, "Where are they taking me?" (Katz, 1963)

Guidance, then, is one of the most highly individualized components of education. It has emerged from such phenomena as the division of labor in society and respect for individual differences. It recognizes that different people have different needs, values, circumstances, backgrounds, preferences, plans, developmental rates, and styles and that these differences affect the options that are available to them, the choices they make, and the processes by which they reach decisions.

Traditionally, to cope with such differences and the corresponding need for flexible, individualized treatment, guidance has depended heavily on the dyadic relationship--the professional counselor working with one client at a time. Despite infusions of federal funds to educate counselors and support improvements in the ratio of counselors to students, there has never been any possibility of meeting needs for guidance in this way. More recently another way has been found to make individualized guidance widely and cheaply accessible--through computerized systems. Thus, in accordance with the American genius, individualization has been accomplished through technology. Just as mass production and distribution of automobiles accommodated transportation to people's own schedules and needs, computer-assisted guidance has provided a means for everyone to interact with a guidance resource that is attentive to individual differences and responsive to distinctive needs and content.

Computers have long contributed to record-keeping and data-processing for guidance. But development projects aimed at using computers to assist more directly in career guidance first gained prominence in the 1960's. A continuing group of people (with occasional drop-ins and drop-outs) who had initiated such projects got together in a series of conferences to exchange ideas, discuss problems, and share reports of progress. Previously, they and, no doubt, a number of others had given thought to the capabilities of computers for various guidance purposes--no attempt will be made here to trace the origins of the notion or to establish historical priorities. The point is that the concurrent activities of various people in different places testified to the inevitability of the concept: that interactive computer capabilities could be applied to guidance needs and practices. It is noteworthy that a spirit of cooperation rather than competition characterized these pioneer projects. Thus, their developmental activities surfaced publicly in a kind of floating symposium; from 1966 to 1970, meetings were hosted by Ohio State University, Systems Development

Corporation, International Business Machines, American Institutes for Research, Harvard University, Willowbrook High School, and Educational Testing Service, at their respective sites. Robert Campbell of Ohio State University served as permanent secretary of these conferences, which were chaired at various times by David Tiedeman, John Cogswell, Frank Minor, John Flanagan, JoAnn Harris, and Martin Katz. (For an example of the proceedings of one conference, names of other participants, and brief descriptions of some of the systems, see Computer-based Vocational Guidance Systems, published by the Office of Education, U. S. Department of HEW, 1969.) Usually, the developmental work of the host organization was demonstrated (e.g., ECES* at IBM, CVIS at Willowbrook, SIGI at ETS) or described in detail (e.g., PLAN at AIR, ISVD at Harvard), and various other developers also described their systems (such as the late Joseph Impellitteri's CACE at Pennsylvania State University).

Of these early systems, CVIS is at this writing in operation at about 35 computer sites, with terminals at about 250 schools. ECES IV serves the Genesee County School District in Flint, Michigan. SIGI is at over 50 colleges. Other systems since developed for general distribution include GIS (derived from ILS), DISCOVER, CHOICES and COIN. There has also been a marked trend toward development of specific state systems, starting with the Oregon Occupational Information Access System. The OIAS (under the generic name of CIS), GIS, CHOICES, and COIN have been adapted as the bases for various state systems.

Impetus for implementation of state systems came in 1975, when the Employment and Training Administration of the Department of Labor established a grants program to fund occupational information systems in eight states.

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*See the Glossary of Acronyms, pp. 80-81.

This number has currently been extended under the auspices of the National Occupational Information Coordinating Committee to include 15 additional states in fiscal year 1980. (NOICC was established to comprise the Commissioner of Education, the Administrator for the National Center for Educational Statistics, the Commissioner of Labor Statistics, and the Assistant Secretary for Education and Training.) Of the first eight states, four used the Oregon CIS as a model (Colorado, Massachusetts, Minnesota, and Washington), three adapted GIS (Wisconsin, Ohio, and Alabama), and Michigan developed its own system (MOIS). The extent to which state systems have been disseminated and used varies widely from state to state. Of the 15 states just funded, 5 plan to use CIS, 2 (possibly 2 more) expect to use CHOICES, 2 are committed to GIS, and 1 to COIN. Others are undecided at this writing.

This historical note suggests the rapidly increasing prevalence of computer-assisted guidance systems from 1966 to 1980. Aided by infusions of federal funding, diminishing hardware costs, and demonstrations of feasibility and success, they appear to have emerged from the experimental stage, and the surviving systems have begun to make a substantial showing on the national scene. More data on the prevalence and use of such systems, as well as their respective qualities and relative effects, will be derived from a study sponsored by NIE and NOICC, now under way by a research team that includes the present authors (Werksman, 1979). Definitive statements about the various systems should obviously await the completion of this research. Nevertheless, from a review of the literature, from some first-hand acquaintance and experience with various systems, and from questionnaires already completed by a few of the developers, it is possible to reach some conclusions about the ways in which computer-assisted guidance (hereinafter CAG) relates to other guidance resources and about the distinctive features of some of the systems.

GUIDANCE AND THE COMPUTER

In CAG, what is the computer assisting? What sort of assistance does it provide? As a helping profession, guidance implies some theory of intervention (Katz, 1963, 1969a). There is assumed to be prior understanding of the phenomena with which the intervention is concerned--for example, what the nature of career decisions is and how they are made in the absence of a planned professional intervention. Studies in the "natural history" of career development, however, while relevant for guidance theory, are not sufficient for it--just as theories of learning are not sufficient for a theory of instruction. Presumably, "the role of guidance [in career decision-making] is to reduce the discrepancy between a [person's] untutored readiness for rational behavior and some hypothetical ideal state of knowledge and wisdom" (Katz, 1963). To fulfill this role, career guidance procedures typically (from Parsons, 1909, to the present) include attention to three major topics. Activities devoted to <u>appraisal of the client</u> loom large in most (but not all) guidance programs. Another major component is generally <u>information about options</u>. A third has to do with the evaluation of options, or <u>strategies for decision-making</u>. To these may be added <u>planning</u> for appropriate action--ways of implementing decisions. Competencies in these four areas may be said to comprise the "curriculum" for career development (Katz, 1973).

A primary distinguishing feature of any CAG system, then, is its <u>scope</u>: which of these major components does it attempt to deal with, and to what extent? (Scope should also include the populations of clients and the settings in which systems are to be used.) Another source of variation is the range and nature of the content of each component. Still another is the structure of the system--the interrelationships and linkages between components, the routing of students through them. There are also stylistic differences--methods of presentation, format, language, graphics, methods of communication. (Subsumed under style--usually exercising a powerful influence on it--is the particular hardware used, although similar hardware configurations can be employed in strikingly different ways. Here one may also consider the extent to which a system is self-contained--or involves off-line materials, people, or activities. One facet of style which warrants particular attention is the degree of interactivity.) Another rubric of interest is the procedures used by developers--how they arrive at their own decisions (e.g., which occupations to include; what topics of appraisal or information; what sources of data, what methods of collecting, analyzing, and interpreting data; the number, training and responsibilities of staff; frequency of updating; use of reviewers; pricing and marketing strategies). Although comparisons are often difficult to make, the cost of each system is important to prospective users. Even more important may be effectiveness--what evaluation studies have been made, and what do they show about the effects of a system? Finally, one may consider the underlying rationale for guidance, the model of career decision-making on which each system is based. Different theories may be embodied in different systems. But there are also differences in the degree to which any coherent theory undergirds a system. Whether the theory is explicit, implicit, eclectic, or nonexistent may have implications for a system's integrity. Explicit theory may also provide particularly interesting opportunities for research aimed at illuminating the career decision-making process. Each of these rubrics will serve as a focus for discussion of the capabilities of computers in reference to other resources for guidance and also as dimensions along which various computer-assisted guidance systems can be described and differentiated.

SCOPE

The term computer-assisted guidance implies that the computerized activities are embedded in a more comprehensive program of guidance. Included may be such other resources as people (counselors, teachers, family, friends), printed materials (books, periodicals, pamphlets, briefs, directories), audio-visual media (films, slides, videotapes, cassettes, microfilm, microfiche), tests and inventories (including interpretive guides), sorting materials (keysorts, needlesorts), and school-arranged experiences (courses in career planning, units in subject matter classes, exploratory work-experience, career days and fairs, career clubs, site visits, job shadowing, conferences, simulated job experiences). Each of these resources in itself may be broad or narrow in scope. There is considerable redundancy in them. One may sometimes complement another, sometimes be used in its stead--depending perhaps on cost-effectiveness, perhaps on the predilections of those in charge of the program. Different resources may be used for different subgroups of clients. Thus, total programs in various places may involve different mixes of these resources and CAG. The design and composition of such programs is a function of the school or other sponsoring agency. In any case, each CAG system--intended for a variety of institutions--tends to be devised with a minimum of assumptions about the nature of the entity of which it may be a part. It is rarely expected to stand alone, with no other resources available. Yet within the limits set by its own purposes, each attempts to be as independent as possible so that it will not be locked out of use by the absence of certain resources. At any rate, the scope of each CAG system specifies what functions it may serve and how it can best be articulated with other resources.

Information and Guidance

The major objective of many of the systems has been to provide occupational information. This objective is the mandated point of departure for the state systems in the federally funded program. The names of the sponsoring federal agency--National Occupational Information Coordinating Committee (NOICC)--and of the state agencies (SOICC) established by it under the Education Amendments of 1976 (PL 94-482) make clear that occupational information is the name of the game. The Youth Employment and Demonstration Projects Act of 1977 (PL 95-93) adds emphasis on the problems of unemployed youth, and also on assisting and encouraging the use of occupational information in career decision-making, to the NOICC responsibilities. The Comprehensive Employment and Training Act Amendments of 1978 (PL 95-524) require NOICC to "give special attention to the labor market needs of youth," including "assistance for programs of computer on-line terminals...to improve the match of youth career desires with available and anticipated labor demand." Finally, the NOICC announcement lists among the specific objectives of the Computerized Information Delivery Systems grants program helping "entrants into the labor force become aware of occupations that they would find acceptable and personally satisfying" and encouraging "persons in the process of career exploration and decision-making to seek out vocational information on their own." Thus, the federal grants program, starting with emphasis on information about occupations (and other options--education, training, local jobs), seems to be extending its scope somewhat. Self appraisal and decision-making appear to be wrapped in the phrase "acceptable and personally satisfying," and decision-making is specifically mentioned along with exploration.

The existing state CAG projects, perhaps in response to the original emphasis of the sponsoring Employment and Training Administration of the Department of Labor, tended to focus almost entirely on information. They designated themselves unequivocally as information systems (e.g., Career Information System, Guidance Information System). The pioneering projects were more diverse. While Computerized Vocational Information System, as its name implies, limited itself pretty much to information (as did Computer-Assisted Career Exploration), the others tended to have markedly broader scope. For example, Educational and Career Exploration System offered background instruction in the vocational development process and the types of information that are needed at different stages in the process. ISVD attempted to "encompass a complete...decision-making environment," with particular emphasis on users' understanding of the process itself and development of a "sense of agency"--control of and responsibility for their own career choices. Among current systems SIGI and DISCOVER are broadest in scope. SIGI addresses in its six major sections (Values, Locate, Compare, Prediction, Planning, and Strategy) all of the components of guidance listed above. DISCOVER also addresses all of these components, although with a different balance.

Thus, of the present population of CAG systems, most set out to be primarily information systems, with some rudimentary extensions to appraisal and decision-making. SIGI and DISCOVER purport to be information and guidance systems, although both are offered with suggestions for supplementation by other resources.

Data Processing

The earliest way in which the computer served guidance was to extend the size, ease, and speed of statistical calculations. It made feasible and commonplace the computation of large intercorrelation matrices, stepwise multiple regression equations, large-scale factor analyses. The prospect of such capabilities so bedazzled Clark Hull that he envisioned a ...gle universal battery" of 30 or 40 tests used to "sample all the important aptitude determiners"; the scores would be fed into a machine:

> Upon the basis of this one battery there will be constructed separate forecasting formulae for each of the more important type occupations....In its final form, this machine will have the different forecasting formulae placed in it permanently....As the machine makes its forecasts it will stamp them down on ...[a] card automatically....
>
> The card of forecasts, when removed from the machine, will then present in orderly array and in units of single uniform scale, permitting of instant comparisons, forecasts of the individual's probable success in all of the chief occupations of the world (Hull, 1928).

Hull's logical extension and application of trait-and-factor theory, as he gazed prophetically into the brave new world of psychometrics and computing machines, did not anticipate the stubbornness with which the data would resist neatly differentiated forecasting formulas.

Still, the CAG work of Cogswell and Estavan at SDC in the 1960's focused for a while on counselors' use of computers to do the calculations for statistical studies that would presumably provide data for counseling. But a field test showed that counselors, intrigued with this computer capability, spent all of their time running the studies and had no time left to use the findings in guidance of students. Hence the project changed course.

Computers have continued to play a large part in data processing for massive longitudinal studies that contribute to guidance programs--for example, the analyses of Project TALENT data that have gone into AIR's publication, Planning Career Goals (1976). Oddly, such computations and studies that were made possible by computers do not play a role in most of the current CAG systems. The exception is the Prediction section in SIGI, which enables students to plug their own scores and informed self-estimates into regression equations (for predicting success in "key courses") developed by the system staff and each college.

Populations and Settings

Some CAG systems have been aimed at highly specific types of users and settings for use, while others have been designed for more general use. The original version of CVIS was intended for high school students, and because it used pre-programmed information about the students' grades, it was meant to be used in the high school setting. State systems are generally intended for use in secondary schools, two- and four-year colleges, technical schools, State Employment Service offices, public libraries, correctional institutions, and CETA agencies.

Some systems have been modified for a wider variety of populations and settings than the ones they were first intended for. CVIS, for example, has been adapted for use by junior high schools and community colleges. CHOICES, originally developed for use in Canada Manpower Centres, is currently being adapted by at least two American states for use in a variety of settings. DISCOVER was developed for grades 7-12, but has more recently been adapted for use in college settings. SIGI was originally developed for students in (or about to enter) colleges, but some colleges have made it available to "feeder" high schools and CETA centers, and an adaptation is under way for the general adult population. In general, differentiation between systems in terms of populations and settings seems to be diminishing.

CONTENT

Guidance systems of similar scope may vary in the content of each component. For example, the appraisal component may include different attributes, or emphasize some more than others. Assessment may also take place in different ways. By the same token, information may involve different arrays of options, different topics, different methods of acquisition and different interpretations. While some of these and other differences will be elaborated under the headings of Structure, which immediately follows this section, and Models, with which the paper concludes, it is useful to touch on the highlights here.

Appraisal

Among the individual attributes that are often considered important for guidance are aptitudes, abilities and accomplishments, interests, values, physical handicaps, financial resources, attitudes, and temperaments.

Domains and dimensions. Each of these domains is represented in some CAG system, although it is difficult to say whether any system includes them all: Nomenclature is sometimes fuzzy--for example, temperaments may turn out to be operationally defined to overlap interests and values.

Space is not available to try to resolve these perseverant "jingle" and "jangle" phenomena here. It should be noted, however, that distinctions between sometimes-confused domains have been clearly comprehended and readily used in career decision-making by 8th- and 9th-grade students (Katz, 1959; Gribbons, 1960; Shimberg & Katz, 1962), have been explicated in logical terms (Katz, 1963), have been spelled out operationally at the item and inventory level (Katz, 1969b), and have been substantiated through factor analysis of test and inventory scores (Norris & Katz, 1970). The tenor of such distinctions may be suggested by the following excerpt:

> If needs are regarded as basic motivating forces, values may refer to characteristic outer expressions and culturally influenced manifestations of needs. They are teleologically described, in terms of the satisfying goal or desired state that is sought rather than in terms of the motivating drive, on the one hand, or specific instrumental actions, on the other hand. More specifically, values represent feelings [and judgments] about outcomes or results, such as the importance, purpose, or worth of an activity. Interests apply to the differentiated means by which the valued goal may be reached. They are concerned with satisfactions inherent primarily in the process rather than in the outcome of an activity. Thus, altruism and high income may be (often conflicting) occupational values.

> How one likes to help people or make money--by talking to groups, or repairing machinery, or solving mathematical problems--expresses occupational interest.
>
> Confusion occasionally appears...because the concept of interest--in the sense of engaging in an activity that is intrinsically enjoyable--may be more or less highly valued by various individuals.... In other words, the importance to an individual of doing work that is intrinsically interesting--as compared, say, with work that pays a high salary or work that helps others--is an indication of his values. The particular clusters of activities that he finds intrinsically appealing are an indication of his interests.
>
> The dimensions of interests, then, should not be mingled--in conception or in measurement--with the dimensions of values. Interest measures may be expected to identify and classify the activities that an individual finds intrinsically interesting. Such measures will not generally predict his global satisfaction in various options; they can predict only the satisfaction of his interests. When an individual has decided which clusters of activities are intrinsically interesting, he must still decide how much importance he wants to attach to satisfying intrinsic activity interest--compared, say, with such other occupational value dimensions as altruism, wealth, autonomy, and so on. For this comparison, a measure of his values is appropriate. Measures of values permit, ultimately, explicit prediction of the total satisfaction that he may derive from various options, provided that the instrumentality of each option in respect to each value can be rated (Katz, 1969b).

CAG systems differ in the extent to which they make or recognize such distinctions between domains and also in the attention or emphasis they give to any domain. For example, SIGI puts great emphasis on Values, whereas GIS allows users to decide whether they will emphasize Interests, Aptitudes, Lifestyle, or several other considerations.

In appraisal for guidance, confusion also prevails over the dimensions within each domain. There may be consensus on some factors used to represent a given domain, and considerable divergence on others. To illustrate from the domain of interests, sometimes so-called interest categories refer to occupational clusters ("engineering, physical sciences, mathematics, and architecture"), sometimes to types of activities ("persuasive"), sometimes to the objects of activities (e.g., "plants and animals"), sometimes to the purpose of activities (e.g., "protective"), sometimes to the setting of activities (e.g., "industrial"). Developers of some CAG systems appear to be either totally baffled or quite unperturbed by this chaotic state and do not even try to choose between divergent or anomalous dimensions. Thus, Michigan MOIS offers no fewer than three sets of interest dimensions: the user can choose SDS codes, OVIS scales, or a self-rating on People, Data, Things. At any rate, the systems diverge on interest dimensions at least as much as the extant standardized inventories. Of course, even when there is conceptual agreement on a dimension (say, scientific interest), different measures may give somewhat different results.

Methods of assessment. In guidance generally, standardized measures of aptitudes and interests have long been used. A number of factor analytic studies have identified certain reference factors that are useful in defining common and unique constructs embodied in the various measures. Still, a cursory glance at batteries and instruments shows little tendency towards convergence among those currently published and in wide use. Thus, interest inventories may have over 100 empirically derived occupational scales, or 6 or 10 or 12 or 24 analytically or logically derived scales. Even when two inventories produce equal numbers of scales, the names of the scales and the constructs they represent will vary. Thus, different instruments define the domain of interests differently. Similar observations hold for other domains of appraisal.

In addition to standardized tests or inventories, clients' own ratings are often used--sometimes quite formally, as in questionnaires or workbooks, sometimes informally, as in interviews with a counselor. To make such ratings, clients--instead of responding to many items that comprise a scale, with responses aggregated into a score on each scale--make a single response to a definition or representation of the sense of the scale. Virtually all CAG systems invite users to put in self-ratings on dimensions defined as comparable to those in various standardized instruments, plus a good many others.

CAG systems can involve users in five methods of appraisal. (1) A standardized test or inventory can be presented on line in a procedure as close as possible to the paper-and-pencil version, as DISCOVER does with the SDS and CPP. (2) Scores or results of such a test or inventory, taken off line, can be fed into the system: Thus, OVIS or SDS results can be entered into the Michigan MOIS; scores on any standardized test generally administered by a college can be entered into the SIGI Prediction section (provided that results of regression analyses warrant using them as predictors); GATB scores can be entered into CHOICES. (3) Users can rate themselves on scales defined to represent dimensions or constructs associated with various domains--virtually all CAG systems exemplify this procedure. (4) In Computerized Adaptive Testing (CAT) the computer selects items sequentially from a pool of items of known characteristics, thus "tailoring" the test to each individual for more efficient measurement than would be obtained by a conventional paper-and-pencil instrument representing the same item pool. So far, no CAG system employs CAT. (5) While CAT has so far tended to use conventional test items, some work has been done on computer-based interactive tests or inventories, involving construction of innovative types of exercises in which a user's responses generate new information and options. Such interactive measures can be applied to familiar constructs or to some that have not been tapped by conventional paper-and-pencil tests. The nearest paper-and-pencil counterpart is the "tab" test (sometimes used for simulations of real-life problem-solving), which is much more cumbersome and less flexible than a computerized interactive procedure. As an illustration of the latter, the "Values Game" in SIGI confronts students (who have weighted ten occupational values according to importance) with a series of values dilemmas; having made a choice, they encounter consequent problems or opportunities that give rise to new dilemmas involving further choices between competing values; at various points, choices are summarized graphically (in the form of a balance scale), and inconsistencies between the resolutions of dilemmas and the previous weights assigned to values are displayed; finally, values are reweighted after students have played as many (non-repeating) rounds of the game as they wish. The adjusted weights represent a profile of each student's "examined values." This kind of exercise is, of course, not strictly a test or inventory but also a learning experience: the learning process is mediated and the results are observed by the CAG system.

Information

CAG systems vary in the options about which they provide information. All of them have information about occupations. Some include as options "clusters" of occupations. The occupational data bases may be national, regional, state, local, or some combination. Local data bases may also include jobs within a given area (e.g., ECES IV, which incorporates a local "job bank" in its Placement component). Educational options may include colleges and other postsecondary institutions, covering the nation, region, and/or state.

At first glance, the topics of information covered in each system might appear quite similar. Virtually all the occupational data bases, for example, include a definition and description of the occupations, requirements for entry, wages and salaries, outlook, and the like--the "bread and butter" information. Closer inspection shows sharp distinctions between some of the systems. Even on a "bread and butter" topic like wages and salaries, GIS reports only the "most commonly occurring salary"; Iowa's CISI provides the average and range for beginning wages; SIGI gives beginning, median, top, and variation in salaries for each occupation.

In keeping with its emphasis on values, SIGI also provides information on opportunities for various kinds of satisfactions, linked to the values domain. (Linkages in various systems between appraisal and information are considered in the section on Structure, below.) In general, although the two domains are not isomorphic, topics included and emphasized in the information component of most systems tend to reflect those in the appraisal component of the same systems.

Decision-making

As indicated under Scope, most CAG systems do not include an explicit decision-making component. Implicit in them is often the notion that after having obtained a list of occupations (through structured access) for further investigation, students can use direct access to reduce or otherwise modify the list. Then, off-line contemplation of the options, "gut feelings," perhaps help and advice from off-line resources, are expected to lead to decisions. It is often not clear how this decision-making should take place, except for a vague sense that there should be some kind of match between the students' specifications and the characteristics of the occupations or other options chosen.

SIGI provides an explicit algorithm for evaluating occupations after the list has been winnowed. In the Strategy section, occupations can be compared in two major ways: overall desirability and probability of success in gaining entry. In effect, components of clients' values, occupational information, and predictions of success in preparatory education are brought together. Clients examine options in the light of relative rewards and risks; they learn and apply decision rules to make informed and rational choices.

Planning

Logically, planning of steps to enter an occupation would appear to follow the decision about which occupation one wants to enter. There is, however, some force to the argument that plans and decisions form a feedback loop. Sometimes a detailed appreciation of steps prerequisite or recommended for entry gives rise to second thoughts about one's resources for implementing a decision. Of course, information about requirements for entry is universally provided in all CAG systems. But these requirements are likely to be stated in general terms. They do not have the impact of step by step planning. It is one thing to see that a Bachelor's degree in engineering is required. But a detailed listing of programs and courses that would have to be taken to complete that degree may give the client pause. Also, as Freedman and Dutka (in press) point out, a mere listing of alternative pathways often fails to make clear which one is preferred or more likely to be productive. Furthermore, planning involves knowledge not only of the requirements for entry into an occupation, but also of available resources and assistance, such as special tutoring, financial aid, and the like.

At present, SIGI comes with a rudimentary Planning section; at the option of each college, a unique Planning section is tailored to the college, the work being done cooperatively by ETS and the college staff in accordance with instructions in a Planning System Manual (Chapman, 1977). This tailored Planning section is updated at the discretion of the college. A "universal" or more generalized Planning section, developed in the light of experience with a number of tailored sections, is now being constructed to replace the current abbreviated section.

Michigan's MOIS employs "cross-walks" (prompts suggesting the next logical step) among its files so that users are led to increasingly detailed information on planning. A user might pursue the following series of branches after reading an occupational description: the user might learn about what levels of education or training are preferred or optional for the occupation just examined; learn about what programs are offered at any of these levels, such as common college courses; perform a structured search of post-secondary schools offering programs preparing for that occupation, by selecting type of school and region of Michigan; get detailed information about any of the schools thus accessed.

STRUCTURE

Students seeking guidance often don't know what information they need, don't have what information they want, or can't use what information they have (Katz, 1963). The structure of a CAG system can help users learn what aspects of themselves and of the world of work they should learn more about; it can help them find the personal and occupational information that is relevant for their decisions; and it can help them interpret and integrate information in such a way as to make informed and rational decisions about their career plans.

Since the process of career decision-making embraces all of these activities, the structure of the CAG system must erect bridges between these components so that users can move through the complete system purposefully. Bridges alone, however, will not insure that a group of components can function together as parts of a system. A bridge between two islands will permit traffic to flow between them, but if the inhabitants of the two islands speak two different languages, commerce will be hindered and interchange of ideas will be garbled. Similarly, if a CAG system's components use inconsistent concepts of guidance, users will become confused and will not acquire a coherent sense of themselves, the world of work, and their plans for entering the world of work.

Direct Access to Information

One important aspect of the system's structure is how the information files are accessed. "Direct access" is analogous to using the index in a book and then turning to the pages where the information resides. For example, the user may consult a list to learn the code for a given occupation (analogous to the page number), then enter that code and receive the occupational description.

In many CAG systems, direct access retrieves the complete description of the occupation; this is analogous to reading a complete page or consecutive set of pages in a book. So that users can browse as well, some systems (e.g., CVIS) print out a capsule description of the occupation, then allow the user either to choose among more detailed categories of information about the occupation, or to move on to another occupation. Other systems (e.g., SIGI and CHOICES) permit the user to select one detailed category of information (such as outlook) or ask a pointed question on some topic. They then display the appropriate entries for three occupations simultaneously for comparison. To apply the analogy of a book to this operation, one must imagine tearing similar paragraphs from three separate pages and piecing them together for the sake of comparisons. The unique capabilities of the computer make such an effect possible without damage to the medium.

Direct access programs tend to use specific occupations as discrete units; the information about each occupation may be subdivided into detailed categories, but information about a fixed "cluster" of occupations may not be retrieved together by a single command. By way of contrast, some books are organized to group occupations by clusters: in the Occupational Outlook Handbook, for example, one may consult the table of contents and see reference to a chapter on "Clerical Occupations," which consists of 13 occupations such as receptionist and stock clerk described in close proximity. Direct access programs function not like a table of contents to access chapters, but rather like an index to access discrete units of information.

Structured Search for Occupations

"Structured search," on the other hand, does permit users to access ad hoc groupings of occupations by using the special capabilities of the computer to assemble a cluster of occupations uniquely suited to the user. The user specifies a set of characteristics, and the computer sorts through its file of perhaps several hundred occupations to find those which fit the set of characteristics specified. Usually the computer displays the selected occupations merely as a list of titles and code numbers, under the assumption that the user may not want to retrieve additional information about all of them. The user can then follow up by retrieving more detailed information on occupations of interest through direct access. A common traditional feature of structured search is the "why not?" option, which allows the user to ask why an occupation in the computer's file did not appear on the list generated by structured search; the computer responds by itemizing the characteristics specified by the user which have ruled out the missing occupation.

The computer's search capability thus works quite differently from the table of contents of a book, which usually organizes the material by a single classification scheme. The table of contents of the Guide for Occupational Exploration (United States Department of Labor, 1979), for example, divides the book's collection of occupations into 12 interest areas (Artistic, Scientific, Mechanical, etc.). Although a book's chapters may be subdivided according to additional schemes of classification, the result will still not duplicate what a computer can do in a structured search. Imagine a book about occupations with a table of contents divided into chapters organized by interest fields, subchapters organized by level of income offered, subsubchapters organized by physical strength required, and so on through ten tiers of classification. This work of classification would be impressive, but would still be helpful only to the user who wants to search using the characteristics in the (arbitrarily) hierarchic order given. A user wanting to search first by level of income (the subchapter level) would have to keep skipping from one interest field (one chapter) to another. Beginning the search with the fifth-tier characteristic would be impossibly cumbersome. Most CAG systems, on the other hand, permit users to select search characteristics in a combination or order of their own choosing. A search in a book is rigid and one-dimensional, while a computerized search is flexible and multi-dimensional. It can slice through the universe of occupational characteristics in a variety of planes.

One difference between CAG systems is whether the computer responds to each search characteristic immediately after it is entered, telling how many occupations are appropriate (as do GIS and CHOICES), or whether the computer waits until a complete set is entered before responding (as do CVIS and SIGI). In CIS-based systems the computer waits but can, at any time during the set of search questions, be commanded to tell how many occupations currently fit the specified characteristics, or to list the occupations.

Search characteristics, search rules, and philosophy of guidance. Another major difference between systems is which particular characteristics are used for structured search. They vary considerably, reflecting the different theories of guidance (or lack of theory) inherent in the systems. Some characteristics are expressed in terms of the user: Colorado's COCIS (an adaptation of CIS), for example, asks whether or not the user has poor eyesight. Other characteristics are expressed in terms of tasks, rewards, or conditions of work: COCIS asks whether the user would prefer jobs which are mostly indoor or mostly outdoor. However the questions are asked, the underlying assumptions are that the user-related characteristics (e.g., poor eyesight) can be matched to some occupations that are somehow appropriate, and that the job-related characteristics (e.g., outdoor work) are meaningful to clients in discriminating between occupations.

Some characteristics, such as poor eyesight, permit only a yes/no choice (or "no preference," if the user does not want to search with that characteristic), while others, such as average level of pay, permit a scale of choices.

As each search characteristic is entered, the computer may follow any of several "rules" in searching through its set of occupations. To begin with, the computer may search for occupations which have a certain characteristic, or for occupations which do not have that characteristic. In GIS, either rule may be specified for any characteristic. A characteristic which offers a scale of choices allows several possible search rules. For example, when a user specifies a desired income range of $15,000 to $19,999 per year, the computer may search for only those occupations with income falling in that range (an "equal to" rule), or for occupations with income in that range or higher (a "greater than or equal to" rule). The latter rule is based on the assumption that higher income than specified is always acceptable and should not be used to rule out any occupations. On the other hand, when a user specifies physical strength at a "heavy" level (lift over 50 pounds, carry over 25 pounds), the computer may search for only those occupations which demand such strength, such as carpenter (an "equal to" rule), or for occupations which demand such strength or less (a "less than or equal to" rule). The latter rule is based on the assumption that less exertion than specified is always acceptable and should not be used to rule out any occupations.

The question of which rule the computer should be programmed to follow is thus a question of philosophy of guidance. Should a person content with $15,000 per year be discouraged from considering a more lucrative occupation, such as physician? Should a person capable of lifting over 50 pounds be discouraged from considering a sedentary occupation, such as accountant? Each decision about search rules reflects the system developer's underlying intention either to "match" the user to a set of occupations or merely to suggest to the user a set of occupations worth further exploration.

This issue is raised not solely by search characteristics which offer a scale of choices; the system developer must confront the same philosophical issue when coding occupations for retrieval by yes/no characteristics. For example, which occupations should be ruled out for users specifying that they have "very poor eyesight"? In Michigan's MOIS, the search coding for accountant causes the computer to retain this occupation for blind users but rule it out for deaf-mutes. Can the system developer avoid such arbitrary distinctions? More fundamentally, can the system developer offer guidance and yet avoid dictatorial prescriptiveness? Obviously, such dilemmas are inherent in the nature of some of the characteristics used for structured search. One way to prevent these dilemmas from arising is, when the CAG system is first being developed, to avoid using search characteristics which might arbitrarily and unfairly restrict the occupations that users can consider. The user's sex, for example, is not used as a search characteristic in any system currently operating: using it would obviously be unfair, if not illegal. The question of which characteristics are "fair" depends on a philosophy of guidance.

One way of looking at all these questions regarding search coding is to consider them parts of a more fundamental question of the CAG system's structure: What connections are made between what the computer "knows" about the user and what it "knows" about occupations? If, for example, the computer knows the user's aptitude test and interest inventory scores, how is this knowledge to be connected to what the computer knows about carpenter?

Searching by overall resemblance. One possible rule for linkage is overall resemblance. The computer following this approach considers an entire set of characteristics of the user and compares these to characteristics of workers in each occupation. When a close resemblance is found, the occupation is put on the user's list of likely choices. If, for example, the user's degree of mechanical aptitude, degree of spatial perception, interest in technology, and skill at eye-hand coordination were all considered, the combined profile might show an overall resemblance to the typical profile of carpenters which would be sufficiently close to retain this occupation on the list. Whenever more than one characteristic is used simultaneously, therefore, the computer must have a rule to determine what proximity of resemblance equals a "match," plus information about which characteristics are significant for an occupation and which are trivial, plus another rule to add up the complete set of matches vs. non-matches or use some other classification or discriminant function and thus determine whether an occupation fits or misses the individual's characteristics.

This is a very complicated set of rules and information. In practice, system developers do not use the approach based on overall resemblance of users to workers, but grant each single characteristic the power to forge a link (or to sever links) between users and occupations. All trivial--not to mention unfair--characteristics are simply eliminated from the system. Each characteristic remaining is deemed to be sufficiently important to warrant, in and of itself, disqualification of occupations that fail to match it. Since each characteristic thus has, in effect, veto power, the system developer does not need to establish a formula for allowing one characteristic to be outweighed by others. Nor is any complicated rule necessary to decide what proximity of resemblance equals a match. Instead, any yes/no user characteristic (such as preference for outdoor work) which is "equal to" some equivalent aspect of the occupation (such as work tasks which are mainly outdoor) is declared a match. User characteristics with a scale of possibilities (such as level of physical strength) allow a match to be declared when the level specified by the user is either "equal to," "less than or equal to," or "greater than or equal to" the level of the equivalent aspect of the occupation (such as weight of objects commonly lifted on the job). Which of these three rules is used varies, as shown above.

Another fundamental rule of the commonly used search formula which represents a departure from the overall-resemblance approach is giving users some freedom to choose which characteristics they want to apply to the structured search. Instead of comparing the user and the worker for resemblance on a full profile of traits, the free-choice search formula used by most CAG systems is based on the assumption that different users will want to employ different characteristics to link themselves to appropriate occupations. Characteristics which some users consider worthy of veto power will appear trivial to others; therefore, a variety of characteristics is offered, and users are free to endow some with veto power while ignoring other characteristics.

Of course, this provision for the user's freedom to choose from a variety of characteristics allows trivia to creep back into the system and allows important characteristics to be ignored. Thus, the user cited in the example above might find carpenter on the list after searching with such characteristics as degree of mechanical aptitude, degree of spatial perception, interest in technology, and skill at eye-hand coordination; yet that same user might be incapable of meeting the occupation's heavy physical demands, having neglected to specify that characteristic in the search.

To avoid this kind of mismatch resulting from a superficial search, system developers take care that, once users have received their list of occupations and have selected one for further exploration, they can learn how this occupation is rated for all of the characteristics which the system uses. Thus, the user who has not used physical demands as a search characteristic will discover in the occupational information about carpenter that this occupation often requires lifting and carrying heavy materials. Some systems also include a special command which retrieves a full list of search ratings for any occupation. Iowa's CIS-based CISI itemizes the codes of the responses on QUEST (a questionnaire filled out off line beforehand) which will cause an occupation to be retained on the list; the sister Colorado COCIS system, on the other hand, itemizes the codes of the responses which will cause an occupation to be dropped from the list. GIS itemizes in phrases rather than in codes. The information GIS thus produces is intended to complement rather than overlap with the information contained in the descriptive text.

When occupational information overlaps with the information conveyed (implicitly or explicitly) by the occupation's search ratings, the system developers must be careful to avoid contradictions. COCIS says in its descriptive text that an accountant "must have very good ability with numbers," yet structured search will still retrieve the occupation if the user specifies only "fairly good (medium) ability with numbers." This contradiction may have resulted from a deliberate attempt to avoid an overly prescriptive search, or simple oversight could be to blame.

Another consequence of giving users the freedom to choose which characteristics they want to use in a search is the opportunity for system developers to recognize differences in the amount of knowledge users already possess about themselves and about the world of work. At one extreme, the developer may assume that users already know enough about themselves and about various occupations to be able to name a particular category of occupations (e.g., the U. S. Office of Education's cluster of Construction occupations) which they would be interested in. Thus, GIS search characteristics include USOE clusters, DOT families, and U. S. Department of Labor work areas. At the opposite extreme, the developer may assume that users know very little about themselves and about various occupations and thus need either to take an assessment test or be taught how to assess themselves. Thus, users of CHOICES may conduct structured search by entering scores from GATB after taking it off line.

Most systems use a set of search characteristics which represent a compromise between these or a mix of items from both extremes. For example, Michigan's MOIS Inventory, which is taken off line, includes "areas of work" for sophisticated users (choice of five), "physical capabilities" for unsophisticated users (five sensory or motor tasks which users can ask not to be required by the occupations selected), and "temperaments" for users who are sophisticated enough to know whether they would prefer work situations which involve "interaction," "logic," "persuasion," or other types of activities. These three types of characteristics, among several others, aim at making the MOIS Inventory meaningful to a variety of users.

Searching by predictors, abilities, preferences, or values. After having selected a set of search characteristics of which each is "fair," as well as important and intelligible to some segment of the user population, the CAG system developer must create a link between each characteristic and the total amount of information available about each occupation. So far we have been looking primarily at the resemblance-based approach to creating this link, recognizing developers' attempts to provide simplified search rules, freedom of choice for the user, and implicit justification of the importance of the characteristics used.

Another possible approach would be the predictive method: the computer could use a regression analysis that selects and weights the best composite of predictors for some important criterion. Then it could use error terms to calculate (for example) the odds that a person with the user's set of characteristics can succeed at entering the occupation. Such an approach requires, however, that the computer have as its data base the characteristics of a large number of people who have attempted to enter the occupation and have succeeded or failed. Therefore, this approach is not used by any extant system, with a single, limited exception: the Prediction section of SIGI mentioned above.

An approach which is similar in intent, but lacks statistical rigor, focuses on the demands of the occupation's work tasks, comparing these with the user's ability to meet them. Some commonly used characteristics are physical demands (stooping, crawling, crouching, etc.), physical strength (weight that can be lifted or carried), sensory demands, and aptitudes (verbal, numerical). System developers who use this approach assume a certain amount of predictive validity to their judgment about (for example) the inability of people who specify "poor eyesight" to become plumbers. One of the attractions of matching abilities with demands is that users do not need to know much about the world of work. In the process of coding occupations for retrieval by structured search, the system's information developers can easily (perhaps too easily) generalize about the demands of the occupations, especially since the supplement to the 3rd edition of the DOT has already done much of this work for them.

Another approach matches preferences of the user with aspects of the occupation which will satisfy them. Some commonly used sets of alternative preferences are indoor vs. outdoor work, standard hours vs. shift work, variety vs. continuity, and pay at various levels. The universally included question of the educational or training plans of the user may be regarded either as a preference, since the user may have free choice among several alternatives, or an ability, since the user's choice may be limited financially, intellectually, or otherwise. Although it is true that certain abilities are <u>necessary</u> for entry to an occupation, many system developers evidently feel abilities are not <u>sufficient</u> grounds to make an occupation worthy of consideration. A worker capable of an occupation may not be happy in it. On the other hand, it may be argued that a characteristic should be necessary if it is to be granted veto power in structured search. Preferences are more difficult to defend against the charge of triviality. Preferences may also be more difficult than basic abilities for users to assess accurately. Users without much work experience may not fully know whether they prefer shift work or a standard work week, persuading others or being precise--while even very inexperienced users would probably know their sensory and motor capabilities and their verbal and numerical aptitudes. In the process of coding occupations for retrieval by structured search, the system's information developers will be able to generalize as easily about matters of preference associated with occupations as about matters of abilities required. Even the highly specific data about pay will be lumped into large categories for coding occupations. Some information about working conditions is available in the <u>DOT</u> supplement, and more information about these and other matters of preference is available in the <u>OOH</u>, among other sources.

Still another approach emphasizes the user's satisfaction (like using abilities): this approach consists of matching the user's values to the rewards and satisfactions which may be offered by the occupation. Such values as leadership, helping others, high income, variety, and autonomy are operationally defined and used as search characteristics by

SIGI and DISCOVER (which borrowed SIGI's), and each value offers a scale or variety of choices rather than a yes/no choice. Users select a set of values and specify the minimum amount or the kind of satisfaction that is acceptable with respect to each value: obeying a "greater than or equal to" rule, the computer (in SIGI) searches for occupations which meet or exceed the specifications. (DISCOVER uses an "equal to" rule.) Since values are by definition worth pursuing, this type of search characteristic defies the charge of triviality which might be leveled at some preferences. Values are, for most users, not as readily assessed as sensory and motor abilities, but the systems using values help clients with the introspective process of values clarification. The process of coding occupations for retrieval by structured search will be more complicated in values-based systems than in ability-based and preference-based systems, because there are no standard sources of information about the amount of leadership, helping others, or security offered by various occupations. A variety of sources of information must be used, and rules must be formulated to govern the inferences made from available information. Because neither users nor conventional sources of occupational information customarily consider the values associated with occupations, the values-based system can forge a strong link between users and occupations only if it encourages and guides the users in careful introspection and bases its search codi n of occupations on extensive and methodical research in occupational information.

The search characteristics used by most CAG systems represent a mix of approaches, mainly abilities and preferences.

Cross-walks

After structured search has led a user to a system's occupational descriptions (or the user has arrived there unaided, by direct access), cross-references embedded in or appended to the descriptive text usually lead the user on to other files in the system. For example, in the DESC scripts of CIS, the paragraph about educational requirements for entry to the occupation includes the codes needed to access the PREP file for more detailed information on that topic. The PREP script, in turn, includes the codes needed to access the PROG file for detailed information about educational programs. In SIGI, the Planning section gives a user pathways and steps to enter a given occupation including the names of appropriate courses for which to seek predictions in the Prediction section. These "cross-walks" encourage thorough and well-articulated use of a system's various files and subsections.

Even though a system's files may be thoroughly cross-referenced and may include detailed information on local occupational outlook, two- and four-year colleges, technical schools, training programs, the armed services, and job-seeking skills, no system is encyclopedic; nor is it wise to assume that any single medium can provide users with all the guidance and information they need to plan their careers. For this reason many systems include cross-references to other information resources. Some refer to standard reference books: it is common to give the DOT number (or, in the SOICC grantees, the SOC number) for each occupation or for specialized occupations subsumed under the single title used by the system. Connecticut's version of GIS includes a reference to the corresponding Connecticut VIEW (microfiche) script. CIS in Oregon includes a file on people willing to talk about their occupation, as well as a file on Explorer Scout posts through which users can learn more about certain occupations. Finally, as proof that the computer has not taken over the field of guidance, many systems humbly advise the user, "See a guidance counselor."

Recapitulation for Decision-making

Most CAG systems stop at this point, having selected a set of occupations and having led the users to information files and external sources of information about the occupations. Some systems, however, continue the career decision-making process by helping the user to evaluate occupations and to select a few as top choices.

Many of these provisions for evaluation and selection take the form of workbooks filled out before and after on-line use. Typically these workbooks are developed after the computerized components of the system have been well established, or are intended as optional supporting materials rather than as parts of an overall guidance system. For either of these reasons, the computer's scripts rarely include references to the workbooks.

The linkages between the computerized components and the workbooks will be strained further if the on-line and off-line parts of the system use different approaches to guidance. The PROCESS User Handbook (Iowa Department of Public Instruction, n.d.) provided by Iowa's CISI, for example, helps users who have already performed a structured search on line with QUEST--based on abilities and preferences--to conduct a second search off line among the occupations already accessed--this time based on values. The search procedure, called a Values Matrix, requires users to select values that they consider important, and to judge, on the basis of scripts they have already retrieved, which occupations satisfy the selected values. The CISI scripts do not discuss most of these values explicitly, however, so users must infer whether or not an occupation satisfies a value. Such judgments based on limited information written in different terms are certainly questionable.

The same need for conceptual consistency applies to systems which provide on-line help with evaluation and selection of occupations. The Strategy section of SIGI helps users compare occupations directly as potential satisfiers of their values. Each user has previously assigned numerical weights to the system's ten values, and the occupations have been rated on numerical scales by the information developers for how well they offer opportunities to satisfy those values. The weight of the value (importance to user) and rating of the occupation (opportunity for satisfaction) for each dimension are now multiplied and the products summed to provide a numerical index representing the overall desirability of the occupation for each client. The ratings for occupations used here are familiar to the client, because SIGI's occupational information section describes and rates each occupation in terms of the same ten values dimensions. Thus, accessing, discussion, evaluation, and selection are all conducted in terms of these same ten values.

DISCOVER, on the other hand, uses several different concepts of guidance in its different components. The early components explain the use of values in decision-making, but subsequent components on the world of work group occupations by Holland's "personality" types rather than by values. The structured search may be conducted according to the user's values or score on Holland's Self-Directed Search or by three other approaches. The occupational information which is thus retrieved is not written explicitly in terms of values or Holland's personality types. Finally, in the evaluation and selection component, users discard and rank-order remaining occupations by any standards they consider relevant.

CAG systems with modest goals are just as capable of conceptual inconsistency as ambitious systems, but the effects are less serious. A system which simply retrieves information, offering no aid in evaluation and selection of occupations, may be accused of inconsistency for mixing abilities and preferences among its search characteristics (as most do); but the practice might also be defended on the grounds that the system is thus intelligible to a wide variety of users and is adaptable to use within several guidance contexts. With each additional aspect of guidance the system undertakes, however, conceptual consistency becomes more necessary.

STYLE

Differences in style, as well as scope, appear in the many media represented among guidance resources. Some tend to be relatively passive, like an occupational monograph filed in a cabinet. Others, like a display on a bulletin board, are more visible. Still others, like a counselor sending for a student, are active. Some sources of information tend to be vivid and memorable, like first-hand work experience in a slaughterhouse; others--like perusing the Dictionary of Occupational Titles--may seem dull and forgettable. Dramatization and exposition have different impacts. Pictures are different from words. Whether the same words are written or spoken makes a difference in what is communicated to various people. Each medium of communication has its distinctive characteristics, inherent virtues and disadvantages, and each style of communication may encounter a responsive or resistant style in the person to whom it is addressed. CAG systems employ a medium that offers special opportunities and notable constraints.

In addition, stylistic variations within any medium may be as great as variations between media. Thus, all books are not written in the same style: a book may stimulate intensive activity in a reader, who will be spurred to frame questions, seek answers, carry on an unvoiced dialogue; or a reader may be moved only to scan it dutifully, fulfilling an assignment to cover certain pages. Each CAG system, too, has its own style, more or less differentiated from the others. Interactivity is one of the most notable elements in CAG styles.

Interactivity

A batch-processing system like the one Hull (op. cit.) envisioned would be active but would seem to engender passivity in clients. They would not engage in any direct interaction with the system (indeed, its processes would not even be visible to them); they would only be recipients of the output. A step towards greater involvement of clients appeared in batch-processing systems for choice of a college: typically, clients selected specifications for college region, size, curriculum, and the like on an answer-sheet form, mailed the form in, and then received by mail a list of colleges that presumably fit the specifications. Wisconsin's WCIS offers a similar service as an optional alternative to on-line search for occupations. The interval between the client's input and the system's output, plus the fact that only a single exchange takes place, dampens the sense of interaction. In most of the interactive systems, clients may see immediately the effects of a given specification or set of specifications, and can then add, subtract, or change specifications to get a revised list of suggested options. This immediacy and flexibility make the search process for identifying options (e.g., occupations or colleges) highly visible. The client becomes an active participant and indeed a partner of the CAG system. Among such systems, variations in degree of interactivity are a function of hardware, system design, and script-writing.

Hardware. Teletypes (used in CVIS, GIS, CIS, et al.) are inexpensive terminals, but write slowly. Furthermore, the teletype style must be linear. Special formats and graphics are cumbersome and rarely used. CRT terminals, on the other hand, can write at speeds many times faster than teletypes, although a rate of four times as fast is usually found comfortable by users. (Of course, not all systems that use CRTs take advantage of this capability, preferring to cut the costs of modems that would be required for high speeds on dial-up telephone lines.) Considerable variety of format is readily obtained on the CRT, graphics can be constructed, revisions and substitutions in graphics and text can be seen taking place on the screen, elements of a display can be moved from one part of the screen to another--in general, more dynamic displays can be created. Principles from other visual arts can be used to direct, change, and focus a user's attention. Obviously, some systems employ these CRT capabilities more effectively than others.

Other display media may be used to supplement teletype or CRT. Computer-controlled slides, filmstrips, and audio or even video tapes can be presented at appropriate points in the program, or can be incorporated by reference, with activation in the hands of the user. More use of filmstrips (ECES) and slides (SIGI) was made at earlier developmental stages than currently--in part for enrichment through pictorial material and color, but in large part also because mass storage was much more expensive then than it is now.

In terms of hardware, response modes tend generally to include use of keyboard or response keys associated with either teletype or CRT. Only DISCOVER among the current CAG systems uses a "light pen" with which the client can respond by touching a part of the CRT.

Use of all capital letters, as opposed to capitals and lower case, appears to affect a system's readability. A system which capitalizes according to conventional practice (and for occasional emphasis) is more comfortable to read than a system using upper-case letters exclusively. (Parts of CVIS mysteriously use lower-case letters exclusively, producing statements about the "u.s. department of labor," "air force," etc., in the manner of e.e. cummings.)

System design. Even when responses are keyed in, however, there are great differences in the styles of response modes for the various CAG systems. One distinction lies in the extent to which the dialogue is self-contained. That is, if all the necessary instructions, prompts, and cues appear as part of the display on the CRT or on the print-outs rolling through the teletype, clients' attention can remain fixed on the dialogue itself. The need to refer frequently to off-line materials--for example, to look up function codes to be keyed in (as in GIS) or numbers for occupations in direct access (in all of the systems)--can be distracting. It interrupts the flow of the dialogue, and even may--in extreme cases--discourage use of the system by clients.

On the face of it, use of codes may appear to provide clients with more flexibility than responses to multiple-choice options displayed on screen or print-out. It should be noted, however, that at any given point in virtually any CAG system, there is a limited number of options either available or logically desirable to the client. It is often easier for the client, and makes for a more fluent dialogue, if these are forthrightly specified on line--cuing the client to choose one--than if the client is required to search through the total range of codes (either off line or in memory), establish the population of options appropriate at this time, and from these select the one that is preferred. Indeed, such codes often represent a covert multiple-choice scheme. An overt procedure is actually more flexible as well as more fluent, since it can tailor the options more precisely to the occasion.

In this connection, it is interesting to note that ISVD went to the extreme of processing natural language inputs by users. Tiedeman's objective in making this heavy investment was to capitalize on clients' curiosity, give them the illusion of free-wheeling conversation, and enhance their "sense of agency." Laudable as these objectives are, the achievement was probably not worth the disproportionate share of resources consumed by this effort. The latent multiple-choice array could not be disguised. If the system asked the user, "What do you want to do today?" and the user replied, "Play basketball," the system would have to admit that basketball was not in its repertory, and request the user to suggest something else. Eventually, the user might say, "Choose a college" or "Get information about an occupation" or something else that was in the system's repertory. It would take less time, and be less frustrating to users, to list the options available at the outset. Furthermore, since natural language inputs can often be incomprehensible, the system must often seem to the user to be uncomprehending. Thus, it seems particularly costly to trade a forthright and transparent style for one that appears devious and opaque.

Interactivity in a CAG system has many manifestations besides the modes in which the client communicates with the system. There are variations in the ways in which different components (e.g., appraisal, information, prediction, planning, and decision-making) of the system involve direct client participation. Do they (at one extreme) unroll very much in linear fashion, inexorably, like a filmstrip or motion picture without much regard for individual clients' wishes? Or, at the other extreme, do they go any which way the client wants them to go, without regard for previous inputs or interactions? Or do they monitor and guide the client, giving reminders and suggestions, but still allowing plenty of opportunity for branching within a logical structure? These three possibilities offer both different levels and different kinds of interactivity.

Similarly, there are differences in the degree to which different components of the system interact with one another and in the nature of those interactions. Does design of the system itself carry the user through these interactions, or do the connections take place only (if at all) in the mind of the user? Or do they take place only in the system, without close participation by the user? In other words, to what extent does the system itself build visible bridges between components and guide the client across them? Is the client instructed in the topography of the components and the linkages between them, able to reach, use, and even reproduce maps of the system?

Script-writing. Since CAG involves language, all the elements of prose style can be invoked: fluency, diction, clarity, flavor, syntax, and so on. But writing for any medium is a distinctive art form. How, for example, does one fit the message to best advantage within certain limits of space? How does one "choreograph" the substitutions and movements of elements of a display on a CRT? How does one direct attention from one part of the screen to another? How does one build graphics and embed them in text? How does one use codes or multiple choice to convey the illusion of a dialogue?

Some CAG systems perform these tasks with distinctive elegance and verve. Others are less conscious of the opportunities afforded, or handle them with less imagination. Clients may not be conscious of the relative sophistication of a given system. But they know whether it holds their interest or drops it, flows freely or sluggishly, grinds along monotonously or springs occasional variations, talks with them or down to them, is clear or muddy, stimulates them or puts them to sleep.

Critics who are themselves well versed in the medium are often alert to the techniques responsible for these different perceptions. But knowledge of principles and techniques is not sufficient to explain (or produce) "good" scripts. One can recognize good writing--or good art of any kind--without being thereby able to account for it or create it.

It is much easier to identify and explain bad writing. The computer medium appears to demand clarity and conciseness. Murkiness and prolixity are cardinal sins. Perhaps only a venial sin is the pretense of a homunculus in the machine--greeting clients with a cheery (but phony) heartiness, repeatedly addressing them by name, "personalizing" each message: "Hello, John, glad to see you. Okay, John, let's go on...." These vocatives ring false. A machine pretending to be a person seems no more tolerable than a person pretending to be a machine. Honest machines are no less desirable than honest people.

Style is not readily divisible, except for purposes of discussion, into hardware, system design, and script-writing. The smooth interaction of these components produces a sum that is greater than its parts. Hence, systems are not readily differentiated by descriptions. Rather than just read about them, one must use them and experience the stylistic distinctions at first hand.

PROCEDURES

There is a universe of facts about occupations. Some of these facts have come under observation. These observations are collected and organized as data. Data, in turn, are interpreted and transformed into information. Information, having been filtered and absorbed by a client, becomes knowledge. Knowledge becomes useful as it feeds into decisions, plans, and actions. Thus is seen a systematic winnowing process: The observations of facts may be made from one point of view or another, for one purpose or another. (Should one observe, for example, the proportions of various ethnic groups in an occupation?) Similar questions govern collection, organization, interpretation, analysis, and use of what are loosely called "data bases" in CAG systems. Therefore, the system's information developers cannot roam freely collecting facts as if they were picking wildflowers, but must follow methodical procedures concerning what to collect, how to collect it, and how to interpret it.

What to Include

The question of what to collect depends on the purpose of the system. This is defined partly in terms of the user population: a system for a single state (e.g., Michigan's MOIS) may not need national wage levels; a system for vocational students (e.g., Impellitteri's CACE, now defunct) may not need information on white-collar occupations; a system for college students (e.g., SIGI) may not need recommendations for high school courses.

Because the universe of occupations is so large (there are 20,000 in the 4th edition of the DOT), system developers usually combine sets of related occupations under one title and eliminate occupations that employ very few people. State systems are usually said to cover the occupations of 90% of the state's workforce. Some systems request user institutions to recommend additions; in some cases, the information developers attempt to anticipate the emergence of an occupation.

The number of possible topics of information is also large. As is noted above in the section on Structure, the occupational information should include all of the characteristics used in structured search. For this reason the philosophy of guidance which underlies the structured search will also be evident in the topics of occupational information. Because no set of search characteristics can anticipate every aspect of an occupation that might attract or repel interest, the occupational information must also give a general impression of work tasks and surroundings, as well as the preparation and abilities that are needed to enter or succeed in the occupation. A topic cannot be used if there are insufficient data about it for a significant number of occupations.

Sources of Data

In assembling information for the topics chosen, few systems conduct their own large-scale surveys; most rely almost entirely on outside compilers of data. The United States Department of Labor provides many types of occupational information, and professional associations and unions are also frequently used as sources. Information developers for most systems submit drafts of their write-ups to review by knowledgeable persons in the field. This may be regarded as a limited kind of survey; so is the practice, followed by some state systems, of checking "help wanted" advertisements for local wage levels. State and local data may also be available from state departments of labor. Bruce McKinlay's Developing a Career Information System (1974) describes in detail how the pioneer state system, CIS, assembled its data base. Occupational Information in SIGI by Pears and Weber (1976, 1978) is a handbook covering data collection, interpretation, preparation, and documentation.

The state's department of education generally provides useful information about institutions of post-secondary education and training. National information about colleges may be gathered either from sources associated with higher education (e.g., American College Testing, used by DISCOVER) or from surveys conducted by the system's information developers (as GIS does). SIGI's Planning section, which covers programs and courses available to students at a particular institution, is based on information supplied by that institution.

Interpretation of Data

The first problem of interpreting data is deciding what truly represents the universe of facts about an occupation. Professional associations may make exaggerated claims of income, prestige, and job openings, while unions may attempt to discourage competition by painting a gloomy picture. Even government publications may distort reality by generalizing about a small sample. Therefore, information developers must carefully check for the primary sources of data and, if possible, evaluate how the data were prepared. When sources are not fully clear, the data can at least be compared for congruence with data from other sources.

The next problem of interpreting data is generalizing in ways which will be meaningful to users but will not create distortions. This is complicated by restrictions of space in the computer's storage and by the reading level of users. Ideally, the system's staff will have set down policies in an information developer's manual, explaining what data permit what kinds of generalizations to be made, what disclaimers should be used when necessary, and what verbal formulae are clearest.

The manual should also cover how data are to be translated into the codes that are assigned to occupations for structured search. As seen in the section on Structure, considerable leeway is possible here, depending on how narrowly prescriptive the system developer feels the search should be. Nevertheless, careless assignment of search codes can result in a list of occupations that has little relevance to the user. Therefore, a consistent and careful policy is necessary.

Systems which allow user institutions to supply data develop the information in various ways. The option of user input raises the problem of finding a compromise between uncontrolled flexibility and inflexible control. DISCOVER gives user institutions free rein to change any display in the system or to add displays. These changes and additions can be made at the user's terminal. GIS III allows user institutions to provide data on some locally relevant topics (e.g., sources of financial aid), but GIS actually puts the information into the system, thus retaining some control over the material. SIGI does the same with the information in its Planning section. SIGI's Prediction section provides a manual and work sheets to user institutions to supply data on programs, key courses, and the test scores, in[illegible] self-estimates, backgrounds, and grades of students in those courses; SIGI staff then carry out the regression analyses and enter appropriate equations into the system.

Updating Information

Schedules for updating information vary widely. Most systems update all occupations yearly, but this may be accomplished in fractions, such as one half of the occupations every half year. A system which operates out of only a few computer centers (e.g., Alabama's AOIS, operating out of two) may easily update one or two occupations at any time during the year as new information is developed, since there will be only a few tapes or disks to alter or replace. On the other hand, a system with many tapes or disks distributed among far-flung users will incur greater expense with each update; thus its information developers will more likely save newly developed information for the regularly scheduled updates.

Expense is not the only consideration: frequent, incomplete updates also mean that some information will be several months newer than other information. For example, the average salary given for plumber may be based on data from September, while that for welders may be based on data from the following June. In a period of rapid inflation or recession, such a gap will mean that the two salaries are not readily comparable. Even regularly scheduled annual updates will face this problem, since the data available to information developers are inevitably based on several different time periods. Therefore, some systems (e.g., DISCOVER) identify the different years to which salary information applies, thus encouraging users either to avoid unwarranted comparisons or to take economic trends into account. Another approach, used by SIGI, is to specify annually the year to which all salary information applies; those occupations lacking salary data from that year are represented by salary projections based on economic trends. This approach allows users to make comparisons without having to perform their own uninformed projections of available information.

COSTS

Costs listed by vendors of various CAG systems are rarely comparable. In one instance, a quoted cost may be for a license to use a system, plus a tape and assorted materials and services. In another instance, certain hardware and communications costs may be part of the package. Costs may also be quoted by CPU time, connect time, semester, year, and so on.

Costs for a license over a given period of time may be comparable in terms of revenue to the vendor. But to the buyer, the cost of hardware and communications required to run the system is likely to loom as the largest consideration. Then there is often the question of what hardware may already be available for other purposes: Will a CAG system simply be an added use for a processor already in place, or will it require new capital investment? There is also sometimes the cost of reprogramming a system to run on a particular processor.

Itemization of Components

One way to tackle the complexities of comparative cost analysis is to start by segregating the components of cost. Processors, terminals, other peripherals, telephone line charges, licenses, manuals and handbooks, training workshops, consulting and other services can each be tagged with a price. Separate price tags may have to be used for alternative configurations--for example, if a system runs on either a minicomputer or a mainframe. Then one can calculate what it would cost to deploy each system in a variety of customary circumstances, say for given numbers of terminals.

Typical Costs per Terminal Hour

Another approach is to look at typical or modal configurations of use. Capital expenditures could be charged at the annual depreciation. In cases of multiple-purpose use, an appropriate proportion of the depreciation, commensurate with the proportion of resources taken by the CAG system, could be determined. Maintenance charges, license fees, update charges, and all other such typical costs should be added. When total costs of deployment have been totted up, dividing by sum of hours of use across all terminals yields a cost per terminal hour. Thus, each CAG system might indicate more than one cost per terminal hour, specifying the conditions and premises for each (e.g., as part of a small or large system, with workshops or without). A variation of this method, or a supplement to it, would be the cost per student (obviously, a function of the amount of time students tend to spend on a given system). Probably it would be convenient to exclude from these calculations locally generated costs, such as telephone lines, space, utilities, staff time, etc., since users are in the best position to estimate such costs for their own situations.

These procedures help get a grip on costs, but still leave problems in specific instances. For example, a basic license to use SIGI costs $2000 a year. This includes a copy of distribution tape or disk, annual updates, copies of all manuals and handbooks for installation, management, software support, and associated counseling, and a "reasonable" amount of telephone consultation. A DISCOVER license costs $1000 per month on a two-year paid-up lease basis (i.e., a total of $24,000). It includes tapes and all manuals, but updates cost an additional $1500 per year after the first two years. So if license plus update costs were depreciated over a five-year period on a straightline basis, the annual license plus update cost for the five years would be $28,500; dividing by 5 gives

$5700 per year. With the help of ad hoc adjustments of this sort, at least some limited cost comparisons can be made.

An illustration. The example just given of course excludes hardware costs. Since SIGI has been used as an example, and costs are well known to the authors, it may be helpful to spell out a routine for getting cost per terminal hour. Assume an eight-terminal system to be purchased from scratch. A minicomputer configured to run up to eight terminals for SIGI currently costs about $40,000. CRT terminals and printers cost about $2500 for each terminal station. Two modems for each dial-up or leased line cost $1600 (modems are not needed if terminals are hard-wired to the processor). Maintenance on all hardware would be about $8300 per year. A conservative assumption of use (generally exceeded in the field) is 225 days per year, 12 hours per day, for each terminal station. Assume five-year straightline depreciation of all hardware. Also make the worst-case assumption that no other use is made of the hardware--it is completely dedicated to SIGI, which must be charged with the full costs. (In practice, processors are used for many additional purposes.) The bottom line, once the appropriate arithmetic has been done, for hardware, software, maintenance and license, comes out to $1.24 per terminal hour. This is an upper bound, since the modems may not be needed for all terminals, and this processor need not be dedicated to SIGI.

While data for similar computations of costs of other systems are not available to us at this time, and SIGI is probably at or near the low end of the scale, most CAG systems probably fall in the range of $2 to $4 per terminal hour (Clyde, in press). The main point is that CAG, in general, is not expensive compared to the time of a counselor, which might be estimated at upwards of $12 an hour. This comparison is not intended to suggest that CAG and counselor do the same thing. Each has distinctive capabilities, and in the absence of one or the other, some things will not get done. But the comparison does put CAG costs in favorable perspective.

EFFECTS

Because of the many problems (conceptual, logistical, and financial) of conducting long-term studies, researchers have concentrated on the short-term effects of CAG systems: users' behaviors, acquisitions of knowledge, and expressions of attitudes and opinions, plus counselors' reactions and changes in guidance programs. This is a wide variety of effects, and therefore comparisons between studies are difficult.

CVIS has been the subject of a number of studies. Two reports of users' opinions (CVIS, 1969; Arutunian, 1973) showed that most users felt they learned something about themselves, occupations, and the relationship between the two; an overwhelming majority found the occupational briefs interesting and informative. Price (1971) found no significant differences between the effects of CVIS and guidance counselors on students' course selections. Harris (1973) pre- and post-tested an experimental and a control group with Super's Career Development Inventory (CDI) and with her own Vocational Plans Questionnaire. She found no significant increase in the number of occupations which users viewed as options, nor in the congruence between the level of users' educational-vocational goals and the level suggested by their test scores and grades, nor in the accuracy or range of information students possessed about their chosen occupations. Users did show significant gains in "vocational maturity," specifically in awareness of the need to plan and in knowledge of resources for career exploration. Maola and Kane (1976) divided 72 disadvantaged vocational students into a group which used CVIS for weekly sessions, a group which met weekly with a counselor using the same materials, and a control group. Before and after the four-week experimental period, all were given the Assessment of Career Development. On all three scales, the CVIS group showed greatest gains, the control group least, and the counseled group an intermediate amount.

ECES has also undergone several studies, some of them similar. Myers et al. (1972) pre- and post-tested users on CDI and found small gains in awareness of need to plan and in knowledge of resources for career exploration (cf. Harris, 1973). Pilato and Myers (1973) found by pre- and post-testing of users and controls that users learned better how to judge their intelligence (but not interests) than did non-use[illegible] Pilato and Myers (1975) found by pre- and post-testing that users who had also taken a mini-course on occupational clustering surpassed controls at increasing the congruence of their career goals with the levels suggested by their test scores and grades--but not with their interest fields (cf. Harris, 1973). Drake (1979) pre- and post-tested ECES III users and controls on CDI and found the users gained more than the controls on four scales. Mallory, Drake, and Holder (1979) showed that users of ECES IV increased the quantity and quality of their occupational knowledge, gained confidence in their career knowledge, and raised their educational goals.

Oregon's OIAS has been studied with regard to the popularity and usage of its components. McKinlay and Adams (1971) surveyed users in a high school field test and found that they averaged 2.3 sessions each. The overwhelming majority used QUEST and the occupational descriptions and found them fun to use and easy to understand. The other information files were used much less. McKinlay (1974) tested a needlesort version and found exploratory activity similar to that recorded during computer usage: students tended to try several combinations of search characteristics.

A survey of users of EUREKA (Richmond Unified School District, 1977), the California version of CIS, showed similarly high usage of QUEST and descriptions, but also high usage of the file on preparation. 69% of users found EUREKA very easy to understand, and 84% found it very interesting.

MOIS of Massachusetts, another CIS-based system, was also studied in a survey of user schools (Welch, 1978). 88% of users found MOIS useful, 96% felt the instructions were clear, but only 66% found the system easy to use without help.

English (1974) tested GIS for effectiveness alongside Connecticut's VIEW, dividing a sample of 11th and 12th graders into GIS users, VIEW users, and a control group. Pre- and post-testing on CDI showed neither experimental group achieved overall gains, although both did register gains on two of the instrument's scales, "Planning Orientation" and "Information and Decision-Making." Heller and Chitayat (1976) studied usage and users of GIS in five New York City high schools for three semesters. Structured search was found to be used much more often than direct access, and batch processing was used more often than on-line interaction. Information about colleges was used slightly more often than occupational information, but the study found no impact of GIS on where students applied to college. GIS users outscored non-users on a test of vocabulary items common in GIS (and presumably having relevance to the world of work), and also showed better recognition of the principle that "as the number of limits placed on a choice increases, the number of options decreases."

Lambert and Caulum (1978) reported on a survey of 192 students using Wisconsin's W IS, a GIS offspring: 87% had used the state occupational file (the most popular file), 73% had performed a structured search, and only 6% found the system difficult to use.

A field trial of DISCOVER, described by Harris-Bowlsbey (1976) and Rayman, Bryson, and Bowlsbey (1978), found students highly favorable toward the system. However, users showed no significant gains on CDI nor on the Assessment of Career Development.

Chapman, Katz, Norris, and Pears (1977) evaluated SIGI at six colleges by a number of methods: interviews with students, questionnaires completed by experimental and control groups, questionnaires completed by counselors, records of students' interactions with the system, and operators' logs. In interviews, users often credited SIGI with leading them toward autonomy and rationality in making career decisions. Questionnaires completed by users and a control group showed users were enthusiastic about SIGI, recommended it to their friends, gained clearer understanding of their own values, goals, and factors involved in decision-making, and acquired more accurate information about occupations they were considering and programs to take. Every component was named "most helpful" by some users. Counselors felt SIGI helped them use their time more effectively and complemented their work. Some user sites had built career decision-making courses around use of SIGI. The record of students' interaction showed wide variation in the weights assigned to values, in the interest fields chosen, and in desirability ratings of occupations. Studies at other individual user sites have corroborated these findings (Tulley & Risser, n.d., Fredericksen, 1978; Career Planning and Placement Center, University of California, Irvine, 1978).

The set of studies cited above is not exhaustive, but it gives an overview of the wide range of effects that researchers have studied. If there is a trend among types of effects selected for study, it is that state systems, designed primarily for information retrieval, tend to be studied largely for their popularity and usage of their components; systems offering guidance, or in some way associated with guidance, tend to be studied for their effects on the career decision-making process.

RATIONALES FOR GUIDANCE AND MODELS OF CAREER DECISION-MAKING

Computer-assisted guidance must be seen against a background of development in the field of guidance generally. Of course, CAG does not involve only application of new technology to old substance. As has been illustrated, computers--both as processors of data and as an interactive medium--have stimulated the development of new substance. (Not always, though: Sometimes they have been used mainly as page turners or as a more expensive way of administering inventories than are paper-and-pencil administrations.) But these developments come out of a context that includes different philosophies, different rationales for guidance and different models of career decision-making.

Variations in substance of the various systems have already been noted. These variations are perhaps more important than variations in individual counselors' beliefs. Embodying some approach to guidance in a CAG system usually leads to much more widespread dissemination of that approach than does training of counselors in one school of thought or another. The treatment represented by a CAG system, definable and consistent in scope, structure, content, style, and so on, is delivered in toto at many sites. In a way that may be paradoxical but is typical of the American genius, computerized systems enable guidance--the most individualistic of educational enterprises, in which the person is a crucial part of the content--to be made widely available through mass production and mass distribution. The underlying philosophy, then, the rationale and model for these systems assume great importance. Out of what set of beliefs about human nature and the world of work have these systems evolved? On what basis do the interventions rest? What models of decision-making are represented? Indeed, to what extent is any philosophy, any rationale, any model discernible in each system?

Three CAG systems were explicitly based on theories formulated and research conducted over many years by their developers. ECES I emerged from the work of Donald Super and his associates on the Career Pattern Study and on propositions about vocational development emphasizing continuity, self-concept, exploratory behavior, planfulness, reality-testing, and compromise (Super, 1953, 1954, 1957; Super & Overstreet, 1960; Super et al., 1963). ISVD was based on the paradigms of career decision-making developed by David Tiedeman and his associates; it emphasized such concepts as fostering inquiry and a sense of agency on the part of the user (Tiedeman & O'Hara, 1963; Tiedeman & Dudley, 1967; Tiedeman, 1979). SIGI embodied Martin Katz's emphases on values and information-processing in a model of career decision-making (Katz, 1954, 1963, 1966, 1974).

Notwithstanding the manifest differences between these three systems, they emerged from theoretical positions that encompassed large areas of agreement on fundamental principles. The discrepancies in the respective rationales and models are primarily functions of differences in focus and emphasis. Indeed, there have been notable continuities, as well as marked discontinuities, in theoretical formulations from the dawn of the "vocational guidance" movement at the turn of the century to current approaches to "career decision-making."

Parsons' True Reasoning

Frank Parsons, a noted pioneer, invoked a triad of activities that he believed should comprise vocational guidance: analysis of the individual, study of occupational information, and "true reasoning" to establish connections between the other two domains (Parsons, 1909). On the face of it, this does not seem far removed from many current trait-matching conceptualizations of the guidance process. But it is revealing to look at this approach in operation in a case report by Parsons on a 19-year-old client who was "sickly looking, small, thin, hollow-cheeked, with listless eye and expressionless face" and wanted to be a doctor. Parsons told him, "You haven't the pleasant manners a doctor ought to have," and advised him to go "into some sort of work where you don't have to meet so many people as a doctor must." He suggested instead that, "Some mechanical or manufacturing industry or wholesale trade where you would handle stock, care of poultry, sheep, cows, or other outdoor work would offer you better opportunities and be better for your health than the comparatively sedentary and irregular life of a physician." Parsons said the youth accepted his advice and changed his goal from physician to cow-herder, although "it was like taking medicine at the time" (Stephens, 1970).

Few counselors today would be so directive. Today, the information about physicians might be somewhat different, and the rationale for suggesting other occupations to be considered would probably also be different.

To clarify these and other distinctions, Figure 1 presents a matrix comparing four significant approaches to guidance, beginning with Parsons.

As can be seen in Column A, Parsons' work was limited in technical sophistication: instruments for individual appraisal and data bases for occupational information were primitive. Even the delineation of goals failed to recognize issues that later had to be confronted. For example, Parsons believed that the right matching of aptitudes, abilities, and other traits with the characteristics of occupations would result in "economic efficiency and success" and therefore "a useful and happy life." He thus failed to perceive any possible conflict between social and individual benefits. (These comments should not be construed as deprecatory of Parsons for not having been farther ahead of his time than he was! It seems worthy of note, in passing, that Parsons campaigned vigorously for inclusion in the public schools of both vocational guidance and what we would today call career education.)

As for Row 2, the report quoted above (of Parsons counseling a client) illustrates some of the quirks and perils of a counselor's perceptions and prejudices in appraising an individual without any check or balance to his fallible judgment. Row 3 perhaps does not do Parsons full justice. Data files about occupations were developed at Parsons' Boston Vocation Bureau, and bulletins describing a number of occupations were published. The main source of information for clients in Parsons' "system," however, was the counselor, who was expected to know the tasks, requirements, and rewards of many occupations and also to judge the traits necessary for success in each.

Then, as indicated in Row 4, it was the counselor again who had to make the right connections between individual traits and occupational requirements in order to match the client to the "right" occupation. This obsession with the "correct" choice, the avoidance of waste, of floundering, of trial and error, pervades the approaches described in columns B and C. One should not ignore the universal protestations on behalf of the client's freedom to choose. But underlying them was the conviction that the wise choice, the right choice, can be known to the expert counselor--but can be properly accepted and implemented only if "freely" reached by the client. This practical concession to individual freedom was viewed more as a trick of the trade than as a basic goal of guidance (as indicated in Row 6).

Trait-Matching for Success or Membership

If indeed the client was "keyed" to one or a few correct occupational positions, the aim of individual appraisal was discovery of the key traits for predicting either success or membership in an occupation. For almost half of the century, there was of course some dissatisfaction with the procedure available for appraisal and prediction. Counselors occasionally felt uneasy about the validity of their observations and predictions. More "scientific" data would make them more persuasive. In short, guidance in its horse-and-buggy days was a set of practices in search of a technology, as illustrated by Clark Hull's vision (op. cit.).

CAG as data processing. Moving out of the horse-and-buggy days, a technology akin to putting the horses under the hood became available in the post-war years with rapid developments in psychometrics, job analysis, statistical techniques, and computers. Standardized tests, particularly of abilities and interests, became widely used (B2). Large-scale programs of job analysis and publication of occupational information were undertaken. Occupations came to be classified in terms of the aptitudes for which measures were available (B3).

Before working farther through this matrix, it should be mentioned that columns B and C are not isomorphic with any single existing system. Rather they are idealizations of sets of practices and procedures. Neither of these approaches, as defined and described here, is necessarily recognized as a theory or school of thought by its practitioners. As indicated in the upper left corner, the purposes and objectives are often implicit, and the other rows also reflect generalizations, abstracted from particular sets of practices, which frequently tend to be ad hoc. The question has been asked, in effect, if there is a point to some guidance practices, what is it? What is the rationale or model that could justify or explain them? This is not an apology, for the authors believe that the descriptions do them justice, and in some cases more than justice. Often, in practice, data are not brought to bear in so rigorous a fashion as the mention of regression analysis or discriminant analysis implies. Many practitioners still substitute their own impressions and judgments for the kinds of data and analyses listed here. Indeed, many use occupational information based on worker traits, which would be suitable for the approach under C, in models otherwise based on approach B.

Predicting success. The Air Force selection program developed in World War II was the model for column B. This program attracted many of the top psychological measurement specialists of the time--such as Flanagan, Thorndike, Guilford, DuBois, and Horst. With success in training as a criterion and a battery of aptitude tests and some biographical data as independent variables, multiple regression techniques were used to weight the contribution of each score to a set of prediction indices. These were then used to assign candidates to pilot, navigator, or bombardier training. Factor-analytic techniques were adapted by Guilford (1948) to refine both predictors and criteria. The development of the GATB by the USES was strongly influenced by this model, which also led to the development of a number of multifactor aptitude tests (Differential Aptitude Tests, Multiple Aptitude Tests, Flanagan Aptitude Classification Tests, Holzinger-Crowder Uni-Factor Tests, Guilford-Zimmerman Aptitude Survey). All of these tests aimed at improving differential prediction through various combinations of some of the "most important" factors.

In practice, the occupational information required for this model depends on job analysis (to determine the kinds of traits that are likely to be involved in an occupation) and on specifying criteria for judging success in the occupation.

This model emphasizes prediction of success and efficiency in selection. It has been justified for <u>selection</u> in a given setting in terms of increasing productivity--to an extent determined by the validity of the tests and by the selection ratio. For use in <u>guidance</u>--on the assumption that maximizing productivity would benefit both society and the individuals--the model would require evidence of differential validity, about which more below.

Resemblance to members. The approach in column C derives from the observation, or premise, that certain characteristics of people in a given occupation tend to differ from those of people in general or those in other occupations. This leads to the inference that occupational choice _does_ take place in a "birds of a feather" way. Next came the assumption that it _should_ take place in this way, only more so. Therefore, guidance practices were developed to increase the homogeneity of people in each occupation (on the given characteristics). So if these characteristics can be spotted in time, one again avoids waste, vacillation, or error along the way.

Empirically, it often turns out that in a rather gross way aptitude measures tend to be associated with differences in _level_ of occupation (which in turn is associated with predictions of success), and interest measures are sometimes associated with differences between _fields_ or occupations at a given level. Hence the special note on interests in C2. Note that in Row 3, we move from an emphasis on _job analysis_ and _requirements for success_ to an emphasis (under column C) on _worker traits_. Just as Paterson and Darley (1936) and Paterson and others (1941) associated with the Minnesota Employment Stabilization Research Institute attempted to classify occupations according to aptitudes--in order to predict success--Strong, Kuder, Holland, Campbell, and the recent Department of Labor _Guide to Occupational Exploration_ have tried to classify occupations according to interests. The reference to discriminant analysis in Row 4 is not limited to the statistical method known as the multiple discriminant function. Strong, for example, used correlations.

Differential validity. In Row 5, note that both models B and C depend ultimately--for use in guidance--on differential validities. For selection of candidates for a given job, the selector may care only about absolute validity--in order to get the best qualified person available. But for guidance in approach B or C differential validities are required. The individual would have to be told that chances of success are better or worse in various occupations or that resemblance to membership of various occupations is greater or less. Some reasonable degree of confidence is required in a rank ordering of occupations according to a given individual's chances of success, or resemblance, or (using a technique like Tatsuoka's [1956]) both simultaneously. Obtained differential validities, however, have been very disappointing to proponents of B and C--as reviews and studies by Super (n.d.), Tiedeman (1958), Cronbach (1956), Thorndike and Hagen (1959), French (1961, 1962), and others have demonstrated. (A study by Katz & Norris, 1972, discusses some of the statistical and theoretical problems in establishing differential validities.) Furthermore, model C--if followed to its logical extreme--would never "improve" the sorting of people into occupations: it would only increase homogeneity of membership within each occupation:

> There is a big step from the observation that certain differentiations do exist to the conviction that they should exist--that, in fact, they should be sharpened, refined, and actively encouraged....The logical conclusion of such attempts would be an essential monotype for each occupation. In the absence of convincing evidence for the existence of occupational monotypes, or arguments for establishing them, the theory for this trait-and-factor approach breaks down and much of the guidance practice based on it breaks down (Katz, 1963).

This is not to say that predictions of success and descriptions of worker traits do not provide useful information. It is to say that they are inadequate for cranking out decisions.

Freedom, Understanding Competence, and Satisfaction

In Column D, the main concern is not success or resemblance, but satisfaction. Those of us who have developed systems based on this approach don't pretend to tell the client the correct choice, but attempt to enhance clients' freedom, understanding, and competence in career decision-making so that they can learn how to maximize satisfaction. Democratic values inspire in us both too much humility and too much pride to want to control decisions--humility concerning our own lack of omniscience, and pride in human capacities for self-determination. We don't know what choice will be best for society or the individual except freedom to work things out in as informed and rational a way as possible. But freedom without competence may be frustrating. While we don't know what the content of an individual's choice should be, we can intervene to help in the process of choosing. In education, enlightened processes are intrinsically important. So we have set out both to expand freedom and to enhance understanding.

Consequently, in Row 2, we recognize that students already possess a great deal of knowledge about themselves. By the time they reach college they have lived a little (and some a lot). They have had experiences, noted outcomes, developed a sense of identity. They have even taken tests and courses, obtained scores and marks, and have swallowed or rejected the results. In short, they have at least the raw material for a self-concept, even though much of it is latent. It is this knowledge that a CAG system can try to help the student uncover, bring into full awareness, and make explicit through structured examination and exploration of values, recognition of interests, and informed self-estimates of abilities. We are concerned with more than observations of relationships--we are concerned with what an individual's perceptions signify to him or her.

In Row 3, occupational information is analyzed in terms that are relevant to the satisfactions that the student has defined and specified. This can be termed the instrumentality of each occupation on each dimension. Here let us underline the distinctions between the kinds of occupational information relevant for the different approaches. From job requirements to worker traits to opportunities for satisfaction--these are not trivial differences. Occupational information for one approach is often inappropriate for another. The algorithm in Row 4 then indicates the extent to which various occupations are instrumental in providing the total configuration of rewards and satisfactions sought by a student--or more precisely, in offering opportunities for such configurations of rewards and satisfactions. It also helps the student to bring to bear the reality factor--the probabilities of success in completing preparation for an occupation, which is almost always more predictable than success in the occupation itself. Again, it provides help with processes, examining desirability, risk, and decision rules, and thus provides a structure for thinking about decisions without dictating the content of the decision.

As for Row 5, such CAG systems allow students to take almost unique slices through the universe of occupations. Finally, in Row 6, there is no differentiation between long-term and short-term criteria. Since career decision-making is not a one-shot episode, but usually a continuing process, students are expected to continue to use the understandings and competencies they have gained through interaction with the system. They are expected to be sensitive to changes in their needs, values, and life situations, to remain open to new information, and to continue to make informed and rational decisions.

CAG AS A SOURCE OF RESEARCH

A final note about CAG emphasizes its potential contribution to research. First, as previously indicated, each system represents a clearly defined "treatment." Second, the computer is capable of collecting observations on the "track" of each client (who has given informed consent) through the system. Third, such data are collected unobtrusively during the process of career decision-making: they neither interrupt the process nor depend on recall or retrospection. In short, the observations are made through a "window" in the career decision-making process. The variables are elements in that process, not made-up answers to questions in an interview or on a questionnaire that may or may not be salient to the respondent.

An illustration of such a study is one on sex differences in the career decision-making process (Norris, Katz, & Chapman, 1978). One can anticipate new and more ingenious studies based on the data collection capabilities of CAG systems.

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GLOSSARY OF ACRONYMS

AIR--American Institutes for Research

AOIS--Alabama Occupational Information System

CACE--Computer-Assisted Career Exploration

CAG--Computer-Assisted Guidance

CAT--Computerized Adaptive Testing

CDI--Career Development Inventory

CETA--Comprehensive Employment and Training Act

CHOICES--Computerized Heuristic Occupational Information and Career Exploration System

CIS--Career Information System

CISI--Career Information System of Iowa

COCIS--Colorado Career Information System

COIN--Coordinated Occupational Information Network

CPP--Career Planning Program

CPU--Central processing unit

CRT--Cathode-ray tube

CVIS--Computerized Vocational Information System

DOT--Dictionary of Occupational Titles

ECES--Educational and Career Exploration System

ETS--Educational Testing Service

GATB--General Aptitude Test Battery

GIS--Guidance Information System

ILS--Interactive Learning System

ISVD--Information System for Vocational Decisions

MOIS--Massachusetts or Michigan Occupational
Information System

NIE--National Institute of Education

NOICC--National Occupational Information Coordinating Committee

OIAS--Occupational Information Access System

<u>OOH</u>--<u>Occupational Outlook Handbook</u>

OVIS--Ohio Vocational Interest Survey

SDC--Systems Development Corporation

SDS--Self-Directed Search

SIGI--System of Interactive Guidance and Information

SOC--Standard Occupational Classifications

SOICC--State Occupational Information Coordinating Committee

USES--United States Employment Service

USOE--United States Office of Education

VIEW--Vital Information for Education and Work

WCIS--Wisconsin Career Information System

Figure 1

FOUR APPROACHES TO CAREER GUIDANCE

	A. Parsons	B. Selection for Success	C. Resemblance to Membership	D. Understanding&Competence in CDM
1. Purpose or objectives (implicit or explicit)	Choose occupation to maximize success and therefore satisfaction of individual and benefit to society.	Prevent waste & inefficiency in preparation by basing choice on differential prediction of success. Improve over-all productivity.	Prevent waste & inefficiency, maximize satisfaction, by basing choice on resemblance to membership in occupation. Increase homogeneity of membership.	Learn career decision-making process to achieve individual satisfaction; make plans that take into account preparatory requirements and probabilities of entry.
2. Appraisal of individual	Counselor's observation and judgment during interview.	Standardized test battery, emphasizing differential aptitudes--off-line. (e.g., Air Force selection, GATB.)	Standardized tests and/or inventories, often emphasizing interests--off-line. (e.g., Strong, Holland, TALENT.)	Individual's informed self-appraisal of values, interests, abilities--interactive.
3. Occupational information	Counselor's knowledge, experience, impressions.	Job analysis to classify occupations by aptitudes and to specify requirements or criteria for success in each occupation. (e.g., Air Force, Shartle, Minn. Employment Stabilization.)	Differentiated characteristics (antecedent or concurrent) of members of each occupation--usually involving scores on same instrument as in (2), above. (e.g., Strong, TALENT.)	Systematic multi-dimensional analysis of opportunities for satisfaction--i.e., "instrumentality" of each occupation on each dimension.
4. Articulation between (2) and (3) above--for "choice" or decision-making	Counselor's judgment--i.e., "true reasoning" by counselor.	Counselor's judgment linking aptitude scores to occupations, or regression analysis--equation using predictor variables, from (2) above, selected and weighted optimally to predict success as specified by criterion, from (3) above.	Counselor's judgment linking interest scores to occupations, or discriminant analysis--showing degree of individual's resemblance to membership of various occupations differentiated by the characteristics measured.	Algorithm for combining individual's weighting of each value with rating of occupation's instrumentality--produces index of "desirability"; decision rules for adjudicating between desirability and risks.
5. Effectiveness depends on data showing	counselor's omniscience and wisdom.	differential validities (which depend, in part, on relatively low correlations between criteria--i.e., differentiated requirements for success in various occupations--and relatively low correlations between predictor composites for various occupations).	differentiated distance of individual from various occupational memberships such that probability of resemblance vs. dissimilarity can be discerned at useful level of confidence.	differentiated opportunities for satisfaction in various occupations consistent with differentiated profiles of examined values.
6. Evaluated by (a) short-term (b) long-term	(a) clients' acceptance of counselor's judgment; (b) later success and satisfaction in occupations chosen.	(a) clients' choices of occupations offering highest probabilities of success; (b) later success in occupations on criteria specified in (3) above.	(a) "hit" ratio: clients' choices of occupations whose members they most closely "resemble"; (b) persistence in occupations so chosen.	(a) & (b) clients' competencies in cdm--e.g., understanding of own values, comprehensive specifications sought from occupations, knowledge of relevant occupational information, accurate interpretations of comparative probabilities of success in various preparatory programs. Choices of occupations consistent with desirabilities and risks.