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ABSTRACT

Through a description of an imitation career, the author introduces the complexities involved in programming a man-machine system which facilitates individualized career development. The interaction of man and machine is programmed, in the imitation career, because the individual descriptions of events in career chronologies, vitae and organizations are programmed for comparison with the computer's public descriptions of them. The imitation career is specified as an instrumentality in career development into which the author has integrated most of the important work on vocational development. The author indicates that more research will provide machines which: (1) can develop careers for individuals in the simulation sense of "imitation;" (2) will develop careers with individuals in the instrumentality sense of "imitation;" and (3) develop careers for themselves in the artificial intelligence sense of "imitation." He concludes, however, that in actuality machines don't develop an individual's career, but only help individuals understand their career development. (TL)

INFORMATION SYSTEM FOR VOCATIONAL DECISIONS

Project Report No. 16a

CAN A MACHINE DEVELOP A CAREER?

A STATEMENT ABOUT THE PROCESSES OF EXPLORATION AND COMMITMENT IN CAREER DEVELOPMENT

David V. Tiedeman

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Graduate School of Education
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July, 1968

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A STATEMENT ABOUT THE PROCESSES OF EXPLORATION AND COMMITMENT IN CAREER DEVELOPMENT*

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Career in Vocational Development

In Salute. I am pleased to participate in this Symposium of Perspectives on Vocational Development. Judson Shaplin is a colleague of yore. I owe much to Shaplin who stood by and helped this neophyte teacher as he strove to embrace in his career the professorship at Harvard. I in turn have been delighted to see him expand and strengthen the Institute of Education at Washington University. Furthermore, our own John Whiteley is a Harvard student seemingly of but yesterday. I continue to expect much from John who already in a few short years at Washington University has so ably demonstrated his capacity to think and do big things in the theory and practice of guidance.

My pleasure at being here extends beyond the merely personal feelings of honor I joyfully bestow upon two former colleagues in their own institution.

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I am indebted to my friend and colleague, Allan B. Ellis, whose question, "Can a machine counsel?" had such penetrating effect as to put me onto the question which became the theme of this paper.

I am also present in this Symposium with three professional colleagues whose work I always attempt to know intimately and whose contributions to the theory of vocational development have been considerable. It has been their work which has in part interactively caused my work to take the directions it now has. This fact appears in my work in two ways. Since I learn much from Holland, Roe, and Super whenever I read their writings, or talk with them, I always attempt to incorporate their understandings about vocational development into mine whenever mine change as they so frequently do. Also, their work is ordinarily of such excellence that I try not to duplicate it. My life is too short and my need for understanding of career development too great, for me to waste time going over ground I find each of them laying out so ably by themselves.

Phases in My Development of a Language of Career. I presently believe that my work in career development and that of my students and associated colleagues at Harvard is best conceived in five phases. The first phase which started in 1947 found me at work on occupational choice. The second phase which started in 1953 because of Super's paper on theory in vocational development (1953) found me wrestling to unite occupational choice and self concept. Beginning around 1957, I found it necessary to expand my concern with occupational choice and to encompass that of choosing anything which is founded in a belief system. The resulting union of choosing and vocational development brought me into the third phase of my thought and found me both realizing that career and vocation are not identical and believing that career is more fundamental than vocation. By 1962, I proved able in my understanding of choosing to work simultaneously with it and the process both of incorporating and of being initiating with what is originally another's

conception. This capability brought me into the fourth phase of my thought. It also gave rise to my concern for the processes of exploration and commitment in career development. Finally, by about 1963, I found myself at work with realization that the processes of exploration and commitment in career development are specific manifestations of general processes in cognitive development. This realization permitted me in turn to become more explicit about the development and application of those general cognitive processes in the realm of career.

Gordon Dudley and I (Tiedeman and Dudley, 1967), in association with Frank Field, Wallace Fletcher, and Chris Kehas, have assembled our recent joint work in a multilithed volume entitled THOUGHT, CHOICE, AND ACTION: PROCESSES OF EXPLORATION AND COMMITMENT IN CAREER DEVELOPMENT. The volume is organized according to the phases in development of my thought which I have just sketched above. The new volume represents my effort to bring my thought up to date from its condition in 1963 when, with Robert O'Hara, I published (Tiedeman and O'Hara, 1963) it as CAREER DEVELOPMENT: CHOICE AND ADJUSTMENT. Dorsey Press has recently agreed to publish a revised version of the new volume. Hence I shall rely upon it to further inform those of you who are curious about not just why I hold my present ideas but also about how my colleagues and I argue extensively for their existence. I want to do something new in this Symposium.

Thesis. This first of our two-day Symposium requires each speaker to lay out his current theory of vocational development. I shall do so in terms of a language of career, not of a theory of vocational development. I do so because I want to treat the concept of career imaginatively in this paper. I personally feel that the distinctions between vocation and career I shall make are both valid and powerful. I hope that their pursuit may bring the whole enterprise of studying vocational development to a new level

of organization with career,not vocation, as central conception. However, I need your understanding both of my career concept and of its importance if such a hope is to be fulfilled.

On the second day of this Symposium, we speakers are to say where we think the study of vocational or career development may be in 20 years, by 1988 in fact. This is a task which challenges the intuitions of each of us speakers. I am sure that each will be humble in the face of all those contingencies which ordinarily delay the emergence of the now possible and of the later emerging. However, you will find that I address my own responsibility in the general effort by both describing a computer-based Information System for Vocational Decisions (ISVD) which I am presently engaged in assembling and considering the implications for us of spreading, studying, and developing the concept of that System beyond where it now is or can be taken within the presently promised financial resources. I personally feel that the interactive possibilities inherent in the developing ISVD are at the heart of considerable and important developments in guidance and individual career development.

Because my second paper will deal with my plans for further expanding both the use and capability of a computer-based career support system, I elect in this paper to straight-forwardly address the question, "Can a machine develop a career?"

I understand that you may first incline to dismiss this question lightly. However, like A. W. Turing (1964), and my colleague Allan Ellis, I consider this question to be an extremely penetrating one. It is intended to cut through the confused and ordinarily emotionally laden feelings usually attending discussion of machines and men, particularly in guidance-like issues such as career development. Furthermore, it is intended to

examine the conditions of machine and career sufficiently closely to achieve a gain in understanding of the two by examining them together.

It is meaningless to negate the question, "Can a machine develop a career?" out of hand. In order to determine whether the question has meaning and power, it is first necessary to analyze what is meant by a career and a machine. Let us do so in that order.

An Imitation Career as Instrument in Career Development

A Time Chronology. A machine is programmed to record the dates on which an individual enters and leaves each event in his work history. If this record was feathered out so that it also gave the hours of particular days on which the person worked as well as their dates, the chronology would more accurately portray the position which the individual gave work in the time use pattern of his life. However, such a record would become more complicated than we have so far made it in vocational psychology. Therefore, let's conceive the chronology in its presently limited sense.

The dates which a person worked at each of the several jobs he held in his life when related to the person's advancing age portray aspects of work in which we have only recently become interested, namely the length of time a person stays on a particular job. Presumably, the length of time a person stays on a particular job increases as he grows older. However, technological change is said to be having considerable effect on this fact at the present time. Technological change is also said to be having effect on the number of jobs which a person will in the future record in his chronology.

A Work Vita. If we programmed the machine to record the name of the jobs an individual held in each of the periods which he worked as well as

the company in which the job was discharged, other matters of interest to vocational psychologists spring into being. We think of jobs in terms of their kinds, their responsibilities, and of the companies in which they are practiced. When we think of jobs in terms of their kinds we frequently call those kinds, "occupations." We thus consider occupation to be a more general term than a job. By making reference to the job and enterprise codes of the Dictionary of Occupational Titles (1966) stored in its memory, our machine can indicate the occupations at which an individual has worked. Our machine memory will also contain the occupational level codes of Holland (1966) and/or Roe (1956). The machine can therefore write a work vita which incorporates inferences about the level of responsibilities an individual has held and now holds. The memory of the machine will also include Super's (1957) code of enterprise. The program can therefore incorporate in the work vita inferential data about the kinds of work organizations in which the work has been and is performed.

The memory of the machine will also include Roe's (1956) group categorization of occupations. A program will be written based on these group classifications which infer the vocation which a person is pursuing. This program will be based on the consistency of the groups in which the person's occupation falls as he changes work. The program for inferring occupation will also compare the levels of an individual's several jobs as well as their groups. A vocation associated with progress in advancement level will be called a career. Persistent advances in level accompanied by changes in groups and/or enterprises will be referred to a new table which will contain career names different from vocation names based on Roe groups. Records of uniform level with variability in Roe groups will be referred to still another career table to find names appropriate for

such records. Records with vacillating levels and groups will be referred to still another type of career table to name the career. Finally, career names associated with employment in the same group at vacillating levels will be obtained from still another type of career table. The machine will also contain a table permitting the inference of interests from the work organizations in which an individual has been employed. This table will particularly differentiate self from company types of employment and in the latter case differentiate work style based on inference about work groups. Inferences about vocation, career, and work style will be further referred to tables from which personality characteristics will be inferred.

Personality Organization* in the Work Chronology and Vita. An individual's naming of his job and the company in which it is practiced can also be referred to the stored Dictionary of Occupational Titles for reference to description of its duties and prerogatives, the interpersonal, material, and ideational relationships it requires and permits, and the experiencing style it requires and permits in relation to the experiencing style effected in the non-work environment. Suppose that we consider as structure the three elements in each kind of description, namely 1) requirements and prerogatives, 2) interpersonal, material, and ideational relationships required and permitted, and 3) the experiencing style required and permitted. Furthermore, let us consider the function of aspiration in growth or effective curiosity as we might better conceive growth. Then we can consider as organization in his personality the change from one structure to another which a person attempts and effects as he vocationally responds

*I am primarily indebted to Gordon Dudley and Eileen Morley for teaching me about the terms and concepts of organization as used herein.

to aspiration in growth. Although I cannot specify the detail at the moment, let us suppose that we can write programs which infer organization when structures are compared, pair by pair in sequence.

When the vocational history has been programmed sufficiently for organization to exist, it becomes possible to conceive development. What develops in vocation is the organization of occupational structures in service of the aspiration function. What develops in our program of vocational development is the linguistic context within which we explain the vocational aspects of the life history.

Education and the Work Chronology and Vita. Suppose that the machine is further programmed to record an educational chronology and vita as well as the work chronology and vita. When the work history is joined with an educational chronology and accompanying naming of the educational experiences associated with each of several discrete periods, we must recognize that education is no longer necessarily all concentrated before work. Therefore, two relationships of interest in vocational psychology must be programmed. One relationship which must be programmed is the interspersing of education and work. The other relationship which must be programmed is the interdependence of education and work. At the present time this interdependence can be either preparatory as it has traditionally been or synergetic as it may well more frequently become. In the synergetic condition we might well conceive a job as causing a person to know that he must expand his knowledge from education and to act upon both what knowledge he has and that prior fact while continuing in his job.

Some of the aspects of the named educational experience which must be programmed because of their interest in vocational psychology are those

associated with 1) the kind of school a person is in during a period, elementary, secondary, tertiary, for instance, and 2) the subjects he studied. The kinds of schools a person attends are programmed to relate with the conception of level in occupation. Cooley and Lohnes (1968) career tree will be helpful in the preparation of this program. However, in broader outline, the subjects a person pursues are programmed to bear both on level in one sense but on kind of occupation in a more important sense. It is the relationship of subject and occupation in the preparatory relationship of education which gives rise to entry into an occupation. It is the relationship of subject and occupation in the synergetic relationship of education which gives rise to satisfaction, success, and possibly progress in career.

Personality Organization in the Education and Work Chronologies and Vitae. Suppose that we can do for education what we have suggested can be done for occupation, namely to expand by way of some dictionary or school catalogue an individual's naming of the schools and subjects in his educational history. We could then program into our machine the provision of the requirements and prerogatives, the interpersonal, material, and ideational relationships required and permitted, and the experiencing style required and permitted for each school and subject. If we then again consider organization in personality to be the change in one structure to another which a person attempts and effects as he responds vocationally to aspiration in growth, we can again imagine a machine program written so that various characteristics of his educational organization may be inferred from comparison of these structures in sequenced pairs. The details of this machine program will be mentioned more specifically in tomorrow's talk. They remain as necessary tasks to be undertaken, not as completed studies.

We don't know much about how epistemological understanding grows.

The existence of educational as well as occupational organization introduces another problem in career which our machine program must handle. I have previously noted the essentially preparatory and synergetic relationships which education may have with occupation in the career. I note here that this relationship may in addition vacillate from time to time in the career. Therefore, our programs which write the interrelationship of education and occupation from chronologies and vitae in the dual realms must pay particular attention to the relationship which one organization is from time to time given opportunity to have on its counterpart organization.

Gribbons' (1959) conception of vocational readiness planning will provide one of the frameworks for programming the intersection of educational and occupational realms in the career. Crites' (1965) and Super's conceptions of vocational maturity (Super and Overstreet, 1960), will also provide a still higher order conception for programming of that intersection. Finally, Super's metadimensions of self concept (cf., Super, Starishevsky, Matlin, and Jordaan,1963) as expanded by O'Mahoney's (1968) theory of vocational self concept will provide the programming guides for the intersection of vocation and career.

Personality Organization in Expanded Chronologies and Vitae. I have so far described my imitation career first in terms of a chronology, next in terms of a vita, and finally in terms of a personality organization for each of two realms of activity, educational and vocational. As I did so, I noted that the issues in machine program involved the existence of a dictionary from which structure can be inferred in each realm. Organization can then in turn be inferred by conceiving the problem of expanded linguistic

meaning which arises from sequentially juxtaposing the structures of pairs in a single realm presuming that structure is changing in service of the function of growth. Finally, I noted that the existence of two organizations added to the problem of inference that of causing the organization in one realm to be programmed in interaction with the organization in the other. In the interaction I proposed that a critical factor should be the programming of the dominating or coordinating effect of one structure on another as organization changed in the function of growth. In this regard, Super's theory of vocational development (1957) might serve as a first order approximation of the needed programming. However, in all likelihood we will need many more studies on the order of that of O'Hara (1958) which dealt developmentally with the dominating and coordinating effects of awareness in several realms of vocational self concept over each of several years.

The programming which I have so far described can therefore first be considered as a general description. Chronologies, vitae, and organizations in additional realms can then also be programmed to the extent that dictionaries of structure and developmental theories of organization are available. The addition of each new realm must of course be programmed so that its effects will be written independently of other effects in pair-wise interactions with all other effects, in triad-wise interactions with all other effects, and so on up to the final single interaction equal to the total number of realms included in the momentary definition of career in personality.

Since working with Matthews (1960), I have been personally convinced that personal and family living is an effect of great importance to career in personality. I therefore ask you to conceive the programs in the imitation career to include the structures of marriage and family. It is not yet very possible to write machine programs for the development in

personality which includes marriage and family structures. However, Jeannette Friend and Matthews have case material from which fair approximations will be possible, at least for women's careers. Furthermore, Super's Career Pattern Study (Super, Crites, Hummel, Moser, Overstreet, and Warnath, 1957) can be counted on for information of this nature.

Dynamic Personality Organization in Expanded Chronologies and Vitae. I have so far deliberately spoken of structures which are defined just in terms of our knowledge. I shall call this knowledge public knowledge (Landy, 1968).

The machine which I shall envisage is to be one in which the individual may enter his programs so that they may also control inferences from chronologies, vitae, and organizations just as our programs control those inferences. In fact, you will see that I will also speak of a machine which permits the individual to substitute his program for parts of ours as he grows in his understanding both of how to do so and of why doing so is advantageous to him.

In terms of the machine which I have just described, I then trust that it is not too great a jump in imagination to consider a career machine which contains the dictionaries and inferential programs of the individual just as they contain our dictionaries and inferential programs. Let us refer to such knowledge as private (Landy, 1968), or experiential knowledge. Such a machine can then be programmed to give to educational, job, and personal and family living events the individual's content as well as ours. For instance, an individual's naming of his job and the company in which it is practiced can very well be expanded by his description of its duties and prerogatives, the interpersonal, material, and ideational relationships it requires and permits, and the experiencing style it requires and permits in

relation to the experiencing style effected in non-work environment. These descriptions can be daily ones or of longer periods of time. Normally they are the latter. The descriptions can also include what is hoped and planned for as well as what is taking place. Finally, the description can provide for continuous revision of past impression based on new experience and thought.

By the same token, an individual's naming of a school and a subject in his educational history can be expanded by his descriptions of its requirements and prerogatives, the interpersonal, material, and ideational relationships each has required and permitted and the experiencing style it requires and permits. Again descriptions can be recorded in minute or large periods of time. Normally they are recorded for larger not smaller periods of time. These descriptions can also include what is hoped and planned for as well as what is taking place. Furthermore, each new recording can include revision of former recordings as new experience and impressions expand the meaning of prior events for the individuals.

Finally, as has been noted when we spoke about the public organization of personality which could be conceived in one realm, then in two, and finally in any number of realms, similar conceptions of the programs for our machine are possible in the realm of private knowledge. One realm of considerable import is that of personal and family living. Events in marriage and family formation and growth can for each such event be expanded by the individual's descriptions of its requirements and prerogatives, the interpersonal, material, and ideational relationships each has required and permitted and the experiencing style it requires and permits. Again, descriptions can be recorded in minute or large periods of time but for the moment we will imagine programs in which the period is larger, not smaller.

Finally, these private descriptions can include what is hoped and planned for as well as what is taking place because our machine permits the direct entry of such personal information without needed recourse to dictionaries and inferences even though such could be personal in the case of private information. Furthermore, each new recording can include a revision of former recordings as new experience and impressions expand the meaning of prior events for the individual.

Suppose, as we did with public knowledge, we define structure in terms of the three elements: 1) requirements and prerogatives; 2) interpersonal, material, and ideational relationships required and permitted; and 3) the experiencing style required and permitted. Furthermore, suppose that in the case of private knowledge, we consider the procedures of 1) review, and 2) planning. Then the machine programs of career in the realm of private knowledge must deal with <u>both</u> structures and procedures as they produce personality organization for the function of aspiration in growth. However, the necessary machine programs cannot be expressed in the linguistic structures of <u>our</u> public analysis of personality organization. When we let the individual program his own descriptions of events giving rise to private structures, we allowed the association of our public linguistic framework of organization with the private procedures of review and planning. We can, of course, simulate some of this planning as Boocock (1967) has done in the case of the Life Career Game.

The machine will be programmed to use the data of the Bureau of Labor Statistics to incorporate localized and continually updated projections about opportunity in <u>occupations</u> and <u>education</u>. This program will be available in connection either with the simulation of the game or with the individual's interactive career describing when he is engaged in the procedure of planning.

When the individual is engaged in the interactive procedure of planning, he will also have available another machine program which allows him to find out what educational and/or occupational opportunities are available for his placement in the near future.

As indicated, the machine program for dynamic personality organization will make explicit the union of the private knowledge of review and planning procedures and knowledge of psychological processes which can themselves only be private. I shall soon say more of these important processes. I want first to enunciate a seeming difficulty I have bought in my imitation of career at the expense of introducing another's terms into our analysis.

When the individual has placed his own organization of educational, occupational, and generational events into the machine, his organization of each may be compared with our organization of them. This comparison is the central dynamic of personality development. We program the machine so that the comparison is made. However, we must also program the machine with care at this point because we do not want unexamined acceptance of our terms. Instead, we want a condition in which the individual comes to realize a harmony in the structures of form and of his experience.* The structures of form are both the public and private structures in his personality organization. The structures of experience are both those unsimulated by the imitation career which is being constructed for him with the machine and those simulated by the machine including simulation

*This concept is due to John Wideman in my awareness. However, Myra Gannaway and Esther Wiedman have given the concept centrality in my concept of the imitation career.

of planning and practice in valuing** and in relating self concept and occupation.***

The judging of harmony in the structures of form and experience occurs in the processes of exploration and commitment**** in career development. Hence, public developmental programs, vocational or career, must also be first programmed so as publicly to monitor these processes in the interaction of machine and individual. Remember that this interaction has now been programmed in our imitation career because the individual descriptions of events in chronologies, vitae, and organizations are programmed for comparison with our public descriptions of them. In the review procedure, the comparison program should foster bisociation (Koestler, 1967) between and among pairs of structures, public and private, in the several realms written into the machine program of the imitation career. The bisociation experience is a part of the exploratory process which the machine program will foster. In the planning procedure, new

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**Martin Katz taught me the importance of the conception of valuing. He is in turn developing a machine (1968) to relate the concept to educational and vocational development. Hutchinson (1967) has a procedure which makes exploration of the consequences of values possible in the predictive realm of abilities and educational or occupational rewards.

***Terence J. O'Mahoney, a doctoral student at the University of Leeds, is developing this procedure based on the principle of comparing and indicating preferences for vaguely defined occupational pictures judged in pairs (See O'Mahoney, 1968).

****O'Hara and I first dealt with exploration and commitment at an implicit level in 1963. In Career Development: Choice and Adjustment (Tiedeman and O'Hara, 1963), we implicitly used these conceptions in our analysis of the procedures associated with decision-making in career development. Field (1964) and Kehas (1964) subsequently helped me to put them implicitly into the context first of purpose and then of self concept. However, it was Dudley (1966) who brought them explicitly to my attention in relation to the choice process. It was Segal who helped me bring them into explicit use in the definition of predicaments, problems, and psychology (1967).

alternatives and their associated structures are to arise from machine programs arranged so that alternatives and structures can be under private consideration both in a condition of exploration and in a condition of tentative commitment. The difference is that in the exploration process fixation of alternative is likely to be only fleeting, while in the tentative commitment process, fixation on alternative is likely to be more enduring and also likely to lead to expansion in private structuring of one or more alternatives because of the condition of bisociation. The process of commitment is associated with the stabilization of fixation on alternatives for a sufficiently long period of time to permit implementation to occur in relation to plan for personality re-organization in career.

Obviously, the programs monitoring the processes delineated cannot now be written with any precision. You will find that their writing remains a task I set for myself and our field in the near future. However, this should not prevent us at the moment of conceiving their existence and in turn of conceiving their revision and use on a personal basis on the part of the individual himself. The existence of our monitor creates the structure within which the development of agency in the personality has possibility of forming. Agency exists in the development of initiative while effecting harmony in the structures of form and experience. In the development of agency there therefore exists chance for the incorporation of the structure of our monitor of that harmonization into the personality itself. The substitution of a personal monitor for our monitor constitutes a recurrence phenomenon which is the ultimate form of the imitation career, namely the developed capacity for harmonization of the public and private forms of harmonies of form and experience. It is in this instrumental sense in the imitation career that I speak of bringing into awareness the

harmony of form and experience within the linguistics of career.

The harmonization of the public and private forms of harmonies of form and experience represents a phenomenon whose form has been given by Landy (1968). Landy proposes that knowledge is public and private, tacit and explicit. Tacit and explicit understanding have been further explicated by Polanyi (1956). Public and private knowledge has been defined in the imitation career. If these two dimensions are conceived as spanning a two-dimensional Cartesian space as Landy conceives them, then awareness of the phenomenon of agency constitutes the personal movement of knowledge from the private and tacit quadrant across into the public and explicit quadrant. Tarule (1968) indicates how this philosophy can be realized in the context of interest, aptitude, and achievement testing. Her structure must therefore be a part of the machine programs creating the imitation career in the linguistic contexts of education, occupation, and generation.

Finally, machine programs in our imitation career which produce the effect of awareness in the individual cause choosing to have explicit form. In the context of choosing, educational, vocational, and generational choices themselves can have explicit existence in the mind of the individual. The patterning of the actual linguistic structure of harmony in form and experience of the individual is his identity. Erikson's schema (1959) of ego identity therefore becomes the final framework within which agency development must be programmed in the imitation career. This is another of the requirements for the imitation career in need of a great deal more work before the imitating of career will become much of a reality.

A Machine*

In examining the question, "Can a machine develop a career?" we frequently erroneously conceive a machine as having the properties of a person who is himself developing the career. I have no intention of conceiving my question this way. Instead, consider a very simple machine, a so-called Turing machine.

According to Turing (1964), a digital computer consists of only three parts:

1) a store;

2) an executive unit; and

3) a control.

The store part of the computer is usually associated with the common conception of "memory." For instance, it is in the store of a computer that we could save the facts/data of our occupational descriptions and the programs which we have previously written to associate occupations with jobs. The store can thus contain both the facts/data which are to be processed and in Turing's terms "the table of instructions" for their processing. I have in the section on the imitation career called Turing's "table of instructions" a computer program.

The executive unit is the part which actually carries out the various individual operations involved in following a program contained in the store. For instance, the actual operations required to transform a new fact into a processed datum would be carried out in the executive unit under control of a program which I have specified.

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*I am particularly indebted to Allan Ellis for putting me on to the form of discussion of a machine which is presented in this section.

According to Turing, "It is the duty of the control to see that these instructions (Author's note: or programs in the store) are obeyed correctly and in the right order. The control is so constructed that this necessarily happens." (Turing, 1964, p. 8)

I trust it is apparent that I have not used the term "compute" in defining the Turing machine. Although a computer is a Turing machine, not all Turing machines need be computers. A Turing machine merely performs explicit operations in definite sequences.

Tomorrow I shall describe a Career Machine, the Information System for Vocational Decisions, which will operate as a Turing machine in an actual computer. However, today I want us to understand that computers don't merely compute. They do of course have the capacity to evaluate with great rapidity mathematical functions of great complexity. However, they are also merely Turing machines which undertake explicitly denoted functions in explicitly known ways. In this way what they do has the appearance of being logical. However, the logic is that we have been able to program the machines to do not anything that the machines originally had programmed into them.

Finally, I trust that one other fact about computing machines has also become apparent from this short description of a Turing machine. The store of a machine can contain "books of instructions" in Turing's terms, or programs in my language of the imitation career. Therefore the executive unit of the machine can be programmed so as to call on stored subsidiary programs at will. Furthermore, these stored subsidiary programs can in turn operate on facts which are momentarily coming into the machine in the definite form which the subsidiary program requires for their recognition and processing. A stored subsidiary program can therefore

put the machine into a particular state which we may want it to have at any instant in which the data appropriate to that state are expected. Thus the modern computer is not a machine; instead it is a set of machines which can be made either at a programmer's will or at direction of his previously stored programs.

Can a Machine Develop a Career?

Return to thesis. This paper addresses the question, "Can a machine develop a career?" I indicated in the beginning that I considered this question to be powerful, not facetious. I also indicated that I would first need to specify both an imitation career and a machine before I could address the question itself. Since I have now indicated both what an imitation career is and what a machine is, I here turn to the major question, "Can a machine develop a career?" I do so in terms of three subsidiary questions, namely:

1) Can a machine develop a career for an individual?
2) Can a machine develop a career with an individual?
3) Can a machine develop a career for itself?

I owe the third question to Allan Ellis who is collaborating with me in preparing a paper on what is to us the ultimate question in guidance, namely, "Can a machine counsel?" My treatment of the career question for the machine will not be like our joint treatment of the counseling question for the machine. I leave full treatment of that question for the future. However, I do here attempt partial consideration of it as a fourth in my series of questions.

Several Meanings of "Imitation" in Literature in the Human Uses of Machines. Ellis has called my attention to several meanings which authors have given to the conception of "imitation" as they address the possibility

that machines can perform psychological functions such as developing careers. One of the senses in which imitation has been used is that of simulation. In simulation, the machine is programmed to engage as much as possible in human-like functions. Therefore, in using a machine for simulation purposes, one is essentially trying to duplicate human processes. Although my consideration of the question, "Can a machine develop a career for an individual?" may at first give the appearance of being based in the argument of imitation as simulation, this is not actually the case. My reasoning with the question will be based on a third and so far little used sense of "imitation," namely that of an instrumentality the examination of which enlightens human reasoning.

A second sense of "imitation" in the literature on machine usage is that of artificial intelligence. In this sense, the machine is programmed to do things which seem to be intelligent. The ultimate in exhibition of intelligence is of course, the development of programs which give the appearance of learning from past events. This is the goal which creators of artificial intelligence strive to reach. Although my consideration of the question "Can a machine develop a career with an individual?" may at first appear based in belief in artificial intelligence, this will again not be the actual case. As I indicated above, I shall examine the question from the third or instrumentality sense of "imitation." As I have so far twice indicated, there is still a third sense in which one can conceive "imitation" in relation to the potential power of humans with machines. In this third sense which I owe to Ellis, the imitated is an instrument. In this usage, the instrument is actually known as an imitation and the person is not therefore deluded into confusing his own processes with those

of the machine. An instrument of this sort can be a powerful aid to understanding. A person may reason with it. A person can learn from reasoning with it and without danger of confusing what he can do with what the instrument can do. Richards (1955) has pointed out the value of such instruments in the study of the humanities. For me, career is a human product which must be treated in human ways. Hence, as I examine the general question, "Can a machine develop a career?" I shall always be doing so while conceiving the Imitation Career which I specify in the second general section of this paper as an instrument with which a person may reason, not as a substitute for either his actual career or his intelligence in that actual career.

Can a Machine Develop a Career for an Individual? You will recall that I specified my imitation career in terms of machine programs which will printout:

1) a time chronology of a work history;
2) a work vita;
3) the personality organization in the work chronology and vita;
4) the union of education and the work chronology and vita;
5) the personality organization in the education and work chronologies and vitae; and
6) the personality organization in expanded chronologies and vitae.

As I proceeded to specify the imitation career in its instrumentality sense, I noted places in which our existing knowledge of vocational development makes it difficult to provide programs for the enlargement of a vocation into a career. However, I also noted that the Dictionary of Occupational Titles and supporting work by the Bureaus of Employment

Security and Labor Statistics make it possible even now to infer occupation from job titles. I also indicated that the work of Holland and Roe made it possible to infer vocation and at least advancement as an aspect of career. Furthermore, their work and that of Bordin, Nachman, and Segal (1963) and Cooley also makes it possible to unite some of the childhood and educational history with the vocational history. Finally, I indicated that Super's work on vocational development makes it somewhat possible to program development in personality organization.

This accumulation of what we know about programming in imitating a career in the simulation sense is not impressive. It is for this reason that I will tomorrow propose a set of studies designed to bring us to an enlarged condition of being able to approximate better the actual career through programming of an imitation career. However, my main point today is that there is nothing inherently impossible, from the standpoint of a machine, in developing careers <u>for</u> individuals, at least in the sense of being able to imitate a career in the instrumentality sense of "imitation." It is quite true that in our present state of knowledge, the imitation will fall far short of the actual career. However, the non-correspondence of reality and imitation is our fault, not the machine's fault.

<u>Can a Machine Develop a Career with an Individual</u>? The final sub-section of the imitation career specified the programs which would be required to imitate the <u>dynamic</u> personality organization in expanded chronologies and vitae. That sub-section was developed on the assumption that a career is not just something which is written; it is something which is had. In having a career an individual comes into interaction with the part of the machine instrumentality that can write a career <u>for</u>

the individual. The imitation career in its simulation sense in turn programmed this interaction so that balance in the structures of form and of experience was continually weighed by a monitoring function. However, the imitation career in its instrumentality sense let the person substitute his monitoring function for ours as the person proved capable of writing his own machine which would possess the balancing effect in structures of form and of experience.

As I again proceeded to do what I could to specify the machine programs which will in simulation do the things I claimed for them, I indicated that Gribbons' vocational readiness planning, both Crites' and Super's conception of vocational maturity, Katz' conception of the valuing process, and Erikson's conception of identity offered the best approximations now available to the form a machine would be given in order to develop a career with an individual. However, I again want to stress that the present large gap in the correspondence of actual and imitated careers which persons are having is no reason to dissuade us that a machine can develop a career with an individual. The problem is not to abandon attempts to create a simulation machine which will develop careers with individuals. The problem is to make our simulation machines which do so prove able to do a more effective job of it. As I shall next indicate, such good simulation machines will still not destroy their instrumentality effect.

Can a Machine Develop a Career for Itself? As I started this paper, I thought that I had pushed my argument to its limit when I had examined the preceding two questions about what a machine can do in developing careers. However, Ellis, in his usual educative way, destroyed satisfaction

with my understanding by in turn asking, "Can a machine develop a career for itself?" He also, as the teacher he is, next aided my balancing of new form and of experience by teaching me about the distinctions in meaning of "imitation" as I have outlined those meanings above.

The Ellis question confused me at first but I came to grips with it by attempting to analyze it. In the first place, I found that one of the meanings of the questions is, "Can a machine develop a career by itself?" I have in the sub-section entitled, "Can a Machine Develop a Career for an Individual?" therefore already examined a part of Ellis unsettling question. Yes, a machine can develop a career by itself. The career, of course, is not that of the machine; the career is that of the individual which the machine imitates in an instrumentality sense.

A second phase of Ellis' question is, "Can a machine develop a dynamic personality organization in expanded chronologies and vitae?" This is of course, the question which I examined when I spoke of a machine developing a career with an individual. However, in doing so, I admitted that the person was in actual interaction with the machine. Furthermore, I admitted that what was originally my monitoring by simulation of the individual's balance of structures in form and experience was gradually to be replaced by the individual's valuing of that balance. It would appear then that I was admitting that the machine could not develop a dynamic personality organization in expanded chronologies and vitae. But wait, tomorrow you will find me advicating research in the interactive functions when an individual is actually engaged in personally determining his career. As such research progresses, I will become able to program the machine so that it in turn writes monitoring programs more closely approximating those written by individuals in the past. I am hopeful enough about the

patterning in that activity to expect that I can get to predict personal monitoring functions reasonably well. When I can do so, I can then in turn program a machine which will develop a career by itself, even in the second or dynamic sense of career. This will be an imitation career in the artificial intelligence sense of "imitation" as well because it will then become a self-correcting program.

Before despairing for humans, however, I trust it is apparent that I argued by recursion as I examined the second of my questions about whether a machine can by itself develop a dynamic career or not. The trouble with the recursion argument is that it collapses in its limit. There will always be some stage of the recursion in which more experience must be accumulated in the present in order to make the machine be more effective in the future when the programming is done on the basis of prediction. Thus although the form of argument I have adopted has gotten me far down the road of believing for myself that a machine can write a career for itself in the sense of artificial intelligence, I have not fully addressed the question, "Can a machine develop a career for itself?"

In its most general form, the question, "Can a machine develop a career for itself?" essentially asks, "Can programs be written for the machine which will have the effect of giving the machine a career?" Although this question may prove threatening, I contend that its examination can prove enlightening. If we can determine to what extent we can generalize the programs in which the machine develops dynamic careers by itself in the artificial intelligence sense of imitation, we can determine to a greater and greater extent what a machine does when it develops a career for itself. Doing so would advance the language and ultimately the

theory of career development a considerable way in my judgment. However, it would not of course either substitute machine careers for human careers nor deny the sense in which the imitation career is an instrument, not a master. Please remember that I have argued by recursion, not by direct logic. The esoteric career will still exist. I merely hope that my imitation career will in turn make it better understood.

Can a Machine Counsel? Although I do not intend to examine this question fully in this paper because I intend to do so with Ellis in a subsequent paper, there are a few observations which Ellis has already brought me to understand which are important for my argument in this paper. When in the just preceding sub-section I admitted that the recursion argument I had adopted to examine the question of whether a machine could develop a career for itself or not was a weak and potentially deceiving argument, I then went on to address the question on different grounds from those of having machine programs written according to an imitation career. By the same token, I can examine the question, "Can a machine counsel?"

If Ellis and I examine the question, "Can a machine counsel?" from the identical standpoint of this paper, we will find ourselves limited by the same logical constraints which gave rise to recursion as ultimate recourse in the question "Can a machine develop a career for itself?" We would first specify imitation counseling, a machine, and then ask questions about whether imitation counseling in simulation and artificial intelligence senses approximated real counseling or not. For this reason, it is well to examine the question "Can a machine counsel" from the instrumentality, not the simulation or artificial intelligence sense of imitation. If we do so, we will address a different set of questions.

Ellis and I are convinced that such a set of questions can help us tease from counseling those things which have to be done by humans because they are human things, from those things which can be done by machines in counseling because they are instrumentality things.

The Value of the Question. I trust that the value of the question, "Can a machine develop a career?" now has some balance of its form with your experience. If so, you will probably attribute value to the question. If not, I have not yet proved convincing. To those not yet convinced, I can merely list here the value which the question has had for me.

In examining the question, "Can a machine develop a career?", I first had to specify the imitation career as an instrumentality in career development. That accomplishment represents the culmination of some twenty years of thought. In specifying the instrumentality of career development, I therefore moved the language of career development which I started to write with O'Hara in 1963 into explicit form so that it may now be investigated by anyone. I have also indicated how I fit the vocational development work of Bordin, Nachman, and Segal and of Holland, of Roe, and of Super into that instrumental framework. I have also indicated that, with more research which I will specify further tomorrow, we can provide machines which will do a pretty fair job of developing careers for individuals in the simulation sense of "imitation." Furthermore, I have indicated that with use of that research we can in turn start doing a reasonably good job of providing a machine which will develop careers with individuals in the instrumentality sense of "imitation." While doing that I also succeeded in explicitly defining processes of exploration and commitment in career development. Finally, I have indicated that several years or so

of doing the latter can in turn give us a machine which will do a fairly effective job of developing careers for itself in the artificial intelligence sense of "imitation." However, in conclusion, I had to admit that I should turn the whole argument into a new set of questions in order to address more squarely the problem of generating a machine which will both develop careers for itself and counsel. Such an address really gains the admission which relaxes us all, even those really helped in their career development by machine. Machines don't actually develop an individual's career. Machines can only <u>help</u> individuals <u>understand</u> their career development. To this end machines are instruments, not masters, in career development.

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