A Biographic Theory of

Aging and Fertility

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This article is drawn from theoretical research which will be published in 1987 under the title "A Biography Approach to Theoretical Demography". The model of permutational sequences presented and discussed in the article is the most general of many models developed during the research work. It contains all the most important elements of the biographic approach adopted, in perticular the concepts of the risk involved in undertaking long-term committments and the concept of "biographic age".

The research is being supported by the German Research Foundation (Bonn). Part of the work will involve an exhaustive survey (n = 1,500), the results of which will be used to test the concepts and theories evolved. An interim report has already been published in German: Birg, H./Felber, W./Flöthmann, E.-J: "Arbeitsmarktdynamik, Familienentwicklung und generatives Verhalten – Eine biographietheoretische Konzeption für Untersuchungen demographisch relevanter Verhaltensweisen –". Materialien des Instituts für Bevölkerungsforschung und Sozialpolitik, Vol. 16, Universität Bielefeld, 1984.

0. Introduction

If the volume of research on generative behaviour – both in the Federal Republic of Germany and abroad – is used as a criterion it could be thought that the topic is exhausted, that all the fundamental aspects of the subject have been investigated and thus that at least all the more important questions have been answered. But this is not the case. Society is still confronted with the largely unresolved fact that the birth rate ist steadily decreasing despite the – as it turned out isolated – encouraging figures from 1980. Although nearly all the experts were then of the opinion that the slightly increased birth rate occuring indicated the beginning of a much prophesied upwards trend, they were proved to be wrong.

In the last few years sociology has discovered (or rediscovered) the research area of "biography". The concept of the curriculum vitae, perhaps more so than any other information vehicle, is suitable for the analysis of generative behaviour within plausible frameworks. The research opportunity opened up by biographical work has, however, remained largely unused. M. KOHLI, editor of a book of signifikant articles on the sociological theory of the curriculum vitae, points out the connection between research on generative behaviour and biographic research in his summarizing article but then only in the form of a comment that "... in view of the long tradition of the problems being discussed here it is not surprising that precisely those problem areas such as population theory and social policy, which were central to sociology at its beginning but which have been now long neglected, are important" (M. KOHLI 1978:28; authors underlining). In a second collection of contributions to biographic theory (J. MATTHES, A. PFEIFENBERGER, M. STOSBERG 1981) there is not a single mention of the problems of generative behaviour in shaping the structure of biographies even though a majority of all men and women become parents in the course of their lives. The exclusion of this central theme can be perhaps explained in that because of the underlying complexity of both topics. In fact both research in "biography" and in "evolution of the family and generative behaviour" require interdisciplinary approaches for which the prerequisites are seldom available.

At present a certain conflict can be seen between biographic research dealing with concrete CV data on the one hand and that concentrating on more qualitative data on the other. But because experiences in life don't tend themselves readily to classification it's not sensible to restrict the data used to any one type. In the research being conducted information of all sorts is being used as raw material, which, however, in the end, has only the significance that the researcher can extract from it. This applies equally to both qualitative and quantitative data. What is important is not the type of data but the integration of information of all sorts into theoretically relevant statements.

It is therefore necessary to approach the central questions from different sides. This means, for example, that hypotheses must be investigated both at the level of the individual as well as for groups of people (inhabitants of certain regions, the population of a country as a whole, specific age groups, etc.). At the present stage of research emphasis has been placed on the individual and on the cohort approach. At the level of the individual differing models have been developed all of which, however, are orientated to a central theoretical concept within the general biographic framework, namely to that of biographic mobility. Biographic mobility, as will be seen, can be understood as an operational expression for two basic theoretical biographic constructions, namely those of biographic coherence and virtual biography. Biographic coherence refers to the inherent consistency of biographies, which occurs both by virtue of the, as here considered, indivisible core of the transcendental unity of the subject as well as of the predetermining and distorting effects of the outside world of family and society on his biography. The expression "virtual biography" or "biographic universe" refers to the practically infinite number of combinations of biographic sequences or alternative courses of life which are possible, only one of which has been realized upon death. Using these biographic constructions and fundamental hypotheses the questions to whether – and if so, why – a given person marries and has children can then be re–formulated: it is then one of searching for the determinants of prevailing virtual biography (or biographic universe) and discovering the personal objectives and conditions which influenced the course of the individual through this biographic universe to the point of marriage and/or having

children. One of the principal problem areas of this work – the question of the influence of the economy and labour market dynamics – as well as other related questions (the answers to some of which are already known) can thus be formulated as aspects of a more generalized biographic theme. It cannot be expected, however, that such a theme, even when once satisfactorally formulated, can be fully researched in a short period of time in particular when the already well established research area of "social mobility" has much less in common with biographic questions than the common use of the word "mobility" might suggest. Biographic mobility is a much more encompassing concept than social mobility. Every situation of social mobility is a situation of biographic mobility but not vice versa. One of the main concerns of this approach is to show that there are connections between biographic mobility and generative behaviour and that it is not probable that such a connection can be established in terms of the less encompassing concepts of social mobility alone. As an example of the consequences of narrowing the conecpt of mobility it can be pointed out that, on the one hand, the INED investigation (COURGEAU 1984), in which "mobility" was regarded simply as territorial mobility, was unable (or not yet able) to connect – as expected – fertility rates with mobility.

The hypotheses presented here are based on an theoretical biographic framework and combined into three behavioural models including generative behaviour. For these models, a biographic opportunity cost model, a model of congruent biographic structure and a model of permutational sequences, the information bases are comprised principally of "hard" biographic data. In this paper only the model of permutational sequences will be discussed, leaving the other models for the report on the completed research project. To obtain data a biographic questionaire has been designed and a biographic survey is now being conducted (n = 1,500). It is intended to collect data of different sorts (for the investigation of the above mentioned models and others), not only "hard" biographic facts but also evaluations; complicated scales for the description of attitudes and objectives in life will be employed. The questionaire is so constructed that it should be self–correcting because the "hard" data in life cannot in fact be as accurately recalled as one might suppose.

2. Biographic Coherence and Generative Behaviour – A Biography Approach to Demography

2.1 Biographic Coherence

Virtually all the occurrences in a normal lifespan can be related to basic structural patterns of life even if the relationships are not immediately obvious. As an example, the investigations of genetic codes have made it clear how an enormous multiplicity of life forms can result from the simplest principles of order of relatively few basic elements. A language, despite its inherent infinite potential for expression, is comprised of basic elements (letters, syllables and words) which are finite in number – all the written and as yet unwritten books are comprised of the 26 letters of the alphabet. Music can be regarded as another example; it is written in all its infinite variety using different orders and sequences of the relatively few basic elements of the musical notation. All three examples illustrate the complexity of phenomena that can result from differing orders of a finite number of basic elements.

If the life of a human being is documented in a particular way it can be seen to be composed of stages, circumstances, phases, states, situations and events and if these are considered as basic elements different life histories (CVs) can be constructed by ordering the basic elements in differing ways. Each sequence of elements constructed can represent the course of a life exactly as each sequence of letters of the alphabet (and gaps) can represent a word, a sentence or – if long enough – a classical work of literature. That the biography of an individual has to follow a certain pattern of logic does not make the analogies drawn invalid. Not all sequences of letters form words in a given, or any, language. The analogies are important as valid illustrations but do not help in determining the logic that has to be applied in constructing biographies from basic elements. One difficulty is that the individual has both an "inner" and "outer" life and his biography is the result of influences both from within himself as well as from the "outside" world.

The most important theoretical assumption of the biographic work presented here is that there is a connection and a relationship between the outer, observable, structure of an individual's life and his hidden, inner, personal experience. It could well be that there are relationships between the elements of the inner biography of an individual, for example, due to a realization of the intrinsic sense in living (or perhaps of the futility of life), which cannot be detected by analysis of the elements of his outer, observable, biography. Conversely, one could well detect statistically significant relationships between elements of the observable biography which in fact are purely pseudo correlated if there is no connection between the observed outer elements and the inner attitudes and experience. Nevertheless, a basic assumption of this paper is that the observable data for an individual are correlated with his inner, non-observable, biography, and vice versa.

2.2 Virtual Biography and the Biographic Universe

People are normally in the position to maintain a certain objectivity with respect to their own biography. It is so that reflection, composure, and moral/ethical behaviour are only possible when a certain distance to the events of life can be achieved, i.e. a gap which the subject has to create before he can exercise his intellect. "The essence of thinking lies in refelction, i.e. in distinguishing between one's thoughts and oneself" (W. v. HUMBOLDT 1973:1).

Even considering a relatively small number of basic biographic elements the number of possible biographic sequences that can be constructed by permutation is large – more than 3.6 million hypothetical biographies result from 10 basic elements. Against this background every person conscious of his freedoms of choice is confronted in every decision in life with the possibility of doing the wrong thing, of adopting inappropriate personal objectives, of taking the wrong course in achieving these objectives and of misjudging and so reaching false conclusions from past experience. Given a certain level of self-assurance (or of uncertainty) according to the personality of the individual, then it can be said that the level of potential uncertainty with

which each decision is made increases with the number of alternatives that are open to him. One of the most restricting decisions for the future is certainly that of (marrying and) having children, so that it is clear that the reasons for deciding not to have children cannot be regarded as being independent of those biographic sequences which having children would close, even if some of the alternatives are not realistic. This simple but, for generative behaviour, significant argument has not received its due attention in the literature on decreasing birth rates or in theories of generative behaviour.

Fundamental for the development of the models that follow is the virtual biography and biographic universe. It is assumed: every individual lives at every point in time "in" a virtual biography which is comprised of his factual curriculum vitae, his present situation and all his possible courses of action in the future, in particular of those alternatives of which he is conscious and regards as being relevant. The virtual biography is therefore dependent on, i.e. changes with, time. For example, a young woman could be viewing the next 10 – 15 years in the following way; she sees as relevant and/or possible phases or occurrences:

1. Occupational training
2. Marriage
3. Setting up house together with partner
4. Consolidation of economic position by working
5. Having a child

Ignoring for the moment the temporal mutual exclusiveness or not of the elements on the above list, the five items offer $5! = 120$ courses for the future, a number which can be hardly perceived by any individual. But once the first decision has been taken or course of action undertaken this number reduces considerably ($4! = 24$). However, before this, the virtual biography of the young woman consists of her biography of the point of time of her present situation, all permutations of this listed five phases or occurrences permuted with all possible phases or occurrences of which she is not conscious or prepared to think about in her present situation (e.g. a serious

illness and its consequences) together with all permutations of events that life will have to offer after the horizon of 10 – 15 years. It can be seen that the virtual biography is both manifold and – in terms of the number of possible sequences contained – extremely large.

In this simple example it has been implicitly assumed that the virtual biography includes all possible sequences of phases or events. However, if boundary conditions are imposed, e.g. children occur only after marriage, the number of sequences in the virtual biography is reduced. It should be noted that such a reduction is less significant than that effected either by an implemented decision ($4! << 5!$) or by cancelling an item on the list, e.g. the young woman decides she will not have children.

The virtual biography is a subset of the sequences in the biographic universe which comprises all logically possible ways of forming sequences. But the individual cannot be aware of each element of the biographic universe, i.e. biographic sequence, of the universal set of sequences. The above example of five basic elements leading to 120 alternatives at a given point of time for a given restricted future period illustrates this adequately; 10 basic elements lead to more than 3.6 million sequences and 20 basic elements to the astronomical number of more than 10^{18} sequences in the biographic universe. For the study of behaviour such arithmetical exercises are of no direct relevance. Who can say exactly how many elements or courses of action are open to him at any given point in time, and how many of these are in some way restricted by convention, by the laws, rules and regulations of the society or simply by financial consideration. But the size of the universe that can be constructed mathematically still has effects on the consciousness, perception and emotions of the individual even if these effects cannot be isolated and described. The higher the cliff the more careful one is when nearing the edge without having had the experience of acutally falling off any cliff; there is no need to measure a room to get an idea of its spaciousness. In just the same way there is no need for the individual to make calculations on his biographic universe for him to be conscious of and also influenced by it. The biographic universe affects the behaviour of the individual also when he cannot even imagine many of the sequences it contains.

The size of the biographic universe explodes as the number of basic elements, of which it is composed, increases. It also increases when the number of restricting conditions imposed on the sequences is reduced. Historically seen, the size of the biographic universe has increased steadily for nearly all the individuals of all classes in society. This has occurred because both the variety of basic elements has increased and financial, institutional, conventional and religious restrictions have been relaxed. The increase in the number of basic elements is the result of many differing developments, e.g. of the greater variety of employment available with the development of industry and the increase in urbanization as a result of the improvement in transportation, through better education and because of the increasing life expectancy. If the size of the biographic universe is regarded as an indicator for the degree of freedom which an individual can exercise in his life, then a means of differentiating this concept of freedom and of classifying periods in history and/or societies in a way that has relevance for an explanation of the factual decrease in birth rates could be available. One can imagine that very different societies could exist in which the degree of biographic freedom in this sense is the same but for which this freedom in one case arises, for instance, from the availability of a large number of basic biographic elements although restricted by many conventional, institutional, religious and formal conditions, whereas in another case less basic elements are available but with far fewer restrictions. Life would probably be very different in these two societies. In the first case the atmosphere presumably would be much less agreeable than in the second with the corresponding consequences for behaviour in general and, in particular, for generative behaviour.

2.3 Biographic Mobility and Biographic Subspaces

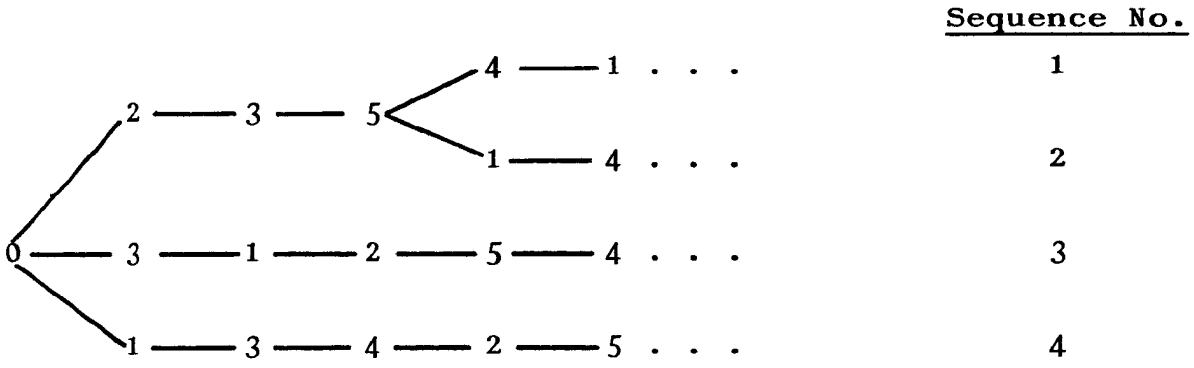
In order to proceed, a concept of "biographic mobility" is necessary in addition to those of "biographic coherence" and "virtual biography" already introduced. A person's life is regarded again as a series of different phases or stages (the elements of sequence). A relevant biographic event in life can then be defined to be the point of change–over between two phases. Per definitionem a relevant biographic event in

life then cannot take place within a phase. With this terminology it is possible to define biographic mobility as changes of phase within the virtual biography (in the language of the natural sciences perhaps as "changes of state"). Of cource, some phase changes can only occur if a specific event takes place, e.g. a phase of the "married state" can only follow that of "being single" by means of the intervening event "marriage". Phases can be of extremely short duration; for instance, the events "marriage" and "setting up house with partner" often – but certainly not always – occur more or less together.

To make this definition more precise two types of biographic mobility, the inter-sequential and intrasequential mobility, are specified. The previous example is used again as an illustration and basis for discussion. Consider the extremely simplified but now more precisely defined biographic universe or virtual biography of a young woman comprising of all 120 possible sequences of the phases between the following six relevant biographic events, whereby the present situation (which it is not necessary to define precisely) is taken as a fixed starting point:

0. Present situation
1. Start of occupational training
2. Marriage
3. Set up house with partner
4. Start working in order to consolidate financial situation
5. Birth of a child

Of the virtual biography of 120 possible sequences of phases between these events four are chosen for illustrative purposes:



The four sequences have the same number of elements (phases) and therefore contain the same number of events but the probability of a birth (event no. 5) presumably is different for the sequences 1 (and 2), 3 and 4. The sequence no. 1 could be classified as "typical" for a woman for whom occupational training has little significance. It should be emphasized that virtual biographies are depicted and that for sequence no. 1 the event no. 1 coming at the end in reality would be seriously considered but usually not implemented.

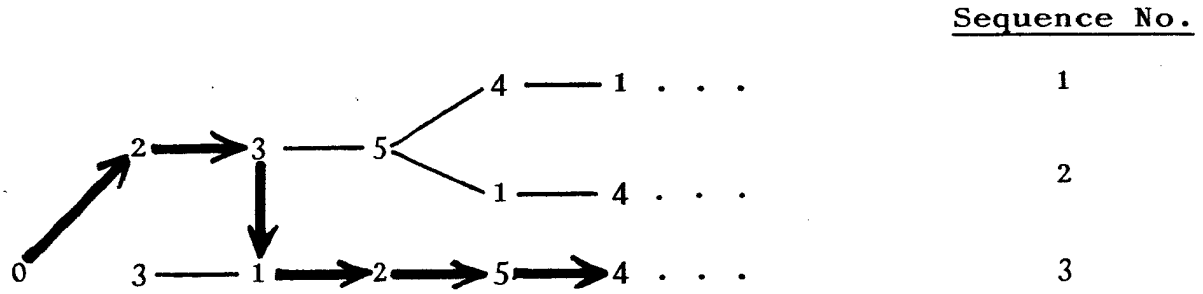
Sequence no. 2 is a variant of sequence no. 1 in which occupational training appears as a prerequisite to obtaining satisfactory employment. Many people (usually men) don't even consciously consider the order of "occupational training" (or "education") and "employment" since the one is automatically a prerequisite for the other, but for this example of a young woman both the sequences 1 and 2 are realistic since it often occurs that, having married and had children, the husband's income is too low to constitute the only means of familiy income. It should be noted that the four sequences are so ordered that the relative importance of occupational training increases from sequence to sequence.

Because the word "typical" has been used the question immediately arises as to whether there is, in fact, a "typical biography" among the considered 120 sequences for a young woman. If it is considered typical that event no. 1 comes before event no. 4, can it also be said that "typically" no. 2 precedes no. 3 and that it is usual nowadays that a sound financial basis (event no. 4) is achieved before the child arrives (event no. 5)? Only if all these points can be answered positively can one say that the sequence 1 – 2 – 3 – 4 – 5 ist "typical". Unfortunately there are no statistics on this matter so that it is not possible to say how the biographies of young women are distributed over the 120 sequences of the considered biographic universe. Without entering into further speculation it can be nevertheless pointed out that even if it should turn out that the sequence 1 – 2 – 3 – 4 – 5 is the most frequent this does not mean that those concerned (namely young women) would also evaluate this sequence as "typical". It could well be that the sequence often occurs involuntarily through force of circumstances. If one can believe the polls taken, the majority of women do not opt for distinct phases of employment and then housework as a mother, but for a combination of both. It isn't profitable continue the discussion at this stage because all the concepts necessary for analysis have not yet been presented. The example being discussed simply serves to illustrate that a biography approach can be used to typify sequences in life in a way relevant to the question of high and low birth rates.

The third and fourth sequences shown represent biographies which can be supposed to be more "modern", certainly biographies which can be observed nowadays with increasing frequency. Occupational training and/or education is increasing in significance (or has absolute priority – sequence no. 4), marriage and children not only actually come later but are also considered to be relatively less important. Whereas occupational training for the sequences 1 and 2 of the virtual biography is not often realized in practice because it occurs towards the end of the hypothetical sequences, the same is true for the event no. 5 in the third and fourth sequences: having a child is discussed, considered for decision, but delayed, and the most suitable point of time often simply slips past without result. Before this particular point the question of the "desirability" of a child probably would be negatively answered, after it, positively.

It is therefore important in designing a questionaire to pay particular attention to age. Accuracy to one year would appear to be a minimum for biographic analysis of birth incidence.

The main objective in introducing the for sequences of the example is to illustrate the definition of intra— and intersequential biographic mobility. Intrasequential biographic mobility is simply the stepwise realization or partial realization of a particular sequence in the virtual biography; thus (sequence no. 3) the young woman actually sets up house with her friend, starts occupational training, marries, has a child and, lastly, takes a job — she actually "moves" along the sequence of phases lying between these events. Intersequential biographic mobility occurs when an individual leaves a sequence in the virtual biography in order to join another sequence of the same virtual biography (intersequential mobility of type A) or indeed to go over to a sequence in another, different, virtual biography (type B). Leaving a sequence and not joining any other sequence is a special case for intersequential mobility — drop-outs from society can be characterized as people whose virtual biography cannot be defined.



The above diagram illustrates both types of biographic mobility. Realizing the phases between events in a given sequence of the virtual biography (sequences beginning 0 — 2 — 3 — 1 ..... are not numbered in the example but are nevertheless elements

of the simple biographic universe being considered) is denoted as intrasequential biographic mobility. The sequences 0 – 2 – 3 – 1 – 2 – 5 – 4, which is not an element of the virtual biography being considered, is depicted above as a change of sequence within this virtual biography (intersequential mobility of type A). One could, however, easily regard this sequence as representing intersequential mobility of type B since before marrying again a divorce must be obtained, which has to be considered as a relevant biographic event, and so the young woman following this course in fact has "jumped" into another virtual biography. Which of the two interpretations of this sequence is more "correct" depends entirely on the methods and informations available for analysing the effects of such a sequence on the probability of the young woman having a child. In the model presented in chapter 3 it is precisely the differentiation of such effects on generative behaviour and therefore the birth rate that are important. In the example it is clear that both intra– and intersequential mobility affect the realization of the event no. 5, "having a child". How mobility and the birth rate are connected cannot be discussed at this point – the concept of biographic sequences first has to be examined in more detail.

The fundamental elements of a sequence, whether these are regarded as phases or events, are first separated into groups. All those elements which effect the occupation of an individual are placed in one group. These could be "occupational training", "first job", "second qualification", "second job", "change of job in the company", "change of companies", "promotion", "dismissal because company folds up", "change of occupation", "change of industrial branch" or "change of job and location", etc. Sequences of such elements which belong to, and are therefore subspaces of, the virtual biography of an individual are collectively called the virtual occupational biography or the occupational biography (according to context).

Secondly, all sequences of elements of the virtual biography which are important for the social life of an individual are placed together in a group. Different stages of education, family experience, relevant friedships (their beginning and end), acquaintances, colleagues, and those occurrences and experiences connected with them which are relevant for social life can be included in such a group. For those employed,

colleagues are often socially important. The occupational biography of an individual is therefore, but not only in this single respect, often closely connected with his social biography, a further subspace of the biographic universe.

The terms family biography or generative biography are used to designate a subspace of elements which can be connected with the sequence of changes of phase which take place in the family history of an individual, i.e. – excluding childhood – those changes which have a bearing on generative behaviour. The biographic events masking such changes could be "marriage", "birth of first child", "birth of second child", "divorce", "re–marriage", "loss of husband/ wife", "first child leaves home", etc. In addition, many people are conscious of continuity in the family, of the continuity of the generations. The existence of such a sense of continuity ranging from mother and father (and perhaps even further back) over themselves to their own children might justify the inclusion of events affecting the continuity of the family, such as "sister's marriage", "death of father" or "divorce of parents" as relevant biographic events for the family biography. The partition of the family cycle into a "lifetime family career" and a "lineage family cycle" over the generations of FELDMAN and FELDMAN (1975) is an attempt to develop this idea.

The succession of phases and events important for the development of the personality is designated in the development/psychological literature the development biography, the "psychobiography" or the "psychological curriculum vitae" (CH. BÜHLER 1969). The course of development of the individual in this sense can be further partitioned, in particular into the identity formation biography and the individuality formation biography. Psychological research on the question of development is, however, only considered here in as far as it contains hypotheses on the determinants of generative behaviour. In this respect CH. BÜHLER (1933 and 1969) and E. H. ERIKSON (1966) are relevant. For the construction of biographic theory as such, i.e. of theory in which the interdependency of biographic subspaces is the primary concern, the above sources provide some important fundamentals but only such of a psychological nature. Neither in work in the area of development psychology nor in sociological or demographic treatments of biography can any thing be found really

relevant to the effects of interdependency between biographic subspace. The contention here, however, is that the development biography the family or generative biography, the social biography and the occupational biography are so closely related that isolated analysis of any one particular subspace cannot lead to a satisfactory explanation of generative behaviour.

BÜHLER's voluminous earlier work, therefore, cannot be regarded as all that relevant especially in that it basically deals with the exceptional biographies of famous people – at least this is the initial direction. The 1933 publication analyses the biographies of great artists, authors, musicians and philosophers. The biographies of ordinary people, the centre of interest here, are hardly mentioned. Her collection of articles (with MASSARIK) from 1969, however, does contain a significant attempt to construct a general theory but the proposed "10 characteristics" of the "general structure of an individual's life" are related almost exclusively to the "psychological curriculum vitae". BÜHLER states that "there are no simple parallels between biological and psychological development" (p. 12) and he avoids integrated approaches as far as possible. But the BÜHLER/MASSARIK collection is nevertheless of considerable value for the implications of biographic mobility on generative behaviour, as will be seen later. Suffice it to comment at this point that BÜHLER recognizes a polarity between two principal objectives in life which can be briefly described as "maintaining standards and/or prosperity" and "creating new potentials and/or achieving something". The objective "achievement" is recognized as a "basic organic tendency"; to the more important" creations of an individual (must be counted – author) ... principally his children" (p. 20, authors underlining).

ERIKSON concentrates primarily on psychological elements. In his publication "Identität und Lebenszyklus" ("Identity and the Life Cycle" – author) from 1966 he postulates a particular state of development of an individual which he characterizes as "generativity": "the state of 'generativity' is principally that of interest in procreation and the education of the next generation ... partners who achieve genuine sexual satisfaction with each other – even if not overtaken by events – will soon want a child together. I've called this wish the aspiration for 'generativity' because it has a

direct bearing on the next generation via the genitals and the genes. The problems to be associated with this state seem to me to be inadequately covered by any of the new concepts such as 'creativity' and 'productivity'. The same applies to 'parentage', a much too concrete expression, which, however, when this work is cited is often used instead of the apparently imperfectly comprehended word 'generativity'" (ERIKSON 1966:117).

Both BÜHLER and ERIKSON come to distinguishing sequential phases in life, BÜHLER has 5 principal phases and ERIKSON 8. The two systems have very little in common. This approach is not adopted; here the virtual biography is structured by considering on the one hand the personality structure of the individual and, on the other, structures in society. It will also not be attempted to analyse the family cycle because family cycles can hardly be imagined that are independent of the structure of personalities or of society. Nevertheless the demographic literature on the family cycle (GLICK 1977, CUISENIER 1977, HÖHN 1982, KUISTEN 1986) has to be examined since it could be expected that theories of the family cycle are based on theories of the life cycle. But apparently some authors would like to see this connection the other way round. Others are unsure and want to have both in parallel: (a) "Analysis of a system of life cycles will not succeed until a clear picture of the family cycle has been obtained by empirical analysis of demographic data." (b) "Partial, methodical studies (of the family cycle: author) ... should be followed with a view to their effective integration in a concept of the life cycle" (CH. HÖHN 1982:100).

The empirically orientated, demographic case studies that have become available in the meantime cannot be ignored. Nearly every author puts forward his own system of phases of family life. Nevertheless only few general hypotheses on the laws governing the structure of biographies in developed societies have been proposed in this literature. Even less points are found as to whether and how these laws (or, better, regularities) are systematically related to the probabilities of procreation. The same applies to the sociological literature on the curriculum vitae. In KOHLI's collection the following sentence can be found: "It (a large part of the sociological biogra-

phic literature: author) more probably can be seen as ... a new characterization of what has always been done, rather than as an indication of the emergence of a new, theoretical, general concept." It won't be attempted here to give a critical appraisal of the contributions in this collection but doubts must arise as to whether the course adopted has any hope of success when the "... basis for a sociology of the curriculum vitae (is seen as: author) ... an analysis of the implications of age as a dimension of the social structure" (M. KOHLI 1978:11). It would appear to be much more promising to try to replace the variable "age" with fresh conceptions which also make it quite clear why "age" is so very important for sociological explanation of the curriculum vitae. The concept of the biographical sequence would seem to be advantageous in this respect as initial empirical analysis of some 30.000 occupational biographies indicates. A definition of "biographic age" in which time plays no important role will be introduced in chapter 3.3.

The very cyclical property of a life cycle reduces in significance once the concept of "life cycle" is understood to be much more than the simple fact that to every birth belongs a death. The family cycle is in fact becoming less cyclic than before. Systems of phases of family life usually rely on descriptions based on age, for example, the average age with which one becomes father or mother, has a second child, is divorced perhaps, the average age of retirement and, finally, death. Such age data, as well as those for the various postulated phases, are, of course, statistical values which, falsely, tend to give the impression that statements on the family cycle including them actually apply to a large part, if not to a majority, of the population. In fact the number of those that follow all phases of an average, "standardized", family cycle is very small, as the following argument shows: Let it be assumed that five age groups come into question for the event of "leaving home", five for the "first marriage", five for having the first and again five for the second child. With this simple structure – even assuming that the events take place in the given order – 625 different family cycles are possible. Combining these for the woman with the corresponding 625 for the man and taking into account that different generations marry and have children at different times of life then several millions of possible family cycles result, possibly more potential cycles than the number of families being stu-

died. Under these conditions it is extremely improbable that 30, 40 or even 50 % of the cases fall in a single family cycle category; quite logically there is going to be a large dispersion about any sort of mean family cycle that can be constructed. UHLENBERG (1969:408) supports this view: "By concentrating on median and mean ages at events, it does not indicate the distribution of women on these variables nor the proportion of women who actually experience such a family cycle. It is quite possible that very few women in fact follow the pattern that is described by the averages." An argument upon which the life cycle concept is rejected and, simultaneously, the family cycle concept approved, is put forward by CH. HÖHN (1982:98) based on the view that the life cycle is more diversified than the family cycle: "The large variety of possible curricula vitae quickly leads to the thought that every life cycle is in a category of its own. Finally, therefore, it is only possible to observe individual biographies. But this would be the end of any attempt to formulate concepts, which can't be done without using classifications." As the above little exercise shows, not only the life cycle concept but also the family cycle concept must be abandoned if nothing can "be done without using classifications". Any argument that the life cycle is more complicated to analyse than the family cycle must be refuted since families are made up of individuals and the whole cannot be regarded as less complicated than any of its individual members.

There is no other way than to start analysis at the level of the individual biography. Theories of life or family cycles which avoid this initial step must rely on classification and the description of aggregated effects. This will lead nowhere. The objective has to be to extract that which is common to individual biographies and not to assign to individual biographies averages abtained from aggregated classes, since average "values" in this sense have little to do with typical situations or cases. For instance, it is typical to be either male or female, not something inbetween.

But how should one proceed if classifications and average values are to be abandoned? Of course, the individual biography, as already made clear, is just as frighteningly complicated and varied as the economic, social, family and psychological backgrounds out of which its elements, phases and occurences, are drawn. The total

of all possible sequences of elements out of this background, of which each individual case is only one, has been called the biographic universe. Does the "individual case" as such then have any analytic value? Surely so, for the individual case is always a result of general rules existing for the universe (all articles in the english language are comprised of the 26 letters of the alphabet combined by means of rules which the authors have more or less learnt). Without such rules not even individual biographies could exist.

3. A Model of Permutational Sequences

3.1 Concepts and Definitions

Fundamental to this model is the idea that the practically infinite number of distinct potential sequences in the life of an individual can be so arranged that every sequence can be regarded as a particular "branch" in the virtual biography when depicted as a "tree" of potential alternatives. A tree in nature changes its appearance in the course of time. The virtual biography is also subject to continual change. But there is an important difference between the changes occurring for a natural tree and those in the virtual biography. The course of growth of a tree is governed by the laws of nature, which do not change with time. The biographic development of a human being is characterized by the fact that planning for the future can change. This implies that the order of the various planned phases in life, as well as their number and character, are not fixed but are subject to sudden alteration. New branches on a natural tree grow out of the old but in virtual biographies drastic changes in order can occur which are not possible in nature.

In the definitions that follow the dimension time is implicitly eliminated from the considerations by viewing, and analysing, the virtual biography at a particular point in time. The first concern is to define a frame of reference for the almost innumer-

able variety of possible virtual biographies and their sequences. Every biography will be regarded as consisting of n separate phases:

$$E_1, E_2, E_3 \ldots\ldots, E_n$$

– the expressions phases, states or levels will also be used. Within each level alternative dimensions or positions are possible. The number of possible positions can be different at each phase – let their number be $s_1,s_2,\ldots,s_n$ for the levels $E_1,E_2,\ldots,E_n$; then the maximum number of biographic sequences contained in the frame of reference is:

$$(1) \qquad B = n!\, s_1,s_2\ldots..s_n = n!\prod_{i=1}^{n} s_i$$

As a rule the virtual biography of an individual is comprised of only a subset (= virtual biography) of all possible sequences (= biographic universe) since even with small numbers of phases and positions the total number of possibilities for conscious consideration and for decision becomes very large. Four phases alone lead to 4! = 24 different sequences (Fig. 1). If every phase has two possible positions this number climbs to 384:

$$B = 4!2^4 = 384$$

Fig. 1 illustrates the situation for four phases (without alternative positions within the phases) and Fig. 2 shows the alternative positional sequences that can arise for a given sequence of phases, namely for:

$$E_2, E_4, E_3, E_1$$

if two positions A and B are possible within each phase.

Figure 1

Biographic Sequences Arising from Permutations of Four Levels

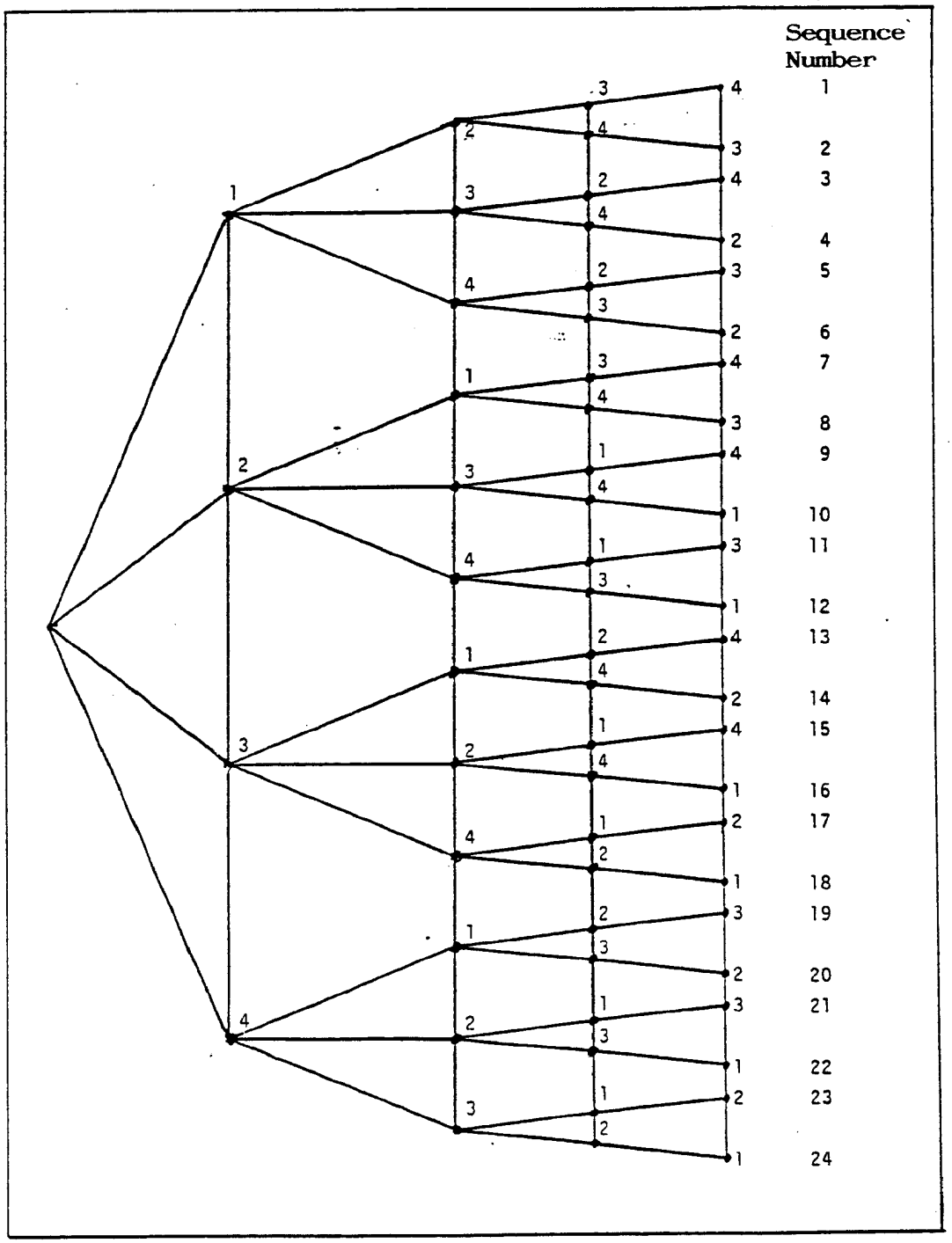
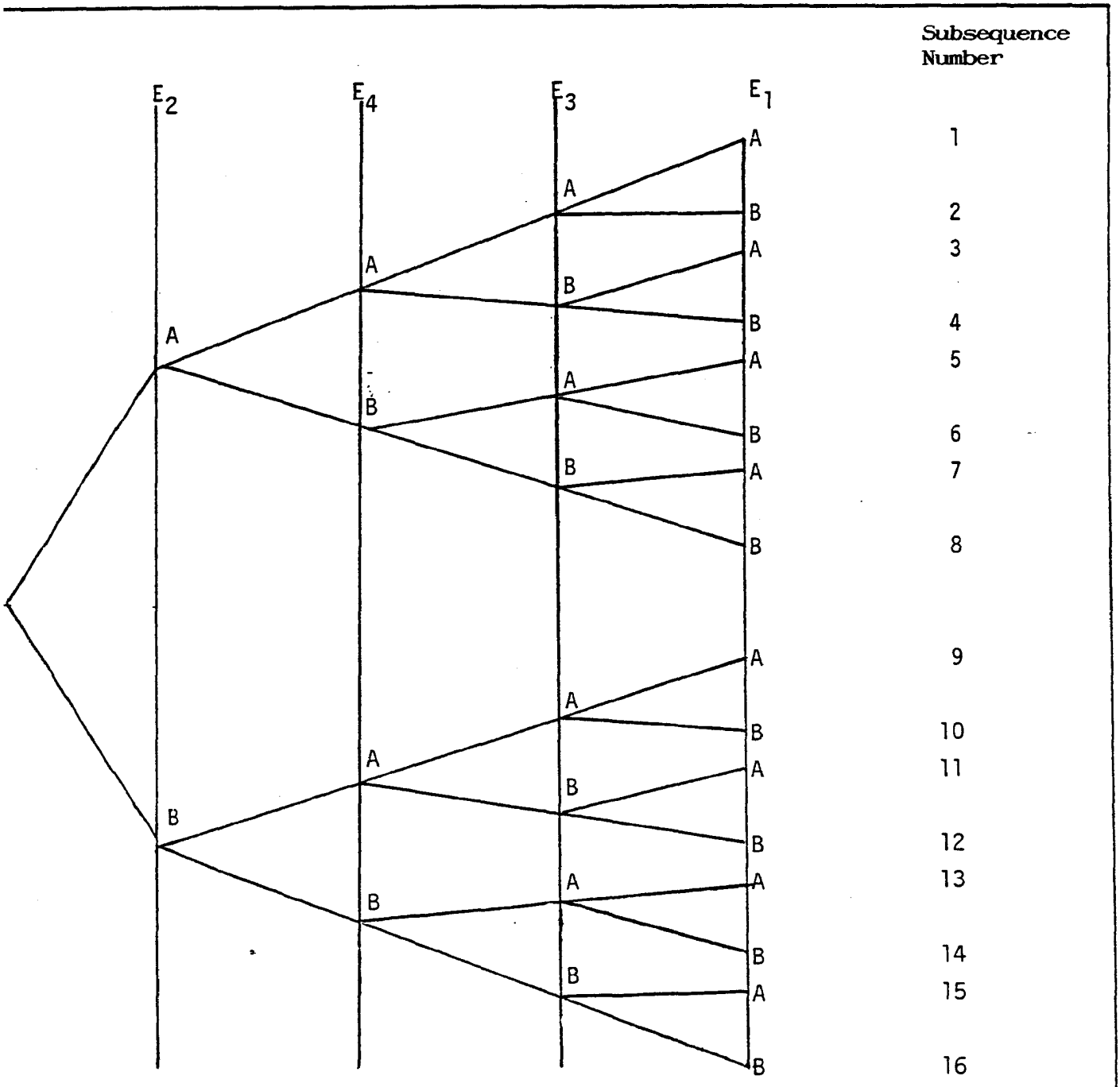


Figure 2

Biographic Subsequences Arising from the Choice of Two Alternative Positions within Each Level of a Given Basic Structure of Four Phases



The organization of the virtual biography into different phases and – within each phase – different positions is structurally analogous to virtual biographies in reality. The sequence of phases determines the basis structure of a virtual biography. Once this basic structure is fixed the number of variations that are possible is rather limited. For most people the order of the phases, at least up to the end of occupational training, is determined by various institutional regulations and strongly influenced by the parents, but also after occupational training observance of the conventions and norms of a society leads to a situation favouring specific sequences. The question as to which basic elements or phases belong to the favoured sequences considered by the individual, and which not, is – at least partially – determined in the same way. The choice of position within a given phase is subject to the same influences but it is assumed here that the individual has more freedom of choice in this secondary area. However, one of the key questions to which every biographic model should try to provide an answer is that of the extent to which the choice of position is influenced by the sequence of previous phases. Also the problem in reverse, namely whether and to what extent future phases in life are influenced by the positions adopted beforehand is central to biographic model building. The model of permutational sequences presented here does not attempt to provide solutions to these important problems. The model has to be understood as a framework within which certain biographic regularities find expression, all of which have to receive consideration in the specific, more concrete models that can be constructed within the framework. It is only when specific models are constructed that the central questions of the connections between the choice of positions and the choice of levels can be – specifically – resolved. It is not likely that a general answer will ever be found.

(a) Definition of Biographic Separation between Sequences

For a given number of biographic phases in a virtual biography the biographic separation $\overline{S_iS_j}$ between two sequences S_i and S_j contained in it is defined as the number of phases that must be traversed in the reverse direction (of the order of sequences) until (the rest of) S_i and S_j become identical. The definition is symmetrical, so that:

(2) $\overline{S_iS_j} = \overline{S_jS_i}$

Example: Considering the first two sequences of Fig. 1, i.e. $S_1 = [E_1,E_2,E_3,E_4]$ and $S_2 = [E_1,E_2,E_4,E_3]$, two levels have to be traversed until the common sequence $S_1 \cap S_2 = [E_1,E_2]$ is found, so that

(3) $\overline{S_1S_2} = \overline{S_2S_1} = 2$

Further examples are:

(4) $\overline{S_1S_3} = \overline{S_1S_4} = \overline{S_1S_5} = \overline{S_1S_6} = 3$

$\overline{S_1S_7} = \ldots = \overline{S_1S_{24}} = 4$

There is only one sequence with a separation of 2 from S_1 but five sequences with a separation of 3 and 18 sequences with a separation 4 :

Biographic Separation from Sequence 1	Frequency
0	1
1	0
2	1
3	4
4	18
	24

The structure of the separation matrix for all S_i and S_j (i,j = 1,2,...,24) for a virtual biography with four levels is shown in Table 1.

It is clear that the number of separations (and so their magnitudes) depends on the number of levels being considered. The distribution of separations for the general case with n levels is indicated in Table 2.

Table 1

Biographic Separation Matrix $[\overline{S_i S_j}]$ for Sequences with Four Phases

$S_i S_j$	Sequence Number 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	0	2	3	3	3	3	4	→																
2		0	3	3	3	3	4	→																
3			0	2	3	3	4	→																
4				0	3	3	4	→																
5					0	2	4	→																
6						0	4																	
7							0	2	3	3	3	3	4	→										
8								0	3	3	3	3	4	→										
9									0	2	3	3	4	→										
10										0	3	3	4	→										
11											0	2	4	→										
12												0	4	→										
13													0	2	3	3	3	3	4	→				
14														0	3	3	3	3	4	→				
15															0	2	3	3	4	→				
16																0	3	3	4	→				
17																	0	2	4	→				
18																		0	4	→				
19																			0	2	3	3	3	3
20																				0	3	3	3	3
21																					0	2	3	3
22																						0	3	3
23																							0	2
24																								0

Sequence Number

all Elements = 4

$\overline{S_i S_j} = \overline{S_j S_i}$

Table 2

Biographic Separation for Sequences with n Phases

Number of Levels	Total Number of Sequences	No. m of Sequences for which the first n-i elements are the same		Number of Sequences with a Separation of i to a Given Sequence									
				i									
n		i	m	2	3	4	5	6	7	8	9	10	n
1	1			-									
2	2	1	1	1									
3	6	2	2	1	2(2!) = 4								
4	24	3	6	1	4	3(3!) = 18							
5	120	4	24	1	4	18	4(4!) = 96						
6	720	5	120	1	4	18	96	5(5!) = 600					
7	5 040	6	720	1	4	18	96	600	6(6!) = 4320				
8	40 320	7	5 040	1	4	18	96	600	4 320	7(7!) = 35 280			
9	362 280	8	40 320	1	4	18	96	600	4 320	35 280	8(8!) = 322 560		
10	3628 800	9	362 280	1	4	18	96	600	4 320	35 280	322 560	9(9!) = 3 265 920	
. . . n	n!	n-(n-1)	(n-1)!	1	4	18	96	600	4 320	35280	322 560	3 265 920	(n-1) (n-1)!

(b) Definition of Biographic Separation between Sequences of Positions

For a given sequence of biographic phases S_i where different positions can be adopted within each phase there exist – internal to the basic structure S_i – various sequences S_{ij}, S_{ik}, ... of positions (ref. Fig. 2). For the sequences of positions a separation can be defined analogous to that for the phases: The biographic separation $\overline{S_{ij}S_{ik}}$ between sequences of positions is the number of positions that must be transversed in the reverse direction (of the order of positions) until (the rest of) S_{ij} and S_{ik} become identical. Examples from Fig. 2 are:

$$\left.\begin{aligned} S_i &= [E_2,E_4,E_3,E_1] \\ S_{i1} &= [A,A,A,A] \\ S_{i2} &= [A,A,A,B] \end{aligned}\right\} \quad \overline{S_{i1}S_{i2}} = 1$$

$$\overline{S_{i1}S_{i3}} = \overline{S_{i1}S_{i4}} = 2$$

$$\overline{S_{i1}S_{i9}} = \ldots \qquad = \overline{S_{i1}S_{i16}} = 4$$

As before, the definition is symmetrical, i.e. $\overline{S_{ij}S_{ik}} = \overline{S_{ik}S_{ij}}$. A table of separations analogous to that of Table 2 is difficult to construct since, in general, the number of positions that can be adopted within the different levels is variable.

3.2 A Model of Permutational Sequences

The choice of type of school education, the choice of occupational training – also the choice of wether to undertake occupational training or not –, of wether and when to leave home and establish a household of one's own, are decisions with predetermining character for later life. In the official statistics virtually nothing is available on the sequential progression of such decisions (1). Even the results of the survey made by the Federal Institute for Labour Market Research (Nürnberg) on the lives of 30.000 economically active women and men mentioned earlier is no exception, even though the survey often uses the expression "course of occupational career" (2). However, on the basis of this survey it has proved to be possible to establish that the broad structure of the education–occupational training – job sequence is systematically connected with the number of children. For example, more than 80 % women with the sequence

S_1 completion of secondary school (compulsary minimum)

L_1 apprenticeship (or equivalent) without obtaining corresponding qualification

F_1 no other occupational training (e.g.for service sector)

had children, whereas only 64 % of the women with the sequence

S_2 Secondary school ('o' Levels)

(1) The possibility of including such information in an official sample census is under discussion.

(2) "Berufsverlauf" (course of occupational career).

L_2 Completed apprenticeship or equivalent

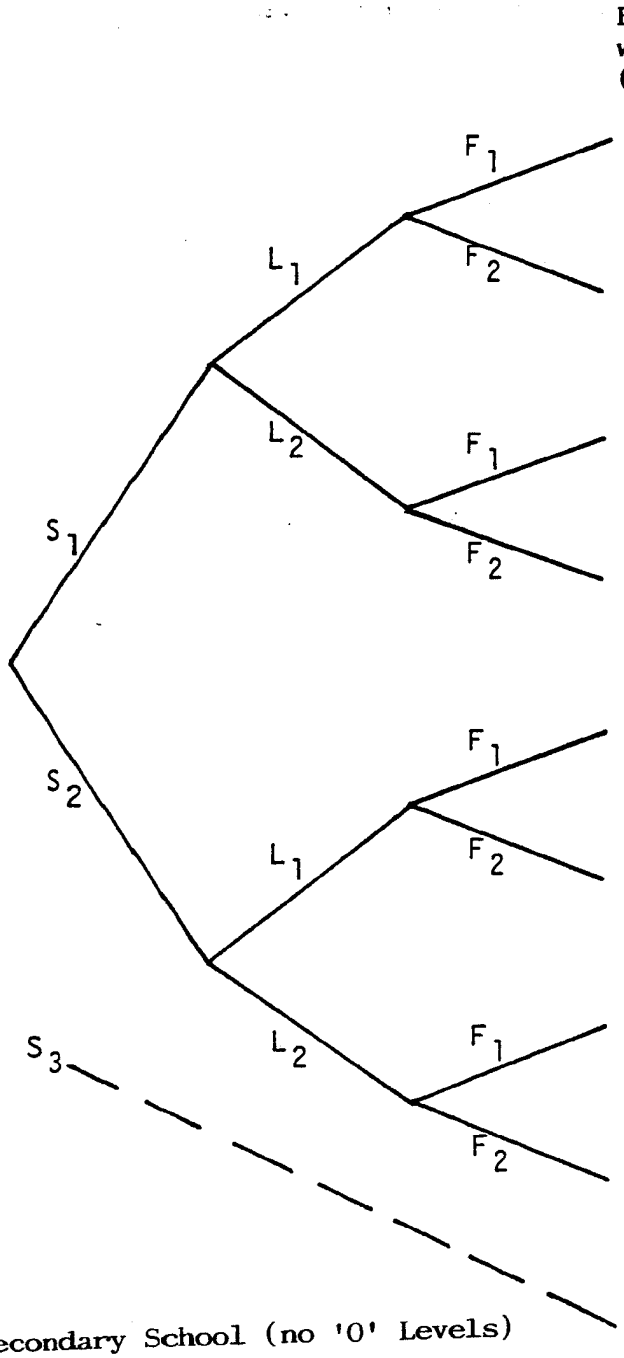
F_2 further occupational training

had started a family (ref. Fig. 3).

Figure 3

Proportion of Employed Married Woman with Children

According to Education and Occupational Training in the F.R.G. (1979)



S_1 = Secondary School (no 'O' Levels)
S_2 = Secondary School ('O' Levels)
S_3 = Secondary School ('A' Levels, University Entrance)
L_1 = No apprenticeship (or Equivalent)
L_2 = With Apprenticeship (or Equivalent)
F_1 = No Other Occupational Training
F_2 = With More Occupational Training

Source: Calculations from the results of the survey made by the Institut für Arbeitsmarkt und Berufsforschung, 1979, on over 30,000 occupational histories.

Quite independent of the real data situation and the problems associated with the collecting data a model is developed in the following sections which allows exact formulation of some key hypotheses of the previously presented biographic theory.

The objective is not to describe reality as exactly as possible but to construct a framework of argumentation which in specific, – for generative behavior – relevant, areas has structural similarity with reality. For the sake of simplicity and brevity the argument will be restricted to the primary area of the permutation of the basic biographic elements of the level s_i without considering the secondary area of the positions adopted within the levels. Of course, these can be considered by extending the model structure. Nevertheless, the conclusions reached within the framework of the simplification are still valid.

Firstly, it is obvious that in reality no virtual biographies can exist that contain all theoretically possible sequences of n even commonly occurring phases, levels or states. No one is in the position to say how many or which phases, levels or states come into question for building the basic structure of his virtual biography. However, the assumption that the virtual biography consists of all permutations assists in reaching conclusions with a strong bearing on real life, especially on generative behaviour. Not every possible sequence has to be actually present in the virtual biography in order that effects result, perhaps unconsciously, on the awareness and self–confidence of the individual even when the source of these effects is only vaguely perceived.

3.3 Biographic Long–Term–Committments and the Concept of Biographic Age

If it is assumed that a virtual biography consists of all permutational sequences of n considered phases then the risk of making a decision in life is particulary large towards the beginning of the sequences. When $n=6$ there are $6! = 720$ different sequences but once the first level or phase has been chosen 600 of these are no

longer possible, and a second decision causes a further reduction of 96. After five phases there is no more choice:

Level	No. of Sequences Eliminated by Decision
1	600 = 5 (5!)
2	96 = 4 (4!)
3	18 = 3 (3!)
4	4 = 2 (2!)
5	1 = 1 (1!)

This numerical fact supports the everyday experience that the risks associated with an irreversible (or long−term) biographic decision are greater the earlier this decision is taken. The analogy with real life can be illustrated in many ways; for instance, with the decision as to the type of school (and therefore of type of education) long−term effects are produced reaching far into later life. In general, decisions taken on the behalf of children, in particular when they are negative, e.g. against occupational or career training, have far−reaching effects on their future biographies.

It can be concluded that awareness of the risks connected with irreversible decisions or long−term committments, in particular, awareness of the loss of freedom (alternatives in life) associated with having a child, can only lead to lower birth rates, especially for young people. Statistics on the birth rate confirm this view; whereas the fertility rate for those under 30 years old has halfed for some specific categories, it has remained constant or even increased slightly for those over 35 (for example, the age−specific fertility rate for third children has decreased from 27.6 per thousand to 12.5 per thousand for women of 29 born in 1951 as apposed to those born in 1936, for women aged 35 only from 11.7 per thousand to 8.2 per thousand (Birg et al., 1984b: 122).

The conclusion can be formalized as follows: the number of sequences eliminated from the virtual biography by a decision in the i th phase is:

(5) $\Delta G_i = (n-i)\,(n-i)!$

The cummulative number of alternatives of the virtual biography eliminated up to and including this decision is:

(6) $G_i = \sum_{j=1}^{i} \Delta G_j = \sum_{j=1}^{i} (n-j)(n-j)! = n! - (n-i)!$

If it is assumed that the probability of making what later turns out to be a wrong decision at some stage in life is directly proportional to the number of sequences eliminated by the decision then the risk q ($o \leq q \leq 1$) can be quantified as the ratio of the number of alternative sequences eliminated to the total number of alternatives vailable at the point of decision. At the first level the risk associated with a decision is therefore:

(7) $q(1) = \dfrac{(n-1)(n-1)!}{n!} = \dfrac{n-1}{n}$

For large virtual biographies, i.e. for virtual biographies with a large number of permutational phases and so alternative sequences, the risk involved in taking a decision is overproportianally large as compared with that involved in making decisions within the framework of a restricted virtual biography. With increase in n the risk becomes greater. Ad absurdum, there is no chance of making satisfactory decisions when freedom of choice in life is unlimited.

For a given n value the risk reduces from decision to decision, i.e. from phase to successive phase. The risk involved at the i th level is:

$$(8) \qquad q(i,n) = \frac{(n-i)(n-i)!}{(n-i+1)!} = \frac{n-i}{n-i+1}$$

For a given magnitude of the virtual biography (n fixed) the risk of a long−term committment decreases from phase to phase. But if we compare virtual biographies of different magnitude we can state that for a given number of phases (i fixed) the risk increases with the magnitude n (Table 3 and Figure 4).

Table 3

Magnitude of the Virtual Biography and
Risk of Long–Term Committments

Phase i	Magnitude n									
	1	2	3	4	5	6	7	8	9	10
1	0	0,500	0,667	0,750	0,800	0,833	0,857	0,875	0,889	0,900
2		0	0,500	0,667	0,750	0,800	0,833	0,857	0,875	0,889
3			0	0,500	0,667	0,750	0,800	0,833	0,857	0,875
4				0	0,500	0,667	0,750	0,800	0,833	0,857
5					0	0,500	0,667	0,750	0,800	0,833
6						0	0,500	0,667	0,750	0,800
7							0	0,500	0,667	0,750
8								0	0,500	0,667
9									0	0,500
10										0

This approach opens the way to a new interpretation of age which – in terms of years – is a decisive parameter in demography. An individual can be regarded as being "old" (a) if he has no, or only few, alternatives remaining in life, and/or (b) when every decision made is heavily restricted by previous phases and/or decisions. This can apply even for the relatively young in terms of years. Getting old in the sense of living through the calendar years is a process running parallel to the process of aging by progressing from phase to phase along a sequence in the virtual biography. This parallelism offers the opportunity for introducing the idea of biographic age as a lack of alternatives or as the degree of dominance exerted by the past biography, in particular within the framework of this model; the definition of biographic Age A^* can be coupled with the number of alternatives (sequences still open for choice) remaining in life. It can be assumed that the biographic age A* in this sense is directly proportional to the total number of alternatives eliminated up to a given point in time, i.e. that:

$$(9) \qquad A^*_i \sim G_i = n! - (n-i)!$$

from equation (6).

For purposes of analysis equation (9) is specified as follows

$$(10) \qquad A^*(i,n) = n! - (n-i)! = n! - \Gamma(n-i+1)$$

Equation (10) may be denoted as a biographic age function, relating biographic age to the magnitude of the virtual biography and to the number of phases already experienced.

With this definition two people can have different biographic ages even when they were born in the same years. The larger the number of levels contained in the virtual biography, the larger is the number of eliminated sequences once on a certain level i has been attained, i.e. the "older" the individual is in comparison upon reaching this

level. In other words, the size of the remaining biographic universe is directly related to the cumulative predetermining effects of age.

For the phase $i=n-1$ the biographic age variable reaches its maximum and this maximum is the same for the last phase $i=n$. This can be interpreted as follows: In the Phase $i=n-1$ the number of biographic alternatives is zero because there is only one phase left. Therefore biographic age remains constant for the last two phases:

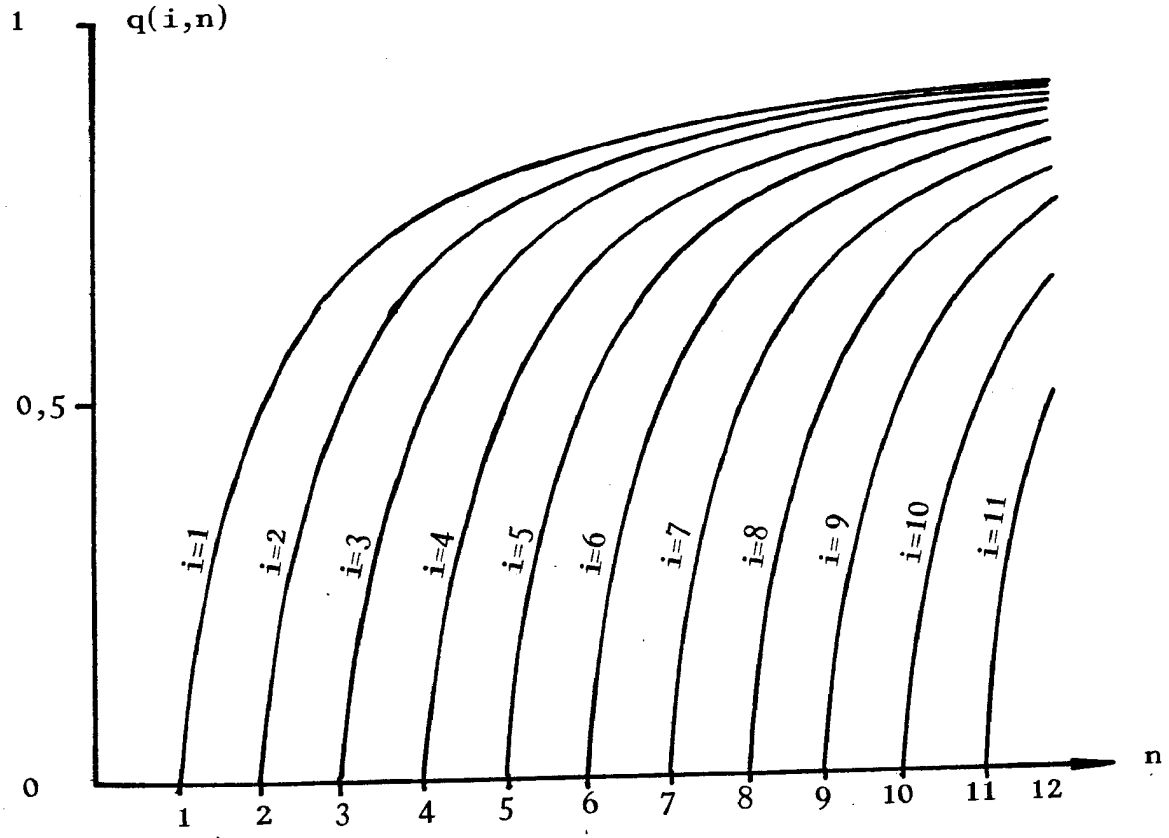
$$(11) \qquad A^{*}_{max} = n! - (n - (n - 1))! = n! - (n - n)! = n! - 1$$

The intensity of the biographic aging process depends on the magnitude of the virtual biography which is a function of the number n. Standardizing the number of phases and the biographic age variable by dividing them by their maximum values, variables are obtained which fall in the interval [0,1]. The impact of the magnitude of the virtual biography on the intensity of the biographic aging process can be illustrated using thse standardized variables, as shown in Figure 5).

Figure 4

The Magnitude of the Biographic Universe and the Risk Involved in Long-Term Committments

(a) Risk and Magnitude of Biographic Universe n



(b) Risk and Level of Decision i

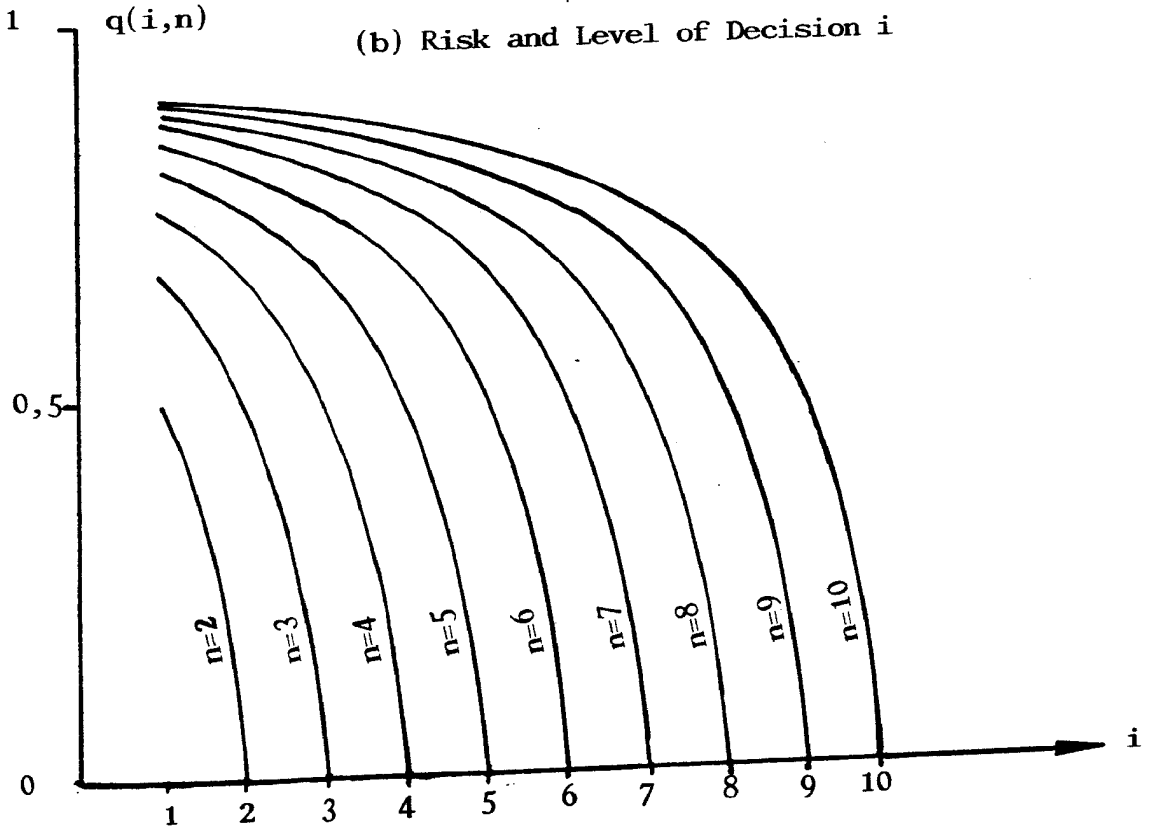
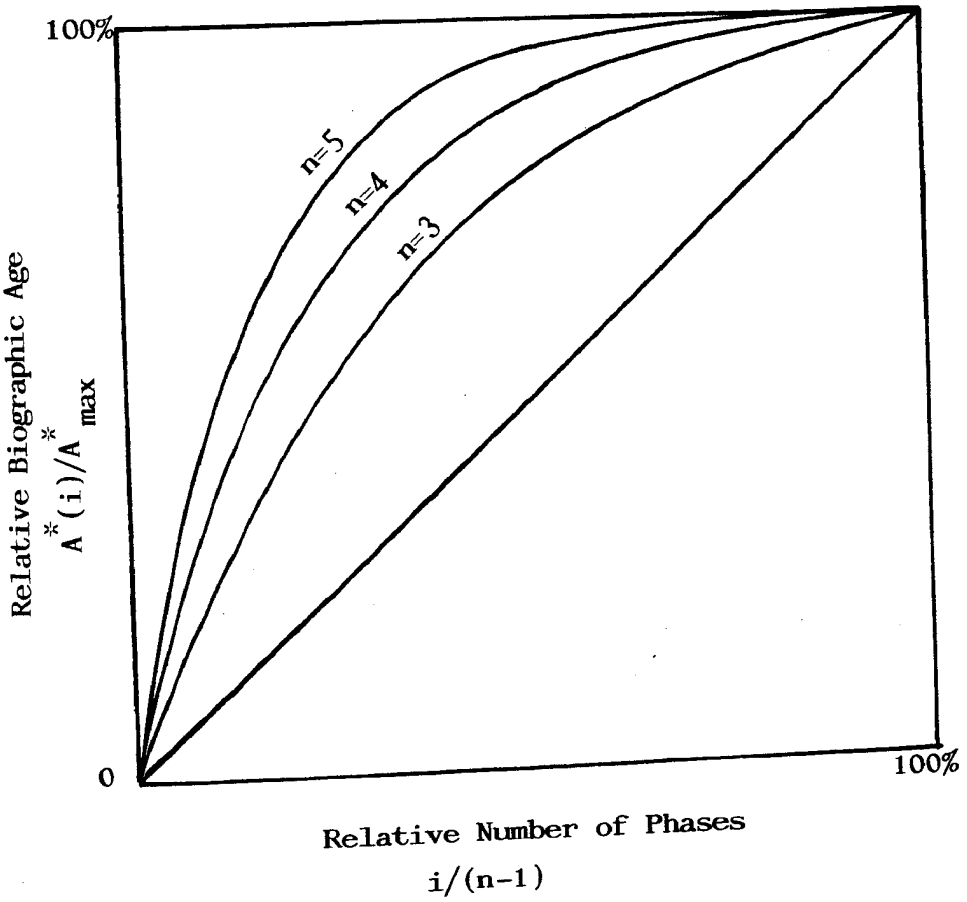


Figure 5

The Magnitude of the Biographic Universe and the Intensity of the Biographic Aging Process



3.4 The Risk involved in Long–Term Committments, Biographic Age and the Probability of Births

With the analytical tools of section 3.3 the function for determining the probability of a birth or any other irreversible biographic event (so defined for marriage, migration etc.) can be derived using the following assumptions.

(a_1) The virtual biography is of magnitude n and contains n! sequences. The individual persues a sequence and plans to have a child (to be married etc.) in phase i^*:

phases 1, 2, . . ., i^*, . . ., n

(a_2) For $i \leq i^*$ the probability of a birth is lower the higher the risk of a long–term committment (q):

$$p = p(\bar{p}, q(i)) \qquad i < i^* \qquad \bar{p} = \text{const.} \tag{12}$$

$$\frac{\Delta p}{\Delta q} < 0$$

From equation (8) and (10) the following relation can be derived between the risk of long–term committment and biographic age

$$q(i) = (A^*_i - A^*_{i-1})/(n - i + 1)! \tag{13}$$

$$= \Delta A^*_{i-1}/(n - i + 1)!$$

Substituting (13) into (12)

(14) $p = p(\bar{p}, \Delta A^*(i))$ $\quad i < i^*$, $\bar{p} = \text{const.}$

$$\frac{\Delta p}{\Delta(\Delta A^*)} < 0$$

$$\frac{\Delta p}{\Delta A^*} > 0$$

(a_3) For $i > i^*$ the probability of a birth is lower the higher the biographic separation between the sequence for which a birth was planned in pase i^* and the actual sequence. As the biographic separation increases with biographic age, the postulated relationships are

(15) $p = p(\bar{p}, D(i))$ $\quad i > i^*$, $\bar{p} = \text{const.}$

$$\frac{\Delta p}{\Delta D} < 0$$

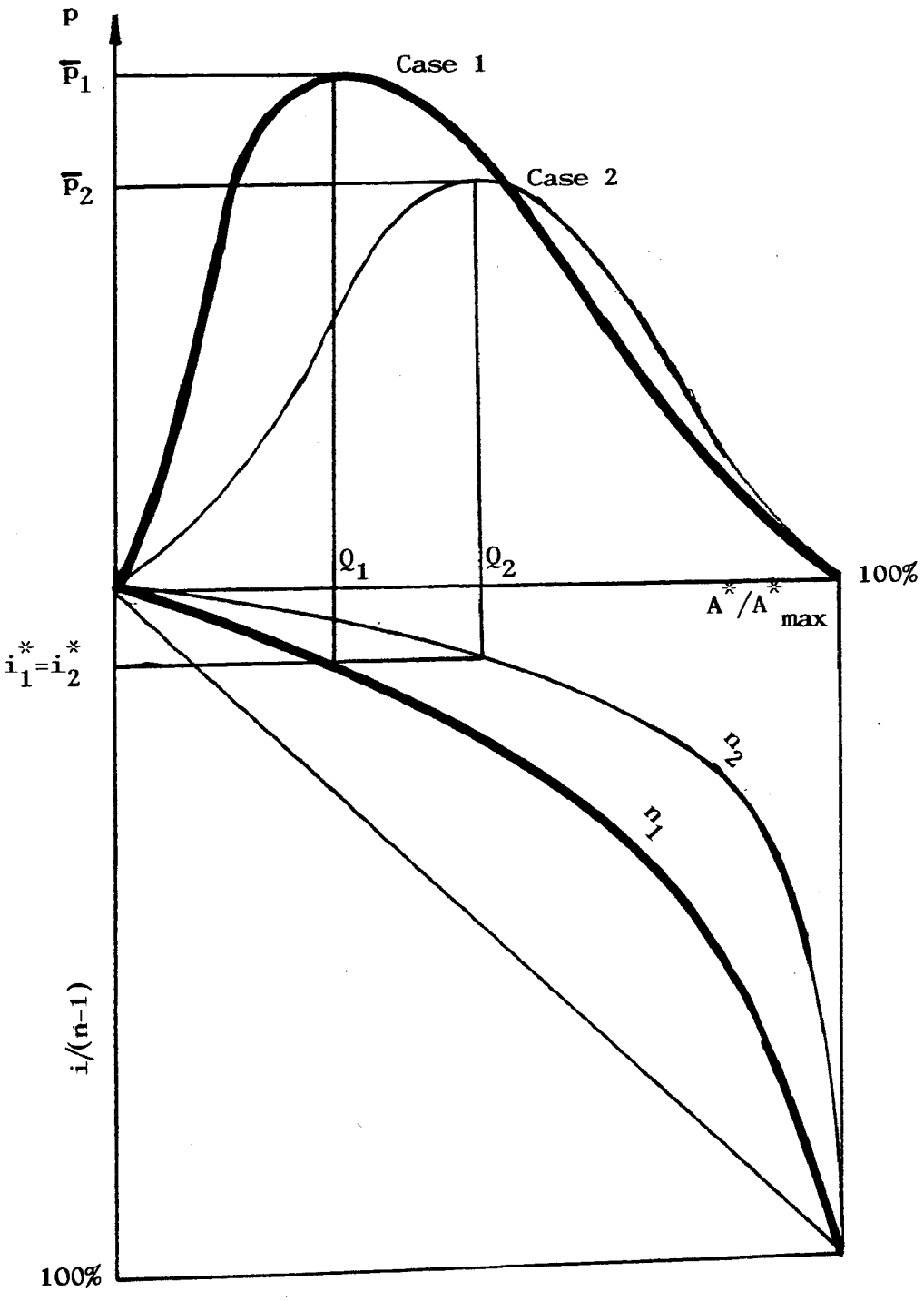
(16) $p = p(\bar{p}, A^*(i))$

$$\frac{\Delta p}{\Delta A^*} < 0$$

The derivation leads to a probability function which increases with biographic age till phase i^* and decreases with biographic age after phase i^* (Figure 6).

Figure 6

The Biographic Aging Process, the Risk Involved in Long-Term Committments and the Probability of Births p



4. A General Theoretical Biography Approach to the Analysis of Demographic Behaviour

The concept of the virtual biography can now be made more precise using the definitions of the model of permutational sequences:

If an individual of given calendar age (=demographic age) can perceive a certain number n of basic biographic elements (phases or levels), say the set $\{E_1, E_2, \ldots E_n\}$, then the expression "biographic universe" refers to the set E of all permutative sequences of the elements $E_1, E_2, \ldots, E_n$. The concept of the "virtual biography" refers to a subset of E, whereby certain sequences have been eliminated from E, namely:

(a) Sequences that are logically impossible, e.g. those in which the second child appears before the first.

(b) Sequences in which the order is in conflict with the institutional regulations of the society, e.g. the temporal order of the various levels and qualifications in the educational system, or the institutionally organized prerequisites for entering and exercising certain professions, etc.

(c) Sequences in which the order is in conflict with the conventions and norms of the society, e.g. having a child before marriage, living together before marrying, etc. The latter example demonstrates that such restrictions are subject to continous change.

Giving the set of sequences that can be eliminated in this way from the biographic universe the symbol X, then

(17) $$E = V + X$$

where V is the virtual biography. It can then be assumed that everyone finds himself in a certain phase of a particular sequence (element) of the set V at every point of time. Further, it can be assumed that every individual's actual situation does not correspond to his wishes. Finally, it can be assumed that his wished–for, ideal, situation is also an element of V, where the separation (D) between the real and subjectively ideal situations can be measured as described above, namely as the number of levels that have to be traversed (in the reverse direction of time) until the rest of the real sequence and the ideal sequence become identical. A change of sequence in this definition of D is not allowed.

With these definitions the following basic biographic relationship can be formulated in which p stands for the probability that a relevant biographic event (marriage, birth of first child, birth of n th child,etc.) can occur. The probability p is a function of three variables, the magnitude of the biographic universe, the magnitude of the set X of eliminated sequences, and the discrepancy or separation D between the real and the ideal (but realistic) biographic sequences. Fundamentally, it is D that has to be regarded as the determing factor of biographic mobility so that in the following equation D could be replaced by any variable through which biographic mobility can be represented, e.g. by the mobility frequency F as used in one of the more detailed biographic models which have been developed by the author on the basis of the theory outlined here.
Defining e,x to be the number of elements of the sets E,X, the basic biographic relationship is:

(18) $$p = p\,(e,x,D)$$

The propositions of § 3 can now be re–formulated and completed with the aid of this equation:

(b_1) The more elements (sequences) contained in the biographic universe the larger is the risk to be associated with the long–term committments, and the more difficult

it is to transfer from one sequence to another in order to succeed, for example, in planing and having a child, an event which in the original sequence appears unlikely; i.e.

$$(19) \qquad \frac{\Delta p}{\Delta e} < 0$$

(b_2) The more sequences that are eliminated, i.e. that do not come into question, because of the conventions, regulations and the system of values of the particular social environment and the society, the smaller is the possibility of active voluntary biographic mobility and the smaller is the probability that long-term committments such as marriage or children will be made:

$$(20a) \qquad \frac{\Delta p}{\Delta x} < 0$$

Biographic mobility has a dual role, (a) mobility as a positive (active) resource and (b) mobility as a defensive unvoluntary reaction. Equation (20a) corresponds to the interpretation (a). If (b) applies then:

$$(20b) \qquad \frac{\Delta p}{\Delta x} > 0$$

The exclusion of sequences from the biographic universe is frequently due to the ordering of biographic phases due to social constraints. The social constraint "marri- age before child" reduces the number e of sequences in the biographic universe by 50 %. If, in general, h phases are constrained socially to have a certain definitive

order, x sequences are excluded and a numbe of e−x sequences remains as the magnitude of the virtual biography (1):

$$(21) \qquad N(V) = \binom{n}{n}(n-h)! = (h+1)\,(h+2)\,\ldots\,n$$

$$(22) \qquad x = N(E) - N(V) = n! - (h+1)\,(h+2)\,\ldots\,n$$

There is a variety of ways in which social conditions and personal preferences can influence the size and form of the virtual biography. Ordering has always the effect of an exclusion of sequences. If this exclusion is involuntary its impact on the probability of long term−committments is negative because it reduces the possibility of active biographic mobility (equation 20a). If the exclusion of sequences results in a reduction of unvoluntary biographic mobility the exclusion increases the probability of births (equation 20b). The latter condition is illustrated by the living conditions of little villages outside the agglomeration areas where fertility rates are high.

(b_3) The greater the discrepancy (biographic separation) between the actual and ideal courses of life the less probable are long−term committments:

$$(23) \qquad \frac{\Delta p}{\Delta D} < 0$$

This model is an attempt to establish a closed framework of argumentation within which specific, alternative models can be developed. Equations (18) – (23) therefore should not be understood to comprise an explicit model which can be tested with

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(1) For the derivation of this and related formulas see: H. Birg u. D. Filip: The Impact of Ordering Conditions on the Size of Virtual Biographies. Forthcoming.

data. But a lot of methods are available for transforming the fundamental arguments into models that can be tested, wether at the level of the individual, at a macro-level, or at intermediate stages of aggregation or disaggregation. However, a pre-requisite for any such model is that carefully chosen biographical data have to be available which contain, implicitly or explicitly, evidence on the connection between sequential phases in life.

A particular application could be to model the biography of a married couple in such a way that the restrictions arising from the virtual biography of the wife are considered in the analysis of the husband (or vica versa). Especially when both work and are following a career it is likely that the mutual restrictions arising from the virtual biographies are more effective and lead to a reduced birth rate for this group. The harmonious co-ordination of two curricula vitae into a single biography for the married couple implies that the respective phases in the two sequences have to fit together extremely well, i.e. that both sides are genuinely willing to make compromises. If this is not so, problems occur which could be called conjugal friction effects. If these are significantly large a harmonious co-ordination is not possible. Conjugal friction effects are evident in the statistics in that it can be seen that children are being born later in life and their presence even in advance is evident in the reduction in the number of marriages of individuals in specific age groups.

5. The Impact of Labour Market Dynamics on Fertility and Biographic Aging

The influence of changes of structure and level in the labour market on marriage and birth rates can be analysed using the basic model if the effects of economic and social change on the variables in equation (18) can be modelled. The continous process of specialization of production brings with it a continous increase in the number of different opportunities available for making a career. In general, this leads to an increased number (n) of basic biographic elements and so to extremely rapid growth in the magnitude of virtual biographies. Occupational specialization, however, implies that a change of occupation is increasingly difficult, with the consequence that

a lot of sequences in biographic universe are eliminated. Specialization therefore has two effects; the first is the increase in the number of alternative sequences in the biographic universe, the second is the reduction in the number of sequences once occupational decisions have been taken and implemented. Both effects result in a decrease in the probability of long-term committments as indicated by equations (19) and (20), and the decrease in the marriage rate and age-specific birth rates is - to a large extent - presumably due to such influences (1).

Finally, it should be pointed out that it is possible to explain regional differences in relevant demographic behaviour (frequencies of marriage, births and migration, and death rates) on the basis of the model. "Regional" circumstances in this sense are those for which a large number of people can be shown to have identical or similar conditions of life, as can be easily perceived, for example, for the inhabitants of a large city; all inhabitants share the same (or similar) advantages or disadvantages of a particular labour market, the same infrastructure facilities and transportation systems, the same accessibility to other regions and cities, etc. This similarity in living conditions and therefore of opportunities in life has the effect that for all sufficiently well-defined groups in the society the individual virtual biographies can be regarded as being almost the same with respect to both the total number of alternatives e in the biographic universe E and the number of alternatives that can be eliminated from E. Both tend to induce similar behaviour. The third variable in the model, D (the separation between the actual and the personally ideal biography), produces differentiated behavioural effects which counterbalance the homogeneous effects of the

(1) The birth rate for younger age groups first increased then decreased from 19 onwards. A slight increase can presently be observed for those over 30. As opposed to the birth rates in the Federal Republic, the conditional probabilities of births according to year of birth, parity and age for those born since 1936 have continously decreased for all those born from 1937 onwards who are more than 20 years old. The figures on births are presented in H.Birg et al. (1984).

first two variables within a particular social group. Heterogeneous behaviour can be expected to occur especially in a big city where obviously different styles of life exist side by side as a result of the awareness created by a concentration of social contact and therefore of information on alternatives.

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