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Cognition, Motor Behavior, and the Assessment of Atypical Aging

TIMOTHY A. SALTHOUSE

Two major themes provide coherence among the chapters in this volume: (1) emphasis on either cognition or motor behavior and (2) a focus on atypical or abnormal rather than typical or normal aging. The discussion in this chapter therefore concentrates on these two topics; no attempt is made to review or summarize the major points raised in the previous chapters, but instead these topics are elaborated by exploring possible linkages across areas and by considering several implications of the focus on atypical aging.

Cognition and Motor Behavior

Although the topics of cognition and motor behavior receive extensive attention in this volume, the two areas were mainly treated in separate chapters. Some chapters were exclusively cognitive in orientation (e.g., Howe, Shimamura), and others focused entirely on motor and physiological behavior (e.g., Dustman et al., Vandervoort & Hill); only two chapters (i.e., Shephard & Leith and Stones et al.) made an explicit attempt to integrate results from the two domains. This is unfortunate because the simultaneous analysis of cognition and motor behavior in relation to age could prove extremely informative about the nature of age-related processes.

As just one example of the potential value of this type of cross-disciplinary investigation, consider the hypothesis that common mechanisms are involved in age-related effects observed in such presumably distinct domains as cognition and motor behavior. Shimamura in his chapter argues that it is desirable to examine several different measures of memory because of the possibility that the distinct types of memory have independent causes. However, an even stronger reason for examining variables from diverse domains occurs in investigating the possibility that the aging phenomena observed with different types of activities have similar causes.

Some precedent exists for examining variables from cognitive, motor behavior, and physiological domains within a single study (e.g., see the dis-

cussion of functional age in the chapter by Stones et al.), but research with variables from several domains is still quite rare. One probable reason for the lack of more studies containing variables representing a variety of activity domains or disciplines is that areas such as cognition and motor behavior are frequently perceived as being quite distinct and having little in common. This perception seems valid only at a superficial level, however, because numerous potentially interesting linkages actually exist between the topics of cognition and motor behavior. To provide evidence for this assertion, two possible linkages, derived from different motivations or rationales, are described briefly.

One intriguing issue that transcends disciplinary boundaries is how complex levels of functioning in a given activity can be successfully achieved based on inputs from presumably more basic processes. Of particular importance is how diverse types of information can be monitored, integrated, and coordinated to accomplish a relatively complex activity. Most readers would probably acknowledge that many cognitive activities require considerable information processing, but it is important to realize that comparable amounts and types of information processing may be required with certain motor activities. Stones et al. (this volume) provide an excellent illustration of this point in their discussion of balance as a skill that "requires integrated contributions from the sensory apparatus, the central nervous system, and the musculature. To maintain balance, the brain must monitor and integrate information from multiple sources, and initiate corrective action by the musculature when equilibrium is in danger of being lost."

A research question that might therefore prove extremely fruitful is whether similar factors are involved in the age-related impairments observed in complex functioning in different domains. For example, researchers working in cognition or motor behavior could attempt to determine if the age-associated deficits in complex functioning can be completely accounted for in terms of deficiencies in the quality or quantity of relevant information. If not, it would be tempting to attribute at least some of the age differences to limitations in the ability to integrate or coordinate multiple sources of information. However, to evaluate the generality of this inference, it is clearly desirable to determine whether similar limitations were evident in different ability domains. In this and many other cases, therefore, confidence in one's conclusions about the nature of hypothesized age-related differences is likely to be greater if similar results are observed with variables from domains as purportedly distinct as cognition and motor behavior.

An alternative motivation for investigating variables in both cognitive and motor behavior domains is to determine whether similar empirical relations exist in the two areas. To the extent that quantitative models of performance in cognitive and motor behavior domains yield similar parameters, one might be able to infer that those phenomena are governed by

similar principles, and perhaps even determined by common mechanisms. A particularly promising candidate for this type of cross-disciplinary investigation is the phenomenon of age-related slowing, because it is evident in variables ranging from electrophysiological measures (e.g., Dustman et al., this volume) to reaction time (e.g., Stones et al., this volume) to an enormous number of cognitive measures.

A very robust empirical relationship has been documented in the cognitive literature in which the times required by older adults to perform various tasks are frequently found to be proportional to those required by young adults to perform the same tasks. In other words, across a wide range of cognitive activities, and corresponding activity durations, the average performance of older adults is well-predicted by a linear equation from the average performance of young adults (Cerella, 1985; Salthouse, 1985, 1988). The best form of the quantitative function is still in dispute, but the basic phenomenon of considerable regularity between the times of young and older adults seems well established.

Among the questions that would be interesting to ask are whether a similar quantitative regularity exists among variables from other domains and, if so, the degree to which the relevant parameters have comparable values. For example, one possibility is that a single age-related slowing factor might be found to characterize an individual's performance across cognitive, motor behavior, and possibly even physiological activities. Alternatively, it may be that variables from different activity domains exhibit quite distinct slowing rates such that the degree to which an individual is slowed in cognitive activities has no relation to the degree of slowing with motor behavior activities. In either of these cases it is virtually certain that the results from the initial investigations will lead to further productive research that should provide valuable information about processes of aging.

Limitations of space preclude more extensive discussion of these, or other, reasons for attempting to integrate research in cognition and motor behavior. It should be clear, however, that there are often considerable advantages to adopting a relatively broad multidisciplinary perspective when attempting to understand a phenomenon as complex as human aging.

Atypical Aging

Most of the chapters in this volume deal with a variety of conditions or factors that many researchers would agree should be distinguished from processes intrinsic to aging. For example, across the chapters one finds discussions of patients with Alzheimer's disease, Parkinson's disease, Down's syndrome, cardiovascular disease, arthritis, depression, amnesia, and frontal lobe damage. Also included are references to individuals with histories of chronic smoking, alcohol abuse, or lack of physical exercise,

and to people possessing certain life-style characteristics such as a positive self-actualizing attitude. Each of these conditions could be, or has been associated with aging in that the effects of the condition are often greater with increased age, either because the individual's vulnerability to the condition increases as he or she ages or because the cumulative impact of the condition is finally substantial enough to be easily detected by the time the person reaches old age. Regardless of the reason for the age association, however, the fact that some people achieve old age without experiencing these conditions suggests that they are secondary or adventitious rather than primary or essential characteristics of aging.

There are two quite legitimate purposes for studying conditions presumed to contribute to secondary aging. One reason of course, is simply that the conditions are interesting in their own right, and their consequences or effects may be easier to study in the elderly because they are more salient in this population. For example, researchers interested in arthritis or osteoporosis may concentrate on elderly individuals because these conditions are most prevalent in this segment of the population.

A second reason for studying what are presumed to be secondary aging processes is that they provide a means toward understanding typical or normal aging. That is, conditions suspected to contribute to secondary aging are studied in the hope that the consequences of these factors may eventually be distinguished from those assumed to be intrinsic to primary aging.

The chapters in this volume vary in the amount of emphasis they place on the first or second of these reasons for studying secondary aging. In the present chapter, however, the focus is restricted to the second goal of studying secondary or atypical aging is as an intermediate step toward understanding primary or normal aging. The discussion is organized in three subsections. Two are primarily methodological, the first being concerned with the question of how one determines atypicality and the second considering the advantages and disadvantages of alternative procedures for investigating processes related to aging. The final subsection addresses two broad issues relevant to the topic of atypical aging, namely, whether there is any natural termination in the investigation of atypical aging, and when the study of atypical aging might not be productive as a means of understanding normal aging.

What Does Atypical Mean?

Typicality is a population-referenced term in that it only appears meaningful in the context of a distribution or population of observations. Its synonyms are regular, normal, usual, and ordinary, all of which imply that, relative to a reference or population distribution, the relevant observations are representative or unexceptional. Because the word atypical is the

opposite of typical, it too refers to a distribution of observations, but in this case the reference is to observations that are *not* representative and *are* exceptional. An operational definition of atypical might therefore be that the entity or observation is one that is outside the middle 90% of a distribution of entities or observations. The 90% criterion is obviously arbitrary, but some reference to a distribution is implied by terms such as un*usual*, ir*regular*, ab*normal*, out-of-the *ordinary*, or a*typical*.

At least three implications can be derived from the view that typicality is meaningful only in the context of a distribution of values of some variable. One is that the distinction between typical and atypical does not necessarily correspond to a contrast between primary and secondary aging. Although atypical observations may sometimes originate because of the influence of processes that are not intrinsic to aging—that is, those that are secondary rather than primary—the correspondence between atypical and secondary aging is not a necessary one. To illustrate, a specific disease might be considered secondary to primary aging because organisms can age without having the disease, but the prevalence of the disease may be so high that most members of a given age group have at least some symptoms of the disease. In a circumstance such as this, the typical observations would reflect the influence of secondary as well as primary processes, and consequently it might be the atypical observations that predominantly reflect the operation of primary aging processes.

A second implication of the distribution-dependent nature of typicality is that the typicality–atypicality distinction does not necessarily correspond to a distinction between successful and unsuccessful aging. It has been suggested (e.g., Rowe & Kahn, 1987; Stones et al., this volume) that older people with atypically high values on some variable can be considered as having aged more successfully with respect to the construct assessed by that variable than their age peers with lower values. This equating of atypical and successful may be misleading, however, because atypical observations are merely those that are extreme, and there appears to be nothing intrinsic to atypicality that is either successful or unsuccessful. These latter connotations depend more on the variable under consideration, and probably also on the value judgments of the person assigning the labels, than on the position of the observations in a distribution.

The third implication of the population-referenced interpretation of atypicality is that atypicality is something that should be observed, and not merely assumed. That is, characterizing the aging processes of people with a given disease or similar degrees of a particular life-history characteristic as atypical can be deceptive if it has not been established that their aging processes are actually unrepresentative of those of unselected people. In a certain sense one can view research on specially selected groups (e.g., individuals sharing a condition suspected to be a secondary aging factor) as testing the hypothesis that their aging processes are atypical. It may therefore be presumptive to use the atypical label until results are available to

document the distinctiveness of the observations and establish that the aging processes are in fact atypical.

To summarize the discussion thus far, atypicality is a characteristic of an observation in the context of a larger distribution of observations. The mere existence of atypicality does not necessarily imply anything about the cause or desirability of that value, and it is a property that should be documented rather than simply assumed. In the following section the discussion shifts to alternative methods of generating the distributions of aging-relevant observations that can be examined to detect the existence of atypicality.

Methods of Assessing Aging

Aging can obviously be defined in many ways, but for the current purpose a useful definition is that aging refers to processes of change occurring over time that are presumed to originate from factors within the organism. Three basic methodological procedures have been used to study aging processes: (1) investigating individual differences within a sample of older adults at one point in time; (2) comparing individuals of different ages at the same point in time; and (3) examining the same individuals as they grow older. Although the relative advantages and disadvantages of these procedures have been well documented, it is nevertheless instructive to reexamine them from the perspective of a focus on atypical aging.

One procedure frequently employed in the study of aging is to focus only on older adults and attempt to determine the factors responsible for the performance variability found within a sample of relatively age-homogeneous individuals. This perspective is illustrated in Figure 7.1, in which observations are derived from one measurement occasion, in late adulthood, with the goal of making inferences about the nature of the processes leading up to that point (i.e., the slopes of the dashed lines).

A clear statement of the rationale underlying this approach was provided by Krauss (1980), who claimed that "determining the contributing causes of the large individual differences among the elderly will provide valuable information on both the origins of decrements associated with aging and the factors contributing to successful aging" (p. 549). As Figure 7.1. illustrates, however, the obvious limitation of trying to study aging from the study of the aged is that it is very difficult, if not completely impossible, to partition the variability at the current measurement occasion (represented by the points above the label "Old") into that which existed at earlier periods (represented by the space of possible points above the label "Young") and that attributable to variability in the aging process (represented by the sample of dotted lines). In other words, the variability observed within a sample of older adults at the current time could have originated either from variability that existed many years ago, when they

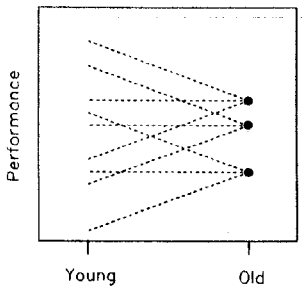

FIGURE 7.1. Schematic illustration of research employing a single group of older adults. The circles represent actual observations, and the dashed lines portray possible age-related changes.

were all young adults, or to variability in aging-related change processes associated with the transition from early to late adulthood.

This logical difficulty of separating effects of change from previously existing effects clearly presents problems in attempting to reach inferences about aging processes on the basis of observations of members of a single age group. Only if the researcher is willing to make very strong assumptions, such as that the variability in the relevant measure was much smaller at earlier ages, could he or she attribute differences among older adults to variability in aging processes. Identification of atypical observations in an age-homogeneous sample of older adults therefore provides a very weak basis for making inferences about causes or types of aging. In fact, one can even question whether it is appropriate to use terms such as *age* or *aging* with reference to age-homogeneous samples, or in connection with measures in which age effects have been statistically removed (see the usual age measure proposed by Stones et al., this volume).

The familiar cross-sectional research design shares several of the limitations of age-homogeneous studies, but the availability of data from people of different age sometimes provides a stronger basis for inferences about aging processes than studies of only a single age group. Figure 7.2 illustrates the major characteristics of the cross-sectional research procedure. Notice that observations are obtained from individuals of at least two different age groups, but because the data from a given individual are obtained at a single point in time, one can only guess about the values of the relevant variable for that individual in the past or in the future. (This uncertainty is represented by drawing multiple lines emanating from each measurement point and portraying them in a dashed format to indicate their speculative nature.) Researchers employing the cross-sectional design sometimes assume that all individuals would have performed equivalently had it been possible to measure them at the same age. This is obviously a very strong

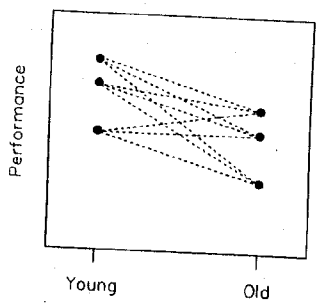

FIGURE 7.2. Schematic illustration of cross-sectional research design. The circles represent actual observations, but they are connected with multiple dashed, rather than single solid, lines to indicate that many possible alternative age-related processes could be operating.

assumption, but some version of it appears necessary to make inferences about aging processes on the basis of observations from cross-sectional comparisons (i.e., only if one assumes the groups were once equivalent does it make sense to draw lines between the variables from different groups).

Although inferences about aging processes can only be tentative and indirect in cross-sectional studies, multiple-age studies do have an important advantage over studies involving individuals from a single age group. The existence of data from several different age groups allows a check on the assumption that aging processes contribute to the results one observes by determining whether similar results are evident at each age group. That is, if the interindividual variability, or the patterns of relations among variables, evident within a sample of older adults is truly associated with processes of aging, then the interindividual variability and the patterns of interrelations among variables should be different within a sample of young adults who have not yet been exposed to the aging process (see the discussion of the homogeneity/heterogeneity criterion by Stones et al., this volume). However, if the sample of young adults exhibits an equivalent degree of across-person variability, or has a comparable pattern of relations among variables, then it would be unreasonable to attribute the results in the older adults to processes of aging when the same results are evident in a sample of young adults in whom little or no accumulation of the consequences of aging-related processes has occurred.

The same type of reasoning seems relevant in interpreting results from intervention studies. Although a finding of a significant benefit in a sample of older adults with an intervention such as physical exercise is sometimes interpreted as implying that physical inactivity contributes to age-related performance declines (e.g., the chapters by Dustman et al., Shephard & Leith, and Stones et al.), this conclusion may be premature. According to the present argument, such a conclusion would be justified only if the same intervention were administered to a sample of young adults and the effects of the intervention were found to be significantly smaller in the sample of young adults than in the sample of older adults.

It is important to note, however, that the preceding argument is not symmetrical in that one cannot infer that a different pattern of results in young and old adults necessarily reflects the operation of aging processes. Samples of different ages may vary because of selection or generation-specific experiential differences; aging-related processes are consequently merely one possible source of any cross-sectional differences observed. Nevertheless, the hypothesis of an influence of aging processes is generally plausible only when there is a difference in the pattern of results across groups varying in age, and for this reason cross-sectional studies with multiple age groups have an advantage over studies with adults from a single age group.

Cross-sectional designs can therefore be quite useful in studies of atypical aging because they allow one to determine whether the factors associated with atypicality vary across ages. According to the argument just outlined, the hypothesis that aging processes contribute to the atypicality would be reasonable only if the atypicality was not present or was associated with different sets of determining conditions in the period of young adulthood before aging processes have had an opportunity to operate.

Longitudinal observations of the same individual at two or more points in time are directly relevant to aging processes because the differences from one measurement occasion to the next can be attributed to time-related changes occurring either within (aging processes) or outside the organism (e.g., changes in the physical, biological, or social environment). If the relevant aspects of the external environment can be controlled in some fashion, or if one is willing to assume that the environment has not changed in significant ways during the interval over which observations are made, then the longitudinal method provides a very valuable means of directly assessing the consequences of aging processes.

Figure 7.3 illustrates the basic properties of the longitudinal design. Because measurements are obtained from the same people at two temporally separated occasions, the solid lines can be interpreted as representing changes occurring within specific individuals. The distribution of difference scores, or slopes of the lines, could therefore provide the basis for determining whether given observations (in this case reflecting changes over time) are atypical.

Longitudinal assessments clearly have the potential to provide relatively direct information about processes of aging, but they are not completely free of problems. Specifically, two characteristics of most previous longitudinal studies have served to limit their potential contributions. These

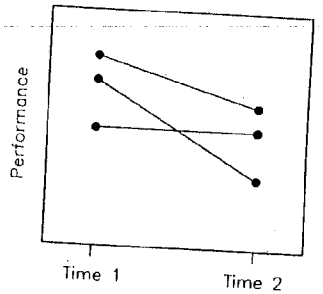

FIGURE 7.3. Schematic illustration of longitudinal research design. Because the same individuals contribute observations at both measurement occasions, the data points are connected by solid lines to indicate that they reflect changes occurring within specific individuals.

features lead to questions about the power to detect age-related differences and about the between-individual comparability of the resulting performance measures.

One limitation of a number of longitudinal studies is that the interval between successive measurements may have been too short to provide sufficient power to detect relatively small changes. The optimal length of the retest interval obviously depends on the rate of change of the variable of interest, but some information about rate of change can be obtained from the results of cross-sectional studies. For example, Overall (1987) recently used cross-sectional data to compute the power to detect longitudinal differences in group comparisons. He estimated that, among adults in their early 60s, sample sizes of more than 400 would be needed to be confident of detecting longitudinal differences in cognitive measures over intervals of 3 years. If one is interested in detecting significant differences within a given individual, then it is the test–retest interval that must be increased rather than the number of individuals in the sample. To illustrate, Salthouse, Kausler, and Saults (1986) estimated that with many current measurement procedures, intervals of 30 or more years might be necessary to detect within-individual longitudinal differences as significant. The implication of both these analyses is that longitudinal comparisons may have relatively low power to detect the effects of age-related processes unless longitudinal researchers (a) greatly increase the sensitivity of the measurements, (b) increase the number of measurement occasions to allow computation of trends rather than simple differences, or (c) extend the interval between successive measurements to allow greater accumulation of the consequences of aging-related processes.

A second characteristic of most previous longitudinal studies that could limit their usefulness for assessing atypical aging is that the results are generally expressed in absolute scores, or transformations of absolute scores, which may not be of comparable sensitivity for all individuals. That is, the same absolute score may have a different meaning in an individual who has a high degree of consistency in the performance he or she produces than in an individual whose performance is extremely variable from one measurement to the next, even within the same test session. Individual differences in within-session consistency may originate for theoretically relevant reasons, such as differing degrees of precision in the coupling of the presumed latent construct to the manifest variable, or for potentially less interesting reasons, such as fluctuations in motivation or attention. Regardless of the source of the differences in variability, however, it is debatable whether a given value has the same meaning when it occurs in a distribution of very low variability or in a distribution with large variability.

One means of attempting to ensure comparable sensitivity across individuals is to scale the measurements in terms of the individual's own within-occasion variability. In other words, instead of reporting the longitudinal change for an individual from time 1 to time 2 in terms of the absolute values of the measured variable, this difference could be reported in the individual's time 1 standard deviation units. Adopting the convention of reporting longitudinal differences in within-individual standard deviation units from the initial measurement occasion would not only provide a potentially more meaningful measure of each individual's change over time, but it also has two further potential advantages. A common scale for all variables would be provided, and the statistical significance of the observed differences could be determined at the level of individual subjects. That is, units of variability provide a metric that is practical and meaningful for virtually any variable, and the statistical significance of the resulting within-individual difference is easily computed.

It is important to emphasize that the present suggestion is to evaluate differences between measurement occasions in terms of the distribution of within-occasion measurements for a given individual. Schaie and his colleagues (e.g., Schaie & Willis, 1986) have frequently reported results in which scores are expressed in units of between-individual variability and longitudinal differences or intervention results are interpreted relative to the between-individual variability at the first measurement occasion. Although superficially similar to the current proposal, the transformations used by Schaie and his colleagues do not accomplish the purpose of the proposed analyses because there is no attempt to scale an individual's scores relative to his or her own within-occasion variability.

When analyzed in the manner just described, data from the longitudinal method can provide extremely useful information about aging processes because the results clearly reflect time-related changes, and one need only isolate the source of those changes to internal or external factors. It is unfortunate, therefore, that the difficulty of conducting research over an

extended period of time has made longitudinal studies of any type quite rare.

The purpose of this brief discussion of methodological approaches to the study of aging was to make explicit the assumptions and pitfalls of studying normal aging from the perspective of atypical aging. Among the major points to be stressed are the necessity of using a distribution of observations to define atypicality and of employing a research design that generates observations capable of supporting inferences about the influence of aging processes.

When Do We Stop Analyzing Atypicality?

Let us now briefly enumerate the steps that seem to be involved in using atypical observations as a basis for understanding normal or primary aging. First, one or more distributions of observations are obtained that are relevant to aging processes. These could be longitudinal change scores or possibly cross-sectional observations from several age groups, but in either case great care should be taken to ensure that the values are of comparable sensitivity and meaning for all individuals. Next, the atypical observations are identified by means of a distribution-referenced criterion, and a search initiated for the factors distinguishing those observations from the rest of the distribution. If distinguishing factors can be identified, and if they are found to have differential importance at different ages, as would be expected if they are truly age-related, one could infer that those factors were indeed secondary, rather than primary, characteristics of aging.

This is a reasonable investigation strategy which should eventually result in a better understanding of the nature of primary aging by discriminating it from a variety of secondary aging characteristics. What is not clear, however, is whether, and if so how, this investigative sequence would ever terminate. That is, under what conditions could one conclude that all of the secondary aging characteristics had been removed and that remained was entirely attributable to primary aging processes?

One condition under which the process of focusing on atypical observations would cease to be productive, and would logically terminate, is when little or no variability exists among the remaining observations. Because this potential outcome of the focus on atypicality has important implications for the nature of primary aging, it is useful to examine it more carefully.

A criterion of minimal variability is obviously vague, but it is clear that identification of the atypical instances presumed to reflect the contribution of secondary aging processes grows progressively more difficult as the distribution of observations becomes more homogeneous and less variable. For practical purposes, then, it could be argued that virtually all of the secondary aging factors had been eliminated when the remaining distribution of observations had very little, or possibly even absolutely no, variability. It is sometimes hypothesized that universality is a characteristic of primary aging, but the most convincing evidence for true universality might be a discovery of little or no residual variability after the influence of secondary aging factors is removed. In this respect, therefore, the progressive elimination of factors contributing to atypicality might prove extremely informative in determining whether characteristics of primary aging are actually universal.

A second implication of a discovery of minimal variability after accounting for the contribution of major secondary factors concerns the very existence of the concept of primary aging. That is, one conceivable outcome of the partitioning of age-related differences into consequences of other factors that tend to be correlated with age is that nothing may remain to be explained when the influence of all secondary factors have been taken into consideration. An outcome of this type might be considered consistent with the metaphorical view of aging as like an onion, in that after all of the secondary layers are stripped away one finds there is no core corresponding to primary aging. This would clearly be an important result for a variety of reasons, not the least of which is that it may lead directly to the disappearance of the entire field of gerontology. If all age-related phenomena can be completely attributed to various combinations of secondary factors, with nothing left to be associated with primary aging processes, a separate discipline concerned with aging phenomena would no longer be justified.

The preceding paragraphs have described several important reasons for studying atypical aging, ranging from the identification of potential causes of secondary aging to discovering the ultimate nature of primary aging. It should be pointed out, however, that many of these goals might also be accomplished without focusing on atypical aging. If potential secondary factors can be identified, they can presumably be investigated directly, without going through the process of determining which observations are atypical and then attempting to discover the reasons for the atypicality. All that may be required is to group individuals with respect to their level on the hypothesized causal variable, and then to determine whether there are significant between-group differences in the variable assumed to reflect aging processes.

It could therefore be argued that a focus on atypical aging as a means of understanding normal or primary aging is useful only if one does not yet have hypotheses as to the possible sources of atypicality. If the factors that might contribute to secondary aging phenomena can be identified, as seems to be the case from thte large set of diseases or life-style variables discussed in the chapters in this volume, then their influence can be directly examined to determine whether they do in fact lead to atypical aging. Atypicality, in this case, is the hypothesis under investigation and not a phenomenon to be explained. In light of this argument, it may be desirable to clearly distinguish between the research strategy of focusing on atypical

aging as a means of investigating primary aging and the hypothesis concerning the representativeness or typicality of the aging processes of individuals sharing some characteristic.

Summary

The two primary topics addressed in this chapter are the relations between cognition and motor behavior and the meaning of the term *atypical aging*. It was suggested that although there are currently few studies designed to investigate both cognitive and motor behavior variables simultaneously, research of this type should definitely be encouraged. Not only could interesting theoretical issues be addressed, but cross-disciplinary perspectives appear essential in attempting to understand the complexities of human aging.

A dominant focus in the second portion of the chapter is a concern that the term *atypical aging* is potentially confusing because of its multiple connotations and the variety of motivations for being interested in atypical aging. Analysis of the words *atypical* and *aging* suggests that their combination refers to the extremes in a distribution of observations relevant to age-related change processes. It is emphasized that the term *atypical aging* is most meaningful when clear evidence exists that the relevant observations fall within the extremes of a distribution of observations and when those observations are capable of supporting inferences about age-related change processes. There are other, possibly more direct, methods of studying primary aging, but the approach from the perspective of atypical aging does offer the potential of revealing important characteristics of primary aging, including providing evidence relevant to the fundamental issue of whether there is any substance to primary aging independent of secondary aging processes.

References

Cerella, J. (1985). Information processing rates in the elderly. *Psychological Bulletin*, *98*, 67–83.

Krauss, I.K. (1980). Between- and within-group comparisons in aging research. In L.W. Poon (Ed.), *Aging in the 1980s* (pp. 542–551). Washington, DC: American Psychological Association.

Overall, J.E. (1987). Estimating sample size for longitudinal studies of age-related cognitive decline. *Journal of Gerontology*, *42*, 137–141.

Rowe, J.W., & Kahn, R.L. (1987). Human aging: Usual and successful. *Science*, *237*, 143–149.

Salthouse, T.A. (1985). Speed of behavior and its implications for cognition. In J.E. Birren & K.W. Schaie (Eds.), *Handbook of the psychology of aging* (2nd ed.) (pp. 400–426). New York: Van Nostrand Reinhold.

Salthouse, T.A. (1988). The complexity of age × complexity functions: Comment on Charness and Campbell. *Journal of Experimental Psychology: General*, 117, 425–428.

Salthouse, T.A., Kausler, D.H., & Saults, J.S. (1986). Groups versus individuals as the comparison unit in cognitive aging research. *Developmental Neuropsychology*, *2*, 363–372.

Schaie, K.W., & Willis, S.L. (1986). Can decline in adult intellectual functioning be reversed? *Developmental Psychology*, *22*, 223–232.