Concepts and Criteria for Functional Age

K. Warner Schaie and Joyce P. Schaie

Andrus Gerontology Center, University of Southern California
and
Department of Psychology, University of California at Los Angeles

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Introduction

The purpose of this paper will be to examine the manner in which behavioral scientists might address definitions of aging which depart from the chronological age framework. In order to do so it will first be necessary to review some alternate views of the concept of functional age. A second concern will be to identify the type of data base which is needed for the development of age functions and to consider what kind of data are appropriate for the different conceptualizations of functional age. A third major purpose of this paper will be to distinguish between functional age as a general yardstick applicable to basic psychophysiological mechanisms (for example, timing mechanisms involved in the feedback loop between cardiac and cortical functions governing behavior or efficiency of cortical functioning such as measured by the CNV), and a matrix of functional ages referring to specific social or environmental situations. In the first instance we would, of course, be concerned with ANS and CNS integrity as they affect behavior, in the latter instance our concern is with the measurement of behavioral competence in specific situations in individuals having specified characteristics.

Some Historical Notes

Although the term functional age has entered common usage only recently, the concept that it would be useful to develop nonchronological age scales was first systematically introduced some time ago by Birren (1959). He suggested that the distinction between pathology and normal aging would require the development of indices which might describe man's development in terms of biological, social and psychological ages. In the area of biological age functions a suggested criterion which received early attention was the reduction of error in predicting residual life-span of individuals over the use of chronological age alone (e.g. Templin, 1959; Jalavisto, Lindquist & Makkonen, 1964).

While longevity may be a rather useful and reliable criterion for biological age functions, it is difficult to think of similar criteria in the psychological or sociological domains. Birren (1959) consequently suggested that psychological age might be an index which summarizes the position of an individual in multi-dimensional space. He expressed the hope that such an index might also serve as an indicator of the individual's capacity to adapt to new environments or to modify his environment in a suitable fashion. Perhaps the first systematic attempt to implement Birren's suggestions is the work of Heron and Chown (1967) who proceeded with a large-scale study of both physiological and psychological indicators which might enter into a functional aging index. Of particular importance for our present concern, is their conclusion that "variation among individuals increases as the age of people studied increases" and that "aging does not appear to be a unitary process (Heron & Chown, 1967, p. 137)." These authors consequently urge that functions which are of interest in their own right ought be studied in relation to age, and functional age be defined in terms of such specific functions.

A alternate point of view was taken by Dirken and his colleagues (1972) who selected a set of eight variables as indicators of functional age. The intent here was to develop a composite index of functional age to replace chronological age. To accomplish this objective variables were selected which showed a linear relation with chronological age (quite successfully so as indicated by a correlation of .87 with chronological age). Implicit in this approach is the assumption of a decrement model of normal aging, an assumption which has recently been challenged (Baltes & Schaie, 1974; Barton, Plemons, Willis & Baltes, 1975; Schaie, 1973).

Another important source of empirical data on functional age has been the Boston Veterans Administration Hospital normative aging study (Bell, Rose & Damon, 1972). In that study a wide array of functions have been defined for the domains of blood chemistry, anthropometric measures, personality, human ability, hearing, and various sociological measures. The basic strategy advocated by this group, however, still awaits to be fully implemented. For their reasoning suggests that the most adequate criterion of functional age ought to be the prediction of nearness to death, or years of life remaining (Nuttall, 1972).

Finally, Gribbin, Schaie and Parham (1974) have worried about the limitations of cross-sectional studies in estimating age functions and have reported an initial approach to using short-term longitudinal data as well as dealing with the confounding of age and generational differences in estimates of age functions. (For a further review of the development of the functional age concept see Birren and Renner, 1977).

Alternate Models of Functional Age

We will now try to identify what seem to be the major alternatives for defining functional age. First, we may note a straightforward longevity model, that is one based on functions which bear linear relations in individual differences in life expectancy, as measured at any (or in a more restricted model, some specific) point of the life span. Second, we have a model based on residual life expectancy. Such a model requires sets of linear relations of variables to individual differences in residual life expectancy, possibly with differential functions depending upon the life stage and generational membership (functionally defined!) from which residual life expectancy is to be estimated. The first two models seem to differ primarily in that the first probably involves identification of predominantly genetic parameters, while the second, when taken from a base past adolescence would largely entail differential impact of environmental parameters. (For a formal discussion of possible models for the segregation of genetic and environmental variance in developmental problems, see Schaie, 1975).

A third model seeks to define the linear relation of a set of behavioral functions which covary inversely with chronological age. The parameter to be fitted here is the individual's standing on such function as indicating that he is parallel, retarded or advanced on such function as compared to his chronological age peers. A fourth model defines a functional profile thought to be of maximal behavioral consequence, and is concerned in determining whether a given individual falls below or exceeds a profile characteristic of his or her chronological age by some critical value. A fifth model defines functions in relation to a criterion variable of adaptation or behavioral competence (see Schaie, 1976), and then places individuals in relation to either normative values or as proportions of optimal level. Finally, a sixth model is concerned with the capability of the individual to acquire or reacquire skills regardless of present performance level. Here the parameter to be estimated is the degree of plasticity of the human organism in relation again to some optimal plasticity level presumably attained in young adulthood. It should be noted here that models three and four assume an irreversible decrement model of aging, that model five explicates an adult stability model, and that model six involves the concept of decrement with compensation (Schaie, 1973). We will examine each of these models in greater detail, but first will have to make some statements about the measurement of age functions in relation to certain methodological issues.

Normative Data Bases for Functional Age Estimates

Six different strategies have been described for the collection of data needed for the development of functional age norms. These are the cross-sectional, longitudinal, time-lag, cohort-sequential (longitudinal sequences), time-sequential (cross-sectional sequences) and cross-sectional sequential methods (for full discussion see Baltes, 1968; Baltes, Reese & Nesselroade, 1977; Botwinick, 1973; Schaie, 1973, 1977; Schaie & Baltes, 1975; Wohlwill, 1973). Here we shall merely identify these strategies in terms of their implication for functional age studies. Figure 1 will help identify each of these strategies.

Cross-sectional Data Bases. It is well-recognized by now that such data bases of necessity confound age changes with inter-generational differences since individuals examined at one point in time differing in age must belong to different birth cohorts. As a consequence, age functions which follow sampling plans such as columns 3 to 6 in Figure 1, will be inaccurate whenever inter-generational differences occur. For physiological data, this may simply effect the origin and slope of age functions. But since cohort patterns for psychological data are not necessarily linear, it should be obvious that cross-sectional data bases are generally inappropriate and misleading in functional age work on behavioral indices.

Longitudinal Data Bases. Sampling plans such as rows b, c, d or e in Figure 1, are the sine qua non for functional age studies of physiological variables. Data acquisitions may either involve the repeated measurement of the same individuals (with segregation into sub-populations having differential attrition or mortality patterns), or random samples of different individuals drawn from the same birth cohort tested only once. The latter plan avoids the need for collateral studies of attrition as well as controlling for reactive effects introduced by the measurement process (cf. Schaie, 1977). The single cohort longitudinal study is useless, however, as a data base for most psychological age functions because it does not control for secular trends; that is, we do not know whether an age function occurred due to a maturational pattern characteristic over a given age range or whether some environmental phenomenon unique to the particular historical epoch during which the behavior was monitored was responsible for the observed change (also see Schaie, 1972).

Time-lag Data Bases. These involve sampling the same age level repeatedly; that is, for different cohorts at different times of measurement. A typical sampling plan would involve cells b1, c2, c3, d4, or any other diagonal in Figure 1. Such a data base would be useful in monitoring age functions to determine whether genetic or environmental modifications had resulted in level differences for otherwise well-established functions.

Cohort-sequential (longitudinal sequences) Data Bases. These are the data bases of choice in that they permit the segregation of age and cohort effects in the independent samples case and in addition segregate intra-individual from inter-individual differences in the repeated measurement case (Baltes, Cornelius & Nesselroade, 1976; Schaie & Baltes, 1975). This design would be represented in Figure 1 by any consecutive set of two or more rows selected from rows b, c, d and e. Such a design permits estimation of average slopes of decremental age functions as well as estimation of variable intercepts for successive birth cohorts. It may not be suitable, however, for certain sociological variables, where maturational decrement is unlikely. And, it involves the assumption that there are no secular trends effecting all cohorts equally.

Time-sequential (cross-sectional sequences) Data Bases. Such data involve the replication of cross-sectional studies at successive measurement points. They permit the segregation of inter-individual differences between those attributable to the age level of the sample and that attributable to secular trends (under the assumption of trivial cohort differences). The sampling plan for such a data base would consist of any two or more successive columns chosen from columns 3, 4, 5 and 6 in Figure 1. This design seems unattractive for the definition of physiological age functions, but is more economical, and thus a good approximation of the cohort-sequential approach, for psychological data. It may be the design of choice if the theoretical age function is presumed to fit a decrement with compensation model.

Cross-sequential Data Bases. Such plans involve the examination of any rectangular set of samples where all cohorts are examined at the same measurement point; for example, cells c4, c5, d4 and d5 in Figure 1. This approach permits segregating birth cohort differences from secular trends (and in the repeated measurement case, intra- from inter-individual differences), if the assumption of trivial maturational changes can be met. This particular data base, of course, assumes an adult stability model, and is essentially non-developmental. It may become of considerable interest, however, for those behavioral variables where we are concerned more with obsolescence than with age decrement.

It should be noted here that data collected in aminimum of three or more longitudinal or cros-sectional sequences can always be analyzed via any of the above-mentioned approaches for purposes of model testing (Schaie & Baltes, 1975).

Relation Between Models and Data Bases

We can now return to a closer examination of the different functional age models, at the same time noting what type of data collection would be required for each model. Further, we will need to identify for each model what specific meaning a functioning age index would attain, in relation to the reference population chosen under the particular model.

Life expectancy model. This model assumes that there is a set of parameters which are linearly related to longevity. To find the best fit we would simply need to estimate the regression of such parameters upon chronological age at death. In principle a single-cohort longitudinal study would suffice, from that point in life at which all parameters thought to have predictive value could be assessed, until that point where all members of the panel had died. However, such a process, time-consuming as it would be, unless solely demographic variables were considered so that a retrospective study could be conducted, would not give us generalizable data without making the strong assumption that neither cohort differences nor secular trends were operating over the period for which data were obtained. The cohort-sequential (longitudinal sequence) approach would therefore be more desirable. As heterogenous a population as possible should be sampled to maximize explication of subtle relationships with life expectancy. Having obtained the appropriate regression equations we would then estimate the functional life expectancy (F) for a given individual and report his or her functional age in relation to the population average for which functional and chronological age would coincide by a formula such as:

$$FA\ 1 = CA + F - A \qquad (1)$$

where FA, = functional age, CA = chronological age, F = estimated maximum age to be attained, A = actuarial maximum age to be attained for individuals of a given chronological age. Such an index would be quite useful for insurance schemes in that it would yield a value which would place all individuals in the same relative position with regard to their individual life expectancy. This index, of course, would tell us nothing about the functional capacity of the individual, and thus would not be helpful for issues of retirement and the like.

Residual Life Expectancy. In contrast to the simple life expectancy model we would here need to begin with samples at many ages to be followed to their demise. Here is, of course, a natural illustration where several cohorts would have to be observed simultaneously over time

(or retrospectively for demographic variables). Complications arise, however, in the case of secular trends. It may thus require supplementation by the time-sequential (cross-sectional sequences) designs which would permit assessment of the effects of such secular trends. The index of functional age would be similar to that given for the simple life-expectancy model. The regressionequations, however, would be specific to each age level at which prediction of residual life-expectancy is made.

Functional age for the second model might be indicated in relation to the population average by the formula:

$$FA\ 2 = CA + RA - RF \qquad (2)$$

where RA = residual years remaining on actuarial basis, RF = functional estimate of residual years, and other notation is as before.

The second model may be more powerful in that it would be more realistic to fit measurements of an individual's state at a given chronological age to residual life expectancy, rather than to absolute life expectancy regardless of the age at which predictors are measured.

It would be possible to combine methods one and two, given proper data bases, to yield a functional age index which would account both for individual differences in absolute life expectancies (perhaps genetically determined) and residual life expectancy (overdetermined by time-dependent life events). The functional age index here might have the form:

$$FA\ 2a = FA\ 1 + RA - RF \text{ or } CA + F - A + RA - RF \qquad (3)$$

Behavioral Functions. This is the most commonly used model represented in work such as that of Dirken (1972) and the Boston Normative Aging study (Bell, Rose & Damon, 1972). Although quite appealing, it is a most insidious approach, since it requires acceptance of the irreversible decrement model of human aging, and requires the search for age functions that decline while ignoring those which show different patterns. Moreover, when based upon cross-sectional data it most likely will result in the definition of cohort rather than age functions, and may thus be quite irrelevant to the issue of functional age. In principle, the age function approach requires a cataloguing of the entire domain of human capacity and performance, with subsequent factor or cluster analyses (e.g. Clark, 1960) to discover those variables which have similar age functions. Again longitudinal sequences would be required to assure us that we are really talking about age functions (slopes) rather than differences between cohorts (levels). We would expect that while there might be a single optimal fit for any such cluster, the joint assessment of all, accounting for most of the individual differences in performance and capacity, is likely to be non-linear in nature, and would thus violate the model.

If a representative set of functions could be found then functional age would be defined as the regression of their linear combination upon chronological age. Again keep in mind that the resulting index would be most heavily weighted for those components which show decrement and would have the same questionable status as the mental age (MA) concept in the measurement of intelligence; that is, it would be an elegant exercise in fitting numbers to persons with no pretense of external validity (Schaie & Gribbin, 1975; Schaie, 1976).

Functional Profile. A much more reasonable approach to the fitting of linear functions to age changes in human performance is presented by the concept of a functional profile advocated by Heron and Chown (1969). Here it is recognized that a single index will not be very useful because of its limited external validity and moreover because the slopes of various age functions are likely to differ markedly. Some basic flaws remain, however. The functional profile as well is handicapped by the fact that age functions (that is prediction of chronological age from function) can be defined only where there are significant decremental functions. The functional profile will yield a series of indices, for each of which one could specify minima required for adequate performance in certain life situations. Once again longitudinal sequences are needed to describe functions adequately, although cross-sectional sequences might serve as first approximations.

Optimal Level. A somewhat different approach to functional age would be the definition of optimal levels for a given function. Such levels might well differ depending upon the life stage of the individuals as well as the societal requirements for performance on a given variable at a particular historical point in time. Individuals' function could then be described as a proportion of optimal level. Such proportions could be regressed upon chronological age or birth cohort to determine linear functions. Ideally, however, assessments of proportion of optimal level could be related directly to criterion situations. Note, that the concept of optimal level would permit age functions which are stable or incremental as well as those which decline (cf. Welford, 1958, and Greenberg, 1971, on performance change in production line jobs). Indeed, if we assume that much of the variability in complex adult function is likely to be determined by inter-generational differences and socio-cultural secular trends, we might well be better off to switch from the concept of functional age to that of functional level. Note, that the cross-sequential method would be most useful to collect functional level data once we move away from the concept that age is the critical variable in accounting for adult behavior change.

Functional level in this model would be described as the proportion of optimal level, or in the form of a functional quotient (FQ) which would represent the ratio of observed performance to that proportion of optimal performance which would empirically be determined to be of average adequacy with respect to the criterion variable. Distributions of performance could be studied to determine ranges of adequate performance and these could be standardized across variables so that FQ profiles could be constructed with respect to all functions of interest. Note that the FQ concept is age neutral. Any normative data collected by age would be purely cohort-specific, and while they would characterize age differences in functional performance at a particular point in time, would have no relevance for the determination of age changes within individuals.

Plasticity Level. If one were to consider an age decrement with compensation model, it will not suffice to provide an estimate of the individual's functional level of performance, but one must further consider to what extent that level can be modified by suitable intervention. We are here considering the degree of plasticity of adult behavior, which becomes quite critical when we assume that many of the disadvantages of the elderly may not be accountable by physiological deterioration, but rather must be attributed to the lack of use, failure to acquire critical skills, or opportunities for performance. Young adults are presumed to be at an advantage in many situations of vocational and social consequence because of their greater learning efficiency and motor performance (Arenberg & Robertson, 1977; Welford, 1977). It would seem quite reasonable therefore to define functional age in terms of learning ability as well as performance functions. If decremental age changes are fairly limited, and differences in performance between young and old often predominantly a function of obsolescence rather than decrement on critical behavior it may then be more important to know the capability of individuals to learn new or relearn old skills, than to worry about a particular performance level. Indeed, this is an area where cross-sectional studies can make contributions, particularly when strengthened by sequential cross-sectional designs.

Functional age expressed as plasticity level may require indices which consider learning both in absolute terms of material acquired as well as in terms of proportion of base performance level. Intuitively we would once again suggest that age functions may be quite irrelevant and that we ought to consider shifting directly to the investigation of individual differences and intra-individual changes in plasticity level as a function of intrinsic and extrinsic environmental causes. Some of these may, of course, be time-dependent but we ought to begin at least with an age-neutral stance.

Criteria for the Content of Age Functions

We must now ask whether we wish to construct measurement batteries which will provide general estimates of the relative state of the individual or whether we wish to predict his relative performance under specific vocational or other life-role circumstances. Both objectives may be quite worthwhile. The first question is concerned with the issue that a minimal relative level ofcertain basic psycho-physiological functions may be required before adequate performance may be possible in any situation of social significance. But such necessary level of function may not be sufficient to predict adequate performance in specific situations. We will therefore next consider what seem to be the most reasonable approaches to defining classes of variables that might have the attributes of being "necessary" functions, and then end our discussion with a description of a possible approach to the determination of variables which are "sufficient" to deal with specific classes of situations in which competent functioning is required.

Classes of Variables Suitable for Generalized Functions. Physiological or, more specifically, nervous system integrity is assumed to be related to behavioral competence and some data to that effect are available, even though correlations between measures of the two domains are far from perfect. Thus, numerous older persons are found to maintain considerable behavioral competence in spite of serious physiological stress (e.g., a CVA), while others show substantial behavioral deterioration with little identifiable physiological pathology. It is important, therefore, to look beyond chronological age differences or changes for a given measure to seek the basic mechanisms by which behavior and physiology influence each other. When such mechanisms are understood, a measure of one should allow relatively good prediction of the other. Regardless of whether we try to organize information from the point of view of physiological systems or behavioral functions, we currently have gaps in our understanding of such mechanisms, but we do know enough to suggest some classes of variables which seem worthy of early attention.

Blood pressure provides an illustration of a physiological measure which is thought to be important for functional capacity. It may, however, be important for a variety of reasons depending on the model of functional age held by the examiner. It would be a relevant measure for persons interested in life expectancy (models 1 & 2). A rise in blood pressure with age has been reported (model 3) though the contributions of age per se and the increased incidence of cardio-vascular pathology in advanced age have not been fully sorted out. Inclusion in a profile to be compared with a peer or ideal young age (model 4) would be useful, however, only as profile characteristics are related to behaviors of interest. Only models 5 and 6 which respectively propose a profile or a description of a person's ability to learn or adapt compared with an optimal or necessary functional level would seem to encourage an exploration of basic physiology-behavior mechanisms.

Correlational studies have suggested the relevance of blood pressure to behavioral competence (Birren & Spieth, 1962). A history of hypertension has been correlated with reduced scores on tests of cognitive function (Spieth, 1964). Further, increased scores on the Categories test have been reported with reduction in blood pressure via biofeedback of persons suffering from hypertension (Goldman et al., 1975). On the other hand, slightly elevated blood pressure in elderly persons has been correlated with better performance on cognitive tasks (Wilkie & Eisdorfer, 1971).

If one is interested in why changes in blood pressure affect behavior and consequently how important blood pressure is as a measure of functional efficiency, one must also explore the various ways blood pressure affects other physiological functions whose relationship to behavior may be better understood. Gribbin et al (1971) reported that both increased age and a history of raised average pressure were associated independently and significantly with reduced baroreflex sensitivity. Stiffer arterial walls resulting in reduced afferent nerve activity was suggested as a possible mechanism. Baroreflex action has homeostatic import because it is the mechanism by which changes in heart rate occur in response to pressure changes. Moreover, changes in baroreflex sensitivity may also be critical for perceptual-motor functional efficiency.

Blood pressure is simply one example of a physiological measure, the explication of whose importance to behavior would clarify its relevance as a measure of functional efficiency. Correlational studies are available which suggest the importance of many other physiological measures to behavior (see Table 1 for examples) and similar explorations of possible mechanisms should be valuable.

Conceptually, one can shift from looking for the behavioral significance of a physiological measure, as we have done above, to consider what physiological measures are affected as persons engage in behavioral tasks. Welford (1977) for example, describes a model for sensorimotor function which proposes that CNS processes for perception, short-term store, gating, choice of response, long-term store and effect or control should be involved. The autonomic system is seen as providing a diffuse activation or arousal system which enhances or reduces cortical sensitivity via brain stem mechanisms depending on environmental demand characteristics. While this model may suggest a number of studies which could help elucidate some basic mechanisms, measures of nervous system function are not readily available to assess all of the components. Further, the components enumerated in the model do not describe processes which are readily translatable into abilities or processes which make sense to persons who want to make decisions on the basis of functional measurements.

We would suggest, then, four classes of processes whose relevance to effective functioning are immediately recognizable and[2] for which at least some central and autonomic measures are now available. The four classes of functions are: orienting processes, control processes, adaptability, and speed. Central and autonomic measures which have been correlated with performance on tasks which can be included in each of these categories are listed in Table 1. Obviously, there is not sufficient time to discuss the relative merits of each measure in this context. It will be noted, however, that the central measures are all evoked potential measures; that is, they record brain activity time-related to stimulus or response occurrance rather than utilizing the spontaneously occurring EEG (cf. Marsh & Thompson, 1977). And, it is generally accepted that evoked potential measures reflect techniques of processing, evaluating or making decisions on the basis of information rather than the content of the information being handled (Schwartz, 1976). The goal of evoked potential measurement would be to assess the relative intactness of persons' abilities to deal with and respond to stimulation from the environment.

The role played by the autonomic nervous system in conjunction with central processes is even less well known although some suggestions are beginning to arise from the research literature. Many investigators have assumed that autonomic participation in behavior serves a fairly unitary arousal function via the ascending reticular activating systems. Others such as Routtenberg (1968) and Post (1975) propose that at least two arousal systems would better account for the data. This position argues

for the existence of one system mediated by the reticular system which maintains arousal level and provides organization for responses, and a second system, mediated by the lymbic system, which provides control of responses through incentive-related stimuli. A variety of hypotheses regarding behavior have been generated from this position. The consolidation process in learning, for example, is thought to require suppression of the first arousal by the second arousal system (Post, 1975).

An even more highly differentiated notion of arousal involving the contribution of specific autonomic functions to brain function and behavior has been offered by Lacey and Lacey (1974). Their work suggests that synchrony in the timing of feedback mechanisms may be necessary between heart rate, baroreceptor activity and cortical sensitivity in order to achieve behavioral efficiency. Because of the changes in baroreceptor sensitivity with hypertension or advanced age, investigation of these feedback timing mechanisms might lead to the development of a very useful and highly generalizable mesure of optimal functioning.

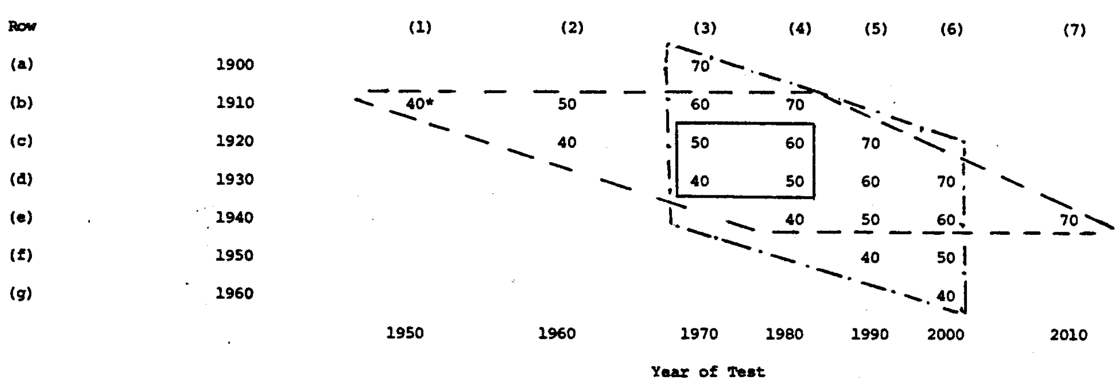
<u>Classes of Variables Suitable for Specific Situations</u>. When we turn to functions which may be of more direct concern in industrial (McFarland, 1973) or other competency-requiring situations we are faced with the general issues of external validity (see Schaie, 1976, for a broader discussion of external validity in the development context). First of all, we must have a better understanding of the classes of situations within which older people are expected to display competence. A first attempt in this direction has recently been reported by Scheidt (1976) who developed a taxonomy of competence relevant situations in older individuals. This taxonomy classifies situations in terms of four fairly independent dimensions: social character (social or non-social), activity level (high or low), commonality (common or uncommon), and supportiveness (supportive or depriving). A Q-sort containing five prototypic situations for each of the sixteen possible classes of situations is available to help define the characteristics of a particular criterion situation for the individual whose competence we are interested in.

Assuming the availability of a method of identifying the characteristics of the situation to which we wish to predict, we must then select measurement variables which are appropriate to the developmental level of the individuals to be tested. That is, we should not expect tasks which have construct validity for young adults to retain such validity for middle-aged or elderly persons. And, we must be sure that our tasks measure the constructs of interest rather than simply being measures of test-taking ability. The latter problem, incidentally will lead us to substantial increases in test-construction activity (for example of new approaches see Krauss & Schaie, 1976; Sinott, 1975). But we must not ignore either the large variety of measures which have shown previous promise in functional age studies in industrial contexts (see Kelleher & Quirk, 1973). What is at issue here is that such measures must be related to classes of criterion situations, and we must know much more than we now do on the task-by-situation interface before applications of functional age to societal concerns such as retirement becomes practicable. We will then be in a position to provide the student of functional age with a catalog of psychometrically valid procedures, from which choice can be made of those variables which are optimal and thus "sufficient" for the determination of age functions with respect to discrete criterion situations. Whether or not a more generalized classification to situations (a la Horst's (1955) multiple absolute prediction method) might be feasible is an empirical question whose solution would seem far in the future.

Some Concluding Remarks

We have attempted to provide a framework which might be helpful in analyzing some of the presentations which are to follow. In each case we would ask, that the question be raised as to what conception of functional age is to be addressed, as to what kind of data base is judged to be relevant, and whether the functions to be presented are purported to be relevant to the general state of the individual or to be made more specific to a given criterion situation. We would hope that the more physiological-minded will address the former while those interested in social-psychological issues will obviously be concerned with the latter. But the boundaries are not always clear and much exciting work and discoveries lie ahead.

Figure 1. Example of Alternate Data Bases for Functional Age Studies Derived from the General Developmental Model (Schaie, 1965)



*Age of sample at time of test

---- Cohort-sequential

-·- Time-sequential

___ Cross-sequential

Table 1. Classes of Generalizable Functions

Class of Functions	Possible Measures
1. Orienting functions, including: simple arousal, differential sensitivity to stimulus characteristics such as different intensity levels.	1. Early components of evoked potentials including augmenting-reducing; contingent negative variation (CNV) o-waves; skin conductance responses, heart rate changes.
2. Control functions, including: attentional, inhibitional (dealing with distraction), expectancies, decision-making.	2. Later components of evoked potentials including P300, CNV-E waves; heart rate changes; ANS/CNS synchrony.
3. Adaptability, including: learning and memory.	3. Classical conditioning, habituation, and biofeedback using autonomic and cortical measures.
4. Speed, including reaction time.	4. Evoked potential latency and recovery measures, timing components of ANS/CNS synchrony.

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Footnotes

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2 The functions discussed here go beyond and assume prior evaluation and compensation of deficits in basic sensory skills such as vision and audition. The critical importance of these processes for functional efficiency is recognized and their complexity is made abundantly clear by recent work in auditory "far-field" evoked potentials. The physiological processes underlying vision and addition are much better understood than the behavioral functions considered here and the reader is referred to recent reviews by Corso (1977) and Fozard et al (1977).