

## One

# Theoretical Issues in the Psychology of Aging

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Much of the research literature in many scientific disciplines can be categorized as primarily addressing empirical, methodological, or theoretical issues. Empirical articles attempt to provide tentative answers to specific questions, methodological articles tend to focus on how to ask answerable questions, and a major goal of theoretical articles is to specify which questions are the most important to ask. The current chapter is primarily concerned with theoretical issues relevant to contemporary research in the psychology of aging, and thus it is focused more on questions than on answers. However, at the outset it is important to acknowledge that no attempt was made to be comprehensive in the coverage of theoretical issues, nor to link the material to the literature in the philosophy of science. Furthermore, the goal was not to review contemporary theories in the field of aging, but rather to stimulate consideration of a number of issues that appear to be central to theoretical speculations in the psychology of aging. Indeed, a major thesis of this chapter is that there is currently a great deal of confusion about what should be considered a psychological theory of aging, at least in

part because there is little consensus with respect to the critical questions that should be addressed in order to qualify as a theory of aging. Because the author is most familiar with research on age differences in cognitive functioning, most of the examples are drawn from that research domain, but the issues are assumed to be applicable to many different domains.

At least two well-recognized advantages of theories are that they organize a great deal of information in a parsimonious manner and they serve to guide future research. One of the primary ways in which theories influence the direction of research is by identifying major issues that ultimately must be addressed by a satisfactory theory. By specifying which questions are interesting and important and, by omission, which are not, theories serve to focus research.

The focusing-of-research function is essential because a nearly infinite number of questions could be asked in most research areas, and the vast majority of them could be justified by the claim that their answers are not yet known. However, not all questions are equally important or informative, and a major role of theories

**Table 1.1**  
Major Theoretical Questions in the Psychology of Aging

| Question | Issue   | Elaboration   |
|----------|---|---|
| What?    | In what psychological respects do people of different ages vary?  | <i>What</i> refers to the phenomenon to be explained.                 |
| When?    | At what ages do the changes occur?  | <i>When</i> refers to the timing of the phenomenon.                   |
| Where?   | Which hypothetical aspects, theoretical components, or neuroanatomical substrates are primarily involved in the phenomenon? | <i>Where</i> refers to conceptual or neuroanatomical localization.    |
| Why?     | What is responsible for the developmental changes?  | <i>Why</i> refers to the causal determinants of the phenomenon.       |
| How?     | What are the mechanisms by which the developmental changes occur?   | <i>How</i> refers to the manner by which the cause exerts its effect. |

is to specify which research questions are central and which are peripheral or irrelevant.

### I. A taxonomy of Major Questions

It is helpful to begin by considering a taxonomy of major questions that ultimately must be addressed by a successful theory. In addition to providing a systematic basis for evaluating theories, the taxonomy may also be useful in understanding how theories differ from one another and why it is often not feasible to make direct comparisons among theories.

The taxonomy, which is summarized in Table 1.1, conceptualizes major issues in the psychology of aging in terms of questions concerning the what, when, where, why, and how of the phenomenon of age-related differences in some aspect of behavior. Each of the questions is important because a phenomenon could be considered to be well understood, and the theory would be considered to provide a compelling explanation of the phenomenon, if all of the questions had convincing answers.

The question of *what* is clearly relevant to distinctions among theories because the answer will affect the intended scope

of the theory. For example, if the theory is primarily concerned with age differences in a limited aspect of behavior, then it would probably be considered relatively narrow in scope. In contrast, if the phenomenon is defined in general terms that encompass many different types of variables, then it would be viewed as fairly broad.

How a theory answers the question of what will also determine which aspects of the phenomenon are considered primary, and perhaps somewhat analogous to the central "disease," and which are considered secondary, and possibly more analogous to "symptoms" of the disease. For example, a variable that is interpreted as representing merely one of many possible manifestations of the phenomenon of primary interest might not be considered a high priority for theory-relevant research.

Because the answer to the question of what serves to specify the primary focus of a theory, this information needs to be considered before attempting to compare two or more theories. For example, if theories differ in their answers to the question of what, comparisons among them may not be meaningful because at a fundamental level they are not addressing the same phenomenon.

To illustrate, two theories may both be concerned with adult age differences in measures of speed, and hence from a certain perspective they might be considered similar. However, one of the theories might be primarily concerned with describing the relations among reaction time measures of speed in adults of different ages (Cerella, 1990), whereas another might attempt to explain the relations between a theoretical construct of processing speed and adult age differences in a variety of measures of cognitive functioning (Salthouse, 1996). Because in the former case the answer to the what question refers to the relation among reaction times in different age groups whereas in the latter case it refers to the role of speed in age-related differences in cognitive performance, the theories are not addressing the same phenomena, and consequently it may not make sense to attempt to make direct comparisons among them.

The question of *when* is relevant to the evaluation of theories because if the theory assumes that the phenomenon begins clearly in adulthood, then the theorist needs to consider what can be learned by studying age differences very late in life, whereas if the theory assumes that the phenomenon begins late in life, then the relevance of observations in early adulthood needs to be considered. In other words, if a theory's answer to the question of when is very late in life, then research on young adults may not be directly relevant to the theory, but if the phenomenon is assumed to begin early in life, then research restricted to older adults may be of limited value. Whether findings from research on adults from different age ranges are relevant to the theory will therefore be determined by the theory's conceptualization of the phenomenon. Many studies compare a sample of young college students with a sample of adults between 60 and 80 years of age, others restrict their focus to adults

above a certain age, such as 50 or 70, and a few studies compare adults across a wide range of 18 to 90 or older. However, depending on the theory's answer to the question of when, it may not be meaningful to treat each of these types of data as equally applicable to the theory because, for example, changes before age 60 may not be viewed as reflecting the same phenomenon or might not be postulated to involve the same mechanisms as changes that occur after age 80.

Most of the theoretical attempts to address the question of *where* have tried to localize age-related effects within some type of conceptual or neuroanatomical model of the behavioral variable of interest. To illustrate, at least five approaches to localization have been employed by researchers investigating influences associated with increased age on aspects of cognitive functioning. In each case a number of conceptually distinct "loci" for age-related influences have been postulated, and a primary goal of the research conducted within that perspective was to determine which of the possible loci have the greatest relations to age. For example, researchers working with correlation-based structural models have attempted to localize age-related influences within models of the organization of cognitive variables such as at the level of individual variables, the level of first-order factors, or the level of higher order factors. Researchers working with componential models have attempted to localize the influences within qualitatively different processing components that are postulated to contribute to performance on the task. Theorists who have proposed stage models attempt to localize age-related influences within components that are postulated to represent an ordered sequence between input and output, such as encoding, storage, and retrieval in the case of memory. Theorists working with computational models attempt to determine

which specific parameters of one or more equations intended to describe relations between hypothetical processes and observed measures of performance are most susceptible to age-related effects. Finally, researchers working within a neuroscience perspective have attempted to localize age-related influences to particular areas of the brain that are active during the performance of relevant cognitive tasks.

Although the question of where, in the form of either conceptual or neuroanatomical localization, has been the focus of a great deal of aging-related research in the area of cognitive functioning, it actually may be the least important of the major theoretical questions. The reason is that while it is clearly useful to be more precise about the exact nature of the observed differences, it is still important to know why and how a given theoretical aspect or neuroanatomical region is affected and not others. In a sense, therefore, rather than functioning as an explanation, answers to the question of where can be considered to provide a more specific level of description of the phenomenon. This is not to say that there is no value in localization research, but rather that localization primarily serves to supply a more precise characterization of exactly what needs to be explained.

Perhaps the most intuitively obvious question regarding developmental phenomena is *why* they occur. A fundamental question for any developmental phenomenon is what are the precursors or determinants of the phenomenon? The question of *why* is often closely linked to the question of *how* because the latter focuses on the specific manner by which the postulated causes (i.e., the hypothesized answer to *why*) produce the phenomenon. A successful answer to the question of *why* should therefore be accompanied by a fairly thorough understanding of the basis for the developmental trends of interest, and a

successful answer to the question of *how* should specify the mechanisms underlying any interventions or moderators that might be found to alter the rate of aging.

Theories can obviously differ in the level of analysis used in attempting to answer the questions of *why* and *how*. For example, the explanatory mechanisms could be very distal, perhaps involving characteristics of the social or cultural environment when the individuals were young, or they could be proximal and at the same conceptual level or measured at the same time as the to-be-explained phenomenon. The degree of reductionism incorporated into a theory largely reflects the preference of the theorist, but it is important to recognize that there may be some practical limits on reductionism if it is considered desirable to use the same level of description in characterizing the phenomenon and in specifying possible answers to the *why* and *how* questions. To illustrate, it may be very difficult in the context of a single theory to interpret age-related changes in relatively high-level concepts such as life goals or reasoning ability in terms of biochemical reactions at the synapses of individual neurons.

## II. Criteria for Evaluating Explanations

Because the questions of *why* and *how* are fundamental with respect to evaluating theories of psychological aging, it is important to consider how the adequacy of their answers might be assessed. Five criteria that could be used to evaluate theoretical hypotheses addressing the *why* and *how* of age-related effects in behavior are outlined in Table 1.2. These are obviously not the only possible criteria that could be used to evaluate age-related hypotheses, but when

**Table 1.2**  
Proposed Criteria to Evaluate Theoretical Hypotheses in Aging

| Criterion              | Elaboration  |
|------------------------|--|
| Construct validity     | Do the variables used to represent the critical construct reflect the hypothesized construct exclusively and exhaustively?                         |
| Age relation           | Is the construct related to age in the expected direction?   |
| Criterion relation     | Is the construct related to the criterion in the expected direction?   |
| Statistical mediation  | Is the age relation on the criterion reduced after statistical control of the variation in the construct?  |
| Effective intervention | Is the age relation on the criterion altered substantially when the level of the construct is manipulated in an experiment with random assignment? |

considered together they appear to be relatively comprehensive. If all of the criteria were to be satisfied, one could probably be confident that the hypothesis provided plausible answers to the questions of the why and how of the phenomenon. Moreover, explicit recognition of the existence of multiple criteria may minimize the tendency for advocates of a particular theory to emphasize only one or two of the criteria, which could lead to distorted evaluations of the relative merits of different theories.

In much of the subsequent discussion the relations of age on some aspect of cognitive functioning will be used as the phenomenon of primary interest, and thus the theoretical hypothesis should specify a mechanism by which increased age is presumed to be associated with lower levels of cognitive functioning. Most of the hypotheses postulate that aging leads to a change in one or more critical constructs that are responsible for many, if not all, of the age-related differences in the relevant measure of cognitive functioning. Aging is typically not considered a causal factor itself, but rather is viewed as a dimension along which causal influences operate.

The first criterion is construct validity, which is essential to establish that the variable actually represents what it is intended to represent. It is widely recognized in many areas of psychology that

few variables are "pure" in the sense that the variable has a one-to-one correspondence with a particular theoretical process or construct. Two analytical approaches have been used to deal with the problem that observed variables are imperfect indicators of the theoretical constructs of primary interest. One approach involves attempting to rule out extraneous influences and to isolate the critical construct by a combination of experimental design (e.g., multiple task conditions) and analysis (e.g., subtraction, process dissociation). The second approach consists of trying to converge on what the construct represents by obtaining multiple indicator variables of the construct from each research participant and focusing on what these variables have in common that is distinct from what is common among variables assumed to represent alternative constructs.

The two analytical methods derive from different traditions within psychology, and thus it is not surprising that researchers working from different perspectives vary in their preference for one procedure or the other. Regardless of the method used to investigate the meaning of the variables, however, establishment of construct validity is a critical criterion for theoretically relevant research because one must have confidence that the key constructs are

assessed appropriately before hypotheses about their roles in aging-related phenomena can be meaningfully evaluated. Although this point may seem obvious, it is surprising how much research in the psychology of aging relies on theoretical constructs that have only face validity. For example, within the field of cognition there is apparently very little evidence of convergent/discriminant validity for such frequently mentioned constructs as processing resources, attentional capacity, inhibition, and executive functioning.

A causal hypothesis of the age relations in cognitive functioning is not plausible if the critical construct is not related both to age and to cognition, and thus the second and third criteria listed in Table 1.2 also need to be satisfied for a developmental explanation to be convincing. However, because a great many variables are related to age, the second criterion of a relation between age and the construct is not very diagnostic by itself. Furthermore, most cognitive variables are positively correlated with one another, and thus the third criterion of a relation between construct and cognition is also not very informative in isolation. Moreover, even if both the second and the third criteria are satisfied, one cannot necessarily infer a causal linkage among the three variables because, for example, the construct-cognition relation may be age specific. To illustrate, use of a strategy (construct) may only be effective in improving performance (cognition) among high-functioning young adults, or an increase in stimulus intensity (construct) may only be effective in improving performance (cognition) among older adults with sensory impairments. In both of these cases the construct is unlikely to be involved in the age-related differences in cognition, and this lack of involvement would be revealed by the fourth criterion, statistical mediation.

The rationale for the statistical mediation criterion is that if the critical construct contributes to the mediation of age-cognition relations, then the strength of the relation between age and cognition should be reduced if there was little or no variation in the level of the construct. Variation in the level of the construct could be reduced by equating people on the hypothesized mediator by selection or matching, but these methods typically result in small samples with low statistical power. A more effective procedure is to control the variation in the construct by means of statistical adjustment, which is why this criterion is known as statistical mediation.

Because many causal factors are likely to be operating simultaneously for most aspects of behavior, it is probably unrealistic to expect any candidate hypothesis to be the exclusive cause of aging-related phenomena such that statistical mediation accounted for all of the age-related effects. However, if there is not at least some attenuation of the age-cognition relations after restriction of the variation in the critical construct, then there would be little evidence that the construct is involved in the phenomenon under investigation.

Statistical mediation can be a powerful tool, but it should be distinguished from causal mediation because evidence of statistical mediation is sometimes interpreted erroneously as implying that the hypothesized mediator is *the* causal factor. For example, assume that a researcher hypothesizes that age-related declines in some aspect of health cause age-related declines in a particular type of cognitive functioning. If the researcher then finds substantial attenuation of the relation between age and cognition after statistical control of the variation in relevant measures of health, it may be tempting to infer that declining health is a major cause of age-related cognitive decline.

However, it is important to realize that an inference of this type is not valid, and in the field of logic it is known as the fallacy of affirming the consequent. The contrast of this invalid form of reasoning with a valid form, known in logic as *modus tollens*, can be illustrated by expressing both types of arguments in abstract terms, with  $p$  representing the hypothesis that age-related decreases in health contribute to age-related cognitive decline and  $q$  referring to a discovery of statistical mediation.

Fallacy of affirming the consequent

If  $p$  then  $q$

$q$

Therefore  $p$

Modus tollens

If  $p$  then  $q$

Not  $q$

Therefore not  $p$

Note that although it may seem counterintuitive, a finding that the age-related effects in the relevant measure of cognition are reduced substantially after control of the variation in the hypothesized mediating construct of health does not imply that the hypothesis is confirmed. The reason is that many other possible factors could contribute to the attenuation of age-cognition relations after statistical control of a potential mediator such as health. In contrast, the valid form of the argument is directly informative about the plausibility of the hypothesis because a discovery of a *failure* to find substantial attenuation of the age-cognition relations after control of the variation in health (i.e., not  $q$ ) would be inconsistent with the hypothesis (i.e., not  $p$ ). Statistical mediation results can therefore provide evidence relevant to the validity of causal hypotheses, but primarily when the outcome fails to support the theoretical prediction. As the philosopher Karl Popper (Popper, 1959) and others have pointed out in

other contexts, however, tests such as statistical mediation can be viewed as opportunities to falsify a causal hypothesis, and thus confidence in a hypothesis should increase when it is successful at surviving serious attempts at falsification, in this case in the form of tests of statistical mediation.

Although the first through the fourth criteria listed in Table 1.2 are necessary, they are not sufficient to definitively establish the credibility of a developmental theory or hypothesis. All of these criteria must be satisfied for the hypothesis to be capable of explaining relations between age and cognition, but even if these conditions are met, the hypothesis and the critical construct still may not have a truly causal role in the phenomenon. Only the final criterion of effective intervention will yield unambiguous evidence that the hypothesized construct and its associated mechanism are sufficient to explain the age-cognition relations because if the construct is truly causal, then manipulation of the level of the construct should alter the age-cognition relation.

In light of the potential informativeness of interventions, it is not surprising that there has been considerable interest in various types of intervention research among researchers investigating aging. Both practical and theoretical benefits could be expected from successful interventions, but two issues need to be considered in the design and interpretation of intervention studies to ensure that the results are truly relevant to the theoretical speculations.

First, for pragmatic reasons of time and expense, most experimental interventions have focused on short-term outcomes, such as improvement in the level of a particular variable immediately after the intervention. If the intervention is judged to be successful based on comparisons involving the appropriate types of controls (e.g., random

assignment to groups that are treated identically except for the critical intervention component), then the manipulated factor can be inferred to affect performance on that variable. In other words, if individuals are randomly assigned to treatment and control groups and the groups are found to differ significantly on the criterion variable after the intervention, then it is reasonable to conclude that the manipulated factor has a causal effect on the level of performance. Moreover, if the participants in the study vary in age, it may also be possible to reach conclusions about the effectiveness of the intervention across different periods of adulthood.

What is often not recognized, however, is that short-term interventions are not necessarily relevant to the effect of the manipulated factor on the relations between age and the target variable of interest. In order to determine whether the intervention has an impact on processes of aging, individuals in the treatment and control groups must be monitored for a long enough period to detect possible alterations in the relations between age and the target variable. Only if the relation between age and the variable is altered after the intervention could one validly infer that the intervention was relevant to the effects of age on the construct of interest, and this determination requires that the effects of the intervention be monitored for an extended period. The most informative contrast from an intervention designed to alter effects of aging is therefore not the difference between the treatment and the control group immediately after the intervention or even a contrast between these groups at various intervals after the beginning of the intervention, it is a comparison of the slopes of the functions relating the target variable to age. Because slopes represent rate of change over time, they should be

considered the key outcome variable in intervention research designed to modify rates of aging. Unfortunately, very few intervention studies have monitored individuals for decades, or even for years, after the intervention and apparently none have reported comparisons of intervention and control groups on measures of rates of age-related change. Short-term effects can be important for practical reasons, but they are not necessarily informative about the effects of an intervention on the rate of age-related change of the target variable. For example, a large immediate effect might dissipate rapidly and have no effect on the rate of aging or the immediate effect could be small but might accumulate over years or decades such that it led to a substantial modification of the relation between age and the relevant behavior.

Another important issue to consider in attempting to relate the outcomes of interventions to theories of psychological aging is the breadth of the intervention effects because the results may not be of much practical or theoretical interest if the effects are restricted to a very small set of highly similar variables. To illustrate, a researcher might find that with appropriate training a group of middle-aged adults is able to improve their memory for faces and that the benefits persist over an extended period such that these individuals experience a smaller age-related change in measures of face memory over the next 20 years than control individuals who did not receive the training. Although these would be very impressive results, they might nevertheless be of limited interest if there was no generalizability of the intervention benefit to memory for other types of information, such as names, stories, telephone numbers, and recipes.

Research findings with a very specific outcome could still have theoretical value, but only if the results of the

intervention are comparable in scope to the phenomenon represented by the theory's answer to the question of what. In other words, if a theory characterizes the phenomenon as age-related influences on many aspects of cognitive functioning but the intervention is found to affect only a limited type of memory, then results of the intervention would likely only be relevant to a portion of the theory.

Although capable of providing some of the most convincing evidence relevant to theories of aging, the criterion of effective intervention obviously poses a major challenge. Not only are most interventions difficult to implement, but it is extremely expensive and time-consuming to monitor individuals for a long enough period after the introduction of an intervention to allow an evaluation of its effects on rates of aging, which is the outcome of primary interest for theories of aging.

### III. Evaluating Criteria

Determination of the degree to which a given criterion in Table 1.2 is satisfied is likely to be somewhat subjective, although quantitative indices such as correlations and effect sizes can be used to assist in evaluating some of the criteria. However, the mere process of articulating criteria such as those in Table 1.2 may facilitate progress in theoretical development and understanding. For example, consideration of the criteria when thinking about one's theory may suggest the type of research that is needed to further explore the viability of theoretical hypotheses.

The classification scheme presented in Table 1.2 may also be useful in helping explain some of the differences in perspective among theorists who investigate psychological aging. Some theorists

appear to have emphasized the first and third criteria and have tended to neglect the remaining criteria, whereas other theorists have emphasized the second and fourth criteria while ignoring the others. It is therefore not surprising that there is sometimes a lack of communication or conflict if the theorists do not share the same values, which in this case can be conceptualized as the perceived importance of the different criteria. However, to the extent that each criterion in Table 1.2 is relevant to the validity of the hypotheses, they should all be considered in evaluating the adequacy of theoretical explanations.

### IV. Theoretical Progress

It is sometimes lamented that there has been relatively little progress in developing and evaluating theories of psychological aging (Bengston & Schaie, 1999). It is certainly true that no consensus has yet emerged as to the most convincing or comprehensive theory in any area of the psychology of aging. This final section of the chapter considers three conceptual and methodological factors that may have limited theoretical progress in the psychology of aging.

The first limiting factor is a failure on the part of many researchers to consider phenomena broader than what is assessed by single variables. Variables do not exist in isolation, and consequently misleading conclusions might be reached if researchers attempt to interpret age-related effects on a particular variable as though they existed in a vacuum. Although it is obviously easier to focus on one variable rather than on many, there is now considerable evidence that age-related effects on different cognitive (and likely noncognitive) variables do not occur independently. Furthermore, most theories are concerned with relations at the level

of theoretical constructs, and it is very unlikely that any single variable exhaustively and exclusively represents a given theoretical construct in psychology. Failure to consider influences on the variable of interest in the context of age-related influences on other variables may therefore result in a distorted characterization of the nature of the phenomenon and could impede progress in the ultimate discovery of explanations.

A second issue relevant to theoretical progress concerns the importance of maintaining close linkages between the theory and potentially relevant empirical observations. In particular, the level of abstraction in the theoretical discussion should be appropriate to link the speculations to data in a testable manner. On the one hand, if the theoretical speculations are too broad and the concepts are too vague to have specific operationalizations or if they allow many potentially contradictory operationalizations, then the speculations may not be testable. The theoretical concepts could still serve as guiding assumptions, but they might better be viewed as a framework, or as a set of biases, rather than as a true scientific theory. On the other hand, if the theoretical speculations are highly specific, as they might be if they are based on formal computational models that incorporate many assumptions that are only weakly related to observable behavior, then they again may not be testable. Exercises of this type can be useful in indicating the sufficiency of a particular set of assumptions, but unless they can be established to be directly related to observable aspects of behavior, they may not be amenable to rigorous evaluation.

A third factor that may have limited theoretical progress in contemporary research on psychological aging is the frequent failure to relate one's results to earlier findings in order to ensure that there is cumulative progress. Researchers

sometimes appear to act as though their results with a particular variable are completely novel and unrelated to all past research, when this is seldom, if ever, the case. Although the goal of research is the discovery of new information, unless linkages are established with prior results there is a risk that the information is not truly new, in which case no progress will be made. A major role of theory is to integrate information, which includes previously established information as well as information that is assumed to be new.

## V. Conclusion

The major theses of this chapter were that a primary purpose of theories of psychological aging is to provide answers to major questions (cf. Table 1.1) and that at least five criteria (cf. Table 1.2) should be considered when evaluating the validity of answers to those questions. It was suggested that communication among theorists, and comparisons of theories, may have been hampered in the past because only a subset of questions and criteria have typically been considered in the description and evaluation of theories. Finally, the chapter concluded with three suggestions that might contribute to more rapid process in the development and evaluation of theories of psychological aging: (a) adopting a broader perspective than a focus on a single variable to ensure that the theory is addressing the "disease" and not merely the "symptoms"; (b) maintaining a close linkage between the level of theoretical discourse and the level of empirical observation to ensure that the theoretical speculations actually address, and are influenced by, empirical results; and (c) ensuring cumulative progress by placing new results in the context of already established results.

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