Creativity and Successful Aging

Theoretical and Empirical Approaches

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Editor

Springer Publishing Company 1998

CHAPTER FOUR

Practical Creativity in Older Adults' Everyday Problem Solving: Life Span Perspectives

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There has been an increasing emphasis in the research literature on contextually relevant assessments of older adults' problem-solving capabilities (e.g., Denney, Tozier, & Schlotthauer, 1992; Poon, Rubin, & Wilson, 1989; Sinnott, 1989; Sternberg & Wagner, 1986; Willis, 1991). Researchers of everyday problem-solving try to understand the cognitive competence of individuals in their real world environments; these everyday competencies have been labeled *practical intelligence* by Sternberg and Wagner (1986).

Practical creativity has remained understudied. For the present purposes, practical creativity is defined as the fluent, flexible, and original generation of solutions to real world problems. Practical creativity is hypothesized to operate in situations where linear reasoning and prior knowledge are insufficient for the solution of particular everyday problems. Prototypical situations could include any or all of the following: (a) problems that are highly novel or are in unfamiliar domains, (b) problems for which previously successful solutions (e.g., well-rehearsed strategies) are no longer effective or useful, (c) problems for which available sources of information (e.g., reference books, close others) are not relevant or useful. Although the concepts of creativity, problem solving, and intelligence have been linked in the theoretical literature, essentially no empirical investigations of creativity or problem solving in late life have actually examined these relationships. In this

chapter, creative problem solving in the everyday lives of older adults is considered from an individual differences perspective. Drawing on psychometric and life span psychological data, we will consider the potential adaptive value of creative mental ability as individuals confront the challenges of old age.

Inattention to practical creativity is somewhat surprising, because some theorists (e.g., Wagner, 1986) have argued that the problems of everyday life tend to be ambiguous, without clear goals or means of solution, and they may be effectively solved with a multitude of potential solutions (i.e., they are ill-structured problems) (Neisser, 1976). It is precisely these kinds of problems that have been identified as requiring creativity for their effective solution (e.g., Voss & Means, 1989). Despite conceptual linkages between intelligence, creativity, and problem-solving, most studies of older adults' problem-solving capabilities to date have focused on what might be called *convergent production* (Guilford, 1970), or individuals' abilities to produce "correct" responses to relatively well-structured problems. In contrast, it is *divergent production* (Guilford, 1970), or individuals' ability to devise original and flexible solutions, that has been linked with creativity. Thus, while well-structured problems undoubtedly constitute a substantial proportion of the problems confronted by older adults, the lack of attention to how individuals differ in their responses to everyday problems characterized by greater ambiguity and novelty appears to limit the generalizability of everyday cognition research to highly structured situations. This leads to the question of what role(s) creativity-related mental abilities might play in the everyday competence of older adults.

In contrast to other points in the life span, where creativity in academic, workplace or leisure contexts may be more important, practical creativity in later adulthood may be increasingly focused on dealing with the challenges of daily life (see Willis, 1991). Flexibility in identifying novel ways of achieving important objectives in the face of age-associated physical losses may constitute a very important adaptive characteristic of individuals in late life (Baltes & Baltes, 1990). Arranging for the completion of tasks like self-care and home care activities under conditions of physical disability, for instance, might be one example of the need for a kind of pragmatic creativity in late life. Furthermore, as one moves out of the formal institutional contexts of school and work (which surround much of young and middle adulthood), there may be an increasing probability of confronting new, idiosyncratic life challenges for which prior experience may only be of limited usefulness. In addition, some of the everyday challenges with which individuals are confronted in late adulthood and throughout the life span may not have a correct answer; for example, how should an older adult deal with a spouse who becomes cognitively impaired?

In this chapter, we will consider the concept we have labeled practical creativity, with a particular emphasis on how mental abilities related to creativity might be important for understanding the everyday competence of older adults. The main position of this chapter is that divergent production abilities of fluency, flexibility, and originality are to practical creativity what other, convergent, production abilities (like inductive reasoning and crystallized knowledge) are to linear, logical everyday problem solving. This chapter is organized into five major sections. First, definitions and theoretical perspectives on everyday problem solving in late life are considered, with a particular emphasis on how cognition in everyday contexts might relate to cognition as it has been traditionally assessed in the laboratory. Second, the concept of practical creativity is discussed from the viewpoint of psychometric intelligence conceptions, and in terms of its application to problem solving. Third, evidence concerning the development of intelligence, creativity, and everyday problem solving across adulthood is reviewed, with the goal of providing an understanding of how basic mental abilities thought to undergird creative everyday problem solving might vary with age. Implications for the developmental trajectory of practical creativity are considered. Fourth, the literature on the adult developmental trajectory of everyday problem solving is considered, with a particular emphasis on problem solving involving fluency, flexibility, and originality. Fifth, a view of one possible role of creativity-related mental abilities in the everyday lives of older adults is presented. This perspective argues that the mental abilities associated with practical creativity may have substantial adaptive value in the later years.

EVERYDAY PROBLEM SOLVING: DEFINING THE DOMAIN

Willis and Schaie (1993) have argued that across several definitions of everyday cognition (Charlesworth, 1976; Neisser, 1976; Wagner, 1986) there are some areas of agreement. In general, everyday cognition seems to involve the application of basic abilities to naturalistic or everyday contexts. Furthermore, everyday problems seem to be complex and multidimensional, requiring the use of multiple abilities and skills (e.g., knowledge, reasoning, memory), and not just single abilities.

As well as consensus, however, there is also disagreement on some of the prototypical features of everyday tasks. Wagner (1986), for example,

has argued that traditional measures of intellectual functioning, labeled *academic intelligence,* are

> (1) well-defined; (2) linear, in the sense of having but one correct solution and one method of obtaining it; (3) disembedded from an individual's ordinary experience and of little intrinsic interest; and (4) complete in that all needed information is available from the start (Wagner, 1986, p. 362, adapted from Neisser, 1976; Wagner & Sternberg, 1985).

Practical intelligence tasks, or "one's cognitive responses to almost everything that happens outside the school" (Wagner, 1986, p. 362) are defined by exclusion. In other words, everyday tasks in adulthood are thought to be comprised of ill-structured problems with multiple potential solutions. These tasks are relevant to daily experience, and their means of solution are incomplete or uncertain. Similar views have been expressed by Resnick (1987).

Wagner (1986) also recognized the existence of other possible definitions. In another view, the kind of ill-structured tasks mentioned by Wagner constitute only a subset of the broader body of daily challenges with which individuals might be confronted. As Willis and Schaie (1993) have noted, some everyday problems (e.g., banking or the use of airlines and other transportation services) are highly structured and would be more likely to have one correct answer (e.g., one must fill out a deposit form correctly; one must get to the correct airport gate on time).

Consequently, this chapter argues that everyday problem solving cannot be defined by exclusion, but rather by inclusion. The everyday experiences in which individuals engage, across the life span, are characterized by substantial breadth and diversity, with a blend of novel and familiar challenges, characterized by variation in intrinsic ambiguity and information provided.

Differences in theoretical definitions of what constitutes everyday tasks have come to be reflected in differing predictions about the relationship between basic intellectual functioning and performance in everyday environments across adulthood. One broad class of theoretical perspectives, *contextual/expertise*-based views, notes the familiarity and repeated occurrence of many everyday challenges, particularly in late life. As a result, these theories emphasize the particular importance of accumulated domain-specific knowledge in understanding the everyday cognitive competence of individuals. A second class of theories, so-called *hierarchical models,* emphasizes the role of a full breadth of intellectual abilities, including knowledge, in everyday task performance. The primary conceptual emphasis of these two approaches,

however, has been on convergent problem solving and linear reasoning. There has been a lack of explicit consideration of divergent production abilities.

Contextual/Expertise Views

The three dominant contextual/expertise views of the relationship between intellectual ability and everyday activities, and their developmental trajectories, are associated with P. Baltes (P. Baltes, 1987; P. Baltes, Dittmann-Kohli, & Dixon, 1984; Staudinger, Cornelius, & P. Baltes, 1989), Berg and Sternberg (1985, see also Wagner & Sternberg, 1986), and Denney (1984, 1989). While their conceptual models seem to primarily emphasize convergent production, all three research groups listed here have actually studied everyday problems that one might consider ill-structured problems of daily living.

With regard to everyday functioning, P. Baltes and colleagues have emphasized what they call the *pragmatics* of intelligence, which individuals acquire in the course of social participation. Drawing on a broad body of cross-sectional and longitudinal literature, cognitive pragmatics appear to evince selective maintenance and growth until very late in the life span (Lindenberger & Baltes, in press; Salthouse, 1991).

P. Baltes and colleagues further assume that the cognitive pragmatics represent the accumulated, experienced-based knowledge which underlies the performance of many routine everyday tasks. Thus, the kinds of tasks embedded within cognitive pragmatics are reading and writing, language, educational achievements, professional competence, and even self-related knowledge and coping skills (P. Baltes, 1993), tasks in which individuals may be said to have a kind of expertise (Ericsson & Smith, 1991). Given high levels of accumulated procedural and declarative knowledge in these familiar task domains, the expectation is that, in selected everyday activities, high levels of pragmatic knowledge may ensure continued preservation of functional competence, despite potential age-related losses in the underlying cognitive mechanics (see also P. Baltes, 1987, 1993).

A related, but somewhat different perspective has been advanced by Denney (1984, 1989). Denney makes a distinction between unexercised potential and optimally exercised potential. Unexercised potential is seen in tasks which are unpracticed and untrained; optimally exercised potential reflects the maximum performance an individual might demonstrate under conditions of practice and training. By implication, the most frequently performed tasks of daily living would be those which most approximate optimally exercised performance levels,

although they may not actually reach the highest potential levels. Regarding developmental predictions, the general expectation is that both exercised and unexercised abilities may follow an inverse U function, with exercised abilities showing a slower rate of decline until advanced old age. Regarding the relationship of everyday tasks to basic intellectual abilities, Denney writes that "traditional problems tend to measure general problem solving *ability,* everyday problems tend to measure *ability plus experience*" (Denney, 1989, p. 46). Thus, basic intellectual abilities should be better predictors of novel everyday tasks, but in familiar everyday problems, acquired experience (possibly reflected in domain-specific knowledge) should be an additional and substantial predictor of performance.

The position advanced by Sternberg and colleagues (Berg & Sternberg, 1985; Sternberg, 1985), the *triarchic theory of intelligence,* also expects a difference between novel tasks and familiar tasks. Although the triarchic theory also considers components of intelligence and contexts in which it operates, its "experiential subtheory of intelligence" describes the cognitive effort required to adapt to novel challenges:

> The first time one encounters a task the ability to deal with novelty is involved. One of the important elements in dealing with novel tasks and situations is the eventual ability to automatize aspects of task performance . . . tasks are apt measures of intelligence when component operations are in the process of becoming automated (Berg & Sternberg, 1985, p. 357).

Thus, the common threads that run through the various contextual-experiential theories reviewed is

1. Emphasis on individual differences and age-group differences in contextually relevant tasks of everyday functioning
2. A view of everyday activities as consisting largely of highly familiar, practiced tasks
3. The assumption that such highly familiar, practiced tasks may show attenuated age-related disadvantages (relative to basic ability functioning) because they are decoupled somewhat from the basic cognitive architecture (since reserves of experience-based procedural and declarative knowledge may ensure at least preserved functioning in these familiar domains)
4. The expectation that older individuals may be at a disadvantage, relative to younger adults, on novel or unfamiliar tasks that pose high levels of challenge. Successful adaptation in such cases relies more heavily on the operation of basic cognitive components, which are expected to have shown some age-related degradation in efficiency.

In the next section, a hierarchical view of everyday cognition is considered. While compatible with experiential models, the hierarchical view differs in emphasis.

Hierarchical Views

The hierarchical model of the relationship between basic intellectual ability and everyday task performance has been most explicitly advanced by Willis, Schaie, and colleagues (Marsiske & Willis, 1995; Meyer, Marsiske, & Willis, 1993; Willis, 1991; Willis, Jay, Diehl, & Marsiske, 1992; Willis & Marsiske, 1991; Willis & Schaie, 1986a, 1993); it is also prominent in the writing of Berry and Irvine (1986).[1] The differences between the hierarchical and contextual-experiential models center on three major points:

1. The hierarchical model views everyday tasks as falling along a continuum of familiarity to novelty.
2. Therefore, in trying to understand the range of individual differences across a broad array of everyday tasks, the emphasis is on the predictive salience of all intellectual abilities (including knowledge-based crystallized abilities).
3. With its origins in a psychometric, individual differences perspective, the hierarchical model has not focused on the measurement of domain-specific knowledge, since good measures of such knowledge (and a meaningful selection of domains to assess) remain to be developed (Willis & Schaie, 1993).

Thus, while not disputing that knowledge-based functioning and expertise may predict high-level performance within particular, individually varying domains, the hierarchical position places a greater emphasis on understanding the predictors of individual differences in a broad

[1] It is important to note here that hierarchical model is not used in the sense of traditional ability structural modeling (e.g., Cattell, 1971), where lower order factors are regressed upon higher order factors, such that higher order factors (e.g., second-order abilities) subsume the lower order factors (e.g., primary abilities), and are not measured independent of the primary abilities. Rather, *hierarchical* in this context is used to reflect the idea that multiple basic cognitive abilities may, together, explain substantial variance in a (independently measured) more complex everyday task.

array of tasks.[2] Furthermore, the hierarchical position has a particular concern with the adaptive feature of everyday problem solving, which (as argued by Berg and Sternberg, 1985) would be best assessed in novel, less familiar (but still ecologically relevant) tasks. Consequently, within a hierarchical view, there has been a greater emphasis on how individuals perform on multiple, critical tasks of daily living, tasks which must be performed well if individuals are to continue to live independently in the community (e.g., Lawton & Brody, 1969).

The hierarchical model is schematically illustrated in Figure 4.1. As the figure attempts to show, this model argues that basic abilities reflect the operation of relatively universal cognitive processes. Particular tasks of daily life will reflect the operation of subsets of basic abilities, and different tasks may draw not only on different abilities, but on different admixtures of those abilities. Regarding the adult development of everyday cognitive capabilities, "age-related change in performance on a practical intelligence dimension should also be reflected in a pattern of change in underlying abilities and processes" (Willis & Marsiske, 1991, p. 185). Note that the hierarchical model assumes that both basic abilities and accumulated domain-specific knowledge are important predictors of individual differences in everyday task performance.

PRACTICAL CREATIVITY AND PROBLEM SOLVING

In the cognitive psychological literature on traditional problem solving, links between creativity and problem solving have been considered explicitly. The information processing approach to problem solving can be credited to Newell and Simon (1972). In their description, they present problem solving as a move from an initial knowledge state to a goal state. To reduce the large number of potential pathways from initial state to goal, individuals are hypothesized to draw on their prior knowledge and a set of heuristics (e.g., rules of thumb, metastrategies for problem solving) to search through these alternative paths. The efficiency and limits on the problem-solving process are determined by basic information-processing capabilities. As a summary of the key features of this problem-solving process, Mayer (1990) listed four major aspects in the definition of problem-solving:

> First, problem solving is cognitive, . . . so that its existence can only be inferred directly from the behavior of the problem solving. Second, problem solving is a process—that is, it involves manipulating knowledge in the problem solver's mind. . . . Third, problem solving is directed—that is, it is intended to produce a solution to a problem. Fourth, problem solving is personal . . . the difficulty of transforming a given state of a problem into a goal state depends on the existing knowledge of the problem solver (Mayer, 1990, p. 284).

[2] Similar issues have been discussed with regard to job performance.

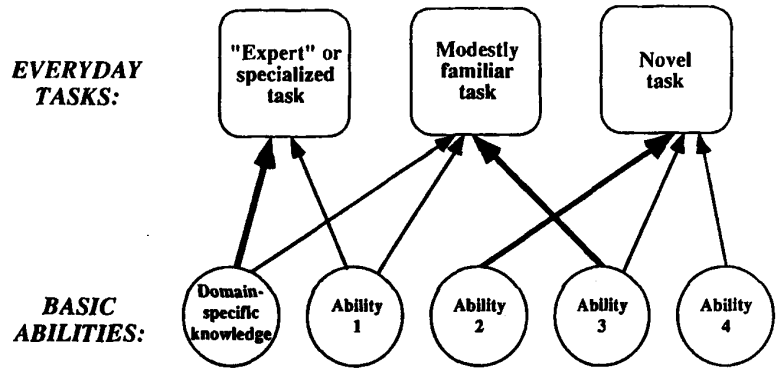

FIGURE 4.1 Schematic of a hierarchical model of the relationship of intellectual abilities and everyday tasks. Bold arrows represent strong predictive relationships, other arrows represent weaker relationships. Different everyday tasks draw on different abilities, and the strength of their relationship may vary by task. When domain-specific knowledge has not been acquired, task performance will rely more heavily on general intellectual competence. This is an elaboration of a figure which appeared in Willis & Marsiske, 1991.

From "Life-Span Perspective on Practical Intelligence," by S. L. Willis and M. Marsiske. In *The Neuropsychology of Everyday Life: Issues in Development and Rehabilitation,* by D. E. Tupper and K. D. Cicerone (Eds.), 1991. Boston: Kluwer. Copyright 1991. Adapted by permission.

As already suggested, there is also a conceptual distinction between well-defined problems and ill-defined problems (e.g., Reitman, 1965; Simon, 1973). In fact, criticisms of problem-solving research have sometimes centered on the fact that laboratory simulations of problem solving often use puzzles characterized by being too well-defined and unfamiliar (i.e., problems requiring little pre-experimental knowledge; Eysenck & Keane, 1990). Ill-defined problems (thought to be more "ecologically valid") are those in which one or more of the given state, goal state, and allowable operators for the problem are not known (Mayer, 1990). With regard to creative problem solving in late life, the

emphasis on novelty and problem structure also seems to neglect one major element of the age-related context of practical creativity: When prior solutions to familiar problems are no longer useful (e.g., because the physical competence to implement particular solutions may have been disrupted), then a situation exists where new means to old problems must be devised. Frustration of old solution strategies will require the availability of alternative solution possibilities, and their flexible use.

Research on the cognitive aspects of problem solving can be traced back, in a fashion, to learning theorists (Kendler, Kendler, & Carrick, 1966) and Gestalt theorists (Wertheimer, 1959). In current years, the dominant perspective has been that advanced by Newell and Simon (1972). Under conditions of unfamiliar, ill-structured problems, the solution procedure becomes complex, as the problem solver proceeds through steps of generating potential actions, testing them, and planning next steps based on the success or failure of the previous step. In this ability to generate potential solutions, presumably via an active search of prior knowledge (Sternberg & Lubart, 1991), creativity is thought to come into play.

Models of creative problem solving have emphasized *analogical mapping* (e.g., Gentner, 1983; Holyoak, 1985; Keane, 1988) in the problem-solving process. Describing a process implicit in the use of metaphor, a base domain of concepts is mapped onto a new target domain. Creative problem solving is evidenced in the transformation of base knowledge that is indirectly applicable to the new goal state. Thus, new problems are solved by transforming old knowledge in novel and flexible ways.

Guilford, arguably the originator of current psychometric conceptions of creativity, proposed that creativity had a special role to play in the solution of novel problems (Guilford, 1977). Divergent production was important in the flexible combination of and reinterpretation of past information to generate new (emergent) ideas (cf. Michael, 1977). Flexible transformation of knowledge, components of which were actually classified as "convergent production," was described as an obvious basis for creative progress (Guilford, 1970, p. 162). As Sternberg and Lubart (1991) and Voss and Means (1989) have noted, creativity seems to be involved in recasting an ill-defined problem.

Implicit in these formulations of the creative problem-solving process is an association between the concepts of creativity and ability; creativity is a part of the intellect, according to Guilford (1977). Indeed, creativity is reflected in the novel use and combination of stored knowledge and old strategies for the solution of problems. Sternberg (1982) and Sternberg and Lubart (1991) have argued that there is a certain

conceptual link between creativity and fluid intelligence, both of which are hypothesized to be important abilities in the solution of novel, unfamiliar problems (e.g., Cattell, 1971). According to this perspective, creativity, therefore, should not be considered a set of mental skills apart from intelligence, but rather a unique use and application of prior knowledge, memories, and reasoning abilities.

For the present purposes, we take three major ideas from this literature: First, cognitive psychologists have explicitly considered the links between creativity and problem solving, but they have too often emphasized creativity in novel problems. Second, a major contribution of this literature has been the elucidation of the processes of analogical mapping and selective search. These processes emphasize the use of prior knowledge from base domains, and their application to new problem domains. This emphasis is congruent with the flexibility and originality notions of Guilford's notion of creativity, reviewed below. Third, the emphasis on processing has largely neglected application. The role of creative problem solving in everyday life, particularly in older adulthood, needs further consideration. We do not mean to imply that creativity is solely cognitive. While the present treatment emphasizes the cognitive abilities underlying and the cognitive results of creativity, there is a substantial body of work which has emphasized the personality (e.g., Barron, 1963; McCrae, 1987) and motivational/environmental features of creative contributions (e.g., Amabile, 1983).

Fluency, Flexibility, and Originality

Before explicitly considering the divergent production abilities of fluency, flexibility, and originality, it is important to mention that, as Brown (1989) has noted, creative divergent thinking has not been as rigorously subjected to tests of its criterion or predictive validity as other intellectual ability factors. The link between divergent production and creativity was more theoretically than empirically established (Wallach, 1986). This helps to explain why subsequent measurement research has tended to question the utility of the divergent production approach (see Brown, 1989; Hocevar & Bachelor, 1989; Kogan & Pankove, 1974; Weisberg, 1986). Similarly, in specifying domain-general divergent production abilities, the Guilford model of the structure of intellect did not address the question of whether creativity is, in fact, a domain-general ability (Simonton, 1990). Is creativity in the visual arts the same as scientific creativity? Differing developmental trajectories for eminent members of different professions have tended to suggest that there are at least

some domain-specific variations in creative achievement (Simonton, 1991). Furthermore, beyond the threshold of average intelligence, intellectual ability appears to have little utility for predicting outstanding creative achievements in particular domains (Simonton, 1985), undoubtedly due to the greater relevance of domain-specific knowledge (Ericcson & Smith, 1991).

For the present purposes, however, one must note that while the link between fluency, flexibility, and originality and creative achievement in various fields of endeavor may be tenuous, the specific linkages between these three abilities and creative problem solving seem clearer. Fluency of thinking and response flexibility seem directly relevant to the kinds of flexible uses of base knowledge for analogical mapping that define creative problem solving.

Models of Creative Mental Ability

A dominant view on this question was proposed by Guilford (1970), for whom the most important abilities in understanding creativity were those relied on in the operation of divergent production. This concept was broadly defined as an operation involved in the generation of many and varied responses. Guilford's ability model, the structure-of-intellect model, was highly complex, and it is not possible to substantially consider it here; however, it is important to note that Guilford himself did not make the simple distinction between convergent and divergent production that much subsequent investigation has come to rely upon (including the present chapter). But Guilford highlighted the notion that a subset of intellectual operations might not be concerned so much with finding correct answers, but with devising and evaluating new, different, unusual, or varied ideas.

In his earlier writings on the topic (Guilford, 1950), Guilford mentioned a number of abilities: sensitivity to problems, fluency, novel ideas, flexibility, synthesizing abilities, analyzing abilities, complexity, and evaluation (see Brown, 1989, for more detailed critical discussion). Although he later tried to reemphasize the full range of abilities (Guilford, 1970), Guilford and others (especially Torrance, e.g., Torrance, 1988) primarily emphasized fluency, flexibility, and originality as the major components of creative mental ability. *Fluency* was assessed in measures that required individuals to generate as many ideas as possible (number of words beginning with a particular letter, number of words in a particular category). *Flexibility* was assessed in terms of how many different kinds of solutions people were willing to try. *Originality* was assessed as the number of novel, or unusual, ideas people generated; number of

rare and loosely related words in word-association tests might be used as an indicator.

Beyond these operational definitions, in this chapter we have attempted to develop the broader conceptual meanings of these abilities, as major constituents of practical creativity. Fluency, then, is a summary of the availability and accessibility of potential solution strategies. An illustration from common usage may clarify this: To be fluent in a language implies both the availability of a substantial and sufficient vocabulary, but also implies a certain smooth, natural polish in its use. It connotes efficient and appropriate selection from a larger body of knowledge. Flexibility refers to the tendency to adopt multiple or alternative means to particular ends. Borrowing from its use with regard to physical objects, flexibility suggests a certain pliability or malleability. Flexibility presupposes fluency in problem solving (i.e., alternative solution means must be available); if a particular strategy for solving a problem does not meet with success, flexibility is an index of the ability and proclivity to try other strategies. This use of flexibility highlights its location at the intersection of personality (Costa & McCrae, 1985; McCrae, 1987), intellectual style (Sternberg, 1988) and mental ability (Schaie, Dutta, & Willis, 1991). Finally, originality here refers to both the origin of a solution, and its prior natural history. My idea is original if I produced it; an effective solution proposed by another person is not a reflection of my originality. An original work of fiction is one written by the author, and not directly adapted from another source. In a different sense, originality also describes the newness and unusualness of ideas. A solution that has never been tried before, by anyone, might be classified as original. In addition, however, a solution that applies familiar ideas or strategies from another domain might also be an unusual solution in a new domain (e.g., use of a stapler as a hammer in an office; use of a rolling TV-tray as a walker), and might also be classified as original in particular contexts. A related concept is resourcefulness (connoting the effective use of the means at hand), which is considered in greater detail below.

Fluency can only be thought of as an indirect measure of creative potential. As Simonton (1990) has noted, the "linkage between quantity and quality can be subsumed under the more extensive constant-probability-of-success model of creative productivity" (p. 93). Fluency is presumed to measure the wealth of ideas, with the assumption that the more thoughts a person has, the more good thoughts such a person will have. Flexibility is conceived of as the ability to try many approaches to a problem. Flexibility seems to be a more direct indicator of creative processing. If one means of solving the problem proves

to be ineffective, or is thwarted by certain constraints, the flexible individual will be able to proceed beyond the restrictions and devise other means of solving the problem, to transform old ideas in order to apply them in new situations (Guilford, 1970). Finally, originality seems to capture an important contextual feature of creative ability: the newness of the idea. Highly fluent and flexible individuals who nonetheless reproduce responses that have been produced by others would not be considered creative; rather, they might be considered effective implementors of others' good ideas. The creative response is not only to devise many, varied solutions, but also to produce solutions which are fresh or unique. It is important to note that an individual and his or her ideas are not intrinsically original; original is a evaluative term based, in part, on whether that individual or others have had similar ideas before.

It is also important to reemphasize that creative performance in problem solving is not conceived to be a sole function of divergent production abilities. Rather, divergent production seems to refer to a set of knowledge utilization and knowledge transformation abilities which presuppose the effective functioning of intelligence in general. Bodies of relevant knowledge, and basic reasoning and memory processes are required (as in all intellectually challenging tasks) for the divergent production abilities to be useful in the generation of good results.

The links between creativity and intelligence have been explicitly recognized by Sternberg and his colleagues. In their measurement of creativity-relevant mental abilities, for example, Sternberg and Lubart (1991) included measures of fluid reasoning, attentional capacity, knowledge, and intellectual style in their study of the predictors of creative production in writing, drawing, advertising, and scientific problem solution. Over all domains, fluid reasoning was the best predictor, accounting for almost 40% of the variance in some tasks.

Taken together, then, our central assumption, derived from a hierarchical model, is that the abilities of fluency, flexibility, and originality may be related to practical creativity in the same sense as more convergent intellectual abilities (e.g., reasoning and crystallized knowledge) are related to practical intelligence. Practical creativity is hypothesized to operate in everyday, challenging situations that are ill-defined, unfamiliar, and in which known or previously successful solution strategies are no longer useful. Practical intelligence is hypothesized to operate in situations that have greater structure (the problem, its goals, and potential means of solution are fairly easily identified), and in which prior knowledge and linear reasoning may be sufficient for solving presented problems. In the next section, the adult developmental

trajectories of intelligence, the specific abilities of fluency, flexibility, and originality, and everyday problem solving are considered.

THE DEVELOPMENT OF CREATIVE MENTAL ABILITY IN ADULTHOOD

The investigation of the adult development and aging of psychometric intelligence (primarily nondivergent abilities) has been a topic of considerable research interest for most of the 20th century, and there have been a number of good reviews of the major findings (P. Baltes, 1993; Hoyer & Rybash, 1993; Lindenberger & P. Baltes, in press; Salthouse, 1991; Schaie, 1983, in press; Woodruff-Pak, 1989). Substantially less extensive research has been done on the aging of creativity-related mental abilities.

With regard to studies of adult intelligence, a few major summary findings are well accepted:

1. Cross-sectional research on adult age differences has shown that primarily reasoning-based *fluid* intelligence abilities show negative age trends beginning in early adulthood, while the relatively knowledge-based *crystallized* intelligence abilities show cross-sectional stability or increase until at least the seventh decade of life (Cattell, 1971; Horn & Hofer, 1992). There is evidence that speed-mediated ability-general declines in very late life (Lindenberger, Mayr, & Kliegl, 1993). Although suggestive of later mean ages of decline, and somewhat different change trajectories, longitudinal findings generally concur[3] (Schaie, 1994).

[3] Cross-sectional studies confound age differences with systematic differences in life history that differentiate age cohort groups. Longitudinal studies have other methodological problems, including selective subject dropout, uncontrollable nonmaturational influences on development between testings (period effects), and the effects of repeatedly retesting subjects (see P. Baltes & Schaie, 1976; P. Baltes, Schaie, & Nardi, 1971; Schaie, 1965; Salthouse, 1991). In an attempt to deal with the problems of both cross-sectional and longitudinal designs, Schaie has used a most efficient design (1977), which follows multiple cohorts of men and women over the adult life course, sampling from each cohort with replacement at each successive testing period. Although some methodological and substantive issues remain to be resolved (McArdle, Hamagami, Elias, & Robbins, 1991; Salthouse, 1991; Schaie, 1986), this method has provided the most systematic strategy of disentangling age, cohort, and period effects to date. One of the interesting outcomes of this research has been the documentation of substantial generational differences in intellectual performance. Recent cohorts, when compared to other cohorts at the same age, demonstrate positive shifts in some abilities (Inductive Reasoning, Verbal Memory, Spatial Orientation) but negative shifts in others (Perceptual Speed, Numeric Ability, and Verbal Ability) (Schaie, 1994).

2. There are wide inter- and intraindividual differences in the magnitude, timing, locus, and occurrence of age-related declines (see P. Baltes, 1987). Using hazard modeling, Schaie (1989) also documented that, for most subjects, two of five intellectual abilities studied remained stable up to age 74.

3. When a reliable negative change in intellectual functioning is present, there is increasing support for the reversibility of these changes. A substantial body of cognitive training research has demonstrated that older adults can produce significant (P. Baltes & Lindenberger, 1988; P. Baltes & Willis, 1982; Willis, 1987; Willis & Schaie, 1986b) and long-lasting (Willis & Nesselroade, 1990; Willis & Schaie, 1994) performance gains after just a few hours of training or practice (P. Baltes, Sowarka, & Kliegl, 1989; Hofland, Willis, & Baltes, 1981).[4]

Research on the adult development of creativity-related mental abilities has not been nearly as extensive as research on other (i.e., convergent) intellectual abilities. The dominant approach has been the cross-sectional research design, and there have been varied operational definitions of fluency, flexibility, and originality. From these studies, the picture has been one of negative age trends. Alpaugh and Birren (1977) studied a cross-section of adults from 20 to 83 years of age, administering two subtests of the Wechsler Adult Intelligence Scales, and seven Guilford (1967) tests of divergent production. Over all the Guilford tests, age was significantly and negatively related to performance. In terms of variable means, after age 30 older age/cohort groups tended to have successively lower divergent production scores. There was, however, an increase in these scores from age 20 to 30 years, yielding a quadratic curve with a peak in the mid-life, a finding that was subsequently replicated by Ruth and Birren (1985).

Jacquish and Ripple (1981) administered adaptations of Cunnington and Torrance's (1965) measures of fluency, flexibility, and originality to subjects who ranged in age from 18 to 84 years of age. For all three

[4] There is some evidence from cross-sectional studies of memory training, however, that there may be some effect of age on the maximum performance potential (i.e., developmental reserve capacity—Kliegl & P. Baltes, 1987). In studies in which younger and older subjects received up to 25 sessions of memory training and practice, older subjects rapidly reached a performance asymptote that was lower than the maximum performance achieved by younger subjects. At the conclusion of such studies, there was virtually no overlap in the performance distributions of younger and older subjects (P. Baltes & Kliegl, 1992). While there may be age differences in the maximum memory performance attainable, older subjects still evinced substantial cognitive plasticity: their mean performance increased from a recall of 5–7 words to 15 words, in correct order.

divergent production abilities studied, subjects aged 40 to 60 years of age showed the best performance levels, while subjects aged 61 to 84 years of age performed at levels substantially lower than all other age cohort groups, again yielding a quadratic function.

There have been relatively few longitudinal investigations of fluency, flexibility, and originality, and these findings have been generally comparable to the cross-sectional results. Andersson, Berg, Lawenius, and Ruth (1989) studied age changes in divergent production in Swedish adults who were first tested at age 70, and who were retested 13 years later. The authors found no significant effect of age over the period studied, even though subjects had moved from young-old to old-old age. Given the high dropout rate in this study (71% of subjects did not return for follow-up), selective mortality probably attenuated some of the age effects. More typically, in another investigation, which was sequential in nature, McCrae, Arenberg, and Costa (1987) studied men initially aged 17 to 101 over a period of approximately 6 years. Cross-sectional results found curvilinear associations between several measures of fluency and age, while the relationship between age and originality was linear. The magnitude of age effects was not large. Cross-sectional age accounted for only 10% of the variance in a divergent thinking composite score. Longitudinal findings on a highly selected returning sample (less than 34% of subjects returned for follow-up) also documented a curvilinear pattern: In general, peak performances were observed in the thirties and forties.

Fluency and flexibility have also been measured in the context of the Seattle Longitudinal Study (SLS; Schaie, 1983), Schaie's operationalization of the "most efficient design," but were measured somewhat differently from the traditional Guilford approach. Specifically, fluency was measured as Verbal Fluency, and was assessed in terms of the number of words beginning with a particular letter that subjects could generate in a fixed time period. Cross-sectional findings suggested a pattern of modestly negative and relatively monotonic age/cohort trends from the period of 25 to 81 years of age. Longitudinally, a quadratic function was reported; there was relative stability or slight increase in verbal fluency until about age 60, followed by a period of relatively monotonic decline (about .2 of a standard deviation every 7 years) (Schaie, 1994). With regard to flexibility, the SLS measured three dimensions: Attitudinal Flexibility (comprised of items from various personality scales), Motor-Cognitive Flexibility (the ability to change response set), and Psychomotor Speed (requiring quick responses under varying performance instructions). The three flexibility measures were significantly related to all factors of intellectual ability

assessed (Schaie, Dutta, & Willis, 1991). Developmentally, cross-sectional findings have supported linear, negative trends for all flexibility measures, with peak performances observed in the late twenties and early thirties. Longitudinal findings concurred, suggesting negatively accelerated quadratic functions for all rigidity-flexibility dimensions, but with relative stability characterizing the period from the twenties to the late sixties for Psychomotor Speed and Attitudinal Flexibility. Motor-Cognitive Flexibility did not show a significant shift in the direction of rigidity until age 81 (Schaie, 1983).

Other studies of adult intellectual development have also included measures of fluency and/or flexibility (e.g., Horn, 1982; Hultsch, Hertzog, Small, McDonald-Miszczak, & Dixon, 1992) and have reported generally negative effects of age on fluency and flexibility in the later adult years. Based on these findings, a general inverse-U function seems to constitute the developmental trajectory of fluency, flexibility, and originality. In both cross-sectional and longitudinal investigations, the evidence suggests that it is in midlife that peak levels of performance can be observed. Stability of interindividual differences may also be high; longitudinal stability coefficients for the rigidity-flexibility coefficients in the SLS exceed .85 (Schaie et al., 1991). The quadratic inverse-U or inverse-J function for creativity has also been supported, generally, by historiometric investigations of adult creativity development (Simonton, 1990).

Plasticity of creative mental ability in late life has also been studied. One investigation, the Quality of Life study at the University of Georgia (Goff, 1992, 1993; Torrance, Clements, & Goff, 1989) has documented some modifiability of older adults' fluency and flexibility. In a sample of 108 older adults ranging from 51 to 89 years, pretest-posttest changes in these abilities as a function of training were examined. Drawing on Torrance's "incubation model of teaching" (Torrance & Safter, 1990), experimental subjects received 4 months of training, 3 times a week. Compared to untrained controls, trained subjects showed significantly greater improvement on measures of fluency and flexibility.

From the hierarchical perspective, psychometric data on the adult development of fluency, flexibility, and originality (and other abilities) suggest that advanced age may be a time of lower levels of divergent production capabilities, but this can only be a tentative conclusion in the absence of more intraindividual change data. Nevertheless, one implication is that everyday problems that rely heavily on creative mental ability for their solution might also be expected to evince similar quadratic age trends across adulthood. At the same time, preliminary results from a creativity training study suggest that, as with intellectual functioning, there may be plasticity and modifiability in older adults'

fluency and flexibility. In the next section, research which has attempted to assess the developmental trajectory of everyday problem solving directly is considered.

PRACTICAL INTELLIGENCE FINDINGS: A LITERATURE REVIEW

The relative recency of research on the adult development of everyday cognition (Woodruff-Pak, 1989) means that, to date, there is still little research on this topic. Furthermore, substantial heterogeneity in obtained functions for everyday problem solving (Marsiske & Willis, 1995) is undoubtedly due, in part, to the diversity in investigators' approaches to the measurement of this construct. Most of the research to date has also been cross-sectional in nature, inevitably confounded by age group differences in maturational status and life history. There has been virtually no explicit consideration of creative everyday problem solving.

In the research literature on older adults' everyday problem solving, there have been two broad areas of interest. One area has focused on the relationship between everyday cognition and traditional (nondivergent) measures of intellectual functioning. The second has concentrated on trying to estimate the developmental course of everyday cognition in adulthood. Most of the everyday cognition measures used have also emphasized convergent production (especially, coming up with correct answers).

With regard to the relationship between everyday cognition and psychometric intelligence, many studies have reported significant correlations of varying magnitudes. Indeed, significant relationships between measures of fluid and crystallized intelligence, memory, and everyday tasks have been reported for several multidomain measures of real life problem solving, in both cross-sectional (Camp, Doherty, Moody-Thomas, & Denney, 1989; Cornelius & Caspi, 1987; Denney, 1991; Hartley, 1989; Lindenberger, Mayr, & Kliegl, 1993; Poon et al., 1992; Willis, Marsiske, & Diehl, 1991; Willis & Schaie, 1986a) and longitudinal (Willis et al., 1992; Willis & Marsiske, 1991) studies. The variance accounted for by ability measures varied from under 10% (e.g., Camp et al., 1989; Cornelius & Caspi, 1987) to 70% or more (e.g., Willis & Schaie, 1986a; Lindenberger et al., 1993).[5] Fluid and crystallized factors

[5] A measure of practical knowledge and practical reasoning shared so much variance with other indicators of fluid and crystallized intelligence in the Lindenberger et al. (1993) study of adults between 70 and 105 years of age that the investigators chose to treat the practical measures as indicators of the psychometric ability factors.

of intelligence also accounted for 20% to 45% of the variance in everyday problem-solving competence as assessed through behavioral observation (Diehl, Willis, & Schaie, 1995), and fluid intelligence was substantially related (.60<*r*<.90) both to perceived functional (ADL/IADL) competence among adults aged 70 and above, and to the amount of time they spent in discretionary and leisure activities (M. Baltes, Mayr, Borchelt, Maas, & Wilms, 1993).

Findings regarding the developmental course of everyday problem solving have demonstrated even fewer regularities across studies than in the correlational results. While fluid and crystallized intelligence at least emerged as significant predictors of real life task performance in most studies in which they were assessed together, the obtained cross-sectional findings have shown less convergence across studies. This may not necessarily be a problem, if the empirical findings are taken to support a multidirectionality perspective (e.g., P. Baltes, 1987): different developmental functions might be expected to apply to different kinds of tasks (see also Denney, 1989).

In those cross-sectional studies which have emphasized (a) individual differences in problem solving, rather than just a comparison of novices and experts in particular domains, (b) problem solving in multiple everyday domains or situations, and (c) the performance of older adults, there has been substantial task specificity of findings. Early attempts to measure adult-relevant cognition supported a preserved competence view (Demming & Pressey, 1957; Gardner & Monge, 1977). In the more recent research literature, Cornelius and Caspi (1987) found incremental age trends in a sample ranging from 20 to 78 years of age, using a measure which assessed subjects' degree of endorsement of an idealized solution pattern for selected everyday problems.

A rather different pattern of findings was reported by Willis, Schaie, and their colleagues in several studies investigating document literacy and reasoning with everyday printed materials in such domains as food preparation, housekeeping, financial management, and transportation (e.g., Willis & Schaie, 1986a; Willis et al., 1992; Willis & Marsiske, 1991). In old and very old adults, a significant negative association with age was obtained (e.g., Marsiske & Willis, 1995), even when tasks were designed to be highly relevant to the everyday lives of older adults (Diehl, Willis, & Schaie, 1990). In one of the few longitudinal investigations of everyday problem solving in older adults, 7-year change was assessed. Despite significant mean decline over the longitudinal interval, 57% of subjects were actually classified as having remained stable over time (Willis et al., 1992).

Hartley (1989) has provided a nice illustration of the task specificity of obtained developmental trajectories; over three different everyday tasks, he obtained three very different cross-sectional age gradients. Taken together, all of these findings point to substantial measure specificity of obtained cross-sectional and developmental findings. This is supportive of Willis and colleagues' hierarchical contention that everyday problem solving is multidimensional, and developmental trajectories might be expected to vary with the trajectory of the constitutive abilities (Willis & Marsiske, 1991; Willis & Schaie, 1986a).

Data collected within other traditions, including studies of problem solving in particular, circumscribed domains (e.g., Klemp & McClelland, 1986; Lave, Murtaugh, & de la Rocha, 1984; Scribner, 1984), or studies of expertise in particular everyday practical and leisure domains (e.g., P. Baltes, Smith, & Staudinger, 1992; Charness, 1985; Ericsson & Smith, 1991; Krampe, 1992; Salthouse, 1991) have tended to support the view that domain-relevant expertise can buffer against age-associated losses. While a number of these studies have actually included ill-structured problems of daily living, they have not emphasized the creativity dimension in their scoring or analysis.

One major contributor of research on older adults' everyday problem solving, whose studies have appeared throughout the last decade, is Nancy Denney. In the next section, the focus is on Denney's problem-solving research, because it is Denney's work that Marsiske & Willis (1993) and others (e.g., Poon, et al., 1992) have seen as a potential empirical exemplar for the role of creativity and resourcefulness in everyday problem solving.

Fluency, Flexibility, and Originality in Everyday Problem Solving

Earlier in this chapter, the Denney (1984, 1989) model of adult cognitive development was considered in the broader context of contextual/expertise models. Denney's research on the topic of everyday, or practical, problem solving has been cast within her theoretical notions of exercised and unexercised tasks. Traditional problem-solving measures (i.e., those used in cognitive psychological research, like Twenty Questions) are viewed as relatively unexercised tasks, while practical problems of daily life are considered to be exercised tasks whose developmental trajectories would be expected to fall somewhere between the hypothesized trajectories for unexercised and optimally exercised abilities.

Emerging from this theoretical orientation, Denney's earliest work on the topic of practical problem solving in late life took the form of performance comparisons on traditional and practical problems in adults of different ages. Practical problems were administered in the format of brief problem vignettes (e.g., the subject is instructed to imagine awakening in the middle of the night to find that the refrigerator is not working), and subjects were asked to generate the best solutions they could. Over several studies, a cross-section of adults ranging from 20 to 80 years of age was included. In the earliest research, (Denney & Palmer, 1981; Denney, Pearce, & Palmer, 1982), Denney and her colleagues selected the best solution generated for each problem, and rated the solution for efficacy or quality (with the highest scores going to solutions which emphasized effective, independent action). In more recent research, using problems designed to be particularly relevant for older adults (Denney & Pearce, 1989; Denney, Tozier, & Schlotthauer, 1992), subjects were prompted to generate as many solutions as they could for each problem. Subject scores were based on the number of safe and effective solutions generated for each problem, so that more solutions produced higher scores. Over problem and scoring variations, there has been a remarkably consistent pattern of findings: The relationship between practical problem-solving performance and age has been curvilinear, with peak performances observed in subjects between 40 and 50 years of age. Results, thus, were comparable to quadratic functions reported in divergent production research, although performance peaks tended to be younger in divergent tasks, and there were variations with the hypothesized age relevance of everyday tasks in Denney, Pearce, and Palmer, 1982.

The problem vignettes administered by Denney and her colleagues are not substantially different in content or format than those administered by Cornelius and Caspi (1987). However, in the Cornelius and Caspi study, subjects were provided with possible solutions, and asked to rate the likelihood of their using each solution. In Denney et al.'s studies, the emphasis was on solution generation rather than solution selection, so that solution finding was relatively less constrained. These features of open-endedness and relative lack of problem structure in Denney's measures intuitively make them seem useful as assessments of creative problem solving. Because their content focuses on situations from the daily lives of older adults, Denney's measures might be viewed as the application of creative mental ability to real world problems. Thus, Denney's measures might be considered an operationalization of older adults' practical creativity. At least two task

features support this view. First, the problems are either ill-structured or semistructured: Problems in the Denney and Pearce (1989) measure included (a) asking how a newly widowed older woman should adjust to her new situation, or (b) asking how an elderly man with a heart condition and limited financial resources should arrange for his lawn to be mowed. Such problems permit a multitude of potential solutions, rather than only one correct response. Second, the recent shift to a fluency-based scoring of the measure (e.g., Denney & Pearce, 1989; Denney, Tozier, & Schlotthauer, 1992), with scores based on the number of effective solutions generated, highlights the similarity between task characteristics of this measure and those of traditional fluency (e.g., Torrance, 1988). Thus, the Denney and Pearce (1989) measure seems to represent the application of a divergent production task to everyday situations.

The apparent fluency-based scoring of the Denney and Pearce (1989) measure led Marsiske and Willis (1993) to consider whether other dimensions of divergent production might also be found in subjects' solutions to these problems. In a sample of 111 older adults ranging in age from 68 to 94 years, they examined subjects' responses to Denney and Pearce's practical problems. In addition to fluency, subjects' responses were also coded for flexibility and originality. Flexibility was coded as the number of different solution styles subjects used; of four possible styles, most subjects used an average of only two. Originality was coded as the number of "rare" (low frequency) responses given by subjects; by definition, there were relatively few such original responses. One third of subjects, however, generated at least one original response. There was also some evidence for convergent validity among the dimensions coded: each of the three dimensions correlated significantly (r = .19–.47). Thus, Marsiske and Willis (1993) argued, it may be useful to think in terms of fluency, flexibility, and originality when using the Denney and Pearce (1989) everyday tasks, and suggested that these tasks may constitute an operationalization of the application of creative mental ability in everyday contexts.

Poon et al. (1992) have offered a seemingly similar interpretation of older adults' performance on Denney-type practical problems. In the context of their Georgia Centenarian Study, they investigated the performance of individuals 60 and older on an adapted version of the Denney and Palmer (1981) measure. In contrast to subjects' performance on all other measures of intellectual and cognitive functioning in the study, there was no significant effect of cross-sectional age on practical problem solving. This finding led the researchers to speculate:

> Which cognitive resources are important for survival? The data show that practical problem-solving ability is important. The data substantiate our observations that centenarians are a resourceful group. Resourcefulness may be the one ingredient that keeps these centenarians functioning independently or semi-independently in the community (Poon et al., 1992, p. 36).

Explicit in the Poon et al. (1992) view is the idea that the abilities assessed by the practical problem-solving measure may have functional value in very old age. The next section revisits the question of the potential adaptive significance of practical creativity in late life.

CREATIVITY IN EVERYDAY PROBLEM SOLVING: AN EMERGING VIEW

The increasing emphasis on older adults' everyday problem solving seems to have emerged, in part, out of an interest in the question of preserved competence in personally salient life domains (P. Baltes & M. Baltes, 1990). The remainder of this chapter considers more precisely how fluency, flexibility, and originality might play a role in maintaining functional competence in late life.

To date, the research on everyday problem solving in late life has often connected itself, following Sternberg and Wagner's (1986) edited volume, with the concept of practical intelligence. There is undoubtedly more to cognition in everyday contexts than this. Indeed, it has been suggested here that practical creativity, or what Poon et al. (1992) have called "resourcefulness," may be other important concepts related to everyday problem solving. Intuitively, these concepts, when tied to the divergent production view of creative mental ability, point to individuals' fluency, originality, and flexibility in the course of managing the challenges of daily living, and their ability to activate base knowledge for use in new target domains. When the old ways of doing things are frustrated in some way (e.g., an elderly person has had a hip fracture, and can no longer climb the stairs in his or her home to an upper level bedroom), practical creativity would seem to be involved in devising new means for achieving the same objectives. There may be many potentially effective solutions (e.g., sell the home and move to a bungalow or congregate housing facility; install a stair-climbing machine; employ a caregiver; engage in physiotherapy), and adaptive success (e.g., for some, this might be defined as maintaining one's independence in one's home) is contingent on the selective search for and effective implementation of alternative strategies. The term *resourcefulness* here captures the idea of drawing on, evaluating, and applying one's knowledge of existing resources (financial, social, intellectual, motivational, biological)—it captures the ideas of active search and analogical mapping inherent in many models of creative problem solving (e.g., Voss & Means, 1989). It is a creativity that is highly practical because its focus is on managing real-world objectives.

Readers of the literature on adult development and aging may recognize some relationship between this view of practical creativity and ideas associated with successful aging (e.g., P. Baltes, 1993; P. Baltes & M. Baltes, 1990; Brandtstädter, Wentura, & Grove, 1993; Carstensen, 1993; Featherman, Smith, & Peterson, 1990; Heckhausen & Schulz, 1995; Marsiske, Lang, P. Baltes, & M. Baltes, 1995). In the section below, a major model of successful aging, and the role that practical creativity might have in such a model, are both considered.

Creativity and Successful Aging

One widely cited model of successful aging has been proposed by P. Baltes and M. Baltes (1990), who have suggested that *selective optimization with compensation* (*SOC*) constitutes general adaptive strategies which characterize successful development throughout adulthood. Success, here, is defined as the reaching of goals; the particular goals and the domains within which they fall may vary across individuals. Generally speaking, individuals' adaptive processes are viewed as being aimed at achieving progressively higher levels of functioning, and at the avoidance of negative outcomes. Individuals are thought to engage in these processes throughout life, and selective optimization and compensation are thought to operate either consciously or unconsciously, depending on the individual and the domain.

The SOC model is hypothesized to take on new meaning in late life, when normative losses in biological, social, and intellectual resources might occur. Progressive specialization (selective optimization) into individually defined life niches is thought to be a process occurring throughout adulthood. (An implication is embedded in this theory that optimization of functioning in individually relevant life domains comes at the cost of losses in nonoptimized domains [Lerner, 1984]). If performance cannot be optimized in important domains, then it must be compensated for. Old age is seen as a time of loss in reserve capacity (Kliegl & P. Baltes, 1987); under conditions of extreme challenge, older adults might lack the surplus biological, psychological, and socioeconomic resources for managing situations. Age is thus associated with an amplification of the general life SOC process, and the SOC processes

are presumed to describe a set of strategies which may lead to resilient functioning in the face of age-associated losses (Staudinger, Marsiske, & P. Baltes, 1995). As summarized by P. Baltes,

> because of a loss in reserve capacity, we must select critical life domains to preserve at the expense of others. Furthermore, when age-related losses compromise maintenance of adequate performance in target behavior domains, we are challenged to find compensatory ways. (1993, p. 590)

In other words, optimization must become more selective, and compensation may become more important with age (see also Marsiske, Lang, et al., 1995).

As described by P. Baltes and M. Baltes (1990) with regard to aging, selection "refers to an increasing restriction of one's life world to fewer domains of functioning because of an aging loss in the range of adaptive potential" (p. 21). Optimization generally refers to the idea that people "enrich and augment their general reserves" and "maximize their chosen life courses" (p. 22), and also captures the idea that functioning in important domains will tend to be maintained at high performance levels. Compensation is defined as operating when "specific behavioral capacities are lost or are reduced below a standard required for adequate functioning" (p. 22). Compensation (see Bäckman & Dixon, 1992, and Dixon & Bäckman, 1995, for detailed treatments) involves satisfaction or partial satisfaction of goals via alternative means. Increased reliance on social supporters, use of a cane to support walking, or use of a pill reminder to ensure correct medication use in the face of memory loss would all constitute potential compensatory strategies.

While selective optimization and compensation strategies may be applied in selected domains, it is important to underscore that the processes are assumed to be domain general, and to represent a set of strategies which can lead to maintained adaptive competence regardless of phenotypic expression varying across individuals (P. Baltes & M. Baltes, 1990). P. Baltes (1993) has also argued that the life knowledge used to support selective optimization with compensation is a component of the "pragmatics of the aging mind," a kind of stored procedural and declarative knowledge that comes with experience in managing individually relevant life domains.

In our view, selective optimization with compensation provides a good frame within which to view the abilities associated with practical creativity. Compensation, in particular, which emphasizes the ability to come up with new ways of doing things when old ways no longer work and the activation of life knowledge in flexible and novel ways, seems closely allied to the kind of fluency, flexibility, originality, and everyday problem solving that have been emphasized throughout this chapter. The skilled selection of relevant life domains also seems to be conceptually associated with such ideas as "problem finding" and the imposition of constraints on problem solving, ideas associated in the information-processing literature with creative problem solving (e.g., Newell & Simon, 1972).

In order to provide a more concrete illustration of how elements of fluency, flexibility and originality might be important in everyday problem solving, Table 4.1 shows some older adults' responses to a prototypical problem. The problem, drawn from Denney and Pearce's (1989) work, posits an older man who has a restricted ability to mow his lawn (because of a heart condition), but who cannot afford to employ help. The subjects' responses in Table 4.1 are transcriptions of solutions actually generated by participants in the study reported in Marsiske & Willis, 1993, 1995). The problem presented here is an instantiation of an age-related restriction in means; the protagonist used to be able to mow his own lawn, but a physical condition has rendered this old solution no longer useful. Examining the responses of the four subjects, one notes substantial differences in solution fluency. Although there were no limits on how long subjects could take to consider and respond to the problem, the number of solutions generated varied from three to ten. Drawing on the constant-probability-of-success idea (Simonton, 1990), one implication is that the more fluent respondents might have more good ideas available. Flexibility, however, is also important. Subject A, for example, uses only two kinds of solutions. One is avoidant (refusal to mow the lawn), while the other two involve dependence on the help of others. In contrast, Subject B (who has produced only one more solution) shows a much broader range of solution strategies. Two of this subject's solutions involve problem-focused action (selling the house, bartering with a neighbor); another involves a combination of information acquisition (call a human services department) and dependency (get volunteers' help). The final solution is dependent, and very similar to Subject A's solutions. Note, however, that because of greater flexibility, Subject B is better buffered against possible constraints. For example, if no family members live nearby, or social service/help agency assistance is not available, Subject A will not be any closer to solving his/her problem. Subject B, on the other hand, still has at least two other options available. Of course, fluency and flexibility alone do not guarantee a successful solution. Many of the solutions proposed by Subject D (who has produced the largest

TABLE 4.1 Older Adults' Responses to a Semistructured Everyday Problem: Exemplars of Practical Creativity

Problem: **Let's say that a 67-year-old man's doctor has told him to take it easy because of a heart condition. It's summertime and the man's yard needs to be mowed, but the man cannot afford to pay someone to mow the lawn. What should he do?**

Example solutions:

Subject A:

> Do not mow the yard.
> Pray that someone will do it for me . . . Let my church know I have a need . . . Tell any help agency.
> If I have children . . . let them know of my need.

Subject B:

> If the man has a yard, he must be living in a house. The best thing he could do would be to sell the house and move into an apartment with no yard or upkeep.
> He could trade services with a younger neighbor. The neighbor would mow his lawn in return for the man walking the neighbor's dog, watching his children, etc.
> He could call his city or county human services department . . . and ask if there are volunteers.
> He could ask a grandson to mow it without pay.

Subject C:

> Immediately start planning to live in a situation that is suitable to his condition. Plan ahead.
> In the meanwhile, he should see if a relative or friend could help him until he changes abode.
> Possibly he could exchange the mowing for some service he can do, like babysitting or tutoring.
> Be sure to get a second medical opinion.
> Talk to his church or organization people. Trade services.
> Check civic organizations.
> Possibly [borrowing] a riding mower might be suitable—until he changes abode.
> Get a part-time job, and earn enough to pay for help.

Subject D:

> Move to quarters not having a yard to maintain.
> Cover lawn with black plastic sheeting . . . remove plastic in fall and sow rye grass.
> Rent a room to a man who will care for yard as part payment of room.
> Marry a young physical training teacher who loves yard work.
> Tether sheep in yard.

TABLE 4.1 (*Continued*)

> Buy a reconditioned remote controlled power mower, shrubbery and flowers.
> Plant shade trees.
> Cover yard with river rock and/or concrete and apply weed killer when necessary.
> Plant a vegetable garden in yard. . . .
> Plant grain seed and sell harvest.

Note: These solutions are transcriptions of responses generated by 111 older subjects (aged 68–94) from Marsiske & Willis (1993, 1995). The problem comes from Denney and Pearce (1989).

number) would involve an expenditure of economic resources (purchase of plastic sheeting, purchase of a sheep, purchase of landscaping requirements) and physical resources (e.g., the planting of trees and gardens entails some hard physical labor) that ignore the constraints of the problem. Originality is also evident, particularly in Subject C's responses. Two solutions (that were infrequently mentioned by other participants) include getting a second medical opinion, or getting a job. These solutions are not only original in terms of their rarity, but because they go beyond the constraints of the problem. Drawing on prior knowledge (it is good to get second opinions; older adults can still work), Subject C brings additional, fresh, and potentially effective strategies into the problem space, and these may confer an additional adaptive advantage.

Subjects' strategies can be fit into the SOC framework as well: Subjects B, C, and D all mention selection: by selling the house and moving to other quarters, they are suggesting that a reduction in domains of functioning may be an effective solution strategy. Numerous compensatory strategies are also mentioned. Solutions emphasizing the help of others draw on external (social and economic) resources. Subject C's suggestion to borrow a riding mower also involves compensation via substitute skills (Bäckman & Dixon, 1992), as the physically demanding properties of the task are changed. The bartering solutions mentioned by Subjects B and C capture the full range of selective optimization with compensation: by selectively optimizing functioning in effective domains (the marketable skills of walking a dog, babysitting, etc.), they are able to use those skills to acquire the compensatory lawn mowing skills of others.

In summary, then, it has been suggested that, for the subclass of problems in late life with which individuals have little direct experience, or for those which a lack of problem structure (e.g., such

"messy" real-life problems as coping with widowhood, or adjusting to health restrictions), or for problems of aging associated with a loss of performance means and for which new means are consequently required, the ability to think creatively may be a meaningful predictor of the ability to solve (adapt to) such problems.

SUMMARY AND FUTURE DIRECTIONS

In this chapter, we have chosen to take a broad view of the role of creative mental ability in late life, arguing primarily from within the psychometric tradition of research into adult intellectual functioning. The goal was to highlight the potential value of considering practical creativity within the context of trying to understand older adults' intellectual competencies in the everyday world. While there has been relatively little systematic research into the adult development of creativity-related mental abilities, we have tried to advance a view which can be summarized as follows:

1. Creativity and intelligence are fundamentally intertwined constructs.
2. An adequate accounting of older adults' mental abilities must include the specification of domain-specific knowledge bases, general (convergent) intellectual abilities, and at least some divergent production abilities.
3. Domain-specific knowledge may be particularly important in understanding individual differences within selected domains. Across domains of functioning, however, other intellectual abilities (e.g., domain-general crystallized knowledge, domain-general fluid reasoning, functioning of learning and memory "mechanics") may be most important. For a particular individual, novel tasks will most likely require fluid reasoning skills; as tasks decrease in structure (and increase in complexity and ambiguity) fluency, flexibility, and originality may become increasingly important.
4. Developmental evidence suggests that late life is a period of normative loss in intellectual functioning, including fluency, flexibility, and originality. Despite this, many individuals may demonstrate substantial developmental stability on at least some intellectual abilities.
5. Practical creativity is seen as the application of creative problem solving and divergent abilities like fluency, flexibility, and originality to the ill-structured problems of daily life. Such problems might be described as messy or ambiguous. They are the problems which are often regarded as definitional of practical intelligence (Wagner, 1986; Resnick, 1987), but we see them as a subset of a broader class of everyday tasks. We believe that the *practical intelligence* label applies more correctly to abilities required in relatively well-structured problems of daily living, and that *practical creativity* might be a better label for the additional abilities needed for the solution of such ill-structured problems.
6. Ideas associated with practical intelligence can be seen in some common views of successful aging. Particularly the P. Baltes and M. Baltes (1990) and Bäckman and Dixon (1992) conceptions of selective optimization and compensation include proposals that the successful management of the challenges of late life may involve the flexible reassignment of solution strategies and solution goals.

Clearly, the empirical evidence for the adaptive importance of practical creativity is not yet in hand. Existing research on adults' everyday cognition, in general, has not yet shown that "ecologically valid" measures of cognition are good predictors of real-world outcomes (e.g., maintained independence, mortality and morbidity, physical and emotional well-being), or that they are better predictors than traditional measures of intelligence (Willis, 1991). In our view, however, in order to determine whether mental abilities associated with practical creativity might be useful antecedents of successful aging, future research must: (a) include measures of basic cognitive and intellectual abilities, and measures of divergent production and creative problem solving, (b) establish the salience of measures of basic convergent and divergent production relative to measures of practical intelligence or practical creativity for the prediction of late life adaptive criteria (e.g., maintenance of functional independence) using longitudinal and prospective designs, and (c) more clearly specify the aspects of everyday cognition they wish to measure. Global conceptions of everyday problem solving or practical intelligence seem unlikely to be very useful.

In addition, this chapter has attempted to highlight the relative paucity of research on both creativity and everyday problem solving in late life. It is interesting to speculate why creativity has received so much more attention in the educational, industrial, and organizational literature than it has in the adult developmental literature. Has creativity been seen as relatively unimportant in the post-retirement years? While some researchers have suggested that creativity may be related to late life psychosocial outcomes (e.g., Goff, 1993), the practical or adaptive outcomes of creativity, creative problem solving, and divergent production have not been considered. On the other hand, while research

on late life everyday problem solving appears to be an emerging field (Woodruff-Pak, 1989), this area has been plagued by a lack of consistent measurement and theoretical approaches (see Marsiske & Willis, 1995). In our view, however, research on the intersection of creative abilities and everyday cognition may be one promising avenue for understanding maintained adaptive competence and successful aging in late life.

ACKNOWLEDGMENTS

The writing of this chapter was supported, in part, by Grant AG-08082 from the National Institute on Aging to Dr. S. L. Willis. Dr. Marsiske was initially supported by the National Institute on Aging Training Grant, T32-AG-00048, awarded to the Pennsylvania State University. This chapter was completed while Dr. Marsiske was a postdoctoral fellow at the Max Planck Institute for Human Development and Education, Berlin, Germany. Dr. Marsiske is currently an Assistant Professor of Gerontology and Psychology at Wayne State University.

The authors gratefully acknowledge discussions regarding the issues considered in this chapter with our colleagues at the Max Planck Institute for Human Development and Education and the Pennsylvania State University. Special thanks is extended to Drs. N. W. Denney, late of University of Wisconsin-Madison; B. J. F. Meyer, the Pennsylvania State University; and Dr. J. Smith, Max Planck Institute of Human Development and Education for helpful suggestions regarding this paper, and to Drs. A. L. Horgas, Wayne State University, and D. F. Lopez, University of South Florida-Fort Myers, for helpful comments on earlier versions of this paper.

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